16TH REPORT OF THE MALAYSIAN DIALYSIS & TRANSPLANT REGISTRY 2008

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Malaysian Society of Nephrology

Association of Dialysis Medical Assistants and Nurses

16TH REPORT
OF THE MALAYSIAN
DIALYSIS & TRANSPLANT REGISTRY
2008

Sponsors :
Malaysian Society of Nephrology
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Important information:

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

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The Ministry of Health, Malaysia for their grant and other support seen and unseen,

For their generous support:-

Ain Medicare

Baxter Healthcare

Fresenius Medical Care

Roche

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

&

All who have in one way or another contributed to the success of the Malaysian Dialysis and Transplant Registry.

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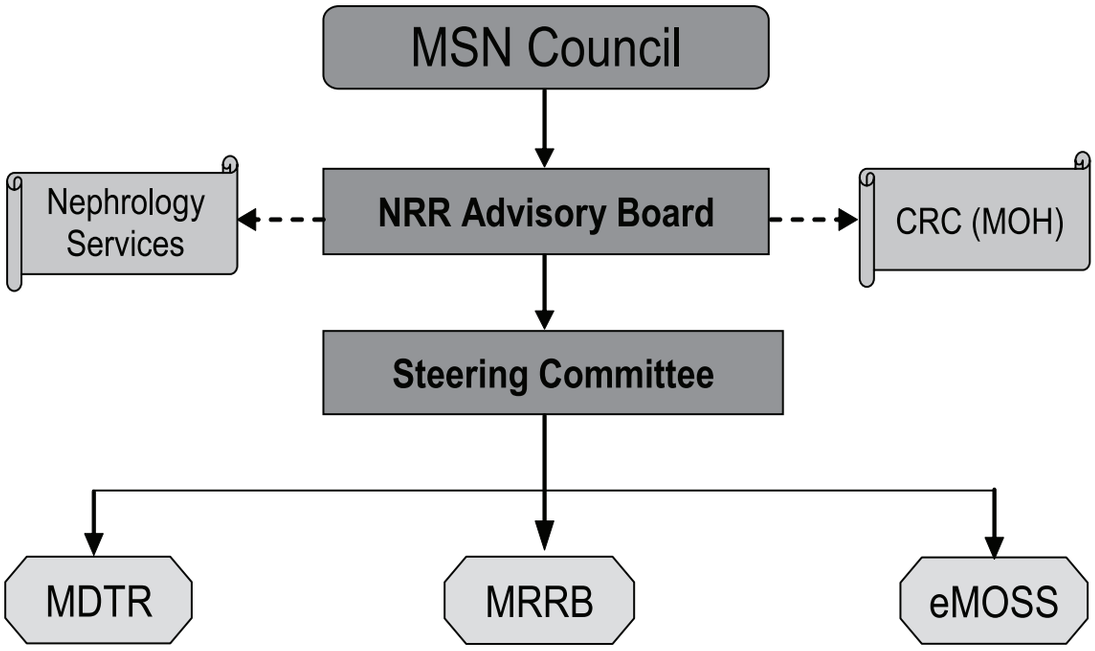
About the National Renal Registry (NRR)

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 NRR organization is as follows:



NRR Advisory Board

This is the committee established by the MSN to oversee the operations of the NRR registries and databases. Members are appointed be the MSN Council for the same duration of the council. Interested parties including source data producers, Renal Registry Unit and target groups or users are represented on this committee. The board will be the liaison between Nephrology Services and the Clinical Research Centre.

Clinical Research Centre (MOH)

The Clinical Research Centre (CRC) is the clinical research arm of the Ministry of Health (MOH) to conduct clinical trials, clinical epidemiology and economic research, and manage complex medical databases. It is through the CRC that the registry received part of its funding from the National Institutes of Health (NIH). One of the public health missions of MOH is to improve patients' health outcomes through ethical and quality clinical research.

Steering Committee

The members in this committee are appointed by the NRR Advisory Board. The chair person shall be co-opted into the NRR Advisory Committee without voting right for decision making. The committee shall oversee to the operation of the designated registry / databases.

The NRR family registries/databases are as follows. The established and operation are:

- Malaysian Dialysis and Transplant Registry (MDTR)
- Malaysian Registry of Renal Biopsy (MRRB)
- e-Malaysian Organ Sharing System (eMOSS) – Potential renal recipient waiting list.

Expert panels

Members appointed by Steering Committee as content experts to the individual chapters of the annual report.

The objectives of the NRR are to:

1. Determine the disease burden attributable to renal diseases, and its geographic and temporal trends in Malaysia.
2. Determine the outcomes, and factors influencing outcomes of treatment and services
3. Stimulate and facilitate research related to renal diseases and its prevention to ESRD.
4. Evaluate the RRT program.
5. Maintain the national renal transplant waiting list.
6. Tracking the nephrology trainee performance of specialize procedures.

ABOUT THE MALAYSIAN DIALYSIS AND TRANSPLANT REGISTRY (MDTR)

The Dialysis and Transplant Registry was established by the Department of Nephrology, Kuala Lumpur Hospital (HKL) in 1992 to collect data from patients on renal replacement therapy within the Ministry of Health (MOH). In order to expand coverage to include non-MOH patients so that the registry may truly claim to be a national one, the ownership was transferred to the Malaysian Society of Nephrology. It was subsequently named Malaysian Dialysis and Transplant Registry (MDTR). MDTR collects information on patients with end stage renal disease (ESRD) on renal replacement therapy (RRT) in Malaysia.

Objectives:

The objectives of the registry are as follows:

1. **Describe the natural history of ESRD.** The registry shall describe the characteristics of patients with ESRD, its management, and patient survival and quality of life outcomes with treatment; and shall describe variation thereof across different groups, healthcare sectors or geographic regions, and its secular trend over time in Malaysia.

2. **Determine effectiveness of treatments for ESRD.** The registry shall determine clinical effectiveness and cost effectiveness of treatments of ESRD in real-world clinical practices in Malaysia.

3. **Monitor safety and harm of products and services used in the treatment of ESRD.** The registry shall serve as an active surveillance system for the occurrence of unexpected or harmful events for products and services.

4. **Evaluating access to and quality of treatment services for ESRD**. The registry shall assess differences between providers or patient populations based on performance measures that compare treatments provided or outcomes achieved with "gold standards" (e.g., evidence-based guidelines) or comparative benchmarks for specific health outcomes (e.g., risk-adjusted survival rates). Such programs may be used to identify disparities in access to care, demonstrate opportunities for improvement, establish differentials for payment by third parties, or provide transparency through public reporting.

5. **To maintain the national renal transplant waiting list electronically – the eMOSS or electronic Malaysian Organ Sharing System.** The dialysis registry shall maintain and update patients on dialysis who do not have contraindications to kidney transplantation onto the national renal transplant waiting list according to published agreed criteria. This list is available on the web for ready access by the transplant physicians any time a deceased kidney becomes available.

Registry design:

This is a multi-center, observational cohort study designed to evaluate the health outcomes of patients with ESRD undergoing treatment at participating clinical centres. Patient inclusion criterion is deliberately broad and shall include any patient with a confirmed diagnosis of ESRD.

There is no prescribed study visits. Patient shall attend the clinical site as and when required per the standard of care at the site. Required data shall be collected as they become available.

- A clinical site shall notify all new patients to the registry, and shall continue to do so until the termination of the registry. Patients shall be follow-up for life.

- Participation. Site shall notify the patients' treatment to the registry in a calendar year of its participation. A site shall similarly notify patients during each year of its participation in the registry.

Registry study population:
The registry study population consists of male or female patients with ESRD to be recruited from participating sites in Malaysia. Participation in this study is voluntary. However, in accordance with the Private Health-care Facilities Act 1998 (AKTA 586), all dialysis health facility are required to submit data to the Malaysian Dialysis and Transplant Registry (MDTR).

All clinical centres or sites that satisfy the following selection criteria will be invited to participate:

1. This registry is opened to all clinical sites that provide RRT services for patients with ESRD in Malaysia.

2. Each site shall have a Principal Investigator who is also a licensed physician / Surgeon and a qualified professional experienced with ESRD management.

3. Each site shall appoint a Site Coordinator (SC). The SC is the person at the participating clinical site who is responsible for all aspects of registry management and data collection at site, and who will liaise with the Clinical Registry Manager (CRM) and Clinical Registry Assistant (CRA) at the Registry Coordinating Centre (RCC).

4. Each site shall accept responsibility for data collection, as well as for ensuring proper record keeping and registry document filing.

5. Each site shall agree to comply with the registry procedures and shall be willing to be subjected to ongoing review of data by CRM or CRA or other representative of MDTR. This may include one or more site visits by prior arrangement

Patient eligibility criteria:

- All new patients with ESRD undergoing treatment at a participating clinical site are eligible for entry into the registry.

- In addition, a site may opt to enter existing patients on follow-up at the site into the registry.

Registry data:
The data elements to be collected by the registry shall be relevant and reliable with modest burden to sites, shall comply with existing data standard where this exists, shall be compatible with established data set used by other existing registries, and shall employ standard terminology (dictionary) where available.

Two datasets are defined:

- Core dataset: These are data elements that are needed to address the key questions for which the registry was created.
- Non-core dataset: these are speculative data elements included to provide an opportunity to generate hypotheses or to explore other subsidiary questions not of primary interest to the registry.

The data domains and related specific data elements to be collected by this registry is tabulated below:

A	Identifier	Name, NRIC number, Other identifying document numbers, Address, Contact numbers
B	Demographics	Age, Sex, Ethnicity, Educational attainment, Occupation, Household Income group, Weight & Height, Use of tobacco, Funding for Treatment
C	Medical history	Medical history/ comorbidities, Family history
D	ESRD diagnosis	Date of first diagnosis, Date re-entering each RRT.
E	Laboratory investigations	Date & time of tests, Blood chemistry, Hematology, Serology
F	Treatment	Modalities of RRT- haemodialysis, peritoneal dialysis; treatment of other uraemic complications; kidney transplantation
G	Outcomes	Patient survival; death, date of death, cause of death Quality of Life/ Work rehabilitation status
H	Economics	Source of funding for dialysis treatment, and immunosuppressive drug treatment for transplantation
J	Healthcare provider characteristics	Sector providing dialysis treatment, (private, public or NGO),

PARTICPATING HAEMODIALYSIS CENTRES 2008

Johor Darul Takzim

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 (Batu Pahat), HD Unit
6. BP Renal Care (Kluang), HD Unit
7. BP Renal Care (Segamat), HD Unit
8. BP Renal Care Simpang Renggam, HD Unit
9. BP Renalcare (Yong Peng), 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 Quarries Association Dialysis Centre, HD Unit
15. Johor Specialist Hospital, HD Unit
16. Kluang Hospital, HD Unit
17. Kota Tinggi Hospital, HD Unit
18. Mersing Hospital, HD Unit
19. Mersing Rotary Centre, HD Unit
20. Muar Dialysis, HD Unit
21. Muar Lions Renal Centre, HD Unit
22. Persatuan Membaiki Akhlak-Che Luan Khor_NKF, HD Unit
23. Pertubuhan Hemodialisis Muhibbah Segamat (Labis), HD Unit
24. Pertubuhan Hemodialisis Muhibbah, HD Unit
25. Pontian Hospital, HD Unit
26. Pontian Rotary Haemodialysis Centre, HD Unit
27. Premier Renal Care, HD Unit
28. Prima Dialysis Kluang, HD Unit
29. Prima Dialysis Masai, HD Unit
30. Pusat Dialisis Nefro Utama (Johor Bahru), HD Unit
31. Pusat Dialisis Nefro Utama (Kota Tinggi), HD Unit
32. Pusat Dialisis Nefro Utama (Pontian), HD Unit
33. Pusat Dialisis Perbadanan Islam (Johor Bahru), HD Unit
34. Pusat Dialisis Perbadanan Islam (Pontian), HD Unit
35. Pusat Dialisis Waqaf An-nur (Batu Pahat), HD Unit
36. Pusat Dialisis Waqaf An-nur (Kota Raya), HD Unit
37. Pusat Dialisis Waqaf An-nur (Pasir Gudang), HD Unit
38. Pusat Dialysis Makmur, HD Unit
39. Pusat Haemodialisis Suria (Tangkak), HD Unit
40. Pusat Haemodialysis Amal Lexin, HD Unit
41. Pusat Hemodialisis Ar-Raudhah, HD Unit
42. Pusat Hemodialisis Darul Takzim, HD Unit
43. Pusat Hemodialisis Hidayah, HD Unit
44. Pusat Hemodialisis MAIJ, HD Unit
45. Pusat Hemodialisis Muar, HD Unit
46. Pusat Hemodialisis Rotary Kota Tinggi, HD Unit
47. Pusat Hemodialisis Rotary Kulai, HD Unit
48. Pusat Hemodialisis Sejahtera Muar, HD Unit
49. Pusat Kesihatan Universiti (UTHO), HD Unit
50. Pusat Perubatan Perbadanan Islam (Segamat), HD Unit
51. Segamat Hospital, HD Unit
52. Sultan Ismail Hospital (Paed), HD Unit
53. Sultan Ismail Hospital, HD Unit
54. Sultanah Aminah Hospital, HD Unit
55. Systemic Dialysis Centre, HD Unit
56. Tangkak Hospital, HD Unit
57. Tangkak Lions Renal Centre, HD Unit
58. Temenggong Seri Maharaja Tun Ibrahim Hospital, HD Unit
59. The Rotary HD Centre (Johor Bahru), HD Unit
60. Yayasan Pembangunan Keluarga Johor-NKF, HD Unit
61. Yayasan Rotary Kluang, HD Unit
62. Zhi En Dialysis Centre, HD Unit

Kedah Darul Aman

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

PARTICPATING HAEMODIALYSIS CENTRES 2008 (CONT...)

Kelantan Darul Naim

91. Gua Musang Hospital, HD Unit
92. Jeli Hospital, HD Unit
93. KB Rotary-MAA Charity Dialysis, HD Unit
94. Kuala Krai Hospital, HD Unit
95. Machang Hospital, HD Unit
96. Nephrolife Haemodialysis Centre, HD Unit
97. Pakar Perdana Hospital, HD Unit
98. Pasir Mas Hospital, HD Unit
99. Pusat Dialisis Yayasan Buah Pinggang Kebangsaan (Kota Bharu), HD Unit
100. Pusat Pakar Dialysis Traktif (Kota Bharu), HD Unit
101. Pusat Perubatan Tentera (Kota Bharu), HD Unit
102. Pusat Rawatan Dialisis Islah (Kota Bharu), HD Unit
103. Raja Perempuan Zainab II Hospital, HD Unit
104. Renal-Link (Kelantan), HD Unit
105. Tanah Merah Hospital, HD Unit
106. Tengku Anis Hospital, HD Unit
107. Tumpat Hospital, HD Unit
108. Universiti Sains Malaysia Hospital, HD Unit

Negeri Melaka

109. 94 Hospital Angkatan Tentera (Terendak), HD Unit
110. Alor Gajah Dialysis Centre, HD Unit
111. Alor Gajah Hospital, HD Unit
112. Amitabha Centre (Melaka), HD Unit
113. Damai Medical & Heart Clinic, HD Unit
114. Mahkota Medical Centre, HD Unit
115. Melaka Hospital, HD Unit
116. Pantai Air Keroh Hospital, HD Unit
117. Pusat Dialisis Giat Kurnia (Masjid Tanah), HD Unit
118. Pusat Dialisis Giat Kurnia (Merlimau), HD Unit
119. Pusat Dialisis Kenanga, HD Unit
120. Pusat Dialysis Comfort, HD Unit
121. Pusat Haemodialysis Suria (Jasin), HD Unit
122. Pusat HD SJAM Bacang Melaka, HD Unit
123. Pusat Hemodialisis Krisda, HD Unit
124. Pusat Hemodialisis SJAM Pulau Sebang, HD Unit
125. Sinar Hemodialisis, HD Unit
126. Tenang Haemodialysis Centre, HD Unit
127. Tenang Haemodialysis Jasin, HD Unit
128. Yakin Jaya, HD Unit
129. Yayasan Kebajikan The Southern Melaka, HD Unit

Negeri Sembilan Darul Khusus

130. Giat Kurnia Dialysis Centre (Nilai), HD Unit
131. Haemodialysis Mawar Gemas, HD Unit
132. Jelebu Hospital, HD Unit
133. Persada Dialysis Centre, HD Unit
134. Port Dickson Hospital, HD Unit
135. Pusat Dialisis Suria (Tampin), HD Unit
136. Pusat Haemodialisis Renalife, HD Unit
137. Pusat Hemodialisis Berkat Seroja, HD Unit
138. Pusat Hemodialisis Mawar N. Sembilan (Bahau), HD Unit
139. Pusat Hemodialisis Mawar N. Sembilan (Lukut), HD Unit
140. Pusat Hemodialisis Mawar N. Sembilan (Rantau), HD Unit
141. Pusat Hemodialisis Mawar N. Sembilan (Seremban), HD Unit
142. Pusat Pakar Dialisis Traktif (Kuala Pilah), HD Unit
143. Pusat W aqaf An-nur (Senawang), HD Unit
144. Seremban Specialist Hospital, HD Unit
145. Tampin Hospital, HD Unit
146. Tuanku Ampuan Najihah Hospital, HD Unit
147. Tuanku Jaafar Hospital (Paed), HD Unit
148. Tuanku Jaafar Hospital, HD Unit

Pahang Darul Makmur

149. Bentong Hospital, HD Unit
150. Fitra Med, HD Unit
151. Jengka Hospital, HD Unit
152. Jerantut Hospital, HD Unit
153. Kuala Lipis Hospital, HD Unit
154. Kuantan Clinical Diagnostic Centre, HD Unit
155. Lipis Dialysis Centre, HD Unit
156. MAA-Medicare Charity (Mentakab), HD Unit
157. Mentakab Haemodialysis Unit, HD Unit
158. Muadzam Shah Hospital, HD Unit
159. Pahang Buddhist Association, HD Unit
160. Pekan Hospital, HD Unit
161. Pusat Hemodialisis Islam Makmur, HD Unit
162. Pusat Rawatan Dialisis Tun Abdul Razak-NKF Kuantan, HD Unit
163. Raub Hospital, HD Unit
164. SJAM-KPS Haemodialysis Centre 9 (Raub), HD Unit
165. Sultan Haji Ahmad Shah Hospital, HD Unit
166. Suria Dialysis Centre (Temerloh)
167. Tengku Ampuan Afzan Hospital (Paed), HD Unit
168. Tengku Ampuan Afzan Hospital, HD Unit

Perak Darul Ridzuan

169. 96 Hospital Angkatan Tentera (Lumut), HD Unit
170. Batu Gajah Hospital, HD Unit
171. Berchaam Dialysis Centre, HD Unit
172. Changkat Melintang Hospital, HD Unit
173. Fatimah Hospital, HD Unit
174. Gerik Hospital, HD Unit
175. Hope Haemodialysis Society Ipoh, HD Unit
176. Kampar Hospital, HD Unit
177. Kuala Kangsar Hospital, HD Unit
178. MAA-Medicare Charity (Teluk Intan), HD Unit

PARTICPATING HAEMODIALYSIS CENTRES 2008 (CONT...)

179. MB Star Rawatan Dialisis, HD Unit
180. Parit Buntar Hospital, HD Unit
181. Perak Community Specialist Hospital, HD Unit
182. Persatuan Amal Chin Malaysia Barat, HD Unit
183. Pertubuhan Perkhidmatan Haemodialisis Ar-Ridzuan, HD Unit
184. Pertubuhan Perkhidmatan Hemodialisis AIXIN Kerian, HD Unit
185. PMA Chan Meng Khor-MAA Medicare Charity Dialysis Centre, HD Unit
186. Pulau Pangkor Hospital, HD Unit
187. Pusat Dialisis Darul Iltizam Taiping, HD Unit
188. Pusat Dialisis Ehsan Perak (Parit Buntar), HD Unit
189. Pusat Dialisis Intan, HD Unit
190. Pusat Dialisis Kuala Kangsar, HD Unit
191. Pusat Dialisis Penawar Permai, HD Unit
192. Pusat Dialisis Setia (Ipoh), HD Unit
193. Pusat Dialisis Taiping (Kamunting), HD Unit
194. Pusat Dialisis Taiping (Kuala Kangsar), HD Unit
195. Pusat Dialisis Taiping (Parit Buntar), HD Unit
196. Pusat Dialisis Taiping, HD Unit
197. Pusat Dialysis Setia, HD Unit
198. Pusat Hemodialisis Darul Iltizam (Ipoh), HD Unit
199. Pusat Hemodialisis Kampar Yayasan Nanyang-SJAM, HD Unit
200. Pusat Hemodialisis Manjung, HD Unit
201. Pusat Rawatan Dialisis Wan Nong, HD Unit
202. Raja Permaisuri Bainun Hospital, HD Unit
203. Raja Permaisuri Bainun Hospital, Home Unit
204. Renal Care (Ipoh Specialist), HD Unit
205. Selama Hospital, HD Unit
206. Seri Manjung Hospital, HD Unit
207. Sg Siput Hospital, HD Unit
208. Slim River Hospital (Tanjong Malim), HD Unit
209. Taiping Hospital, HD Unit
210. Tapah Hospital, HD Unit
211. Teluk Intan Hospital, HD Unit
212. Woh Peng Cheang Seah, HD Unit
213. Yayasan Akhlak-NKF Taiping, HD Unit
214. Yayasan Dialysis Pendidikan Akhlak Perak-NKF Ipoh, HD Unit

Perlis Indera Kayangan

215. Tuanku Fauziah Hospital, HD Unit
216. Tuanku Syed Putra_NKF Kangar Haemodialysis Centre, HD Unit

Penang

217. AMD Rotary (Penang), HD Unit
218. Asia Renal Care (Penang), HD Unit
219. Balik Pulau Hospital, HD Unit
220. Buddhist Tzu Chi Dialysis Centre (Butterworth), HD Unit
221. Buddhist Tzu Chi HD Centre (Penang), HD Unit
222. Bukit Mertajam Hospital, HD Unit
223. Fo Yi NKF Dialysis Centre (1), HD Unit
224. Fo Yi NKF Dialysis Centre (2), HD Unit
225. Gleneagles Medical Centre, HD Unit
226. Island Hospital, HD Unit
227. K K Tan Specialist (BM), HD Unit
228. Kepala Batas Hospital, HD Unit
229. Lam Wah Ee Hospital, HD Unit
230. Loh Guan Lye Specialist Centre, HD Unit
231. MAA-Medicare Charity (Butterworth), HD Unit
232. NEPH Sdn Bhd, HD Unit
233. Pantai Mutiara Hospital, HD Unit
234. Penang Adventist Hospital, HD Unit
235. Penang Caring Dialysis Society, HD Unit
236. Persatuan Kebajikan Haemodialysis St Anne BM, HD Unit
237. Pertubuhan Dialisis Rotary-Satu Hati, HD Unit
238. Pertubuhan Hemodialisis SPS, HD Unit
239. Province Wellesley Renal Medifund, HD Unit
240. Pulau Pinang Hospital (Home), HD Unit
241. Pulau Pinang Hospital (Paed), HD Unit
242. Pulau Pinang Hospital, HD Unit
243. Pusat Dialisis Ehsan Perak (Pedar), HD Unit
244. Pusat Haemodialisis Zakat (Jawi), HD Unit
245. Pusat Hemodialisis Zakat (Balik Pulau), HD Unit
246. Pusat Hemodialisis Zakat (Bukit Mertajam), HD Unit
247. Pusat Hemodialisis Zakat (Butterworth), HD Unit
248. Pusat Hemodialisis Zakat (Kepala Batas), HD Unit
249. Pusat Hemodialisis Zakat (P. Pinang), HD Unit
250. PWRM (BM) Dialysis Centre, HD Unit
251. Renal Link (Penang), HD Unit
252. Seberang Jaya Hospital (Butterworth), HD Unit
253. Seberang Perai (Bagan), HD Unit
254. SJ Dialysis Centre, HD Unit
255. Sungai Bakap Hospital, HD Unit
256. The Penang Community HD Society, HD Unit
257. TSC Renal Care, HD Unit

Sabah

258. Beaufort Hospital, HD Unit
259. Beluran Hospital, HD Unit
260. Duchess of Kent Hospital, HD Unit
261. Keningau Hospital, HD Unit
262. Kota Belud Hospital, HD Unit
263. Kota Kinabatangan Hospital, HD Unit
264. Kota Marudu Hospital, HD Unit
265. Kudat Hospital, HD Unit
266. Labuan Hospital, HD Unit
267. Lahad Datu Hospital, HD Unit
268. Likas Hospital (Paed), HD Unit
269. Likas Hospital, HD Unit
270. MAA-Medicare Charity (Kota Kinabalu), HD Unit
271. Nobel Dialysis Centre, HD Unit

PARTICPATING HAEMODIALYSIS CENTRES 2008 (CONT...)

272. Papar Hospital, HD Unit
273. Persatuan Buah Pinggang Sabah, HD Unit
274. Persatuan Hemodialysis Kinabalu Sabah, HD Unit
275. Queen Elizabeth Hospital, HD Unit
276. Ranau Hospital, HD Unit
277. Rotary Tawau Tanjung, HD Unit
278. Sabah Medical Centre, HD Unit
279. Sandakan Kidney Society, HD Unit
280. Semporna Hospital, HD Unit
281. Sipitang Hospital, HD Unit
282. Tambunan Hospital, HD Unit
283. Tawau Hospital, HD Unit
284. Tenom Hospital, HD Unit

Sarawak

285. 801 Rumah Sakit Angkatan Tentera (Kuching), HD Unit
286. Bau Hospital, HD Unit
287. Betong Hospital, HD Unit
288. Bintulu Hospital, HD Unit
289. CHKMUS-MAA Medicare Charity, HD Unit
290. Hospital Daerah Daro, HD Unit
291. Kanowit Hospital, HD Unit
292. Kapit Hospital, HD Unit
293. KAS-Rotary-NKF, HD Unit
294. Kuching Specialist Hospital, HD Unit
295. Lawas Hospital, HD Unit
296. Limbang Hospital, HD Unit
297. Lundu Hospital, HD Unit
298. Marudi Hospital, HD Unit
299. Miri Hospital, HD Unit
300. Miri Red Crescent Dialysis Centre, HD Unit
301. Mukah Hospital, HD Unit
302. Normah Medical Specialist Centre, HD Unit
303. Rejang Medical Centre, HD Unit
304. Renal Life Dialysis Centre, HD Unit
305. Saratok Hospital, HD Unit
306. Sarawak General Hospital, HD Unit
307. Sarikei Hospital, HD Unit
308. Serian Hospital, HD Unit
309. Sibu Hospital, HD Unit
310. Sibu Kidney Foundation, HD Unit
311. Simunjan Hospital, HD Unit
312. SJAM-KPS 10 (Bintulu), HD Unit
313. SJAM-KPS Haemodialysis Centre 8 (Sibu), HD Unit
314. Sri Aman Hospital, HD Unit
315. Timberland Medical Centre, HD Unit

Selangor Darul Ehsan

316. 819 Rumah Sakit Angkatan Tentera, HD Unit
317. Ampang Hospital, HD Unit
318. Ampang Puteri Specialist Hospital, HD Unit
319. Apex Club of Klang-NKF Charity Dialysis Centre, HD Unit
320. Assunta Hospital, HD Unit
321. Bakti-NKF Dialysis Centre, HD Unit
322. Bangi Dialysis Centre, HD Unit
323. Banting Hospital, HD Unit
324. Berjaya NKF Dialysis Centre, HD Unit
325. Caring Dialysis Centre Andalas (Klang), HD Unit
326. Damansara Specialist Hospital, HD Unit
327. EAM Dialysis Centre, HD Unit
328. Haemodialysis Association Klang, HD Unit
329. Haemodialysis Edina, HD Unit
330. Healthcare Dialysis Centre, HD Unit
331. Hemodialisis Yayasan Veteran ATM, HD Unit
332. Kajang Hospital, HD Unit
333. Kelana Jaya Medical Centre, HD Unit
334. KPJ Kajang Specialist Hospital, HD Unit
335. KPJ Selangor Specialis Hospital, HD Unit
336. Kuala Kubu Bharu Hospital, HD Unit
337. MAA-Medicare Charity (Kajang), HD Unit
338. Persatuan Dialisis Kurnia PJ, HD Unit
339. Persatuan Dialisis Touch, HD Unit
340. Pertubuhan Hemodialisis Pasar Besar Meru, HD Unit
341. Ping Rong-NKF, HD Unit
342. PNSB Dialisis Centre, HD Unit
343. Pusat Dialisis Aiman (Shah Alam), HD Unit
344. Pusat Dialisis LZS (Kapar), HD Unit
345. Pusat Dialisis LZS (Sg. Besar), HD Unit
346. Pusat Dialisis LZS (Shah Alam), HD Unit
347. Pusat Dialisis Pakar Medi-Nefro, HD Unit
348. Pusat Dialisis Putra Jaya (Kajang), HD Unit
349. Pusat Dialisis Sijangkang, HD Unit
350. Pusat Dialysis Mesra (Rahman Putra), HD Unit
351. Pusat Dialysis Mesra KKB, HD Unit
352. Pusat Dialysis Putra Jaya (Semenyih), HD Unit
353. Pusat Haemodialysis Nilam, HD Unit
354. Pusat Hemodialisis Fasa, HD Unit
355. Pusat Hemodialisis Kau Ong Yah Ampang, HD Unit
356. Pusat Hemodialisis Mawar N. Sembilan (Sepang), HD Unit
357. Pusat Hemodialisis Mawar N. Sembilan (Seri Kembangan), HD Unit
358. Pusat Perubatan Primier HUKM, HD Unit
359. Pusat Rawatan Dialisis Islah (Batu Caves), HD Unit
360. Pusat Rawatan Dialisis Mukmin, HD Unit
361. Pusat Rawatan Dialisis Nefro Utama (Puchong Jaya), HD Unit
362. Pusat Rawatan Dialisis Traktif (Selayang), HD Unit

PARTICPATING HAEMODIALYSIS CENTRES 2008 (CONT...)

363. Pusat Rawatan Hemodialisis Felina, HD Unit
364. Putrajaya Hospital, HD Unit
365. Rawatan Dialysis Bukit Tinggi, HD Unit
366. Renal Associates, HD Unit
367. S.P. Menon Dialysis Centre (Klang), HD Unit
368. S.P. Menon Dialysis Centre (Petaling Jaya), HD Unit
369. Selayang Hospital (Paed), HD Unit
370. Selayang Hospital, HD Unit
371. Serdang Hospital, HD Unit
372. Sime Darby Medical Centre Subang Jaya, HD Unit
373. SJAM-KPS Haemodialysis Centre 1 (Raja Muda Musa), HD Unit
374. SJAM-KPS Haemodialysis Centre 2 (Klang), HD Unit
375. SJAM-KPS Haemodialysis Centre 3 (Banting), HD Unit
376. SJAM-KPS Haemodialysis Centre 5 (Rawang), HD Unit
377. SJAM-KPS Haemodialysis Centre 6 (Kuala Selangor), HD Unit
378. SJAM-KPS Haemodialysis Centre 11 (Shah Alam), HD Unit
379. SJAM-KPS Haemodialysis Centre 12 (Balakong), HD Unit
380. SJAM-KPS Pusat Hemodialisis Tasik Puteri, HD Unit
381. Smartcare Dialysis Centre (Subang Jaya), HD Unit
382. Sri Kota Medical Centre, HD Unit
383. Sungai Buloh Hospital, HD Unit
384. Sunway Medical Centre (2), HD Unit
385. Sunway Medical Centre, HD Unit
386. Syukur Elit Sdn Bhd, HD Unit
387. Tanjung Karang Hospital, HD Unit
388. Tengku Ampuan Jemaah Hospital, HD Unit
389. Tengku Ampuan Rahimah Hospital, HD Unit
390. Universiti Kebangsaan Malaysia Bangi, HD Unit
391. Yayasan Kebajikan SSL (Petaling Jaya), HD Unit
392. Yayasan Kebajikan SSL (Puchong), HD Unit

Terengganu Darul Iman

393. Besut Hospital, HD Unit
394. Dungun Hospital, HD Unit
395. Hulu Terengganu Hospital, HD Unit
396. Jerteh Dialysis Centre
397. Kemaman Hospital, HD Unit
398. Pusat Dialisis Terengganu/NKF, HD Unit
399. Pusat Hemodialisis Nabilah, HD Unit
400. Pusat Pakar Dialisis Traktif Sdn Bhd (Besut), HD Unit
401. Pusat Rawatan Dialisis Islah (Kuala Terengganu), HD Unit
402. Sultanah Nur Zahirah Hospital, HD Unit
403. YKN Dialisis (Terengganu), HD Unit

Wilayah Persekutuan Kuala Lumpur

404. Aiman Dialysis Centre, HD Unit
405. Charis-NKF Dialysis Centre, HD Unit
406. Cheras Dialysis Centre, HD Unit
407. Kampong Baru Medical Centre, HD Unit
408. Kuala Lumpur Hospital (Home), HD Unit
409. Kuala Lumpur Hospital (Paed.), HD Unit
410. Kuala Lumpur Hospital (Unit 1), HD Unit
411. Kuala Lumpur Hospital (Unit 3), HD Unit
412. Kuala Lumpur Hospital (Unit 4), HD Unit
413. Kuala Lumpur Lions Renal Centre, HD Unit
414. MAA-Medicare Charity (Cheras), HD Unit
415. MAA-Medicare Charity (Kuala Lumpur), HD Unit
416. MDZ Haemodialysis Centre, HD Unit
417. National Kidney Foundation Dialysis Centre (KL), HD Unit
418. Pantai ARC Dialysis Services, HD Unit
419. Pantai Indah Hospital, HD Unit
420. Pantai Medical Centre (KL), HD Unit
421. Poliklinik Komuniti Tanglin, HD Unit
422. Pusat Dialisis Falah, HD Unit
423. Pusat Dialisis Pusat Punggutan Zakat (Kuala Lumpur), HD Unit
424. Pusat Hemodialisis Dato' Lee Kok Chee, HD Unit
425. Pusat Hemodialisis Harmoni, HD Unit
426. Pusat Hemodialisis KEMENTAH, HD Unit
427. Pusat Hemodialisis Mawar N. Sembilan (Seputih), HD Unit
428. Pusat Hemodialisis PUSRAWI, HD Unit
429. Pusat Hemodialisis Waz Lian, HD Unit
430. Pusat Hemodialisis Yayasan Felda, HD Unit
431. Pusat Pakar Tawakal, HD Unit
432. Pusat Perubatan Universiti Kebangsaan Malaysial, HD Unit
433. Pusat Rawatan Dialisis Nefro Utama (Setapak), HD Unit
434. Renal Dialysis Centre, HD Unit
435. Rotary Damansara-NKF Dialysis, HD Unit
436. S.P. Menon Dialysis Centre (Kuala Lumpur), HD Unit
437. Sentosa Medical Centre, HD Unit
438. Smartcare Dialysis Clinic, HD Unit
439. The Kidney Dialysis Centre (1), HD Unit
440. The Kidney Dialysis Centre (2), HD Unit
441. The Nayang-NKF Dialysis Centre, HD Unit
442. Traktif Specialist Dialysis Centre (Wangsa Maju), HD Unit
443. Tung Shin Hospital & Yayasan Nanyang Press, HD Unit
444. Tung Shin Hospital, HD Unit
445. University Malaya Medical Centre, HD Unit
446. YKN Dialisis (Kuala Lumpur), HD Unit

Participating PD centres 2008

Johor Darul Takzim

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

Kedah Darul Aman

Sultanah Bahiyah Hospital, CAPD Unit

Kelantan Darul Naim

Raja Perempuan Zainab II Hospital , CAPD Unit
Universiti Sains Malaysia Hospital, CAPD Unit

Melaka

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

Negeri Sembilan Darul Khusus

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

Pahang Darul Makmur

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

Perak Darul Ridzuan

96 Hospital Angkatan Tentera (Lumut), CAPD Unit
Ipoh Hospital, CAPD Unit

Penang

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

Sabah

Likas Hospital (Paed), CAPD Unit
Queen Elizabeth Hospital, CAPD Unit
Sabah Medical Centre, CAPD Unit

Sarawak

Kuching Specialist Hospital, CAPD Unit
Sarawak General Hospital, CAPD Unit

Selangor Darul Ehsan

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 Darul Iman

Sultanah Nur Zahirah Hospital, CAPD Unit

Wilayah Persekutuan Kuala Lumpur

Kuala Lumpur Hospital (Paed.), CAPD Unit
Kuala Lumpur Hospital, CAPD Unit
Pusat Perubatan Universiti Kebangsaan Malaysia, CAPD Unit
University Malaya Medical Centre, CAPD Unit

Participating Transplant follow-up Centres 2008

Johor Darul Takzim
Batu Pahat Hospital
Hospital Sultan Ismail Pandan
Kluang Hospital
Pakar Sultanah Fatimah Muar Hospital
Pontian Hospital
Segamat Hospital
Sultanah Aminah Hospital

Kedah Darul Aman
Hospital Sultanah Bahiyah

Kelantan Darul Naim
Hospital Raja Perempuan Zainab II
Universiti Sains Malaysia Hospital

Negeri Melaka
Melaka Hospital
Wee Kidney & Medical Specialist Clinic
(Mahkota Medical Centre)

Negeri Sembilan Darul Khusus
Hospital Tuanku Ja'afar Seremban

Pahang Darul Makmur
Tg. Ampuan Afzan Hospital

Perak Darul Ridzuan
Hospital Raja Permaisuri Bainun
Taiping Hospital

Penang
Pulau Pinang Hospital

Sabah
Duchess of Kent Hospital
Queen Elizabeth Hospital
Sabah Medical Centre
Tawau Hospital

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

Selangor Darul Ehsan
Ampang Puteri Specialist Hospital
Selayang Hospital
Serdang Hospital
Sri Kota Medical Centre
Sunway Medical Centre
Tan Medical Renal Clinic
Tg. Ampuan Rahimah Hospital

Terengganu Darul Iman
Hospital Sultanah Nur Zahirah
Kemaman Hospital

Wilayah Persekutuan Kuala Lumpur
Fan Medical Renal Clinic
Kuala Lumpur Hospital
Pusat Perubatan UKM
Smartcare Dialysis Centre (Cheras)
University Malaya Medical Centre

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FOREWORD

Prevalent dialysis patients are now close to 19,000 giving a rate of nearly 700 per million population (pmp), an increase from 626 pmp at the end of 2007. A few years ago we predicted that the prevalent dialysis patients will reach 20,000 by the year 2010. The continued impressive increase in the number of new patients accepted for dialysis coupled with a stable annual mortality rate of about 10% means that this number will be reached earlier than 2010. The "high performing states" continued to do well in 2008 with acceptance rates greater than 200 pmp. Almost all states showed an improvement in acceptance rates but some can and should do better to improve equity in dialysis provision.

Renal transplantation rate continued to be dismal and unchanged in the last many years. The Ministry of Health had initiated many new measures since 2007 but they do not seem to make an impact. A National Organ Transplantation Policy was enunciated, the organizational structure for transplantation services was strengthened and more money was allocated for the service but yet organ transplantation (and not just renal transplantation) did not increase. The ubiquitous dialysis centres (from "shop-lots centres" to hospital- based facilities) could possibly be blamed for the lack of interest in kidney transplantation but heart and liver transplantation fared worse. The apathy amongst the public needs to be studied.

The Registry has been collecting data on funding for many years now. The data shows that the government is still the major sponsor of dialysis funding. In fact the Registry presently can only collect data on direct funding of dialysis treatment – either full subsidy as in Ministry of Health dialysis centres or partial subsidy in the NGO centre. There is however a substantial indirect subsidy by the government for which no data is available. This include evaluation of patients in the immediate pre-dialysis period (most of these patients eventually were dialysed in NGO or private centres), continued provision of medications and performance of regular blood tests even when they are on Dialysis at non- government centre, creation of vascular access and admission for dialysis related complications. The involvement of government agencies in dialysis funding is only expected as most patients cannot afford the total costs of dialysis care. There should perhaps be a clearer structure on government involvement and contribution so that the true costs of dialysis can bee seen. The NRR can certainly facilitate an initiative to study the contributions of government agencies to funding of dialysis. The results of such a study may help the formulation of clearer policies on funding and monitoring of such funding.

As in the previous ones, this report also looks at quality measures and variation in practices and outcomes. There have been no substantial changes in the quality measures. There still is variation in practices which impact on outcomes. It is only through continuing education and training that such variations can be reduced. And the Registry hopes that professional bodies such as the Malaysian Society of Nephrology and the Association of Dialysis Medical Assistants and Nurses will intensify their training programs

The National Renal Registry is taking on additional responsibilities. It has initiated a number of new renal-based registries. The Malaysian Registry of Renal Biopsies has produced its first report. Two other registries are in the planning stages: the Registry of Interventional Nephrology and the Registry of Diabetic nephropathy. This additional workload has placed considerable stress on the facilities and staff of NRR. The staff under the able leadership of Lee Day Guat has coped admirably well and the Advisory committee of NRR expresses it thanks and appreciation to them. We are also indebted to the two editors Dr Lim Teck Onn and Dr Lim Yam Ngo for once again producing an excellent report.

Dr Zaki Morad
Chairman
National Renal Registry

CONTENTS

CONTENTS (CONT...)

CONTENTS (CONT...)

LIST OF TABLES

LIST OF TABLES (CONT...)

LIST OF TABLES (CONT...)

LIST OF TABLES (CONT...)

LIST OF TABLES (CONT...)

LIST OF TABLES (CONT...)

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LIST OF FIGURES(CONT..)

REPORT SUMMARY

- Intake of new dialysis patients increased linearly from 1559 in 1999 to 3874 in 2007 with corresponding treatment rates of 69 and 143 per million population.
- Prevalent dialysis patients increased from 5542 (244 per million population) in 1999 to more than 17015 (626 per million) at year end 2007 and almost 19000 in 2008. Transplant numbers and rates showed a decreasing trend last 2 years.
- Except for Sabah and Kelantan, all the other states have treatment rates of more than 100 per million state population since 2007. Pulau Pinang, Melaka, Johor, Negri Sembilan and WP Kuala Lumpur have dialysis treatment rates exceeding 200 per million.
- Centre survey report December 2008: 485hemodialysis centres and 31 peritoneal dialysis (PD) centres provided dialysis care to 19221 patients. The MOH provided dialysis to 32.4% of patients, NGO 29.9% and the private sector at 36.3%. Public sector dialysis centres provided PD to 98% of PD patients.
- The treatment gap between men and women has remained consistent over the years.
- Dialysis treatment rates for those >55 years of continued to increase.
- 86% of new patients were accepted into centre haemodialysis
- The government continued to fund about 54% of new dialysis treatment, NGO funding was 10% in 2007/ 2008, and self funding 25%.
- The proportion of new ESRD patients due to diabetes mellitus was 58% in 2006 and 2007 and 55% in 2008.
- The rapid economic growth led to rapid increase in dialysis provision by government, non-government and private sectors.
- Factored for inflation, the price of dialysis has declined in real terms
- The affordability of dialysis has improved, although at 65% of average household income needed to maintain one patient on dialysis, it remains a catastrophic illness for family finances when compared to affordability in most developed countries.
- The extent of inequality in provision is declining across all sectors. Public sector provision now significantly favours those in less developed states. NGO and private provision still favours the more developed states
- The annual death rate for those on PD and HD in 2008 was 14.5% and 9.6% respectively.
- Cardiovascular disease and death at home remained the commonest cause of death in 2008 at 29 and 22% respectively; death due to sepsis accounted for 17%.
- The overall unadjusted 5 years and 10 years patient survival on dialysis were 58% and 35% respectively
- There was wide centre variation with regards to HD and PD patient survival at one and 5 years adjusted for age and diabetic status. The median one-year survival for HD centres was 96% and PD centres 94%.
- There was at least 2-fold variation in odds ratio of death by dialysis centres.

- For HD patients, there were positive correlation between age of patient, diabetes mellitus, diastolic BP, serum calcium, serum phosphate and hepatitis B antigenaemia with mortality while negative correlation was noted between serum albumin, haemoglobin concentration, calcium phosphate product and Kt/V with mortality. Patients commencing dialysis in 2007-2008 has 12% lower adjusted hazard ratio for mortality when compared to those started dialysis from 2000-2006. PD patients did not show correlation with serum cholesterol, hepatitis B status and Kt/V.

- Median QoL index scores were satisfactory and HD patients achieved a lower score than PD patients. Diabetes Mellitus and older age group are factors associated with lower median QoL index scores.

- In 2008, 87% of HD and 77% of PD patients were on erythropoietin (EPO). Blood transfusion rate in dialysis patients was 16% in 2008. Use of parenteral iron has increased, with corresponding reduction in oral iron prescription. 23% of HD patients were on IV iron therapy in 2008. The median weekly EPO dose remained at 4000 units, in both HD and CAPD patients. 86 % of patients have serum ferritin of >200 ng/ml and 56% of patients >500 ng/ml. 91% of all patients have transferrin saturation greater than 20% Median haemoglobin level was 10.8g/L in 2008. Wide variations were seen in the use of EPO, blood transfusion rates, measures of iron stores and hemoglobin levels in HD and PD centres

- Serum albumin levels remained at mean and median of about 40g/L for HD and about 33 g/L in PD patients in 2008. There were wide variations in the proportion of patients with serum albumin of at least 40g/L in HD and serum albumin of >35 g/L in PD centres.

- Body mass index for HD patients has stabilized around 23 to 24, but was still increasing for patients on PD. There was wide variation in proportion of patients with BMI $\geq$ 18.5 and serum albumin > 40 g/L in both HD and PD centres.

- In 2008, predialysis systolic BP remained high in HD patients. There was better control of predialysis diastolic blood pressure in HD patients. Blood pressure (BP) control in PD patients improved 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.

- Serum cholesterol and triglyceride levels were lower in HD than in PD patients. There remained significant variation in lipid control between dialysis centres.

- In 2008 about 92% of HD patients and 86% of PD patients were still on calcium carbonate. . Calcitriol remained the main vitamin D used in both HD and PD patients and its use continued to rise. The percentage of patients who underwent parathyroidectomy has doubled in 2008 compared to 2005 among those HD and PD patients The mean corrected serum calcium remained slightly lower in the HD patients compared to PD patients. Phosphate control continued to be better in PD patients. The proportion of PD patients achieving target serum phosphate 1.13-1.78 mmol/l was 55% compared to 48% of HD patients. Mean (iPTH) level seemed to be on increasing trend among both HD and PD patients. There was wide variation in the median levels of serum calcium, phosphate, calcium phosphate product and iPTH among both hemodialysis and PD centres.

- The prevalence of hepatitis C in HD patients continues to decline annually by 2-3%. Prevalence of hepatitis B though low, is also declining annually 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: In 2008, 91% of patients used native arteriovenous fistula. There was increased use of brachiocephalic fistulae, higher blood flow rates, increased usage of synthetic membranes, and almost universal use of bicarbonate buffer. 95% reuse dialysers. Although the prescribed median Kt/V was 1.6 in 2008, the delivered median Kt/V was only1.4. The percentage of patients with a delivered Kt/V $\geq$ 1. 3 was 58%. The median urea reduction ratio was 71.3% and the percentage of patients with URR $\geq$ 65% was 79%. 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. Younger age groups and the non-diabetics have better technique survival but the year of starting dialysis did not impact on technique survival.

- Chronic PD practices - . In 2008, there is a 13% increment of PD utilization compared to year 2007 with a total number of 2083 patients. APD accounted for 12% in 2008. For CAPD, 94% were on Baxter disconnect system. 86% were on 4 exchanges a day, 88% used a fill volume of 2 L. The median delivered weekly Kt/V was 2.0, 82% achieved target Kt/V of $\geq$1.7 with a 1.8 fold variation between the highest and the lowest performing centres. The risk factors associated with poor PD technique survival are older age, diabetes, peritonitis episodes, cardiovascular disease, low BMI, hypoalbuminemia, abnormal lipid profile, serum haemoglobin less than 11g/dL, high calcium phosphate level and assisted PD The commonest reason for PD drop-out was peritonitis, followed by membrane failure and patient preference.

- In 2008, the median peritonitis rate dropped to 28.4 pt-months per episode. There is still a wide inter-centre variation with the highest and lowest peritonitis rates of 12 and 132.2 pt-months per episode median peritonitis rate. Gram-positive organisms accounted for 27% of peritonitis episodes while 34% were due to gram negative organisms.

Renal transplantation

- There were 100 new renal transplant recipients in 2007 and only 88 in 2008. There were 1730 patients with functioning transplants at the end of 2008. The incidence rate and prevalence rate of kidney transplant seem to reduce in year 2008

- Age at transplant has been stable at 34 to 42 years and between 58% and 70% of recipients are males over the last 10 years. 15% were diabetics, 4% HbsAg positive and 4% anti-HCV positive at the time of transplantation.

- Commonest known primary renal disease was chronic glomerulonephritis followed by hypertension and diabetes mellitus.

- Since 2006, the number of life donor has remained low - 31 in 2007 and 25 in 2008. Local cadaveric donation made up 18% of transplants. Commercial transplants from China constituted only 41% and 45% in 2008.

- Proportion of renal transplant recipients on cyclosporine slowly declined to 69% in 2008, Tacrolimus based regimes accounted for 24%. Use of MMF increased to 5% and azathioprine decreased to 28%.

- Seven percent developed diabetes mellitus post transplantation

- The rates of transplant death and graft loss have remained static for the past 10 years. Infection, cancer and death at home were the commonest causes of death. Renal allograft rejection accounted for 50-75% of graft losses for the last 10 years

- Overall patient survival rates from 1995 to 2008 have been 95%, 91%, 88% and 81% at year 1, 3, 5 and 10 respectively. Overall graft survival rate has been 91%, 85%, 80% and 66% at year 1, 3, 5 and 10 respectively.
- Living donor transplantation had the best patient survival. Living done and commercial cadaver grafts had the best graft survival rates.

Paediatric Renal Replacement Therapy

- The dialysis acceptance rate for paediatric patients in 2008 was 7 pmarp
- New transplant rate was 2 pmarp
- The overall incidence rate for all RRT in 2008 was 8 pmarp
- At the end of 2008 there were a total of 555 patients under 20 years of age on dialysis giving a dialysis prevalence rate of 48 pmarp
- The numbers of children with functioning transplants in 2008 was 173, giving a prevalence rate of 15 pmarp
- Dialysis treatment rate were higher in economically advantaged states of Malaysia but the gap is becoming less marked in the last 5 years
- The number of 0-4 year olds provided RRT remained very low
- Chronic PD was the initial dialysis modality in about 54% of patients. Of this 5% were on automated PD
- About 90% of children received their dialysis in government centres
- The commonest cause of ESRD was glomerulonephrits (excluding FSGS), which affected 22% of patients. FSGS on its own accounted for 8% of cases.
- HD patient survival was 94% at 1 year and 82% at 5 years
- PD patients survival was 93% at 1 year and 77% at 5 years
- In the last 5 years; cadaveric renal transplant was the commonest type of renal transplant done, accounting for about 42% of cases compared to 36% for living related.
- Transplant patient survival was 98% at 1 year and 92% at 5 years; graft survival was 89% at 1 year and 75% at 5 years.

ABBREVIATIONS

BMI	Body Mass Index
BP	Blood pressure
CAPD	Continuous Ambulatory Peritoneal Dialysis
CCPD/APD	Continuous cycling peritoneal dialysis/automated peritoneal dialysis
CI	Concentration Index
CKD	Chronic kidney disease
CRA	Clinical Registry Assistant
CRA	Clinical Registry assistant
CRC	Clinical Research Centre
CRF	Case report form
CRM	Clinical Registry Manager
CVD	Cardiovascular Disease
DAPD	Daytime Ambulatory Peritoneal Dialsysis
DM	Diabetes Mellitus
DOQI	Dialysis Outcome Quality Initiative
eMOSS	Malaysian Organ Sharing System (Renal)
ESRD	End Stage Renal Disease
GDP	Gross domestic product
GNI	Gross National Income
HD	Haemodialysis
HKL	Kuala Lumpur Hospital
ITT	Intention to treat
iPTH	Intact parathyroid hormone
JNC VI	Joint National Committee on management of hypertension
Kt/V	Number used to quantify hemodialysis and peritoneal dialysis treatment adequacy
LQ	Lower quartile
MDTR	Malaysian Dialysis and Transplant Registry
MOH	Ministry of Health, Malaysia
MOSS	Malaysian Organ Sharing System
MRRB	Malaysian Registry of Renal Biopsy
MSN	Malaysian Society of Nephrology
NGO	Non-governmental organization
NRIC	National Registration Identity Card
NRR	National Renal Registry, Malaysia
PD	Peritoneal dialysis
PET D/P	peritoneal transport status dialysate and plasma (D/P ratio)
pmarp	per million age related population
pmp	per million population
QoL	Quality of Life
ref	reference
RCC	Registry coordinating centre
RRT	Renal replacement therapy
SC	Site coordinator
SDP	Source data producer
UQ	Upper quartile
URR	Urea reduction rate

CHAPTER 1

All Renal Replacement Therapy in Malaysia

Lim Yam Ngo
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SECTION 1.1: STOCK AND FLOW

The intake of new dialysis patients continued to increase over the years - from 1559 in 1999 to 3874 in 2007. The number of prevalent dialysis patients has similarly increased from 5542 in 1998 to more than 16000 at year end 2007 and almost 19000 in 2008. (Data for 2008 however are preliminary since at the time of writing this report there was still many new patients yet to be notified to registry.)

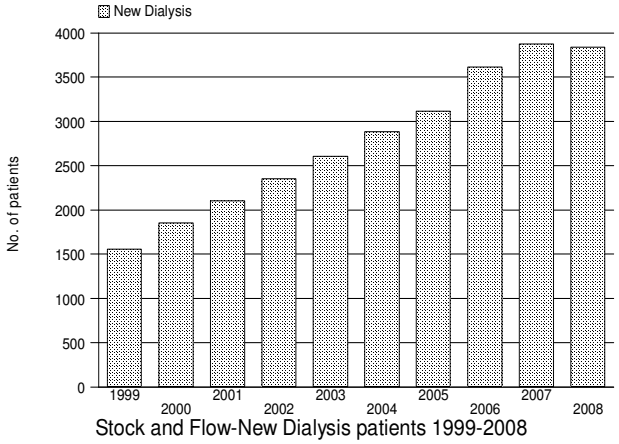
The number of new kidney transplant recipients seems to be showing a decreasing trend from 2005 due most probably to the increasing proscription against commercial transplantation. Patients with functioning renal transplants have also begun to level off since 2006. (Table and Figure 1.01)

Table 1.1: Stock and Flow of RRT, Malaysia 1999-2008

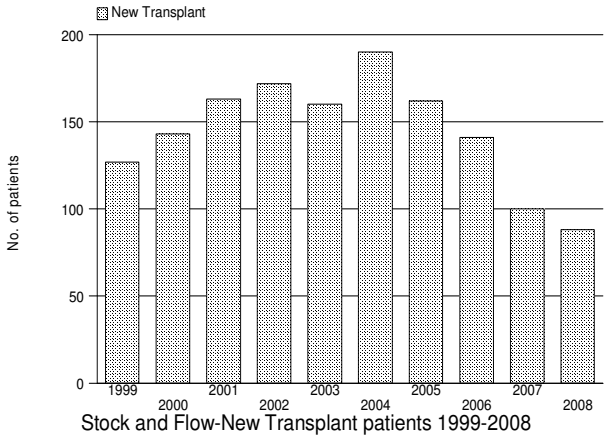
Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
New Dialysis patients	1559	1854	2100	2350	2605	2880	3115	3614	3874	3836
New Transplants	127	143	163	172	160	190	162	141	100	88
Dialysis deaths	493	597	816	929	1161	1278	1430	1696	1780	1803
Transplant deaths	25	30	37	33	37	42	43	50	39	48
Dialyzing at 31st Dec	5542	6694	7847	9119	10438	11884	13403	15084	17015	18856
Functioning transplant at 31st Dec	1178	1250	1333	1428	1505	1595	1683	1726	1732	1730

Figure 1.1: Stock and Flow of RRT, Malaysia 1999-2008

(a) New Dialysis and Transplant patients

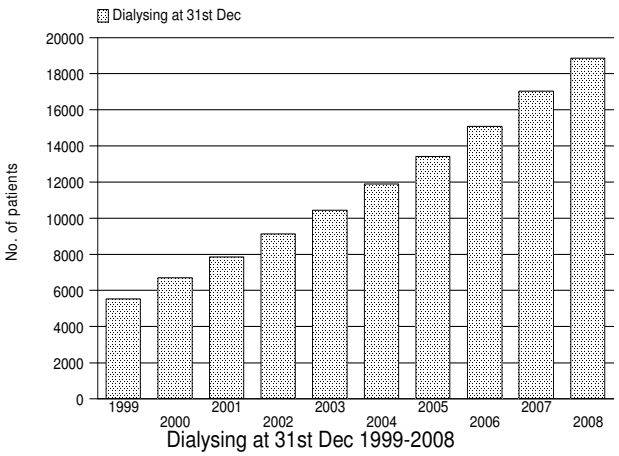


Stock and Flow-New Dialysis patients 1999-2008

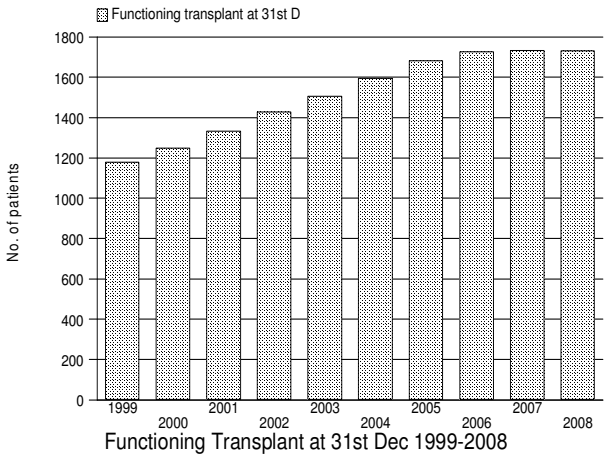


Stock and Flow-New Transplant patients 1999-2008

(b) Patients Dialysing and with Functioning Transplant at 31st December 1999-2008



Dialysing at 31st Dec 1999-2008



Functioning Transplant at 31st Dec 1999-2008

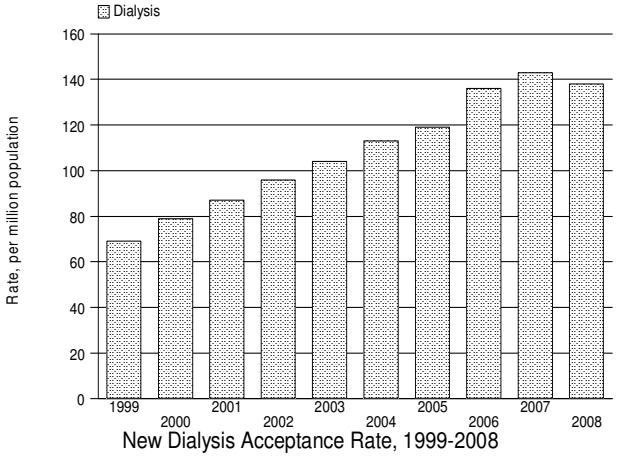
SECTION 1.2: TREATMENT PROVISION RATE

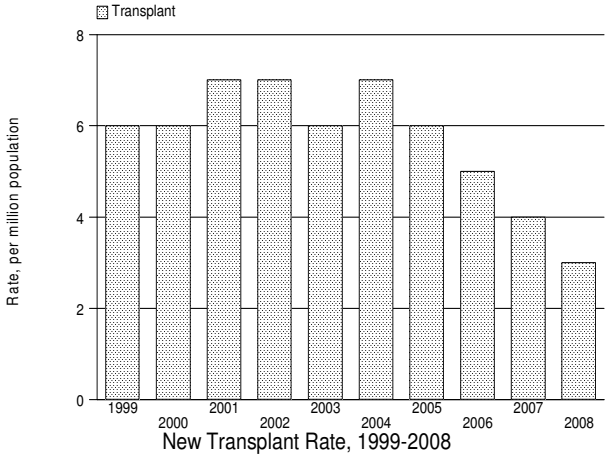
Dialysis acceptance rates also continued to increase linearly from 69 per million population in 1999 to 143 per million in 2007. New kidney transplant rates remained low over the years and were decreasing since 2005. Since 1990, commercial transplantation carried overseas had contributed more than 50% of all new kidney transplantation each year. With the proscription of commercial transplantation done overseas, commercial donor transplantation contributed less than 50% since 2007 and 2008. (see table 14.1.4, chapter 14)

Table 1. 2: New Dialysis Acceptance rate and New Transplant Rate per million population 1999-2008

Acceptance rate	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
New Dialysis	69	79	87	96	104	113	119	136	143	138
New Transplant	6	6	7	7	6	7	6	5	4	3

Figure 1.2: New Dialysis Acceptance and New Transplant Rate 1999-2008



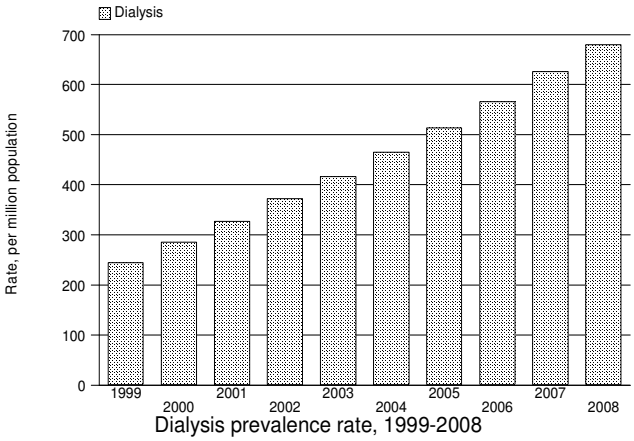


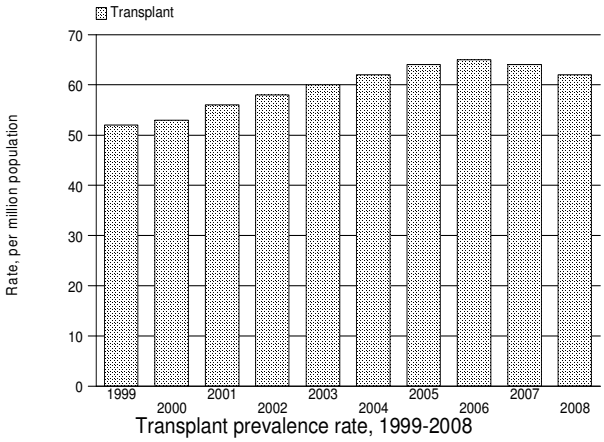
Dialysis prevalence rate continued to increase linearly over the last 10 years, from 244 per million population in 1999 to more than 600 since 2007. The transplant prevalence rate however seems to be beginning to show a downward trend. (table and figure 1.03)

Table 1.3: RRT Prevalence Rate per million population 1999-2008

Prevalence rate	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Dialysis	244	285	327	372	417	465	513	566	626	680
Transplant	52	53	56	58	60	62	64	65	64	62

Figure 1.3: Dialysis and Transplant Prevalence Rate per million population 1999-2008





CHAPTER 2

Dialysis in Malaysia

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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 2007, 3874 patients commenced dialysis, giving an incidence rate of 143 per million population. In 2007, just over 17000 patients were reported to the registry as being on dialysis treatment giving a prevalence rate of 626 per million per year. By year end 2008, almost 19000 patients were on dialysis. The proportion of dialysis patients lost to follow-up remained very low at less than 1%.

Table 2.1.1: Stock and flow-Dialysis Patients 1999-2008

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
New Dialysis patients	1559	1854	2100	2350	2605	2880	3115	3614	3874	3836
Died	493	597	816	929	1161	1278	1430	1696	1780	1803
Transplanted	69	106	130	145	121	154	122	121	86	100
Lost to Follow-up	6	8	8	18	25	26	48	128	87	62
Dialysing at 31st Dec	5542	6694	7847	9119	10438	11884	13403	15084	17015	18856

Table 2.1.2: Dialysis Treatment Rate per million population 1999-2008

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Acceptance rate	69	79	87	96	104	113	119	136	143	138
Prevalence rate	244	285	327	372	417	465	513	566	626	680

2.1.2.Geographic distribution

Except for Sabah and Kelantan, all the other states have treatment rates of more than 100 per million state population since 2007. With the growth in dialysis provision shown by Kelantan over the last few years, it may well exceed treatment rate of 100 per million in 2008. (Data for 2008 is preliminary as at the time of writing of this report, many patients have yet to be notified to the registry).
However, Pulau Pinang, Melaka, Johor, Kuala Lumpur and Negri Sembilan – the highest dialysis provision states have incident rates of 200 or more per million state population.

Table 2.1.3: Dialysis Treatment Rate by state, per million population 1999-2008

State	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Pulau Pinang	124	110	125	158	145	213	201	214	215	157
Melaka	88	150	156	175	186	210	170	199	208	215
Johor	104	131	138	147	147	156	170	209	187	211
Perak	76	105	103	116	129	147	170	185	174	168
Selangor & Putrajaya	93	84	94	111	120	123	134	150	160	150
WP Kuala Lumpur	122	158	188	172	193	208	200	218	243	230
Negeri Sembilan	97	116	110	133	147	157	154	149	212	201
Kedah	60	66	63	88	103	98	108	115	110	143
Perlis	49	72	104	103	128	95	102	127	129	68
Terengganu	36	37	76	90	66	80	100	104	170	122
Pahang	48	49	52	52	68	74	88	122	109	108
Kelantan	27	31	61	61	74	66	80	80	95	71
Sarawak	44	50	67	59	62	73	73	86	105	107
Sabah & WP Labuan	31	26	35	37	44	49	46	64	71	79

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

Data submission of individual dialysis and transplant patients to the National Renal Registry was entirely voluntary prior to 2006. Since then, with the implementation of the Private Health Care Facilities and Services Act 1998 and its Regulations in 2006, submission of data from private and Non-governmental organization (NGO) centres has been made compulsory. However, enforcement of this Act is still in the preliminary stages. In contrast, data submission from centres managed by the Ministry of Health, Ministry of Defence or the Universities is still voluntary.

Dialysis centre surveys have been conducted in December of each year since 1999. This annual cross-sectional survey was carried out to describe the most current level and distribution of dialysis provision for both hemodialysis and peritoneal dialysis at the end of each year. This section reports the results of the centre survey carried out in December 2007. Dialysis provision is expressed in terms of number of centres, HD machines, treatment capacity (one HD machine to 5 patients) and patients.

In December 2008, 484 hemodialysis centres and 31 peritoneal dialysis (PD) centres provided dialysis care to 19221 patients. (Data on 18856 inidividual dialysis patients were reported to the Registry giving a dialysis patient ascertainment rate of 98%). The Ministry of Health (MOH) provided dialysis to 32.4% of patients, non-governmental organizations (NGO) 29.9% and the private sector at 36.3%. Almost all private patients received centre haemodialysis treatment compared to the MOH sector where patients on PD comprised 26% of all dialysis patients. There were no PD patients in the NGO centres. (table 2.2.1)

Of the 3 main sectors providing HD treatment, the private sector had the largest number of dialysis centres, treatment capacity and patients. NGO centres was a close second. The Ministry of Health had the lowest HD treatment capacity to patient ratio at 1.39 in 2008. The HD capacity to patient ratio has decreased in the NGO sector from 1.98 in 2007 to 1.64 in 2008.

Table 2.2.1 : Number of dialysis centres, HD machines and treatment capacity by sector, December 2008

Sector	HD centre (No.)	Centre HD machines (No.)	Centre HD capacity (No.)	Centre HD patients (No.)	Centre HD capacity: patients ratio	PD centre (No.)	PD patients (No.)	All Dialysis patients (No.)	All Dialysis patients (%.)
MOH	136	1269	6345	4573	1.39	22	1654	6227	32.4%
NGO	126	1893	9465	5756	1.64	0	0	5756	29.9%
Private(PRV)	210	2001	10005	6941	1.44	5	29	6970	36.3%
University(UNI)	6	50	250	119	2.1	3	57	176	0.9%
Armed Force(AF)	7	42	210	88	2.39	1	4	92	0.5%
TOTAL	485	5255	26275	17477		31	1744	19221	100%.

Figure 2.2.1(a): Distribution of dialysis centres by Sector, December 2008

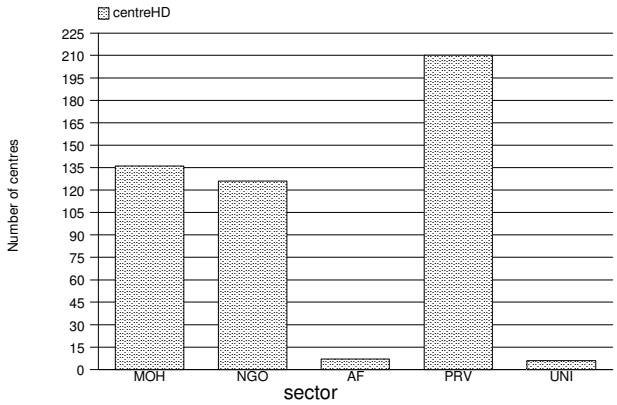


Figure 2.2.1(b): Distribution of HD capacity by Sector, December 2008

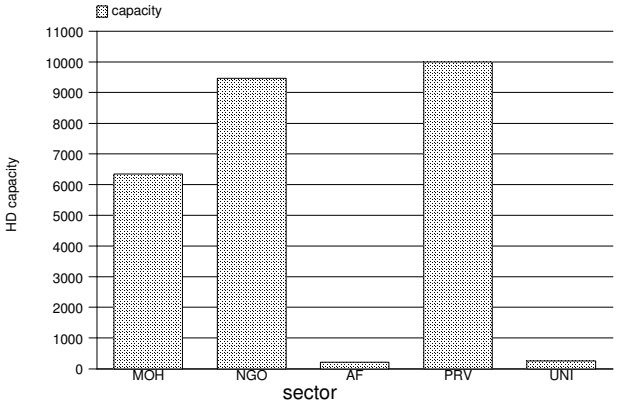


Figure 2.2.1(c): Distribution of dialysis patients by Sector, December 2008

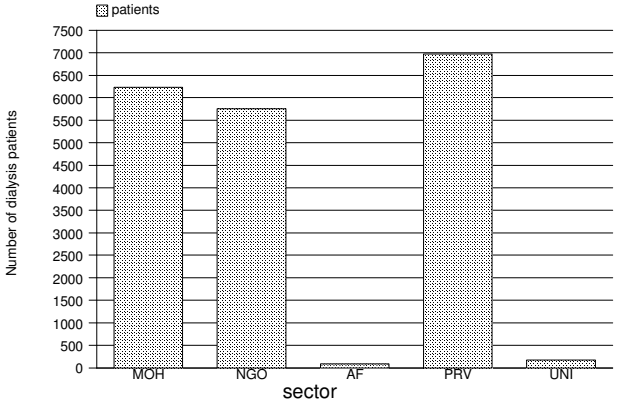
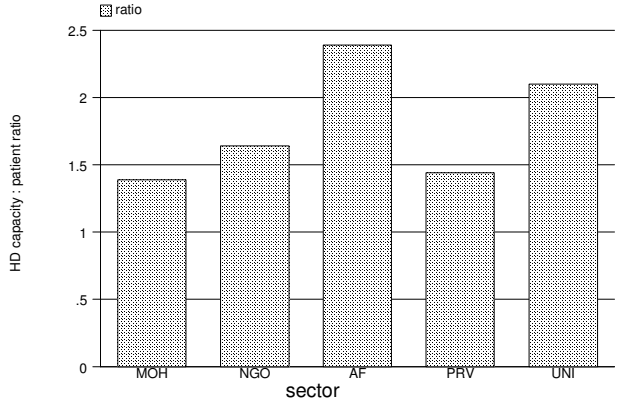


Figure 2.2.1(d): HD capacity: patient ratio by Sector, December 2008



2.2.2. Geographic distribution (centre survey)

The economically advantaged states of Pulau Pinang, Melaka, Johor, Perak, Selangor, WP 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 prevalence 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). Unlike in previous years, the HD capacity to patient ratio did not vary too widely between the different states. PD prevalence rates however did not correlate as closely to the economic status of the state. Pulau Pinang, Kuala Lumpur and Terengganu had PD prevalence rates exceeding 100 per million state population. Perak had PD rate of 34 per million state population.

Table 2.2.2 : Number of dialysis centers, number of HD machines and treatment capacity, HD capacity to patients ratio and number of dialysis patients by state in December 2008

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 (No.)	Centre PD patients (No.)	Centre PD patients pmp	All Dialysis patients (No.)	Dialysis treatment rate pmp
WP Kuala Lumpur	44	571	350	2855	1752	1726	1059	1.65	4	297	182	2023	1242
Pulau Pinang	42	505	326	2525	1632	1468	949	1.72	2	191	123	1659	1073
Melaka	21	235	312	1175	1559	684	908	1.72	2	40	53	724	961
Johor	66	747	226	3735	1128	2816	850	1.33	5	249	75	3065	925
Negeri Sembilan	20	221	222	1105	1110	797	801	1.39	2	83	83	880	884
Perak	54	568	242	2840	1208	1956	832	1.45	2	80	34	2036	866
Selangor & WP Putrajaya	91	1064	210	5320	1049	3343	659	1.59	4	346	68	3689	727
Perlis	2	36	152	180	762	138	584	1.3				138	584
Kedah	33	309	158	1545	789	1079	551	1.43	1	38	19	1117	570
Sarawak	31	323	132	1615	658	1169	477	1.38	1	77	31	1246	508
Terengganu	11	120	110	600	548	434	397	1.38	1	113	103	547	500
Pahang	22	184	122	920	608	536	354	1.72	2	97	64	633	418
Kelantan	18	151	95	755	473	538	337	1.4	2	68	43	606	380
Sabah & WP Labuan	30	221	69	1105	343	793	246	1.39	3	65	20	858	267
Malaysia	485	5255	190	26275	948	17477	630	1.5	31	1744	63	19221	693

Figure 2.2.2(a): Distribution of hemodialysis centres by State, 2008

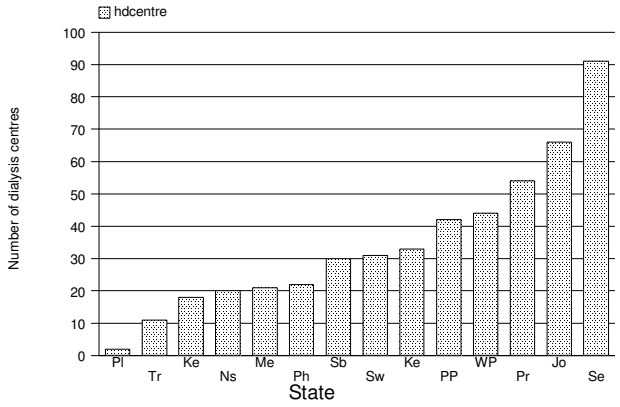


Figure 2.2.2(b): Distribution of dialysis patients by State, 2008

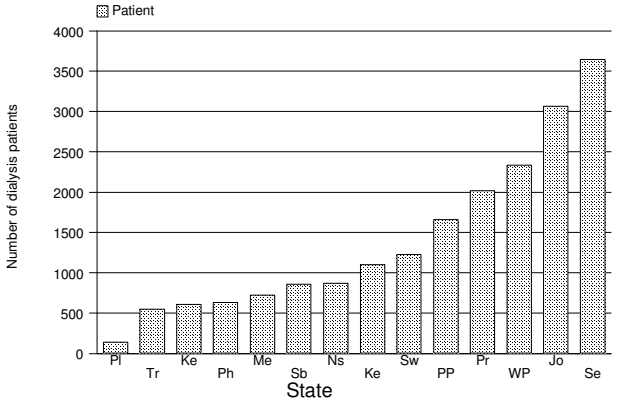


Figure 2.2.2(c): Distribution of patients/million population by State, 2008

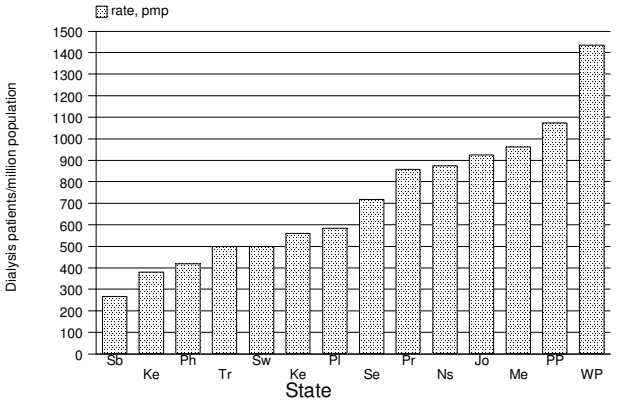
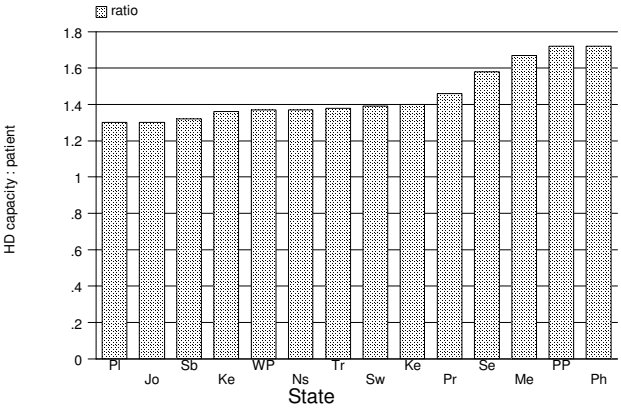


Figure 2.2.2(d): HD capacity to patient ratio by State, 2008



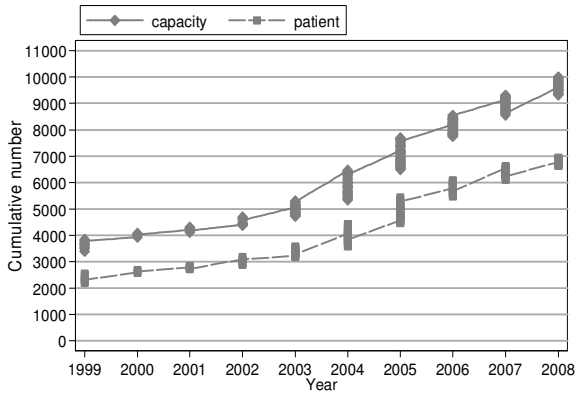
2.2.3 Growth in dialysis provision by sector

The number of patients on HD continued to increase in the private sector. In the NGO and MOH sector the growth has been minimal over the last few years. (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 was widening. (figures 2.2.3a-c)

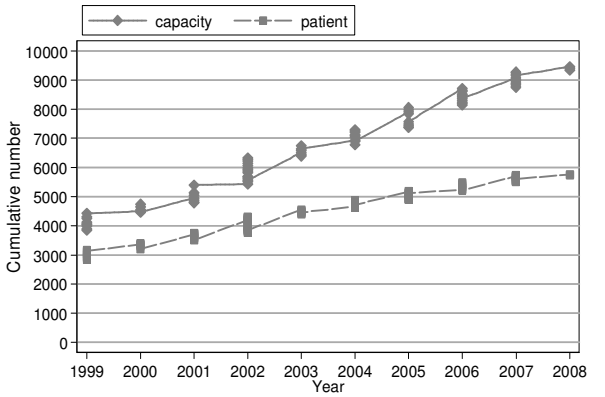
Table 2.2.3: Growth in HD capacity and HD patients in Private, NGO and MOH sectors, 1999-2008

Sector	Private		NGO		MOH	
	Cumulative HD capacity	Cumulative HD patients	Cumulative HD capacity	Cumulative HD patients	Cumulative HD capacity	Cumulative HD patients
1999	3845	2538	4420	3169	3665	2504
2000	4075	2670	4735	3405	3850	2652
2001	4305	2827	5400	3748	4230	2939
2002	4690	3175	6330	4303	4650	3292
2003	5295	3570	6745	4561	4875	3448
2004	6460	4418	7290	4872	5585	4049
2005	7700	5429	8055	5180	6485	4615
2006	8545	6083	8715	5485	6735	4743
2007	9305	6623	9280	5734	6765	4773
2008	10005	6941	9465	5756	6805	4780

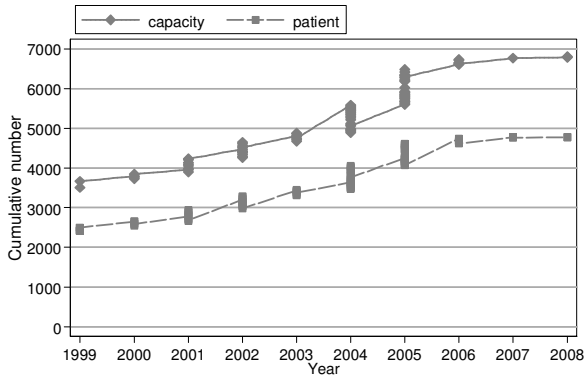
Figure 2.2.3: Growth in HD capacity and HD patients in Private, NGO and MOH sectors, 1999-2008



Growth in HD capacity and patient, private sector 1999-2008



Growth in HD capacity and patient, NGO sector 1999-2008



Growth in HD capacity and patient, MOH sector 1999-2008

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. Since 2001, the proportion between prevalent male and female patients has remained the same unlike in the earlier years when a convergence was seen. It was initially thought that the survival advantage in female patients resulted in this convergence in prevalent patients. This survival advantage was still demonstrated in our dialysis patients (refer chapter 4, table 4.4.1). However the higher proportion of males in the incident patients compared to prevalent patients could still account for this difference.

Table 2.3.1(a) : Dialysis Treatment Rate by Gender, per million male or female population 1999-2008

Gender	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Male	81	92	97	111	123	129	140	154	163	159
Female	61	73	89	95	96	111	112	132	137	133

Figure 2.3.1(a) : Dialysis Treatment Rate by Gender 1999-2008

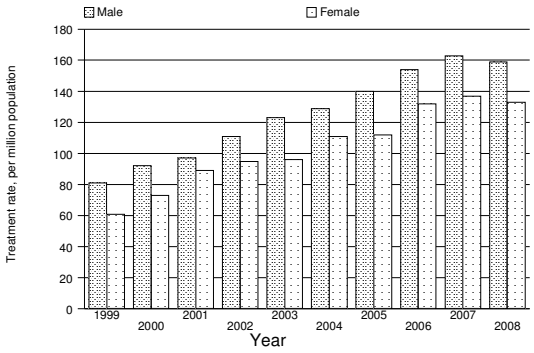
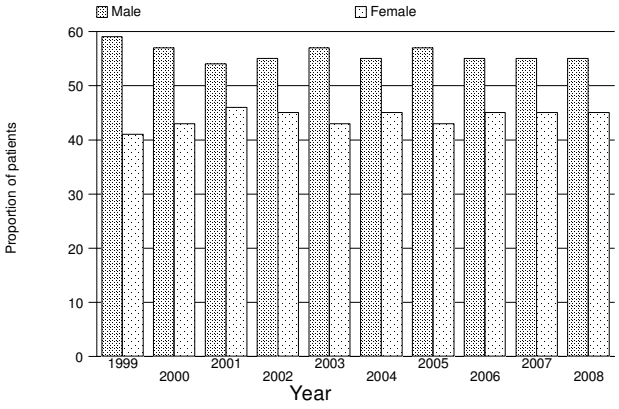


Table 2.3.1(b): Gender Distribution of Dialysis Patients 1999-2008

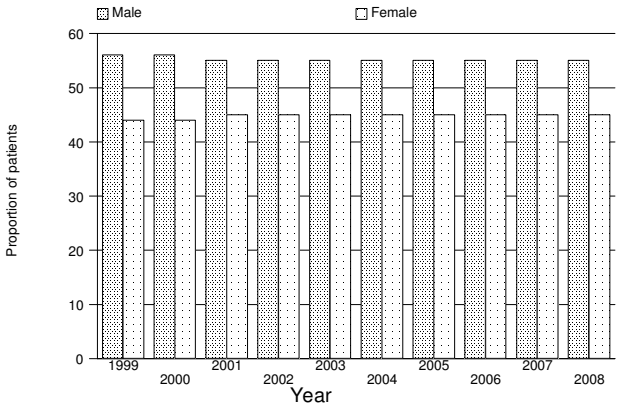
Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
New Dialysis patients	1559	1854	2100	2350	2605	2880	3115	3614	3874	3836
% Male	59	57	54	55	57	55	57	55	55	55
% Female	41	43	46	45	43	45	43	45	45	45
Dialysing at 31st December	5542	6694	7847	9119	10438	11884	13403	15084	17015	18856
% Male	56	56	55	55	55	55	55	55	55	55
% Female	44	44	45	45	45	45	45	45	45	45

Figure 2.3.1(b): Gender Distribution of Dialysis Patients 1999-2008

(i) New Dialysis patients



(ii) Dialysing patients at 31st December



2.3.2 Age distribution

New dialysis treatment rates in the age-groups less than 55 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 55 years and older have continued to increase. The most rapid increase in treatment rate is seen in those 65 years. The treatment rate for this group was more than 800 per age group population since 2006.

Table 2.3.2 (a): Dialysis Treatment Rate by Age Group, per million age group population 1999-2008

Age groups (years)	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
≤14	4	4	4	5	4	5	5	5	5	5
15-24	16	18	22	29	26	28	30	31	31	27
25-34	43	47	47	55	52	51	56	60	63	65
35-44	85	98	103	100	103	116	112	124	123	132
45-54	226	249	252	275	280	310	303	360	356	339
55-64	369	432	508	535	587	593	653	674	747	655
≥ 65	301	347	439	502	585	654	663	804	820	822

Figure 2.3.2 (a): Dialysis Treatment Rate by Age Group 1999-2008

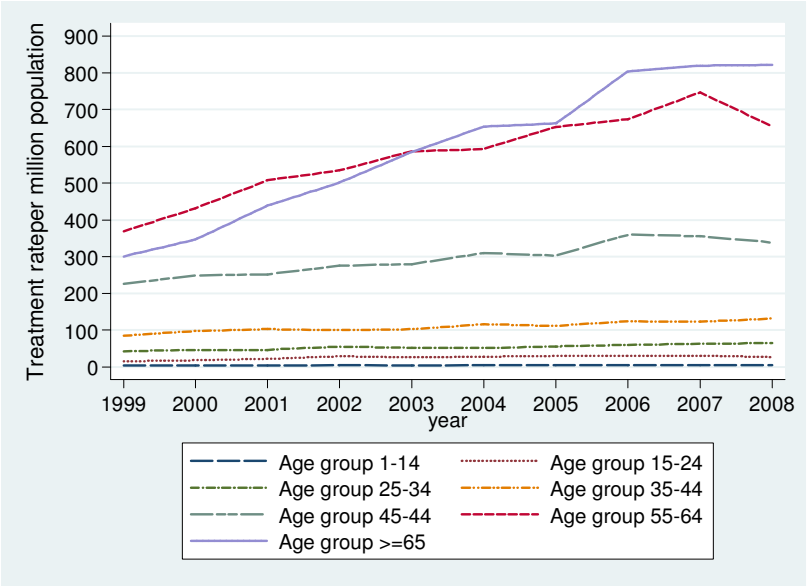
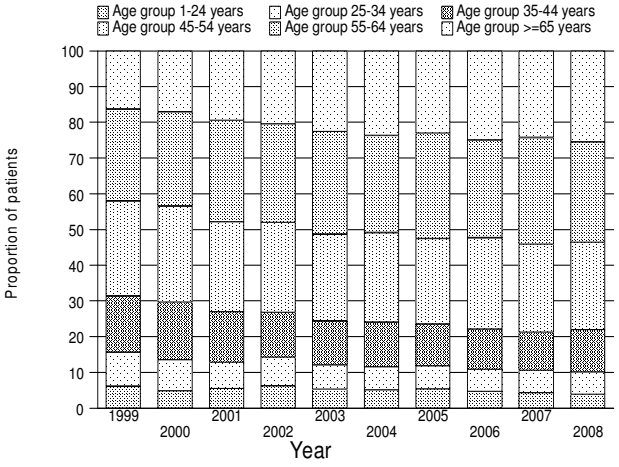


Table 2.3.2(b) : Percentage Age Distribution of Dialysis Patients 1999-2008

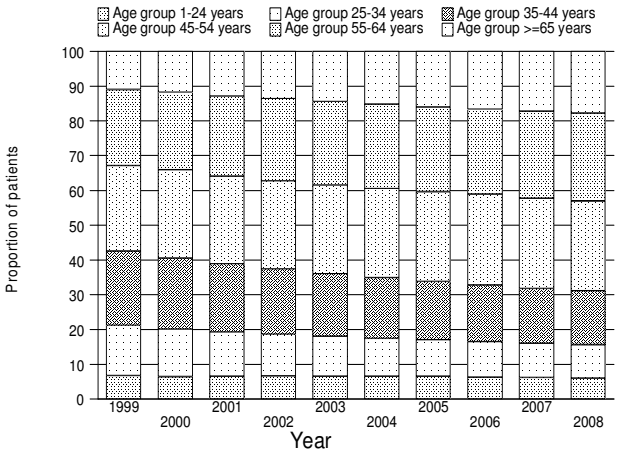
Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
New Dialysis patients	1559	1854	2100	2350	2605	2880	3115	3614	3874	3836
% 1-14 years	2	1	1	2	1	1	1	1	1	1
% 15-24 years	4	4	4	5	4	4	4	4	3	3
% 25-34 years	10	9	7	8	7	6	6	6	6	6
% 35-44 years	16	16	14	13	12	12	12	11	11	12
% 45-54 years	27	27	25	25	24	25	24	26	25	24
% 55-64 years	26	26	28	28	29	27	30	27	30	28
% >=65 years	16	17	19	20	23	24	23	25	24	26
Dialysing at 31st December	5542	6694	7847	9119	10438	11884	13403	15084	17015	18856
% 1-14 years	2	1	1	1	1	1	1	1	1	1
% 15-24 years	5	5	5	5	5	5	5	5	5	5
% 25-34 years	14	14	13	12	12	11	10	10	10	10
% 35-44 years	21	20	20	19	18	17	17	16	16	15
% 45-54 years	25	25	25	25	26	26	26	26	26	26
% 55-64 years	22	22	23	24	24	24	24	24	25	25
% >=65 years	11	12	13	14	14	15	16	17	17	18

Figure 2.3.2 (b): Age Distribution of Dialysis Patients 1999-2008

(i) New Dialysis patients



(ii) Dialysing patients at 31st December



2.3.3 Method and Location of dialysis

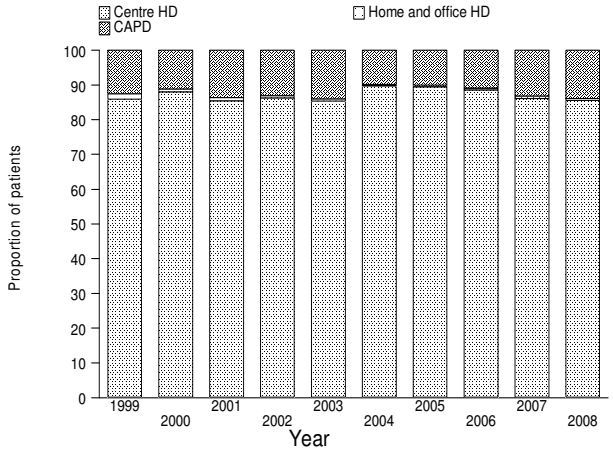
86% of new patients were accepted into centre haemodialysis in 2007 and 2008. With the conscious effort by the MOH to place PD first, the proportion of new patients accepted onto chronic PD program has shown a small increase over the last few years. However, PD only accounted for 8% of prevalent dialysis patients in 2007. There were still a handful of new patients accepted into the home and office HD programme. (table & figure 2.3.5)

Table 2.3.3: Method and Location of Dialysis Patients 1999-2008

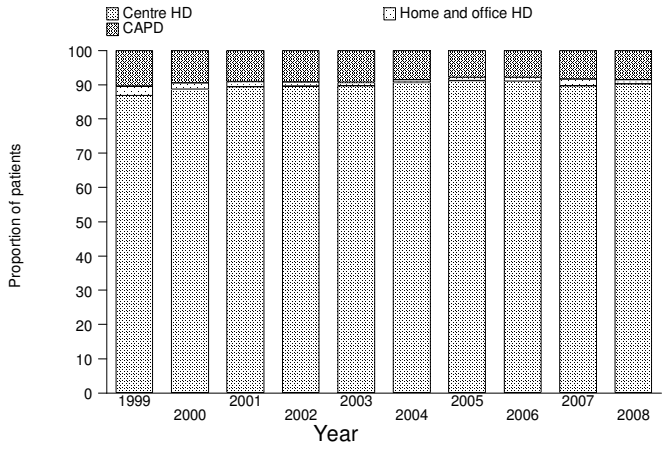
Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
New Dialysis patients	1559	1854	2100	2350	2605	2880	3115	3614	3874	3836
% Centre HD	86	88	85	86	85	90	89	89	86	86
% Home and office HD	2	1	1	1	1	0	0	0	1	1
% PD	13	11	14	13	14	10	10	11	13	14
Dialysing at 31st December	5317	6420	7493	8677	9942	11290	12733	14336	16181	17924
% Centre HD	87	89	89	90	90	91	91	91	90	90
% Home and office HD	3	2	1	1	1	1	1	1	2	1
% PD	10	9	9	9	9	8	8	8	8	9

Figure 2.3.3: Method and Location of Dialysis Patients 1999-2008

(i) New Dialysis Patients



(ii) Dialysing patients at 31st December



2.3.4 Funding for Dialysis Treatment

Funding for dialysis in Malaysia may be from multiple payers. In the initial years of the registry, data for funding of dialysis treatment were obtained mainly from the initial notification of the patient. In 2006, data on funding was included in the annual returns as it was noted that funding for dialysis treatment in an individual patient can change with time.

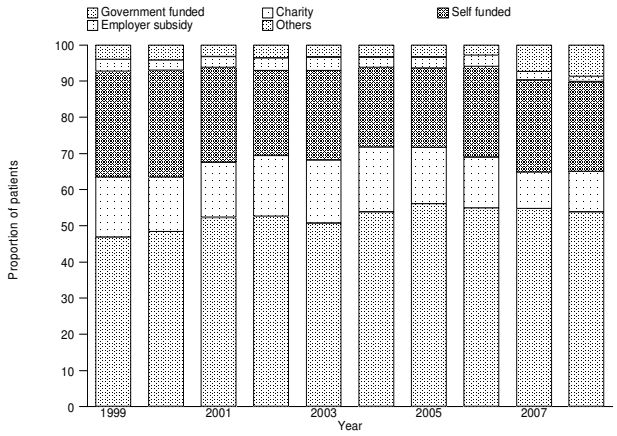
The government continues to be the main payer for dialysis therapy. These funds are channeled not only to the government dialysis centres but also as subsidies to NGO centres and payment of dialysis treatment for civil servants and their dependents in private centres. A quarter of patients paid for their dialysis treatment initially however only 15% of prevalent patients paid for their dialysis treatment. Funding from NGO bodies accounted for between 10-26% over the last 10 years. (table & figure 2.3.4)

Table 2.3.4: Funding for Dialysis Treatment 1999-2008

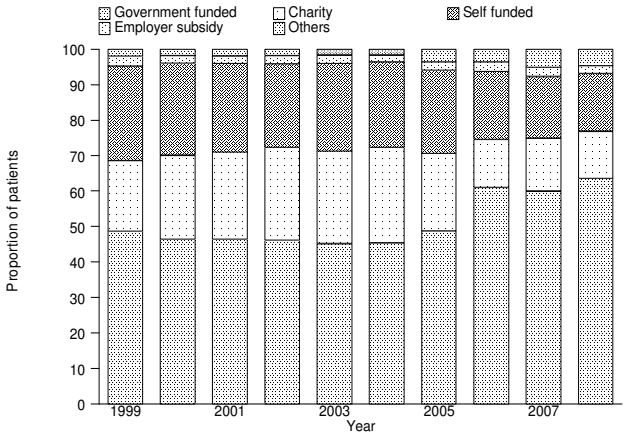
Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
New Dialysis patients	1559	1854	2100	2350	2605	2880	3115	3614	3874	3836
% by Government	47	48	52	53	51	54	56	55	55	54
% by Charity	17	15	15	17	17	18	16	14	10	11
% self funded	29	30	26	24	25	22	22	25	25	25
% subsidized by Employer	3	3	3	3	4	3	3	3	2	1
% Others	4	4	3	4	3	3	3	3	7	9
Dialysing at 31st December	5318	6420	7493	8677	10206	11744	13505	15565	17646	19555
% by Government	49	46	46	46	44	44	46	56	55	58
% by Charity	20	24	25	26	25	26	21	13	14	12
% self funded	27	26	25	24	24	23	22	18	16	15
% subsidized by Employer	3	2	2	2	2	2	2	3	3	2
% Others	2	2	2	2	2	2	3	3	5	4

Figure 2.3.4: Funding for Dialysis Treatment 1999-2008

(i) New Dialysis Patients



(ii) Dialysing patients at 31st December



2.3.5 Distribution of dialysis patients by sector

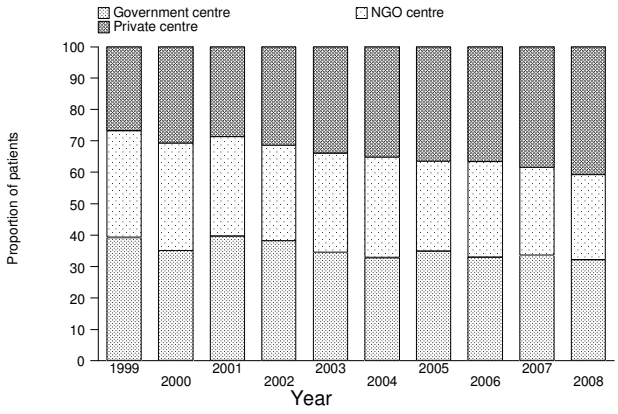
The proportion of incident and prevalent dialysis patients in private centres continue to increase particularly in incident patients with a corresponding decrease in government centres. However, 36% of patients were in government centres, 33% in private centres and NGO centres 31%.

Table 2.3.5: Distribution of Dialysis Patients by Sector 1999-2008

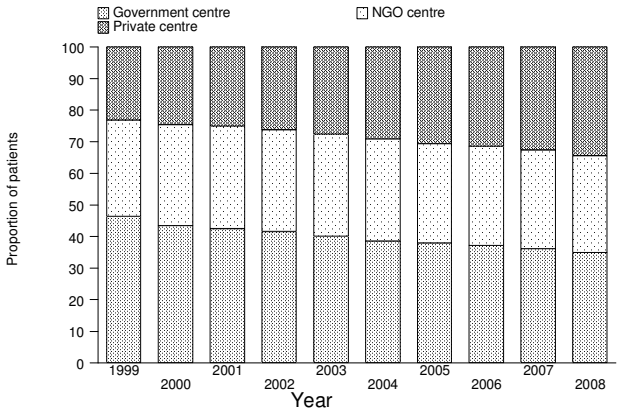
Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
New Dialysis patients	1559	1854	2100	2350	2605	2880	3115	3614	3874	3836
% Government centre	39	35	40	38	34	33	35	33	34	32
% NGO centre	34	34	32	30	32	32	29	30	28	27
% Private centre	27	31	29	31	34	35	37	37	38	41
Dialysing at 31st December	5540	6692	7845	9118	10437	11883	13402	15084	17015	18856
% Government centre	46	43	42	42	40	39	38	37	36	35
% NGO centre	30	32	33	32	32	32	31	31	31	31
% Private centre	23	25	25	26	28	29	31	31	33	34

Figure 2.3.5: Distribution of Dialysis Patients by Sector 1999-2008

(i) New Dialysis Patients



(ii) Dialysing patients at 31st December



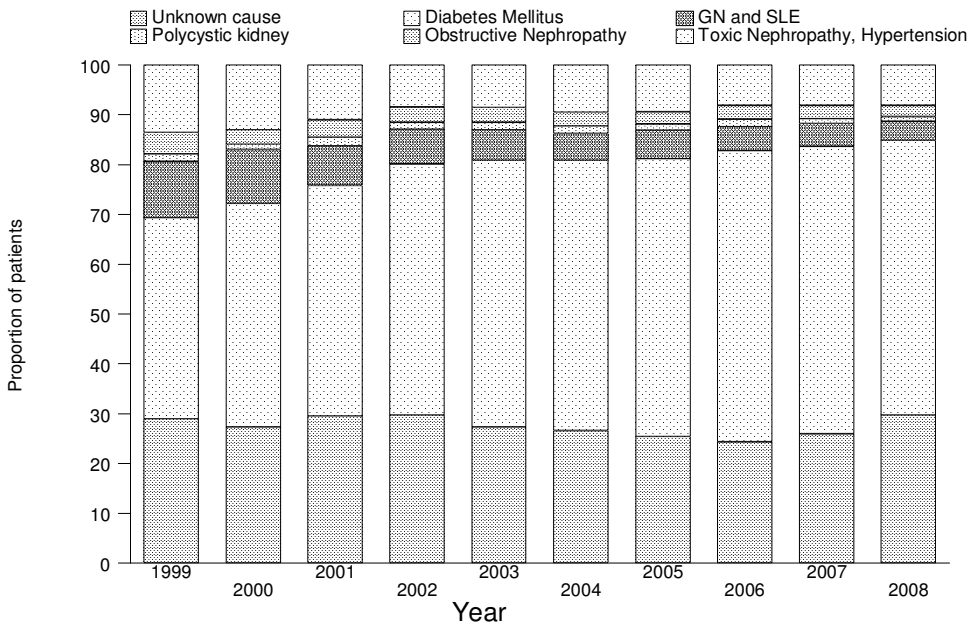
SECTION 2.4: PRIMARY RENAL DISEASE

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. The 3rd National Health and Morbidity Survey, Malaysia 2006 showed that the prevalence of diabetes mellitus has risen to 14.9% from 8.3% ten years earlier. Hence it would be anticipated that diabetic nephropathy would still account for the majority of ESRD for many years to come unless concerted efforts are taken to combat this epidemic at all levels. Hypertension was the second commonest known cause of ESRD at about 7%. Glomerulonephritis as a cause of ESRD has decreased from 10% in 1999 to only 4% in 2007. Systemic lupus erythematosus (SLE) continued to contribute 1% of new ESRD patients.

Table 2.4.1: Primary Renal Diseases New Dialysis Patients 1999-2008

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
New Dialysis patients	1559	1854	2100	2350	2605	2880	3115	3614	3874	3836
% Unknown cause	29	27	30	30	27	27	25	24	26	30
% Diabetes Mellitus	40	45	46	50	53	54	56	58	58	55
% GN	10	9	6	6	5	4	5	4	4	3
% SLE	2	2	1	1	1	1	1	1	1	1
% Polycystic kidney	1	1	2	1	1	1	1	1	1	1
% Obstructive Nephropathy	4	3	3	3	3	3	3	3	3	2
% Toxic Nephropathy	1	0	1	0	0	0	0	0	0	0
% Hypertension	11	12	9	7	7	8	8	7	7	7
% Others	2	1	1	1	1	1	1	1	1	1

Figure 2.4.1: Primary Renal Diseases for New Dialysis Patients 1999-2008



CHAPTER 3

Economics of Dialysis

Lim Teck Onn
Adrian Goh

Introduction

Over the last 25 years, the Malaysia healthcare system been able to improve population health, including the rapid expansion of dialysis services. (Table 3.1) The expansion of dialysis service was such that by 2005, despite being only a developing country, Malaysia was able to achieve treatment rates comparable to those in developed countries. (Table 3.2, Figures 3.2(a) & 3.2(b))

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

Table 3.2: Prevalence of renal replacement therapy (RRT), dialysis and renal transplant 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	512	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 Sources: 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

Figure 3.2(a) Prevalence of renal replacement therapy (RRT) among various regions in the world 2005 and by countries' per capita GNI according to World Bank classification

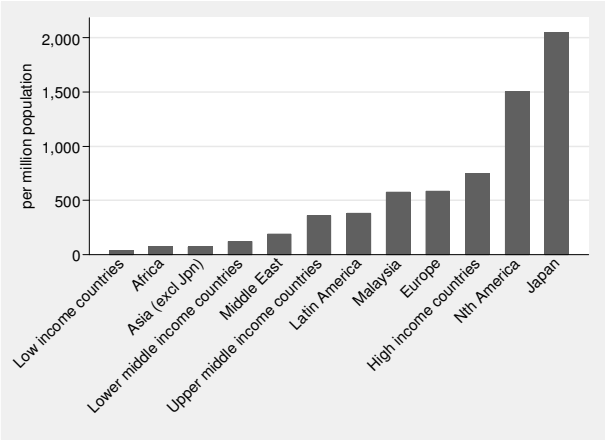
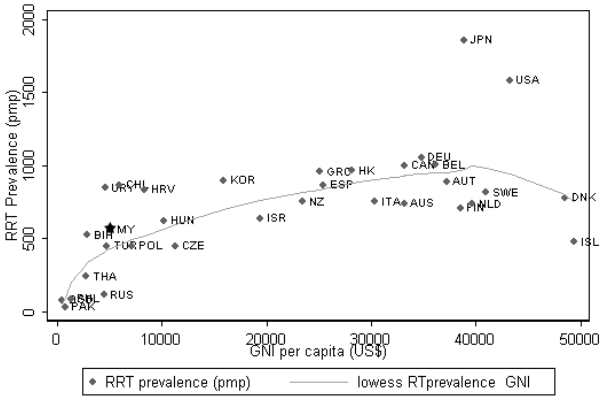


Figure 3.2(b): International comparison of income & RRT treatment prevalence, 2005

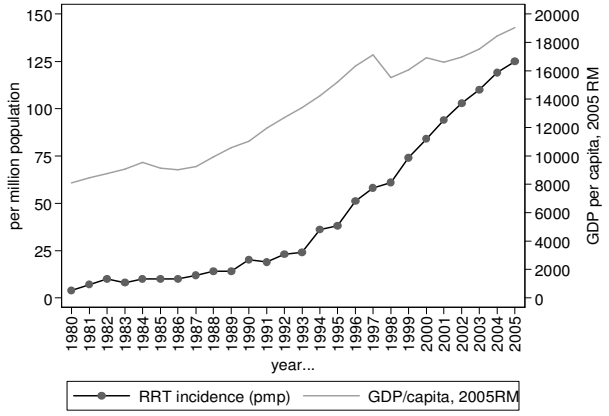


Data: USRDS Annual Data Report 2007, World Bank World Development Indicators

Dialysis and income

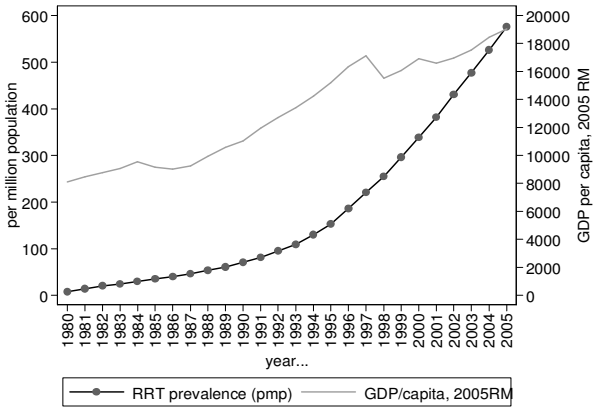
The rapid increase in provision of dialysis from the mid-1990s was preceded by rapid economic growth since the late 1980s (Figures 3.1(a) & 3.1(b)). With economic growth more resources could be allocated to provide dialysis. Resources not only came from traditional Government sources but also the private sector and the public, such as through donations to charities or direct out of pocket payments for treatment (Table 3.3, Figures 3.3(a) & 3.3(b)

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



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

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



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

Table 3.3: Trends in dialysis funding and provider mix

	1990	1995	2000	2005
Dialysis incidence	13	33	78	119
Dialysis prevalence	44	108	285	512
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

Note on total cost: expenditure estimate based on private sector inflation adjusted HD prices from 1990 to 2005 and govt HD/CAPD inflation adjusted costs in 1996 & 2001.

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

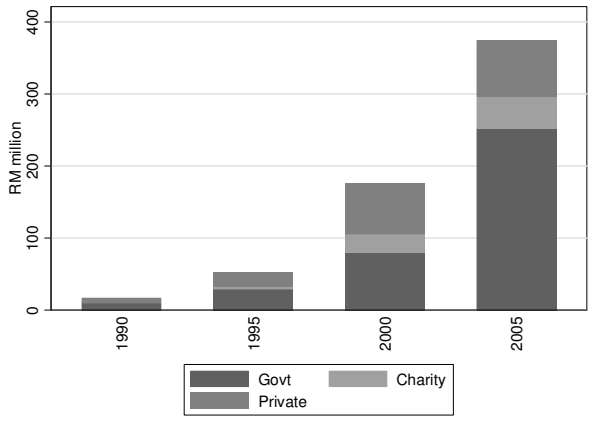
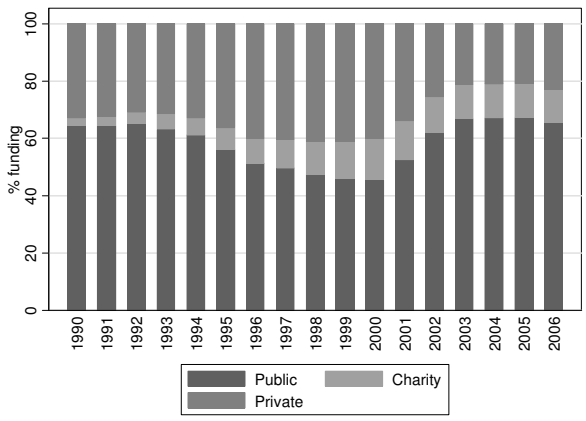


Figure 3.3(b): Dialysis funding by sector, 1990-2005 (%)



Resource Generation

Equally as important as financial resources are the supporting infrastructure needed to provide treatment. Both the physical infrastructure (dialysis centres and HD machines) and human resources (nephrologists and paramedics) were able to expand rapidly in response to increased funding for dialysis. (Table 3.4, Figures 3.4(a) ,3.4(b) & 3.4(c)). Particularly important was the ability of Charity and Private sector providers to expand rapidly in the face of patient needs. (Table 3.3)

Table 3.4: Trends in resource generation for dialysis treatment 1990-2005

	1990		1995		2000		2005	
Resource generation for Dialysis								
Trained nephrologists, No.	5		8		33		89	
Trained dialysis nurses and medical assistants^, number per year (%)								
Public	32		15		96		124	(89)
Private							16	(11)
Total	32	(100)	15	(100)	96	(100)	140	(100)
HD facilities by sector, No. (%)								
Public	22	(9)	30	(42)	56	(35)	153	(39)
NGO	0	(0)	12	(17)	51	(32)	99	(25)
Private	15	(41)	30	(42)	54	(34)	144	(36)
Total	37	(100)	72	(100)	161	(100)	396	(100)
HD machine by sector, No. (%)								
Public					664	(30)	1142	(29)
NGO					830	(37)	1427	(37)
Private					750	(33)	1317	(34)
Total					2244	(100)	3886	(100)

^Trained by Ministry of Health and National Kidney Foundation.

Figure3.4(a): Dialysis human resources, 1990-2005

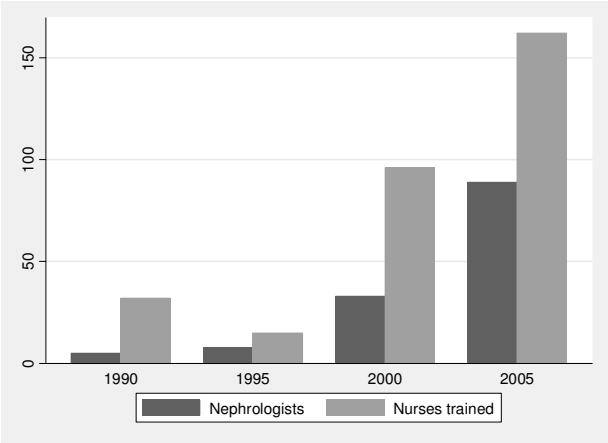


Figure 3.4(b): Haemodialysis centres by sector, 1990-2005

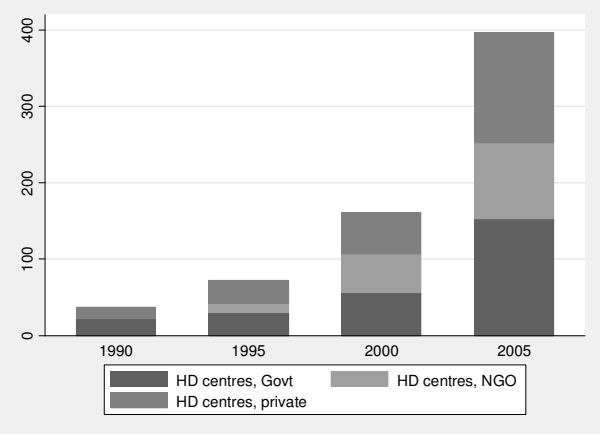
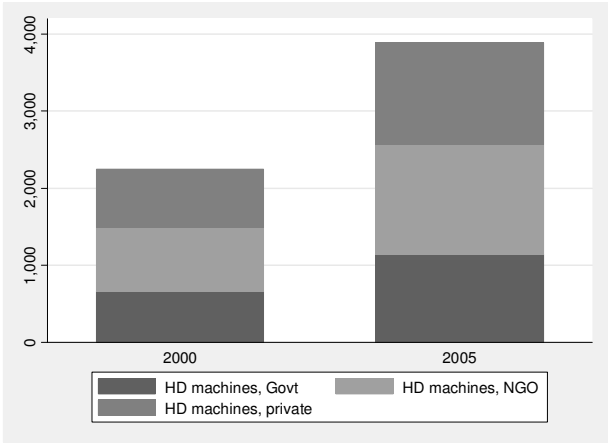


Figure 3.4(c): HD machines by sector, 2000-2005



Dialysis prices and affordability

Over the period from 1980 to 2005, while incomes and prices generally have increased, the price of private sector dialysis has remained relatively constant in nominal terms. Factored for inflation, the price of dialysis has declined in real terms. (Table 3.5) Over the period in review, the number of patients treated has increased by more then the spending on dialysis resulting in 1786 more patients being treated then would be the case if patient numbers had kept pace with funding. (Figures 3.5(a), 3.5(b) & 3.5(c)). The affordability of dialysis has improved, although at 65% of average household income needed to maintain one patient on dialysis, it remains a catastrophic illness for family finances when compared to affordability in most developed countries. (Table 3.6).

Table 3.5: Trends in dialysis market prices

	1990	1995	2000	2005
Dialysis prevalence	44	108	285	512
Price per HD (current RM)	170c	159d	163e	168f
Price per HD (2005RM)	286c	225d	191e	168f
Average Household monthly income (2005RM)	1963	2855	3012a	3356b
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 3.5(a): Trends in dialysis cost-efficiency (HD price in 2005 RM)

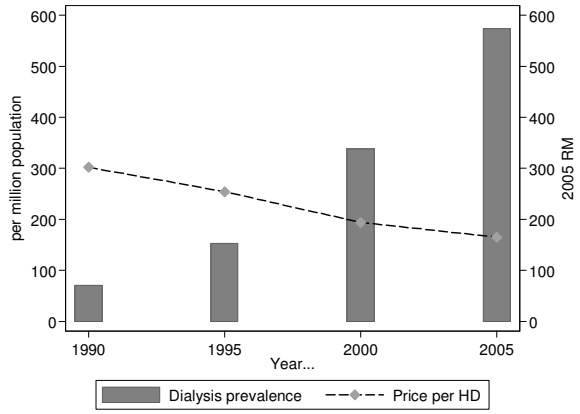


Figure 3.5(b): Trends in dialysis cost-efficiency (HD price as % of household income)

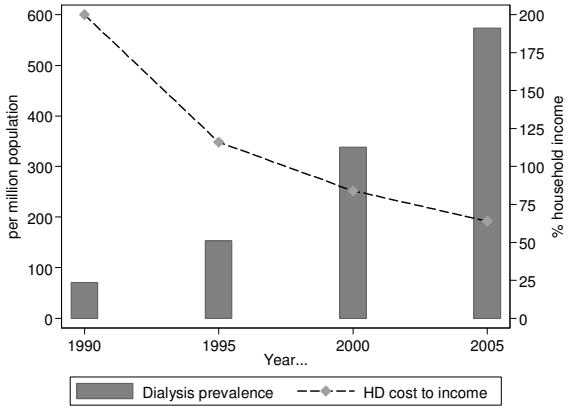


Figure 3.5(c): Trends in dialysis costs: Actual and assuming no efficiency gained

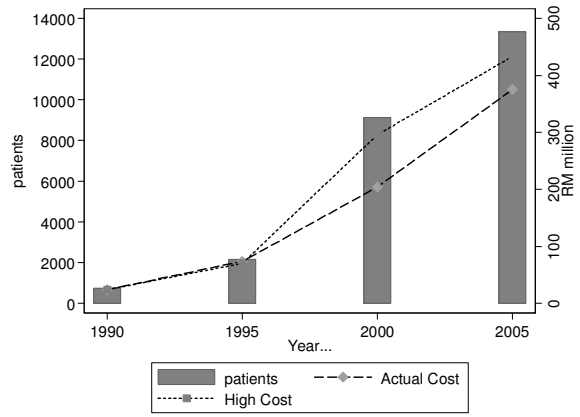


Table 3.6: International comparison of dialysis cost efficiency, 2005

	Malaysia	US	UK	Australia
Dialysis incidence	119	294	89	81
Dialysis prevalence	512	1105	375	424
Price per HD (2005RM/US$/£/A$)	168	150	168	163
Mean Household monthly income (2005RM/US$/£/A$)	3356	5279	2732	5670
HD cost* to monthly HH income (%)	65%	37%	80%	37%

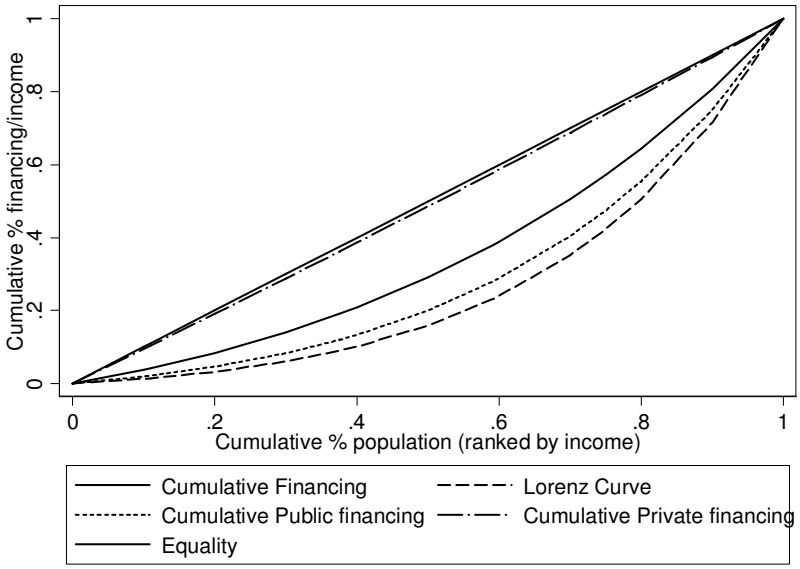
Note: *assuming 13 HD procedures per month

In contrast the vertical equity of dialysis financing is inequitable, although public financing is less regressive then private financing as measured by the Kakwani Index. (Table 3.7, Figure 3.7)

Table 3.7: Dialysis financing equity, 2005

Sector	Index	
	Concentration	Kakwani
Public	0.41	-0.053
Private	0.02	-0.443
Overall	0.28	-0.18

Figure 3.7: Dialysis financing equity as measured by Kakwani index, 2005



Dialysis access and equality

The provision of treatment is persistently concentrated towards more developed states where patients have greater ability to pay for treatment. However the extent of inequality in provision is declining across all sectors. Public sector provision now significantly favours those in less developed states while NGO and private provision still favours the more developed states (Table 3.8, Figure 3.8, Table 3.9, Figures 3.9(a) & 3.9(b)).

Table 3.8 Geographic distribution of dialysis Treatment in Malaysia, 1990-2005

	1990	1995	2000	2005
Dialysis prevalence	44	108	285	512
Johor	30.4	114	395.3	689
Kedah & Perlis	20.8	69.8	226.1	453
Kelantan	12.6	31.2	102.8	285
Melaka	43.1	182	420.7	773
Negeri Sembilan	35	129	336	595
Pahang	26.6	68.9	195.2	326
Perak	53.7	124	349	631
Penang	50.1	149	442	814
Sabah	14	34.7	95.5	172
Sarawak	45	74.8	201.8	365
Selangor & WP Kuala Lumpur	97.7	191	373.8	632
Terengganu	14	46.6	140.7	332

Figure 3.8: Distribution of Dialysis treatment in Malaysia by state, 1990-2005

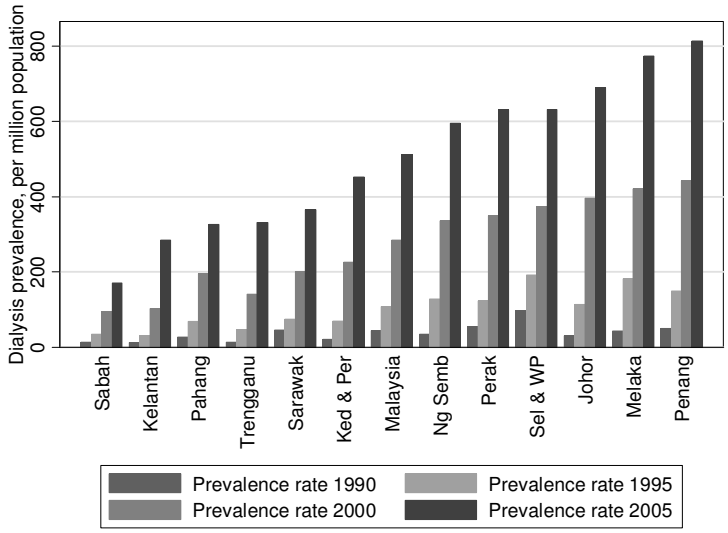


Table 3.9: Trends in dialysis geographic equity as measured by concentration indices

	1990	1995	2000	2005
Dialysis incidence	13	33	78	119
Dialysis prevalence	44	108	285	512
Overall Concentration Index (CI) of dialysis provision	0.091	0.065	-0.02	-0.04
CI of Public provision	0.067	-0.009	-0.116	-0.203
CI of NGO provision	0.164	0.184	0.106	0.076
CI of Private provision	0.285	0.25	0.118	0.063
Household Income inequality (Gini coefficient)	0.442	0.456	0.443*	0.462#

Note: *2001, 2004

Figure 3.9(a): Trends in dialysis geographic equity in Malaysia, 1990-2005

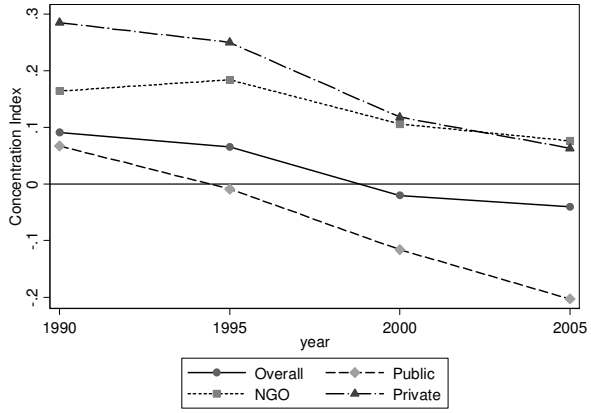
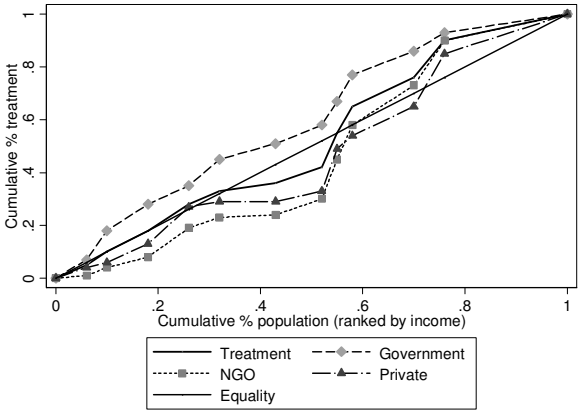


Figure 3.9(b): Concentration curves of geographic distribution of dialysis treatment by provider sector, 2005



CHAPTER 4

Death and Survival on Dialysis

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SECTION 4.1: DEATH ON DIALYSIS

The number of deaths in dialysis patients for 2008 was 1803 (annual death rate of 10.1%). One thousand five hundred and sixty four haemodialysis patients died in 2008 (annual rate of 9.6%) while 239 died while on continuous ambulatory peritoneal dialysis (annual death rate of 14.5%).

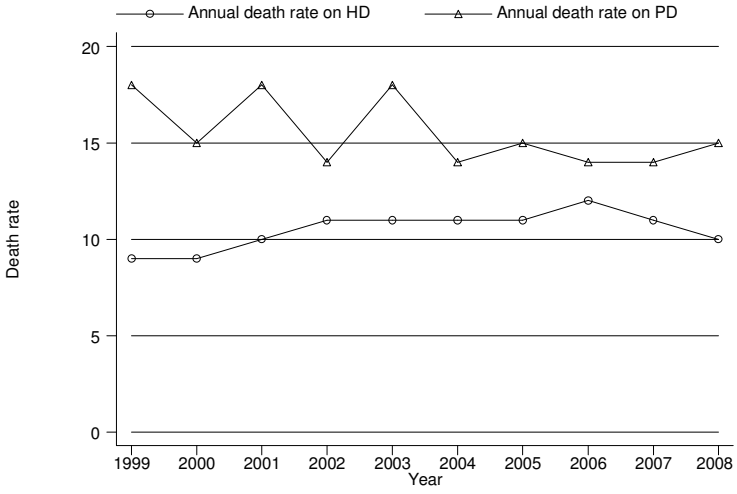
Table 4.1.1: Deaths on Dialysis 1999-2008

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
No. of dialysis patients at risk	5041	6118	7271	8483	9779	11161	12644	14244	16050	17936
Dialysis deaths	493	597	816	929	1161	1278	1430	1696	1780	1803
Dialysis death rate %	10	10	11	11	12	11	11	12	11	10
No. of HD patients at risk	4473	5490	6557	7640	8791	10074	11504	13010	14624	16290
HD deaths	393	505	686	814	983	1126	1259	1528	1574	1564
HD death rate %	9	9	10	11	11	11	11	12	11	10
No. of PD patients at risk	568	628	714	843	988	1088	1140	1234	1426	1646
PD deaths	100	92	130	115	178	152	171	168	206	239
PD death rate %	18	15	18	14	18	14	15	14	14	15

Figure 4.1.1 shows the annual death rate on dialysis from 1999 till 2008. Despite a higher percentage of diabetics and elderly patients (in 1999, 33% were aged more than 54 years compared with 43% in 2008) 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 PD 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 PD in 2008 was 14.5% while the annual death rate for haemodialysis patients in 2008 was 9.6%; a difference of 5% between the two modalities.

Figure 4.1.1: Death Rates on Dialysis 1999-2008



The causes of death on dialysis are shown in Table 4.1.2. Cardiovascular disease remained the main cause of death in 2008; accounting for 29%. This has remained unchanged over the last 10 years. Death at home accounted for another 22% and a majority of these deaths were probably secondary to cardiovascular events. Despite a reduction of the percentage of dialysis patients dying from infection, it remained the third most common cause of death in 2008.

Table 4.1.2: Causes of Death on Dialysis 1999-2008

Year	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
Cardiovascular	129	26	180	30	210	26	307	33	325	28
Died at home	107	22	135	23	228	28	212	23	290	25
Sepsis	84	18	85	14	128	16	141	15	183	17
PD peritonitis	11	2	21	4	29	4	16	2	14	1
GIT bleed	18	4	18	3	18	2	24	3	28	2
Cancer	6	1	8	1	18	2	18	2	27	2
Liver disease	7	1	14	2	11	1	16	2	23	2
Withdrawal	10	2	17	3	20	2	18	2	26	2
Others	65	13	74	12	88	11	104	10	160	14
Unknown	56	11	45	8	66	8	73	8	85	7
TOTAL	493	100	597	100	816	100	929	100	1161	100

Year	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
Cardiovascular	333	26	360	25	477	28	459	26	531	29
Died at home	307	24	317	22	351	21	332	19	389	22
Sepsis	154	11	159	11	206	12	177	10	255	14
PD peritonitis	13	1	22	2	22	1	16	1	22	1
GIT bleed	24	2	28	2	26	2	26	1	39	2
Cancer	20	2	28	2	36	2	29	2	50	3
Liver disease	29	2	25	2	32	2	34	2	36	2
Withdrawal	9	1	11	1	23	1	26	1	19	1
Others	318	25	397	27	386	23	534	30	352	20
Unknown	71	6	83	6	137	8	147	8	110	6
TOTAL	1278	100	1430	100	1696	100	1780	100	1803	100

SECTION 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 (censored for change in modality) were 58% and 35% respectively. The unadjusted patient survival was better for those on haemodialysis compared to those on PD and this survival difference progressively widened with time. At 5 years the unadjusted patient survival on haemodialysis was 59% compared 47% in those on PD.

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 PD were 61% vs 56% and 41% and 43% respectively.

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

Dialysis Modality Interval (month)	PD			HD			All		
	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	4619	100	-	30221	100	-	34840	100	-
6	3920	94	0	26571	94	0	30491	94	0
12	3227	87	1	23078	89	0	26305	89	0
24	2114	75	1	17616	81	0	19730	80	0
36	1373	63	1	13476	72	0	14849	71	0
48	911	53	1	10287	65	0	11198	64	0
60	626	47	1	7794	59	0	8420	58	0
72	402	40	1	5936	53	0	6337	52	0
84	246	34	1	4458	48	0	4704	47	0
96	146	28	1	3360	44	0	3503	42	0
108	85	24	2	2526	40	0	2610	38	0
120	51	19	2	1855	36	0	1906	35	0

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

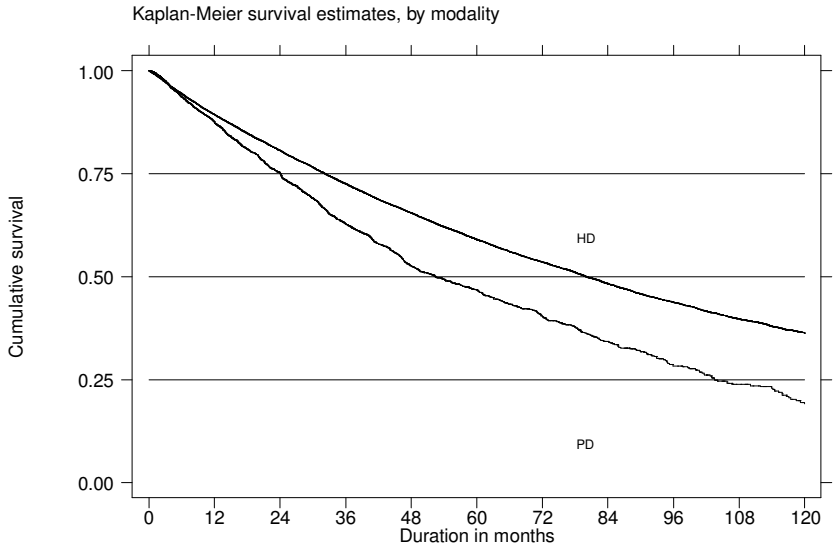
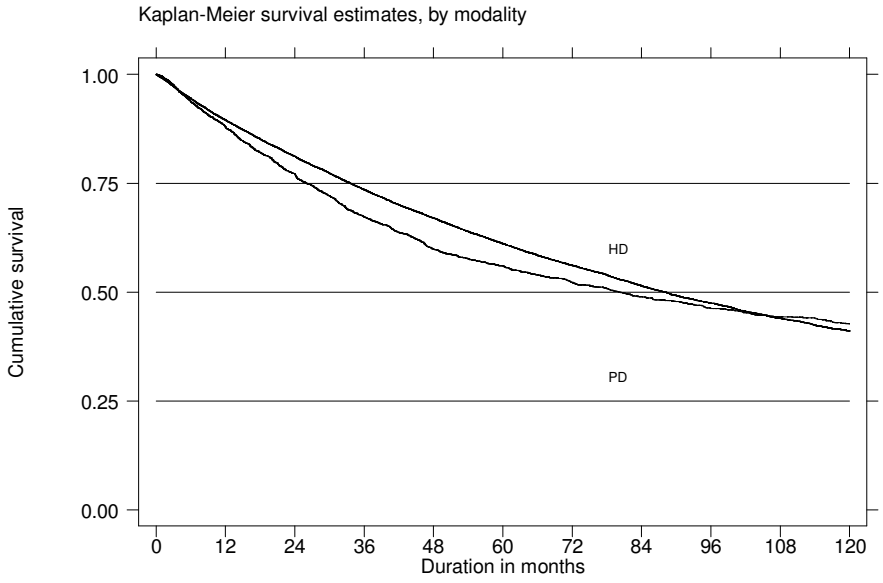


Table 4.2.1 (b): Patient survival by dialysis modality (not censored for change of modality)

Dialysis modality Interval (month)	PD			HD			All		
	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	4619	100	-	30221	100	-	34840	100	-
6	4061	94	0	27022	94	0	31080	94	0
12	3513	88	1	23891	89	0	27404	89	0
24	2592	77	1	18727	81	0	21319	81	0
36	1948	67	1	14638	74	0	16586	73	0
48	1493	60	1	11429	67	0	12922	66	0
60	1188	56	1	8876	61	0	10063	60	0
72	927	52	1	6938	56	0	7863	56	0
84	704	49	1	5356	51	0	6060	51	0
96	528	46	1	4165	47	0	4691	47	0
108	404	44	1	3237	44	0	3640	44	0
120	316	43	1	2487	41	0	2803	41	0

Figure 4.2.1 (b): Patient survival by dialysis modality analysis (not censored for change of modality)



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 2008 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 88-90% and 55-57% respectively.

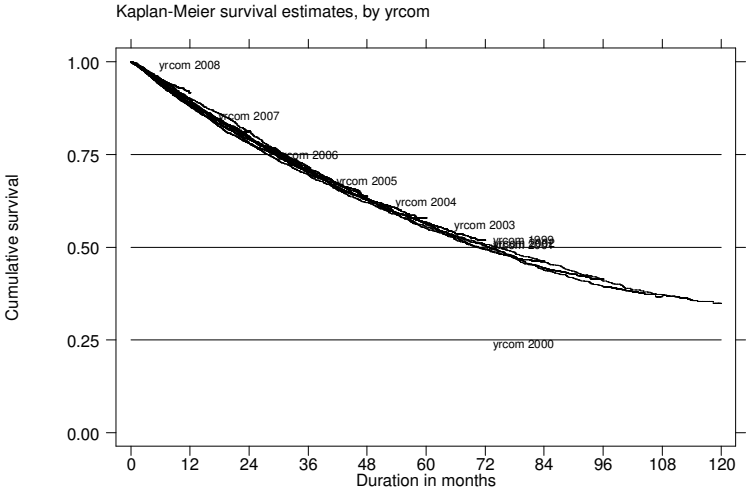
Table 4.2.2: Unadjusted patient survival by year of entry, 1999-2008

Year Interval (month)	1999			2000			2001			2002		
	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	1623	100	-	1945	100	-	2237	100	-	2521	100	-
6	1513	95	1	1808	95	1	2071	94	1	2356	95	0
12	1413	90	1	1668	90	1	1888	89	1	2178	90	1
24	1216	81	1	1416	80	1	1602	78	1	1846	80	1
36	1040	72	1	1226	71	1	1386	70	1	1600	70	1
48	896	63	1	1059	63	1	1203	62	1	1397	63	1
60	789	56	1	918	56	1	1037	55	1	1218	56	1
72	703	51	1	798	50	1	917	49	1	1073	50	1
84	622	46	1	691	44	1	809	44	1	-	-	-
96	544	41	1	607	39	1	-	-	-	-	-	-
108	491	37	1	-	-	-	-	-	-	-	-	-

Year Interval (month)	2003			2004			2005			2006		
	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	2754	100	-	3074	100	-	3295	100	-	3816	100	-
6	2535	94	0	2860	95	0	3017	94	0	3497	94	0
12	2338	89	1	2632	89	1	2772	88	1	3226	88	1
24	2021	79	1	2283	80	1	2385	78	1	2806	79	1
36	1743	70	1	1965	70	1	2113	71	1	-	-	-
48	1528	63	1	1726	63	1	-	-	-	-	-	-
60	1351	57	1	-	-	-	-	-	-	-	-	-

Year Interval (month)	2007			2008		
	No.	% survival	SE	No.	% survival	SE
0	4083	100	-	4055	100	-
6	3784	94	0	2224	95	0
12	3507	89	1	157	-	-

Figure 4.2.2: Unadjusted patient survival by year of entry, 1999-2008



4.2.3 Patient survival by Age at starting dialysis

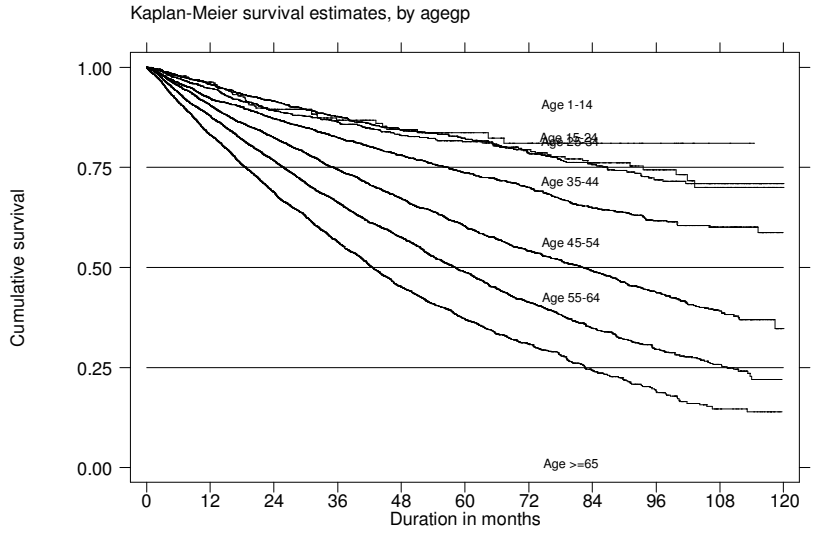
The unadjusted survival for age groups <15 years, 15-24 years and 25-34 years at the start of dialysis were similar, with a 5-year survival of 81-84%. Beyond the age of 34 years old, the unadjusted survival progressively worsens with increasing age. The 9-year unadjusted survival for those who started dialysis at the age of less than 15 years was 81 % compared with 15% in those more than 64 years of age at the time of initiation of dialysis.

Table 4.2.3: Unadjusted patient survival by age, 1999-2008

Age group (years) Interval (month)	1-14			15-24			25-34			35-44		
	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	381	100	-	1237	100	-	2147	100	-	3723	100	-
6	345	98	1	1110	97	0	1914	98	0	3309	96	0
12	299	96	1	967	95	1	1661	96	0	2843	92	0
24	214	89	2	702	89	1	1254	92	1	2209	87	1
36	148	87	2	530	86	1	973	88	1	1706	82	1
48	109	85	2	402	83	1	758	84	1	1309	78	1
60	75	84	3	290	81	1	586	82	1	964	74	1
72	53	81	3	203	79	2	411	79	1	710	70	1
84	26	81	3	132	76	2	270	76	1	466	65	1
96	14	81	3	74	74	2	179	72	2	271	62	1
108	4	81	3	36	70	3	90	71	2	111	60	2

Age group (years) Interval (month)	45-54			55-64			>=65		
	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	7318	100	-	8134	100	-	6463	100	-
6	6498	95	0	7077	94	0	5405	91	0
12	5576	90	0	6012	88	0	4419	83	0
24	4120	82	0	4203	77	1	2918	69	1
36	2972	74	1	2914	66	1	1870	56	1
48	2126	67	1	1977	57	1	1135	45	1
60	1474	60	1	1255	49	1	675	37	1
72	982	54	1	750	41	1	389	31	1
84	619	49	1	421	35	1	194	24	1
96	332	44	1	211	29	1	75	19	1
108	143	39	1	89	26	1	27	15	1

Figure 4.2.3: Unadjusted patient survival by age, 1999-2008



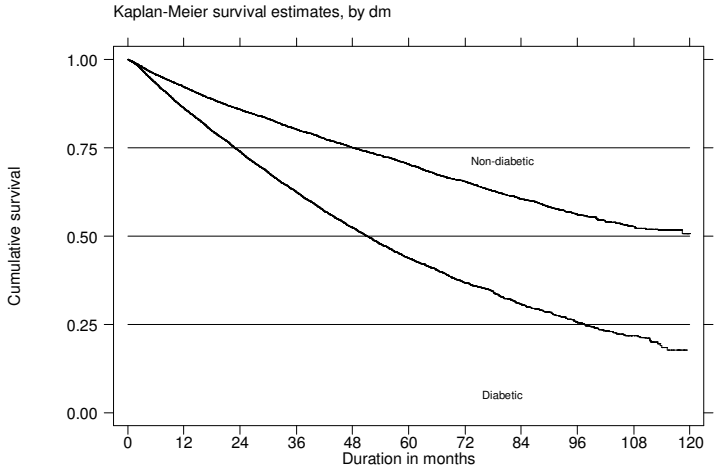
4.2.4 Patient survival by Diabetic status

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 53% and 22% respectively, a two and a half fold difference.

Table 4.2.4: Unadjusted patient survival by Diabetes status, 1999-2008

Diabetes status	Non-diabetic			Diabetic		
Interval (month)	No.	% survival	SE	No.	% survival	SE
0	13798	100	-	15605	100	-
6	12176	96	0	13481	93	0
12	10573	92	0	11203	86	0
24	7956	86	0	7664	74	0
36	6078	80	0	5034	62	0
48	4594	75	0	3211	52	1
60	3358	70	1	1959	44	1
72	2349	65	1	1146	37	1
84	1511	60	1	612	31	1
96	863	56	1	288	25	1
108	397	53	1	96	22	1

Figure 4.2.4: Unadjusted patient survival by Diabetes status, 1999-2008



SECTION 4.3 SURVIVAL OF INCIDENT DIALYSIS PATIENTS BY CENTRE

4.3.1. Survival of incident haemodialysis patients by centre

The median patient survival at 1 year (adjusted for age and diabetes) among haemodialysis centres for the 1999-2007 cohort was 96.8% [Figure 4.3.1(a)]. There was wide centre variation and when the 1 year patient survival of the individual heamodialysis centres were illustrated in the funnel plots [Figure 4.3.1 (b)], a third (167/499) of the haemodialysis centres lies outside the 3SD of the median 1 year patient survival.

Figure 4.3.1 (a): Variation in % survival at 1-years adjusted to age and diabetes, 1999-2007

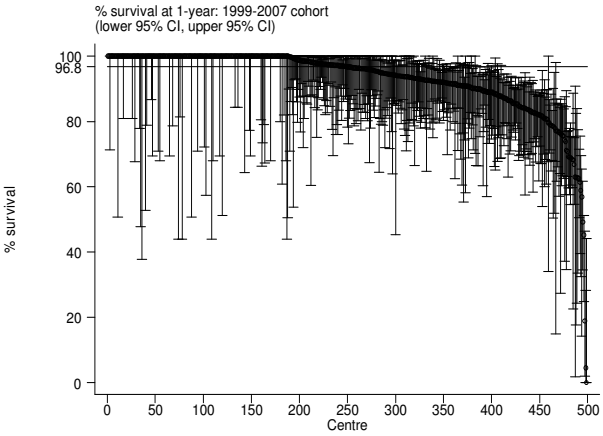
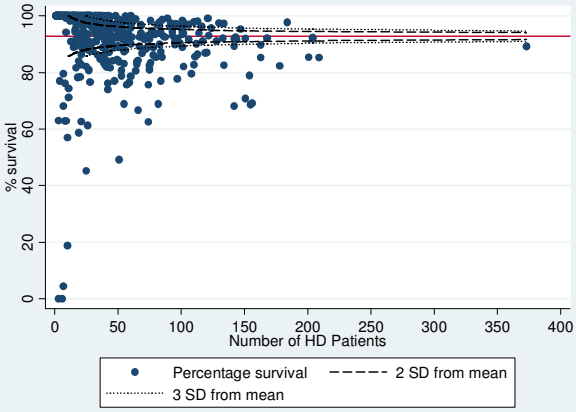
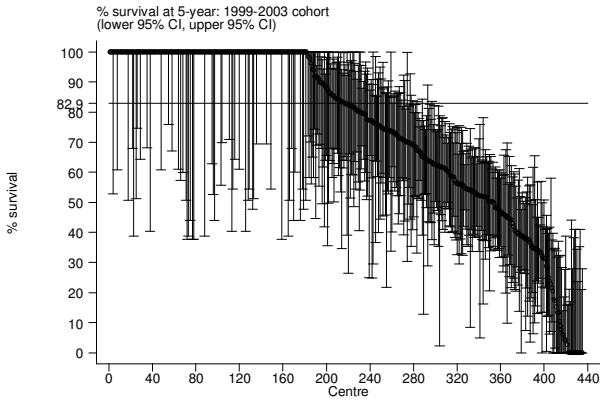


Figure 4.3.1(b): Funnel plot for adjusted age at 60 and diabetes at 1 year, 1999-2007 cohort (HD centres)



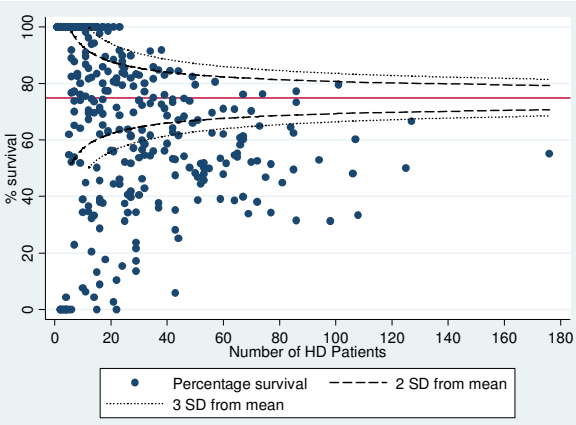
The 5 years median patient survival (adjusted for age and diabetes) among haemodialysis centres for the 1999-2003 cohort was 82.9% [Figure 4.3.1(c)].)]. There was more than 10 fold difference in the centre variation and when the 5 years patient survival of the individual heamodialysis centres were illustrated in the funnel plots [Figure 4.3.1(d)], 33.8% (147/435) of the haemodialysis centres lies outside the 3SD.

Figure 4.3.1(c): Variation in % Survival at 5-years adjusted to age and diabetes, 1999-2003



*Horizontal line represents the median % survival among HD centres

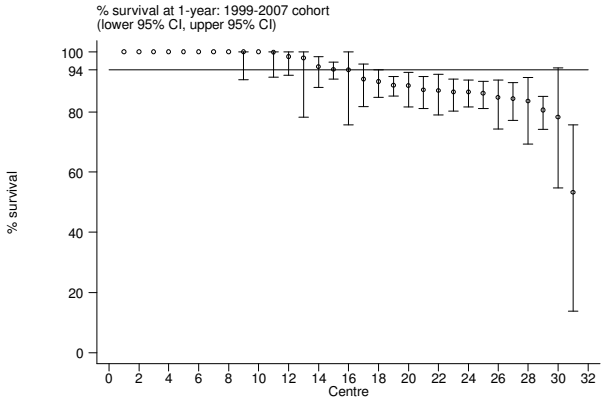
Figure 4.3.1(d): Funnel plot for adjusted age at 60 and diabetes at 5 year, 1999-2003 cohort (HD centres)



4.3.2. Survival of incident PD patients by centre

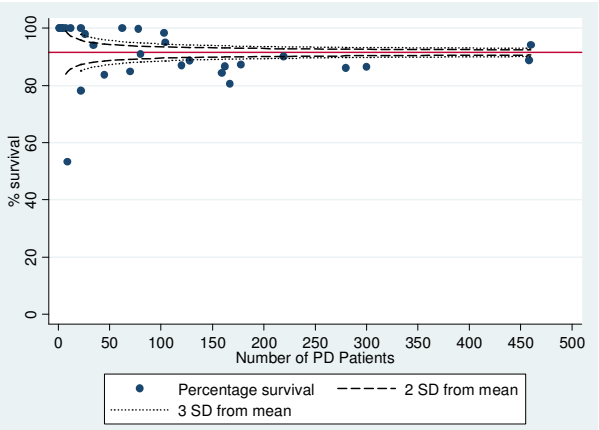
The median patient survival at 1 year (adjusted for age and diabetes) among peritoneal dialysis for the 1999-2007 cohort was 94% [Figure 4.3.2(a)]. There was centre variation and when the patient survival at 1 year in the individual peritoneal dialysis centres were illustrated in the funnel plots [Figure 4.3.1(b)], 12 out of 31 (38.7%) peritoneal dialysis centres lies below the 3SD of the 1 year median survival.

Figure 4.3.2 (a): Variation in % Survival at 1-years adjusted to age and diabetes, 1999-2007



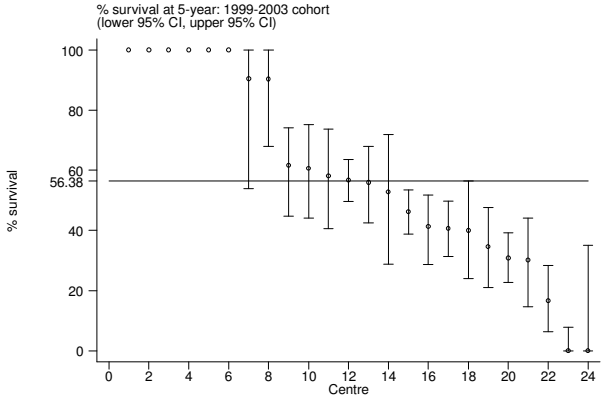
*Horizontal line represents the median % survival among PD centres

Figure 4.3.2 (b): Funnel plot for adjusted age at 60 and diabetes at 1 year, 1999-2007 cohort (PD centres)



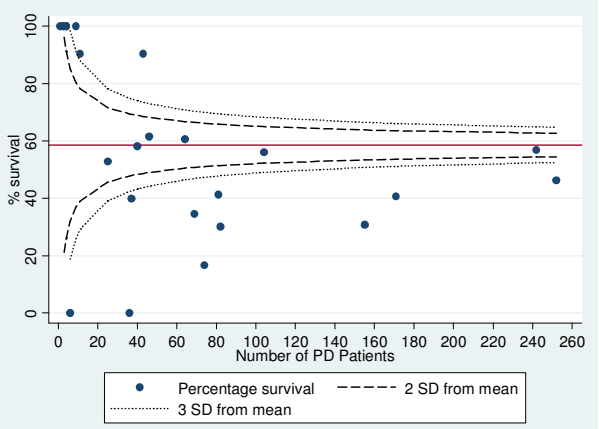
The 5-year median patient survival (adjusted for age and diabetes) among PD centres for the 1999-2003 cohort was 56.38% [Figure 4.3.2(c)].)]. There was more than 10 fold difference in the centre variation and when the 5 year patient survival in the individual PD centres were illustrated in the funnel plots [Figure 4.3.2(d)], 10 out of 24 (41.7%) peritoneal dialysis centres lie below the 3SD of the 5 year median survival.

Figure 4.3.2 (c): Variation in % Survival at 5-years adjusted to age and diabetes, PD centres, 1999-2003



*Horizontal line represents the median % survival among PD centres

Figure 4.3.2 (d): Funnel plot for adjusted age at 60 and diabetes at 5 year, 1999-2003 cohort (PD centres)



SECTION 4.4 ADJUSTED MORTALITY OF DIALYSIS PATIENT

4.4.1. Adjusted hazard ratio for mortality of dialysis patients

Table 4.4.1(a) shows the adjusted hazard ratio for mortality of dialysis patients (1998-2008). The 1998-2008 cohort was adjusted for age, gender, primary diagnosis, year commencing dialysis, dialysis modality, body mass index (BMI), serum albumin, serum cholesterol, 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, diabetic nephropathy as primary renal disease, year commencing dialysis, dialysis modality, BMI, diastolic blood pressure and the presence cardiovascular disease. The biochemical risk factors for mortality were serum albumin, serum cholesterol, haemoglobin, calcium, calcium phosphate product, phosphate, and hepatitis B 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, haemoglobin concentration [Figure 4.4.1(c)], and calcium phosphate product with mortality. Patients commencing dialysis in 2007-2008 has 12% lower adjusted hazard ratio for mortality when compared to those started dialysis from 2000-2006

The adjusted hazard ratio for mortality for hemodialysis patients [Table 4.4.1(b)] in this cohort demonstrated identical pattern with the whole cohort of 2000-2008 dialysis patients. The amount of dialysis treatment (Kt/V) [Figure 4.4.1(d)] has a negative correlation with mortality with hemodialysis patients with Kt/V of > 1.6 having the lowest adjusted hazard ratio for mortality.
The adjusted hazard ratio for peritoneal dialysis patients [Table 4.4.1(c)] showed similar picture with the whole cohort of 2000-2008 dialysis patients However correlation between mortality and year commencing peritoneal dialysis, serum cholesterol, and hepatitis B status were not demonstrated in peritoneal dialysis patients. This difference could be partly contributed by the smaller number of peritoneal dialysis patients in this cohort. Peritoneal dialysis patients with Kt/V of 1.7 or less had 20% higher mortality rate compared with those with higher Kt/V but this did not reach statistical significant [Table 4.4.1 (c) & Figure 4.4.1 (e)].

Table 4.4.1: Adjusted hazard ratio for mortality of all dialysis patients (1999-2008)

Factors	N	Hazard ratio	95% CI		P value
Age (years):					
• Age 1-14 (ref*)	381	1.00			
• Age 15-24	1,237	1.57	(1.12;	2.20)	0.009
• Age 25-34	2,147	1.58	(1.14;	2.20)	0.006
• Age 35-44	3,723	2.23	(1.62;	3.07)	0.000
• Age 45-54	7,318	3.03	(2.21;	4.16)	0.000
• Age 55-64	8,134	3.89	(2.83;	5.33)	0.000
• Age >=65	6,463	5.56	(4.05;	7.63)	0.000
Gender:					
• Male (ref*)	16,331	1.00			
• Female	13,072	0.82	(0.78;	0.85)	0.000
Primary diagnosis:					
• Unknown primary (ref*)	7,988	1.00			
• Diabetes mellitus	15,265	1.57	(1.48;	1.66)	0.000
• GN/SLE	2,056	0.93	(0.83;	1.05)	0.238
• Polycystic kidney	374	1.07	(0.86;	1.32)	0.564
• Obstructive nephropathy	882	1.07	(0.94;	1.22)	0.310
• Others	2,838	1.01	(0.92;	1.10)	0.857

Factors	N	Hazard ratio	95% CI		P value
Year start dialysis:					
• 1999-2000 (ref*)	3,568	1.00			
• 2001-2002	4,758	1.02	(0.96;	1.08)	0.598
• 2003-2004	5,828	1.01	(0.95;	1.07)	0.799
• 2005-2006	7,111	1.05	(0.98;	1.13)	0.139
• 2007-2008	8,138	0.88	(0.80;	0.96)	0.004
Modality:					
• HD (ref*)	25,469	1.00			
• PD	3,934	1.28	(1.19;	1.38)	0.000
BMI:					
• BMI<18.5	2,651	1.32	(1.21;	1.44)	0.000
• BMI 18.5-25	19,381	1.22	(1.16;	1.28)	0.000
• >=25 (ref*)	7,371	1.00			
Serum albumin (g/L):					
• <30	1,858	4.28	(3.90;	4.70)	0.000
• 30-<35	3,953	2.44	(2.27;	2.63)	0.000
• 35-<40	13,861	1.86	(1.76;	1.97)	0.000
• >=40 (ref*)	9,731	1.00			
Serum cholesterol (mmol/L):					
• <3.2	1,168	1.17	(1.05;	1.30)	0.006
• 3.2-<5.2	21,388	1.17	(1.11;	1.23)	0.000
• >=5.2 (ref*)	6,847	1.00			
Diastolic BP (mmHg):					
• <70	3,851	0.87	(0.82;	0.94)	0.000
• 70-<80	11,392	1.04	(0.99;	1.10)	0.091
• 80-<90 (ref*)	10,569	1.00			
• 90-<100	2,930	1.05	(0.97;	1.15)	0.222
• >=100	661	1.95	(1.69;	2.26)	0.000
Hemoglobin:					
• <8	2,550	3.59	(3.26;	3.95)	0.000
• 8-<9	4,209	2.42	(2.21;	2.65)	0.000
• 9-<10	10,356	2.37	(2.18;	2.57)	0.000
• 10-<11	7,156	1.43	(1.31;	1.56)	0.000
• 11-<12 (ref*)	3,437	1.00			
• >=12	1,695	1.04	(0.92;	1.18)	0.526
Serum calcium (mmol/L):					
• <2.2	10,553	0.88	(0.84;	0.92)	0.000
• 2.2-<2.6 (ref*)	18,212	1.00			
• >=2.6	638	1.81	(1.60;	2.05)	0.000
Calcium Phosphate product (mmol2/L2):					
<3.5	10,254	0.98	(0.91;	1.06)	0.586
• 3.5-<4.5 (ref*)	13,041	1.00			
• 4.5-<5.5	4,307	0.66	(0.60;	0.72)	0.000
• >=5.5	1,801	0.63	(0.53;	0.75)	0.000
Serum Phosphate (mmol/L):					
• <1.6	10,820	0.84	(0.78;	0.90)	0.000
• 1.6-<2.0 (ref*)	12,354	1.00			
• 2.0-<2.2	2,700	0.92	(0.83;	1.01)	0.088
• 2.2-<2.4	1,602	1.14	(1.00;	1.30)	0.052
• 2.4-<2.6	943	1.27	(1.07;	1.51)	0.007
• >=2.6	984	1.69	(1.39;	2.07)	0.000
HBsAg:					
• Negative (ref*)	28,253	1.00			
• Positive	1,150	1.15	(1.04;	1.27)	0.007
Anti-HCV:					
• Negative (ref*)	28,333	1.00			
• Positive	1,070	0.94	(0.85;	1.04)	0.229
• Cardiovascular disease (CVD)					
• No CVD (ref*)	24,016	1.00			
• CVD	5,387	1.33	(1.27;	1.40)	0.000

Figure 4.4.1 (a): Adjusted hazard ratio for mortality of dialysis patients by diastolic blood pressure (1999-2008 cohort)

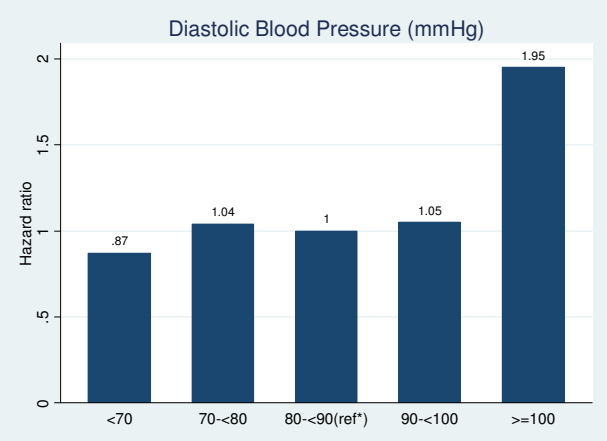


Figure 4.4.1 (b): Adjusted hazard ratio for mortality of dialysis patients by serum phosphate (1999-2008 cohort)

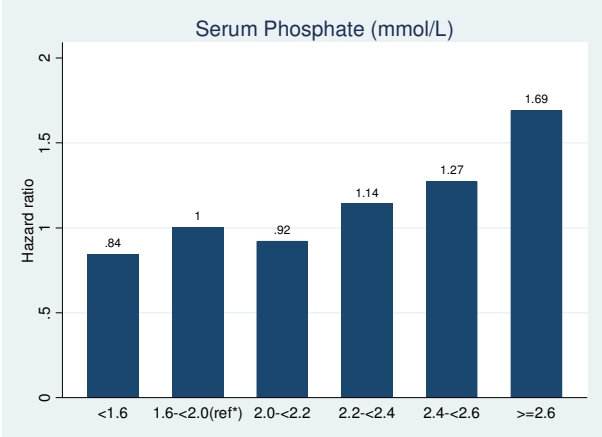


Figure 4.4.1 (c): Adjusted hazard ratio for mortality of dialysis patients by hemoglobin (1999-2008 cohort)

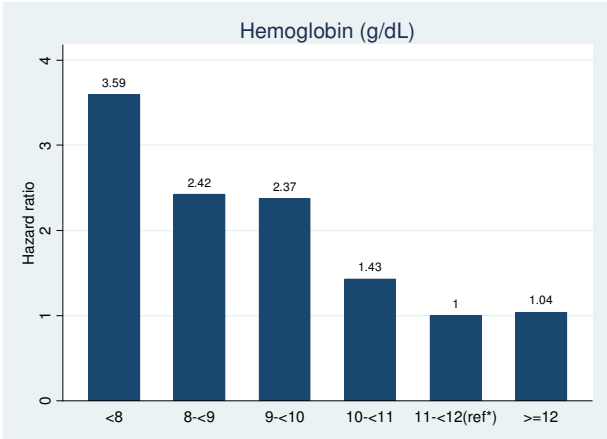


Table 4.4.1 (b): Adjusted hazard ratio for mortality of HD patients (1999-2008 cohort)

Factors	N	Hazard Ratio	95% CI		P value
• Age (years):					
• Age 1-14 (ref*)	106	1			
• Age 15-24	884	0.99	0.53	1.84	0.972
• Age 25-34	1,818	0.87	0.47	1.60	0.657
• Age 35-44	3,227	1.20	0.66	2.20	0.546
• Age 45-54	6,438	1.60	0.88	2.92	0.122
• Age 55-64	7,199	2.03	1.11	3.69	0.021
• Age >=65	5,797	2.94	1.61	5.36	0.000
Gender:					
• Male (ref*)	14,346	1.00			
• Female	11,123	0.85	0.81	0.89	0.000
Primary diagnosis:					
• Unknown primary (ref*)	7,093	1.00			
• Diabetes mellitus	13,432	1.50	1.41	1.59	0.000
• GN/SLE	1,541	0.93	0.82	1.06	0.290
• Polycystic kidney	323	1.00	0.79	1.27	0.978
• Obstructive nephropathy	708	1.08	0.94	1.25	0.274
• Others	2,372	1.04	0.95	1.15	0.384
Year start dialysis:					
• 1999-2000 (ref*)	3,131	1.00			
• 2001-2002	4,048	1.03	0.97	1.10	0.327
• 2003-2004	5,070	1.03	0.97	1.11	0.343
• 2005-2006	6,286	1.06	0.99	1.15	0.096
• 2007-2008	6,934	0.85	0.77	0.94	0.001
BMI:					
• BMI<18.5	2,076	1.50	1.34	1.67	0.000
• BMI 18.5-25	17,307	1.31	1.23	1.40	0.000
• >=25 (ref*)	6,086	1.00			
Serum albumin (g/L):					
• <30	846	4.88	4.38	5.44	0.000
• 30-<35	2,457	2.42	2.24	2.63	0.000
• 35-<40	12,808	1.88	1.77	1.99	0.000
• >=40 (ref*)	9,358	1.00			
Serum cholesterol (mmol/L):					
• <3.2	1,090	1.20	1.06	1.35	0.003
• 3.2-<5.2	19,460	1.23	1.16	1.31	0.000
• >=5.2 (ref*)	4,919	1.00			
Kt/V					
• <1	704	1.52	1.32	1.74	0.000
• 1-<1.2	2,311	1.10	1.00	1.20	0.039
• 1.2-<1.4 (ref*)	5,467	1.00			
• 1.4-<1.6	7,156	1.04	0.98	1.11	0.202
• >=1.6	9,831	0.85	0.79	0.91	0.000
Diastolic BP (mmHg):					
• <70	3,368	0.83	0.77	0.89	0.000
• 70-<80	10,098	1.04	0.98	1.09	0.204
• 80-<90 (ref*)	8,959	1.00			
• 90-<100	2,461	1.04	0.95	1.14	0.412
• >=100	583	1.84	1.57	2.15	0.000

Factors	N	Hazard Ratio	95% CI		P value
Hemoglobin:					
• <8	2,329	3.96	3.55	4.42	0.000
• 8-<9	3,751	2.64	2.38	2.93	0.000
• 9-<10	9,419	2.61	2.37	2.87	0.000
• 10-<11	5,908	1.49	1.34	1.64	0.000
• 11-<12 (ref*)	2,747	1.00			
• >=12	1,315	1.01	0.87	1.18	0.887
Serum calcium (mmol/L):					
• <2.2	9,242	0.90	0.85	0.95	0.000
• 2.2-<2.6 (ref*)	15,729	1.00			
• >=2.6	498	1.73	1.51	1.99	0.000
Calcium Phosphate product (mmol2/L2):					
• <3.5	8,097	0.91	0.84	0.99	0.030
• 3.5-<4.5 (ref*)	11,869	1.00			
• 4.5-<5.5	3,851	0.66	0.60	0.73	0.000
• >=5.5	1,652	0.63	0.52	0.76	0.000
Serum Phosphate (mmol/L):					
• <1.6	8,494	0.85	0.78	0.92	0.000
• 1.6-<2.0 (ref*)	11,297	1.00			
• 2.0-<2.2	2,447	0.86	0.77	0.95	0.003
• 2.2-<2.4	1,460	1.09	0.95	1.25	0.239
• 2.4-<2.6	862	1.18	0.98	1.42	0.076
• >=2.6	909	1.62	1.31	1.99	0.000
HBsAg:					
• Negative (ref*)	24,473	1.00			
• Positive	996	1.13	1.02	1.26	0.023
Anti-HCV:					
• Negative (ref*)	24,531	1.00			
• Positive	938	0.92	0.83	1.02	0.106
• Cardiovascular disease (CVD)					
• No CVD (ref*)	21,007	1.00			
• CVD	4,462	1.29	1.22	1.35	0.000

Figure 4.4.1 (d): Adjusted hazard ratio for mortality of HD patients by Kt/V (1999-2008 cohort)

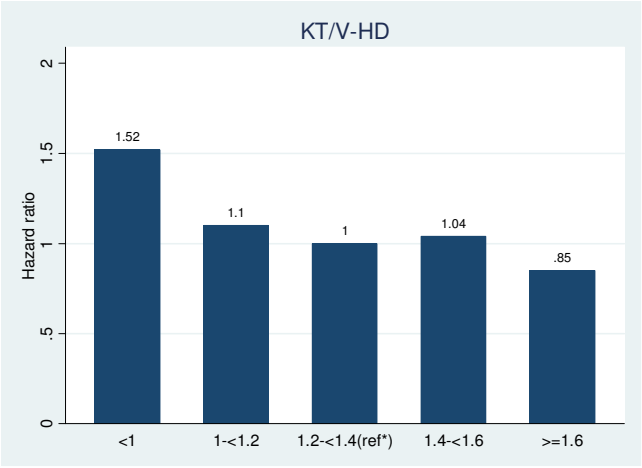
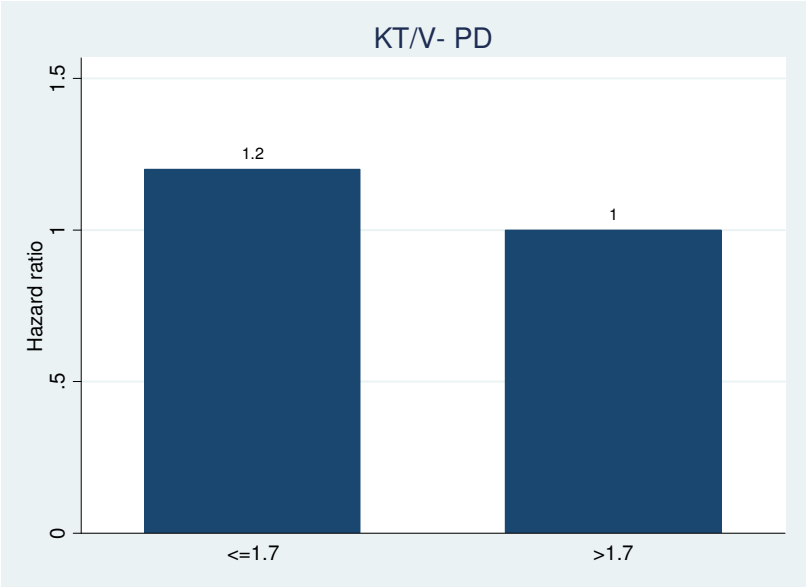


Figure 4.4.1 (c): Adjusted hazard ratio for mortality of PD patients (1999-2008 cohort)

Factors	N	Hazard ratio	95% CI		P value
Age (years):					
• Age 1-14 (ref*)	275	1			
• Age 15-24	353	1.55	0.98	2.44	0.058
• Age 25-34	329	1.70	1.04	2.76	0.033
• Age 35-44	496	2.52	1.57	4.03	0.000
• Age 45-54	880	4.14	2.65	6.49	0.000
• Age 55-64	935	5.00	3.22	7.77	0.000
• Age >=65	666	7.99	5.08	12.56	0.000
Gender:					
• Male (ref*)	1,985	1.00			
• Female	1,949	0.84	0.74	0.96	0.010
Primary diagnosis:					
• Unknown primary (ref*)	895	1.00			
• Diabetes mellitus	1,833	1.98	1.64	2.39	0.000
• GN/SLE	515	0.96	0.73	1.26	0.763
• Polycystic kidney	51	1.41	0.85	2.34	0.186
• Obstructive nephropathy	174	1.08	0.76	1.52	0.670
• Others	466	0.92	0.73	1.17	0.512
Year start dialysis:					
• 1999-2000 (ref*)	437	1.00			
• 2001-2002	710	1.07	0.90	1.28	0.456
• 2003-2004	758	1.03	0.86	1.24	0.750
• 2005-2006	825	1.02	0.83	1.24	0.876
• 2007-2008	1,204	0.96	0.76	1.22	0.761
BMI:					
• BMI<18.5	575	1.67	1.34	2.08	0.000
• BMI 18.5-25	2,074	1.26	1.11	1.43	0.000
• >=25 (ref*)	1,285	1.00			
Serum albumin (g/L):					
• <30	1,012	1.93	1.44	2.59	0.000
• 30-<35	1,496	1.31	0.98	1.75	0.063
• 35-<40	1,053	0.93	0.69	1.26	0.648
• >=40 (ref*)	373	1.00			
Serum cholesterol (mmol/L):					
• <3.2	78	1.43	0.99	2.07	0.057
• 3.2-<5.2	1,928	0.90	0.80	1.02	0.093
• >=5.2 (ref*)	1,928	1.00			
• Kt/V					
• <=1.7	1,113	1.20	0.93	1.56	0.158
• >1.7 (ref*)	2,821				
Diastolic BP (mmHg):					
• <70	483	1.26	1.04	1.52	0.016
• 70-<80	1,294	0.98	0.85	1.12	0.767
• 80-<90 (ref*)	1,610	1.00			
• 90-<100	469	1.22	0.98	1.53	0.075
• >=100	78	2.17	1.42	3.31	0.000
Hemoglobin:					
• <8	221	2.25	1.68	3.00	0.000
• 8-<9	458	1.81	1.44	2.28	0.000
• 9-<10	937	1.59	1.32	1.91	0.000
• 10-<11	1,248	1.21	1.02	1.44	0.031
• 11-<12 (ref*)	690	1.00			
• >=12	380	1.04	0.82	1.32	0.762

Factors	N	Hazard ratio	95% CI		P value
Serum calcium (mmol/L):					
• <2.2	1,311	0.87	0.75	1.00	0.052
• 2.2-<2.6 (ref*)	2,483	1.00			
• >=2.6	140	2.14	1.62	2.82	0.000
Calcium Phosphate product (mmol2/L2):					
• <3.5	2,157	1.33	1.09	1.64	0.006
• 3.5-<4.5 (ref*)	1,172	1.00			
• 4.5-<5.5	456	0.87	0.67	1.14	0.320
• >=5.5	149	0.83	0.48	1.41	0.486
Serum Phosphate (mmol/L):					
• <1.6	2,326	1.02	0.82	1.27	0.840
• 1.6-<2.0 (ref*)	1,057	1.00			
• 2.0-<2.2	253	1.49	1.10	2.02	0.010
• 2.2-<2.4	142	1.38	0.88	2.16	0.159
• 2.4-<2.6	81	1.81	1.05	3.14	0.034
• >=2.6	75	1.43	0.68	3.04	0.347
HBsAg:					
• Negative (ref*)	3,780	1.00			
• Positive	154	1.16	0.88	1.53	0.279
Anti-HCV:					
• Negative (ref*)	3,802	1.00			
• Positive	132	1.23	0.94	1.61	0.128
• Cardiovascular disease (CVD)					
• No CVD (ref*)	3,009	1.00			
• CVD	925	1.53	1.34	1.73	0.000

Figure 4.4.1 (e): Adjusted hazard ratio for mortality of PD patients by KT/V (1999-2008 cohort)



4.4.2. Variation in odds ratio of death by state in 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, a difference in odds ratio of death of 0.57. The state of Johor has a mortality rate most similar to national mortality rate while dialysis patients in Sabah and Labuan has the highest mortality and patients dialysing in Kuala Lumpur has the lowest mortality;.

Table 4.4.2: Variation in odds ratio of death by centre state 2007

		Variation in odds ratio						
		Min	5th centile	LQ	Median	UQ	95th centile	Max
		0.580	0.580	0.868	0.939	1.095	1.152	1.152
State	Number of centres				Odds ratio			
Pulau Pinang	60				0.868			
Melaka	31				1.110			
Johor	92				1.000			
Perak	74				0.933			
Selangor and WP Putrajaya	123				0.802			
WP Kuala Lumpur	77				0.580			
Negeri Sembilan	26				1.022			
Kedah	36				1.068			
Perlis	3				1.124			
Terengganu	17				0.939			
Pahang	27				1.095			
Kelantan Darul Naim	26				0.886			
Sarawak	40				0.793			
Sabah and WPLabuan	35				1.152			

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

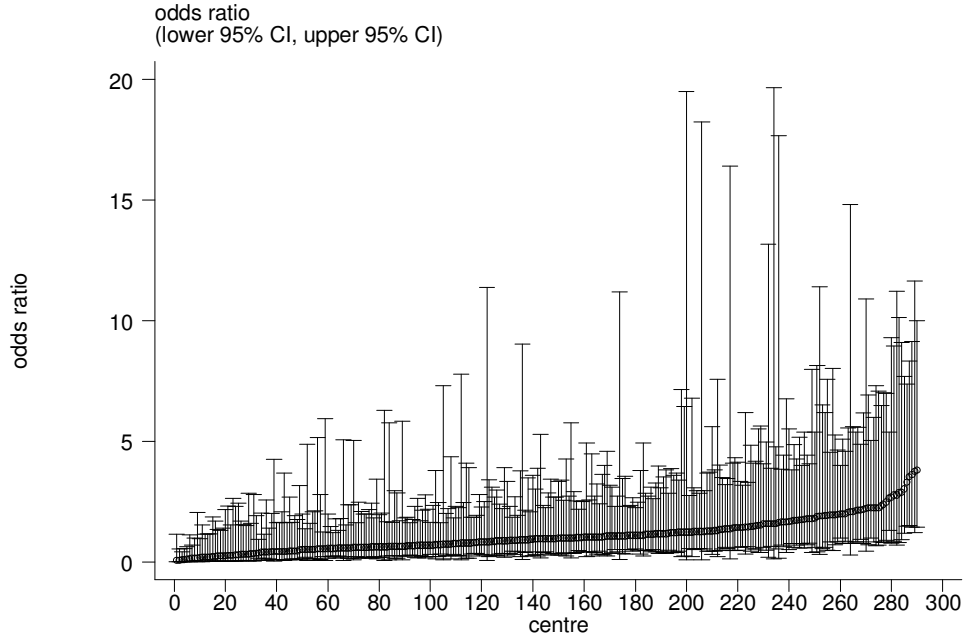
4.4.3. Variation in odds ratio of death by dialysis centre

Table 4.4.3 show the odds ratio of death by all centres in 1998 till 2007. The number of centres has increased from 49 in 1998 to 303 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 fold (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	49	0.077	0.277	0.96	1.461	2.462	5.337	15.798
1999	52	0.013	0.147	0.562	1.362	2.901	4.471	10.504
2000	81	0.028	0.098	0.314	0.733	1.334	3.05	5.082
2001	119	0.102	0.167	0.555	0.903	1.815	3.42	7.601
2002	145	0.095	0.174	0.668	1.071	1.809	3.841	12.178
2003	176	0.104	0.243	0.748	1.389	2.16	6.525	16.577
2004	203	0.000	0.000	0.497	0.779	1.26	2.866	7.488
2005	239	0.081	0.187	0.494	0.852	1.323	2.64	6.075
2006	272	0.095	0.186	0.497	0.877	1.186	2.226	5.442
2007	303	0.061	0.226	0.608	0.983	1.498	2.87	5.887

Figure 4.4.3: Variations in odds ratio of death by centre, 2007



*from 303 centres, 13 centres have upper OR bound more than 20.

CHAPTER 5

Quality Of Life and Rehabilitation Outcomes of Patients on Dialysis

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SECTION A : QoL index score

21711 patients who entered dialysis between 1999-2008 were analysed. 18298 HD patients and 3413 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 non-diabetics (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 PD cohort over the last 10 years. (Table 5.5, Table 5.6, Figure 5.5 and Figure 5.6)

Table 5.1: Cumulative distribution of QoL-Index score in relation to dialysis modality, All dialysis patients 1999-2008

Dialysis modality	PD	HD
Number of patients	3413	18298
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 1999- 2008

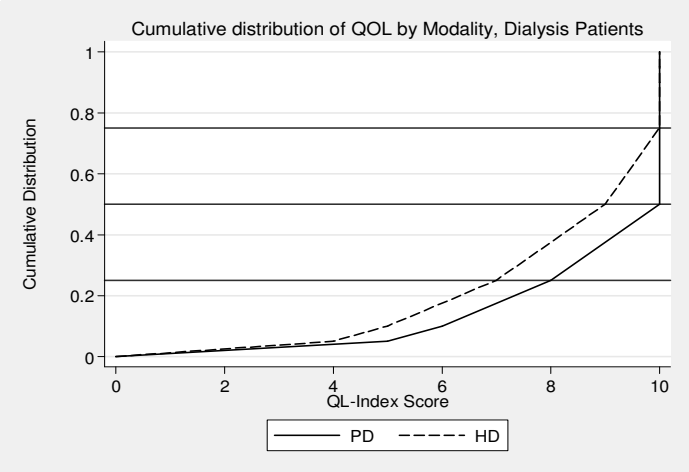

Table 5.2: Cumulative distribution of QoL-Index score in relation to Diabetic, All dialysis patients 1999-2008

Diabetes mellitus	No	Yes
Number of patients	10662	11049
Centile		
0	0	0
0.05	5	4
0.1	7	5
0.25 (LQ)	8	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 DM, All Dialysis patients, 1999-2008

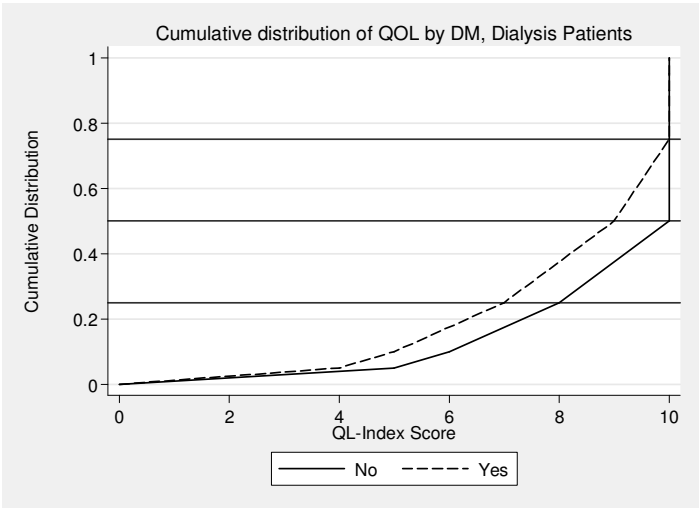

Table 5.3: Cumulative distribution of QoL-index score in relation to Gender, All Dialysis patients 1999-2008

Gender	Male	Female
Number of patients	12017	9694
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, 1999- 2008

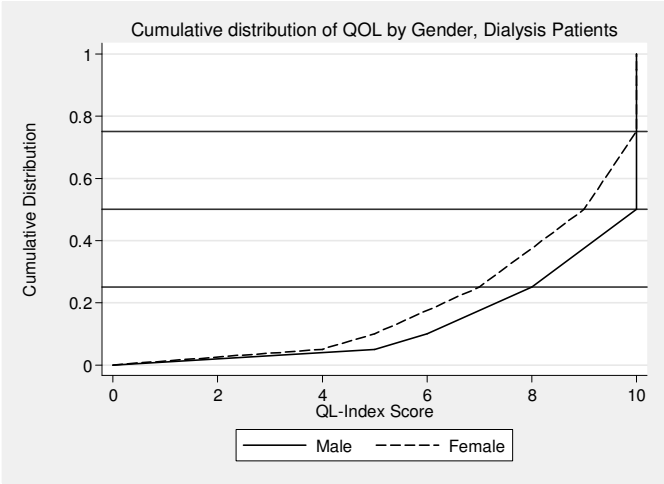

Table 5.4: Cumulative distribution of QoL-index score in relation to Age, All Dialysis patients 1999-2008

Age group	<20	20-39	40-59	>=60
Number of patients	799	3516	10379	7017
Centile				
0	0	0	0	0
0.05	6	6	5	4
0.1	7	8	6	5
0.25 (LQ)	9	9	8	6
0.5 (median)	10	10	9	8
0.75 (UQ)	10	10	10	9
0.9	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, 1999-2008

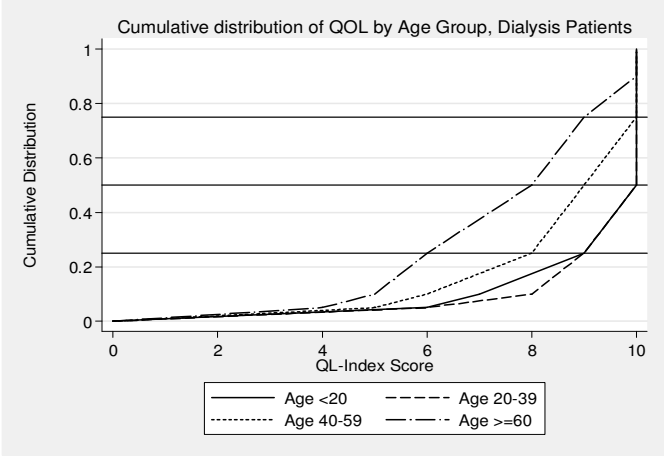

Table 5.5: Cumulative distribution of QoL-Index score in relation to year of entry, HD patients 1999-2008

Year of Entry	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number of patients	1041	1274	1439	1649	1708	2033	2122	2458	2460	2114
Centile										
0	0	0	0	0	0	0	0	0	0	0
0.05	5	5	5	4	5	4	4	4	4	4
0.1	6	6	5	5	5	5	5	5	5	5
0.25 (LQ)	7	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 1999-2008

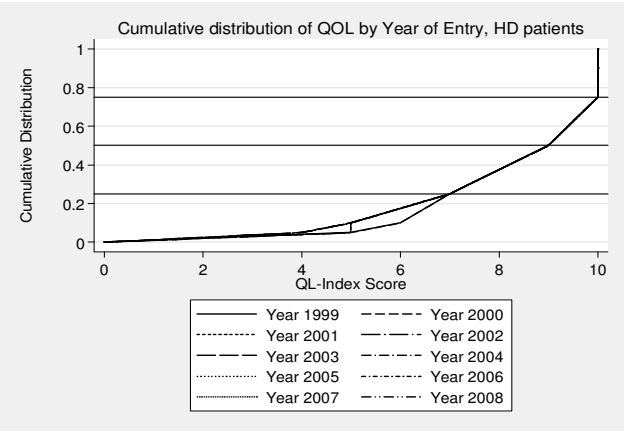

Figure 5.6: Cumulative distribution of QoL-Index score in relation to year of entry, PD patients 1999-2008

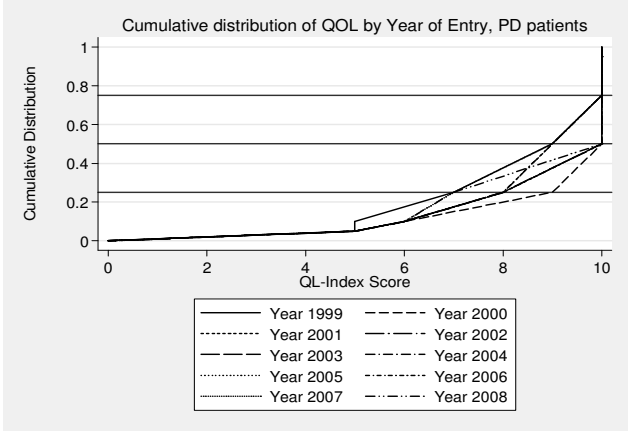

Table 5.6: Cumulative distribution of QoL-Index score in relation to year of entry, PD patients 1999-2008

Year of Entry	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number of patients	167	188	269	320	368	307	319	425	524	526
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	6	6	6	6	6	6	6	6	6
0.25 (LQ)	7	9	8	8	8	8	8	8	7	7
0.5 (median)	9	10	10	10	10	9	10	9	9	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=7199) and CAPD patients (n=1112) who entered dialysis between 1999 –2008, (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 70%)

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, 1999-2008

Modality	PD		HD	
	n	%	n	%
Number of patients	1112		7199	
Able to return for Full or Part time for pay*	792	71	5013	70
Unable to work for pay	320	29	2186	30

Table 5.8: Work related rehabilitation in relation to year of entry, HD patients 1999-2008

Year		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number of patients		534	591	604	690	707	807	788	906	850	722
Able to return for Full or Part time for pay*	n	405	455	439	510	516	555	546	614	555	418
	%	76	77	73	74	73	69	69	68	65	58
Unable to work for pay	n	129	136	165	180	191	252	242	292	295	304
	%	24	23	27	26	27	31	31	32	35	42

Table 5.9: Work related rehabilitation in relation to year of entry, PD patients 1999-2008

Year		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number of patients		48	64	85	119	140	103	112	142	152	147
Able to return for Full or Part time for pay*	n	35	43	69	90	108	73	81	99	101	93
	%	73	67	81	76	77	71	72	70	66	63
Unable to work for pay	n	13	21	16	29	32	30	31	43	51	54
	%	27	33	19	24	23	29	28	30	34	37

Summary:

Median QoL index scores are satisfactory and HD patients (score of 9) achieve a lower score than CAPD patients (score of 10). Diabetes Mellitus and older age group are factors associated with lower median QoL index scores. Higher employment rate amongst HD and CAPD patients who started dialysis earlier may be confounded by these healthier individuals who survived longer.

CHAPTER 6

Paediatric Renal Replacement Therapy

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SECTION A: RRT PROVISION FOR PAEDIATRIC PATIENTS

This chapter presents data from all patients less than 20 years of age receiving renal replacement therapy (RRT) from 1999 to 2008. The dialysis acceptance rate for the paediatric population in 2008 was 7 per million age related population (pmarp). The dialysis acceptance rate had remained fairly stable over the last 7 years suggesting that probably almost all children with ESRD in Malaysia had access to treatment. The number of new transplants had earlier shown an encouraging increase but has also remained quite stable over the last 4 years with about 20 new transplants yearly. The overall incident rate for all RRT was 8 pmarp in 2008.

As expected the number of prevalent patients continued to rise. At the end of 2008, 778 paediatric patients were receiving RRT in Malaysia. Of these, 555 children were on dialysis. The equivalent dialysis prevalence rate more than doubled over the last 10 years from 20 pmarp in 1999 to 48 pmarp in 2008. The prevalent HD population continued to expand at a higher rate than the PD population although the incident rate for PD is higher consistent with higher technique failure with PD.

Table 6.1: Stock and Flow of Paediatric Renal Replacement Therapy 1999-2008

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
New HD patients	23	12	24	28	33	39	34	51	35	39
New PD patients	30	37	40	54	38	41	47	44	49	46
New Transplants	15	18	11	13	11	11	17	22	20	20
HD deaths	2	4	1	11	6	10	9	7	10	10
PD deaths	2	3	8	8	9	5	9	16	8	8
Transplant deaths	0	1	0	1	2	1	1	3	3	4
On HD at 31st Dec	106	120	144	161	185	218	242	288	316	347
On PD at 31st Dec	92	109	123	152	163	176	192	189	201	208
Functioning transplant at 31st Dec	80	93	101	112	118	126	140	155	166	173

Figure 6.1 (a): Incidence cases of RRT by modality in children under 20 years old, 1999-2008

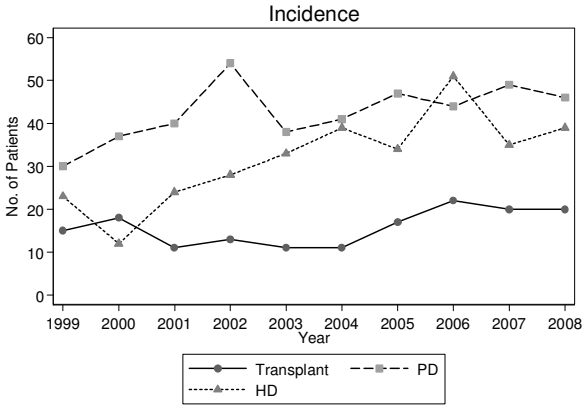


Figure 6.1 (b): Prevalence cases of RRT by modality in children under 20 years old, 1999-2008

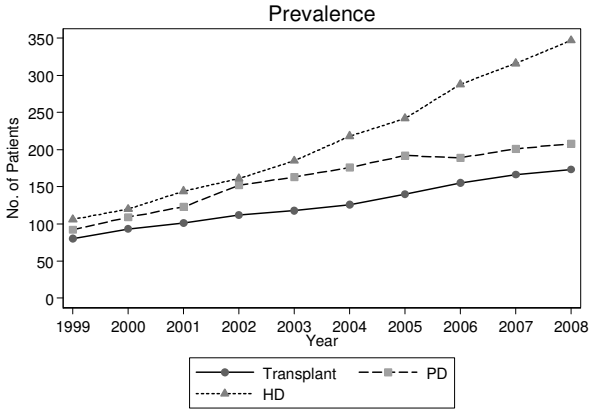
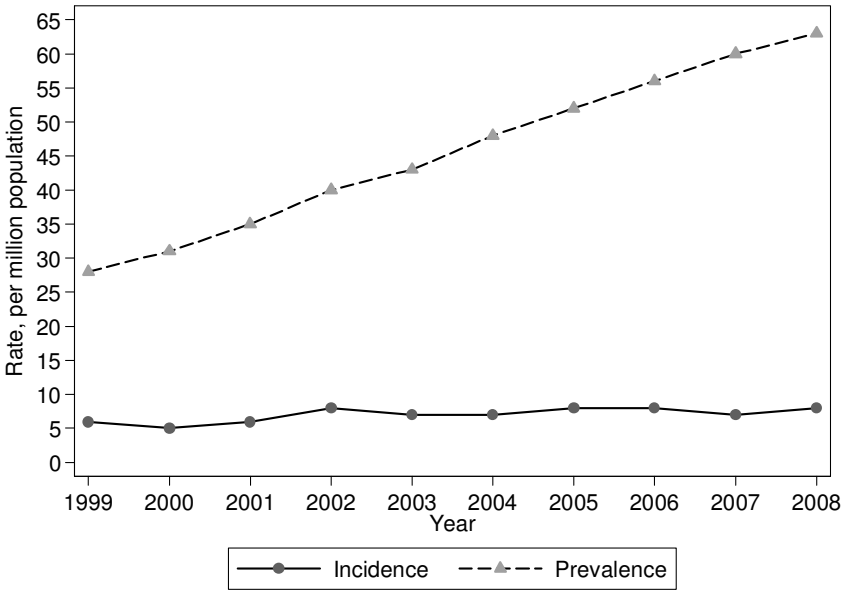


Table 6.2: Paediatric Dialysis and Transplant Rates per million age-group population 1999-2008

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Incidence Rate										
New HD	2	1	2	3	3	4	3	5	3	3
New PD	3	4	4	5	4	4	4	4	4	4
New Transplant	2	2	1	1	1	1	2	2	2	2
All RRT	6	5	6	8	7	7	8	8	7	8
Prevalence Rate at 31st December										
On HD	11	12	14	15	17	20	22	26	28	30
On PD	9	11	12	14	15	16	17	17	18	18
Functioning Graft	8	9	10	11	11	12	13	14	15	15
All RRT	28	31	35	39	42	47	51	55	59	63

Figure 6.2: Incidence and prevalence rate per million age related population on RRT, 1999-2008



SECTION B: DISTRIBUTION OF PAEDIATRIC DIALYSIS PATIENTS

The treatment rate is still consistently higher for states in the west coast of West Malaysia which are deemed to be more economically advantaged compared to the east coast of West Malaysia and in East Malaysia. However this gap is becoming less obvious over the years with the set up of new paediatric nephrology centres in these regions.

Table 6.3 (a): Dialysis Treatment Rate by State, per million state age group populations, 1999-2007

State	1999-2003	2004-2008
Pulau Pinang	9	16
Melaka	7	15
Johor	10	10
Perak	6	10
Selangor & Putrajaya	8	7
Kuala Lumpur	11	12
Negeri Sembilan	8	13
Kedah	10	7
Perlis	16	10
Terengganu	10	10
Pahang	7	11
Kelantan	6	8
Sarawak	4	8
Sabah & WP Labuan	3	7

Table 6.3 (b): New Dialysis Patients by State, 1999-2008

State	1999-2003	2004-2008
Pulau Pinang	22	43
Melaka	10	23
Johor	58	67
Perak	26	46
Selangor & Putrajaya	68	70
Kuala Lumpur	30	35
Negeri Sembilan	15	25
Kedah	37	27
Perlis	8	5
Terengganu	23	24
Pahang	20	33
Kelantan	23	31
Sarawak	17	40
Sabah & WP Labuan	21	47

There has been consistently more males compared to females among the population of children on dialysis and this trend has persisted over the last 10 years. This is probably a reflection of the higher incidence of ESRD among the males. However this gender disparity appears more marked among the transplanted patients.

Table 6.4: Number of New Dialysis and Transplant Patients by Gender, 1999-2008

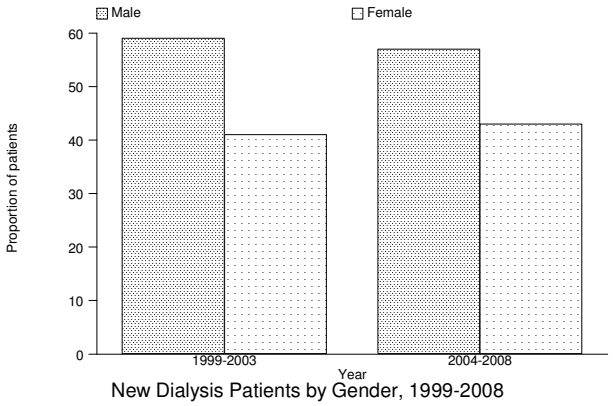
a) New Dialysis

Year	Male		Female	
	No.	%	No.	%
1999-2003	188	59	131	41
2004-2008	242	57	183	43

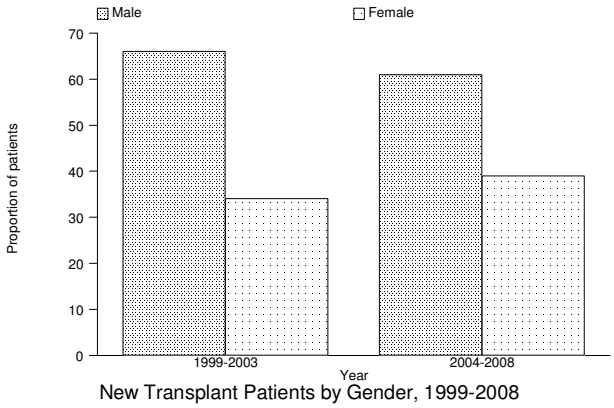
b) New Transplant

Year	Male		Female	
	No.	%	No.	%
1999-2003	45	66	23	34
2004-2008	55	61	35	39

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



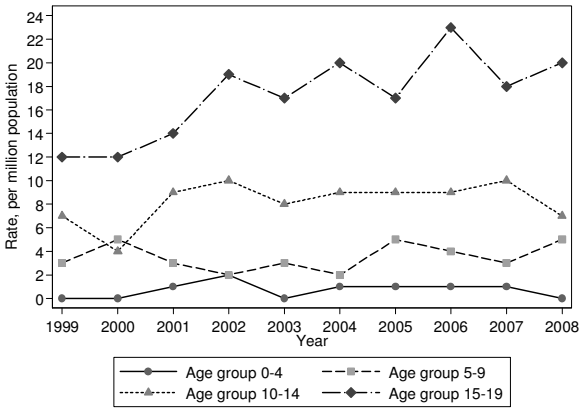
New Dialysis Patients by Gender, 1999-2008



New Transplant Patients by Gender, 1999-2008

The dialysis treatment rate had leveled off over the last 5 years across the paediatric age spectrum. The treatment rate had remained consistently higher among the older age groups. The number of 0-4 year olds provided chronic dialysis treatment remained abysmally low.

Figure 6.5: New RRT Rate by Age group, 1999-2008

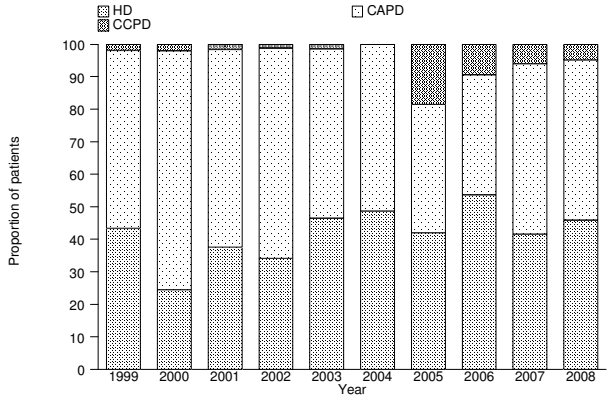


PD was the first modality of dialysis in 54% of patients. In the last 4 years a significant proportion of children on PD were started on automated PD (CCPD) as the first mode of dialysis; the highest number was in 2005 when APD was first made widely available to the paediatric population.

Table 6.6: New Dialysis treatment by dialysis modality, 1999-2008

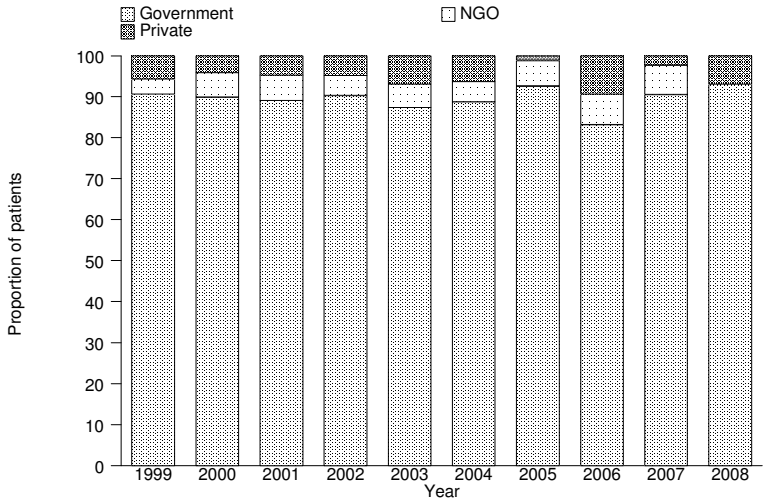
Year	HD		CAPD		CCPD	
	No.	%	No.	%	No.	%
1999	23	43	29	55	1	2
2000	12	24	36	73	1	2
2001	24	38	39	61	1	2
2002	28	34	53	65	1	1
2003	33	46	37	52	1	1
2004	39	49	41	51	0	0
2005	34	42	32	40	15	19
2006	51	54	35	37	9	9
2007	35	42	44	52	5	6
2008	39	46	42	49	4	5

Figure 6.6: New Dialysis by treatment modality, 1999-2008



Most of the children (up to 90%) received their dialysis treatment from government centres and hence were government funded. This figure had not changed over the last 10 years.

Figure 6.7: New Dialysis by sector ,1999-2008



SECTION C: PRIMARY RENAL DISEASE

The most common primary renal disease identified was glomerulonephritis, which affected 30% of the patients. FSGS on its own accounted for 8% of the ESRD population. The number of children presenting with ESRD of unknown aetiology was still high at 48%.

Table 6.8: Primary renal disease by sex, 1999-2008

Primary Renal Disease	Male		Female		All	
	No.	%	No.	%	No.	%
Glomerulonephritis	130	22	91	21	221	22
FSGS	46	8	30	7	76	8
Refux nephropathy	30	5	13	3	43	4
SLE	16	3	46	11	62	6
Obstructive uropathy	41	7	9	2	50	5
Renal dysplasia	15	3	9	2	24	2
Hereditary nephritis	11	2	11	3	22	2
Cystic kidney disease	13	2	3	1	16	2
Drug induced nephropathy	6	1	4	1	10	1
Metabolic	0	0	1	0	1	0
Others	3	1	1	0	4	0
Unknown	272	47	210	49	482	48

SECTION D: TYPES OF RENAL TRANSPLANTATION

Living related renal transplant used to be the commonest type of transplantation done among children. However the trend has changed over the last 5 years in that cadaveric renal transplant is now the most common transplantation done accounting for about 42% compared to 36% for living related renal transplant. About a fifth of renal transplant were done overseas mainly the commercial cadaveric programme.

Table 6.9: Types of Renal Transplantation, 1999-2008

Year	1999-2003		2004-2008	
	No.	%	No.	%
Commercial cadaver	12	18	19	21
Commercial living donor	3	4	1	1
Living related donor	33	49	32	36
Cadaver	20	29	37	42
Living emotionally related	0	0	0	0
TOTAL	68	100	89	100

SECTION E: SURVIVAL ANALYSIS

Renal transplantation has the best patient survival with 92% survival at 5 years and 89% at 9 years. HD and PD showed comparable survival curve up till about 7 years into dialysis when analyzed without consideration of change of modality of dialysis (as per ITT). However when censored for change of dialysis modality; separation of the survival curve occurred earlier, after about 3 years with PD patients showing a much poorer outcome compared to HD (fig 6.10b)

Table 6.10 (a): Patient survival by dialysis modality analysis (not censored with change of modality)

Modality Interval (months)	Transplant			PD			HD		
	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	137	100	-	348	100	-	302	100	-
6	120	99	1	313	97	1	278	97	1
12	111	98	1	273	93	1	246	94	1
24	88	97	2	205	85	2	196	91	2
36	68	96	2	166	83	2	143	87	2
48	52	94	3	125	80	3	113	84	3
60	42	92	3	97	79	3	81	83	3
72	32	89	4	70	76	3	57	80	3
84	20	89	4	38	74	4	42	80	3
96	15	89	4	20	71	4	29	80	3
108	9	89	4	11	71	4	20	77	4

Figure 6.10 (a): Patient survival by dialysis modality analysis (not censored with change of modality)

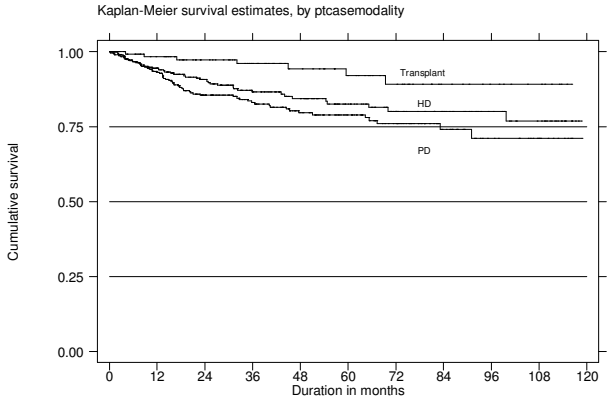


Figure 6.10 (b): Patient survival by dialysis modality analysis (censored with change of modality)

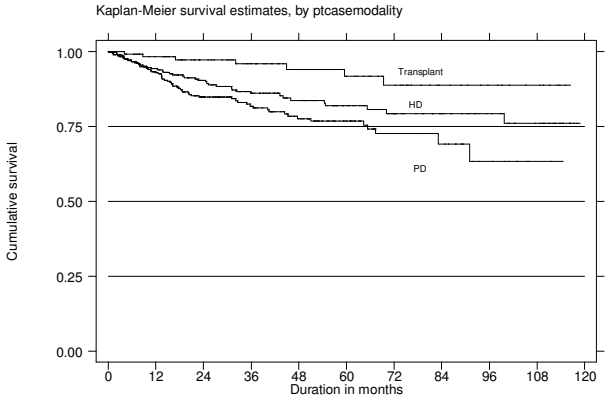


Table 6.10 (b): Patient survival by dialysis modality analysis (censored with change of modality)

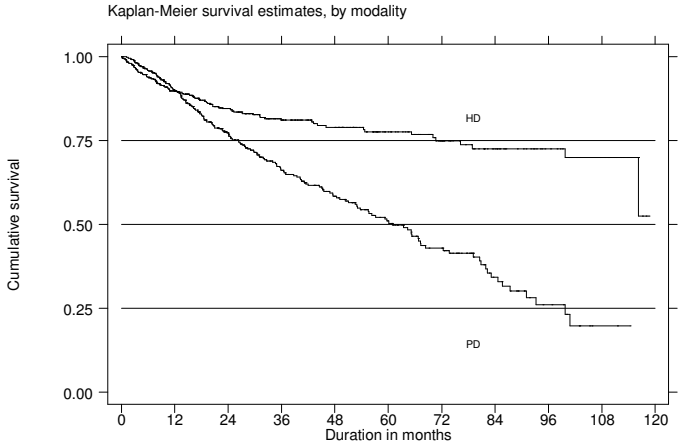
Modality Interval (months)	Transplant			PD			HD		
	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	137	100	-	348	100	-	302	100	-
6	117	99	1	308	97	1	271	97	1
12	108	98	1	261	93	1	235	94	1
24	85	97	2	183	85	2	186	90	2
36	65	96	2	133	82	2	135	86	2
48	49	94	3	98	78	3	107	84	3
60	40	92	4	70	77	3	77	82	3
72	31	89	4	47	73	4	54	79	3
84	20	89	4	21	69	5	39	79	3
96	15	89	4	10	63	7	28	79	3
108	9	89	4	3	63	7	19	76	5

After the first year; dialysis technique failure rate was much higher amongst PD patients with progressive widening of the technique survival curve with increasing years on dialysis. Technique survival at 5 years was only 51% for PD compared to 78% for HD.

Table 6.11: Dialysis Technique Survival by Modality, 1999-2008

Modality Interval (months)	PD			HD		
	No.	% survival	SE	No.	% survival	SE
0	348	100	-	302	100	-
6	408	96	1	390	94	1
12	347	90	1	333	90	1
24	238	77	2	252	84	2
36	169	66	3	184	81	2
48	125	58	3	147	79	2
60	87	51	3	102	78	2
72	60	43	3	75	75	3
84	27	34	4	51	72	3
96	12	26	4	33	72	3
108	3	20	5	19	70	4

Figure 6.11: Dialysis Technique Survival by Modality, 1999-2008

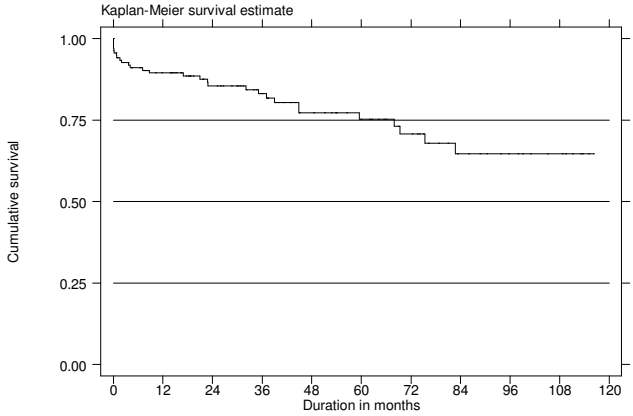


The graft survival for paediatric transplants was 89% for 1 year and 75% for 5 years.

Table 6.12: Transplant Graft Survival, 1999-2008

Interval (month)	No.	% survival	SE
0	137	100	-
6	117	91	2
12	108	89	3
24	85	86	3
36	65	83	4
48	49	77	4
60	40	75	5
72	31	71	5
84	20	65	6
96	15	65	6
108	9	65	6

Figure 6.12: Transplant Graft Survival, 1999-2008



CHAPTER 7

Management of Anaemia in Patients on Dialysis

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Bee Boon Cheak

SECTION 7.1: TREATMENT FOR ANAEMIA IN DIALYSIS

From 1999 – 2008, there was an increasing percentage of patients receiving erythropoietin (EPO); more haemodialysis patients were on EPO; 87% compared 77% in PD. The percentage of patients requiring blood transfusion has remained at 16% for both HD and PD patients over the last few years.

There were a decreasing number of patients receiving oral iron, with a significant increase of HD patients on parenteral iron. (Table 7.1.1 – 7.1.2)

Table 7.1.1: Treatment for Anaemia, HD patients 1999 to 2008

Year	No of subject	% on Erythropoietin	% receive blood transfusion	% on oral iron	% received parenteral iron
1999	2996	51	15	90	5
2000	4392	56	15	88	5
2001	5194	62	13	88	5
2002	6108	67	10	85	7
2003	7017	71	12	83	8
2004	8064	74	11	80	10
2005	9344	80	14	74	11
2006	11679	83	18	76	16
2007	12907	85	15	74	17
2008	15280	87	16	63	23

Table 7.1.2: Treatment for Anaemia, PD patients 1999 to 2008

Year	No of subject	% on Erythropoietin	% receive blood transfusion	% on oral iron	% received parenteral iron
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	71	12	87	8
2006	1552	73	16	83	13
2007	1806	73	16	80	12
2008	2084	77	16	77	12

In 2008, the percentage of patients on EPO among the HD centres varied significantly from 0% to 100%. The median usage of EPO was 91% compared to 50.5% a decade ago. (Table 7.1.3)

Table 7.1.3: Variation in Erythropoietin utilization (% patients) among HD centres, 2008

Year	No of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
1999	76	6	13	41.5	50.5	67.5	82	90
2000	108	0	20	43.5	56	69.5	90	100
2001	127	0	19	49	61	75	88	100
2002	152	14	26	56	70.5	79	91	100
2003	180	17	37	60	72.5	83	93.5	100
2004	210	9	40	65	76	85	97	100
2005	239	8	54	74	83	90	100	100
2006	293	3	55	79	86	93	100	100
2007	313	3	61	81	89	93	100	100
2008	358	0	62	85	91	96	100	100

Figure 7.1.3: Variation in Erythropoietin utilization (% patients) among HD centres, 2008

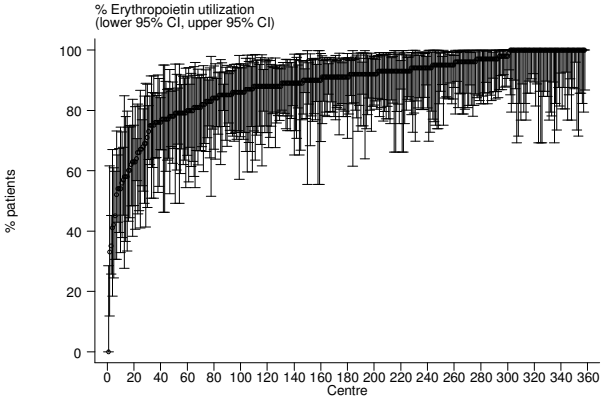
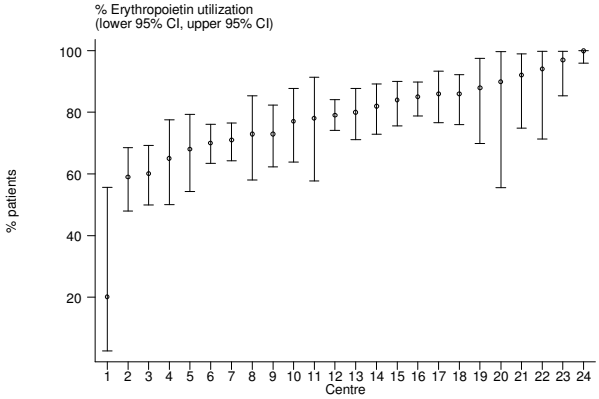


Figure 7.1.4: Variation in Erythropoietin utilization (% patients) among PD centres, 2008



In PD centres, there was a lesser variation in the EPO utilization – 20 to 100 %. The median usage of EPO was 79.5% in 2008. (Table 7.1.4)

Table 7.1.4: Variation in Erythropoietin utilization (% patients) among PD centres, 2008

Year	No of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
1999	10	22	22	32	40.5	54	78	78
2000	11	26	26	33	47	56	70	70
2001	12	25	25	33	47	57	87	87
2002	15	26	26	43	53	59	71	71
2003	19	25	25	38	51	75	92	92
2004	19	5	5	53	64	79	97	97
2005	20	42	48.5	62.5	68.5	83.5	97	97
2006	22	39	51	66	72	86	97	97
2007	24	0	44	65.5	77	88.5	97	97
2008	24	20	59	70.5	79.5	87	97	100

The median weekly EPO dose has remained at 4000 units over the last 3 years in both HD and PD centres. (Table 7.1.5 and 7.1.6)

Table 7.1.5: Variation in median weekly Erythropoietin dose (u/week) among HD centres, 2008

Year	No of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
1999	54	2000	2000	2000	2000	2000	4000	4000
2000	79	2000	2000	2000	2000	2000	4000	6000
2001	95	2000	2000	2000	2000	2000	4000	5000
2002	118	2000	2000	2000	2000	2000	4000	6000
2003	146	2000	2000	2000	2000	2000	4000	5000
2004	177	2000	2000	2000	2000	2000	4000	5000
2005	211	2000	2000	2000	2000	4000	6000	16000
2006	276	2000	2000	4000	4000	6000	8000	24000
2007	300	2000	2000	4000	4000	6000	8000	16000
2008	348	2000	2000	4000	4000	5000	6000	8000

Figure 7.1.5: Variation in median weekly Erythropoietin dose (u/week) among HD centres, 2008

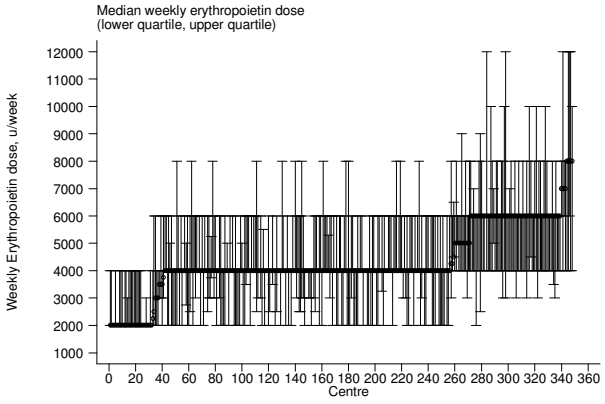


Figure 7.1.6: Variation in median weekly Erythropoietin dose (u/week) among PD centres, 2008

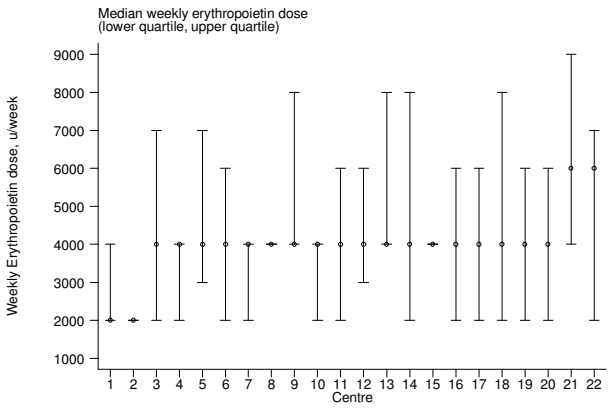


Table 7.1.6: Variation in median weekly Erythropoietin dose (u/week) among PD centres, 2008

Year	No of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
1999	7	2000	2000	2000	2000	2000	4000	4000
2000	8	2000	2000	2000	2000	3000	4000	4000
2001	11	2000	2000	2000	2000	3000	4000	4000
2002	12	2000	2000	2000	2000	2000	4000	4000
2003	16	2000	2000	2000	2000	2000	4000	4000
2004	17	2000	2000	2000	2000	2000	4000	4000
2005	18	2000	2000	2000	2000	4000	6000	6000
2006	22	2000	2000	3000	4000	4000	5000	5500
2007	22	2000	2000	4000	4000	4000	6000	8000
2008	22	2000	2000	4000	4000	4000	6000	6000

In HD and PD centres, the median requirement of blood transfusion has remained at around 16% over the last 3 years. (Table 7.1.7 – 7.1.8)

Table 7.1.7: Variation in use of blood transfusion (% patients) among HD centres, 2008

Year	No of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
1999	76	0	0	4	10.5	21	41	55
2000	108	0	0	4.5	11	21.5	48	77
2001	127	0	0	5	12	19	36	50
2002	152	0	0	2	7	14.5	26	67
2003	180	0	0	3	9	19	36	63
2004	210	0	0	2	8	16	36	50
2005	239	0	0	5	11	20	41	75
2006	293	0	2	10	18	29	50	88
2007	312	0	0	8	15	23.5	43	100
2008	357	0	0	8	16	26	47	100

Figure 7.1.7: Variation in use of blood transfusion (% patients) among HD centres, 2008

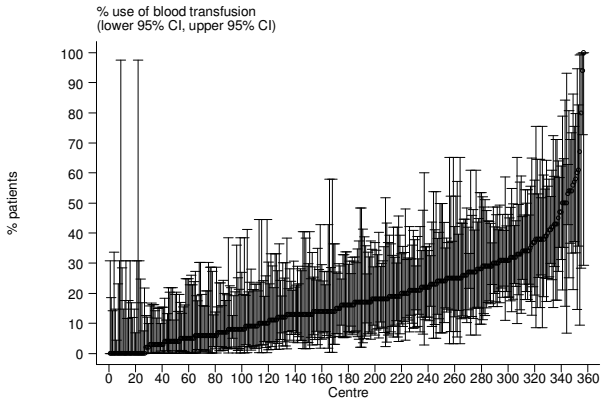


Figure 7.1.8: Variation in use of blood transfusion (% patients) among PD centres, 2008

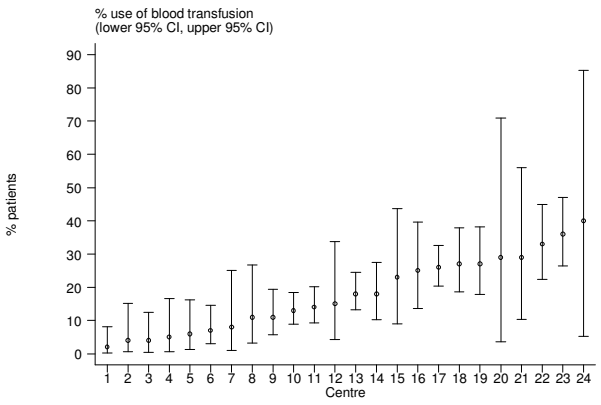


Table 7.1.8: Variation in use of blood transfusion (% patients) among PD centres, 2008

Year	No of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
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	21	42	42
2003	19	0	0	3	12	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	0	4	9	16	27	36	50
2007	24	6	6	11	18	23	36	38
2008	24	2	4	7.5	16.5	27	36	40

SECTION 7.2: IRON STATUS ON DIALYSIS

In HD and PD patients with or without EPO, the mean and median serum Ferritin has remained stable over the years – 400 to 700 ng/ml. Up to 86 % of patients have serum ferritin of >200 ng/ml and 56% that is >500 ng/ml. About 27% of patients have ferrtin >800ng/ml. Generally PD patients have higher ferritin levels compared to HD patients. (Table 7.2.1 – 7.2.4)

Table 7.2.1: Distribution of Serum Ferritin without Erythropoietin, HD patients 1999-2008

Year	No of subjects	Mean	Std_Dev	Median	LQ	UQ	% Patients ≥100 ng/ml
1999	337	517.9	424.3	402.8	162.8	809.5	86
2000	572	486.7	416.8	362.3	151.3	741	83
2001	761	537.2	453.6	382	172	828	87
2002	804	519.6	447	373.5	168.8	780.5	85
2003	922	552.6	433.8	458	192	828.9	87
2004	1048	591.6	463.9	473.8	218.6	911.8	89
2005	1029	618	496.6	487	225.5	902	90
2006	1224	570.1	484.3	425.7	201.3	823.5	87
2007	1253	591.4	501	443.4	200	867	87
2008	1209	578.5	487.1	434	198.5	838	88

Figure 7.2.1: Cumulative Distribution of Serum Ferritin without Erythropoietin, HD patients 1999-2008

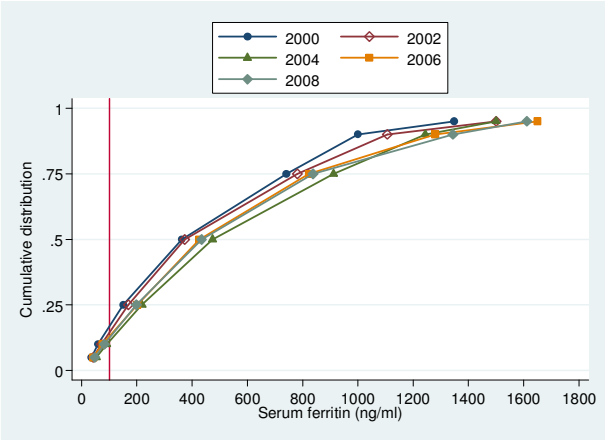


Figure 7.2.2: Distribution of Serum Ferritin without Erythropoietin, PD patients 1999-2008

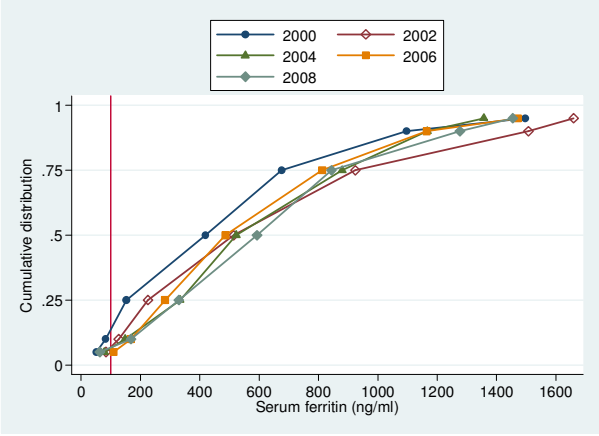


Table 7.2.2: Distribution of Serum Ferritin without Erythropoietin, PD patients 1999-2008

Year	No of subjects	Mean	Std_Dev	Median	LQ	UQ	% Patients ≥100 ng/ml
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	304	608.4	385	522.9	333.5	879.7	94
2005	227	647.3	398.5	597.3	320.5	913.3	96
2006	269	589.5	408	486.1	283	812.5	96
2007	318	637.6	394.4	586.8	343	841.8	97
2008	342	636.2	409.3	592.4	329.4	844.3	94

Table 7.2.3: Distribution of Serum Ferritin on Erythropoietin, HD patients 1999-2008

Year	No of subjects	Mean	Std_Dev	Median	LQ	UQ	% Patients ≥100 ng/ml
1999	586	560.4	418.6	453	225	829	93
2000	1173	588.7	456.5	476	219	860	91
2001	1634	597.8	444.2	491.1	236	894.2	91
2002	2223	593.1	459.5	464.5	231	879	91
2003	3128	640.6	428.3	562.8	298	930.5	94
2004	3898	669.6	460.4	571	306	976	94
2005	5097	683.1	471.3	599.5	316	971.5	93
2006	6710	639.5	459.2	542.5	290	880.4	93
2007	7961	658.6	451.8	564	315.7	914	94
2008	9875	703.6	469.5	611	337.5	979.2	95

Figure 7.2.3: Cumulative distribution of Serum Ferritin on Erythropoietin, HD patients 1999-2008

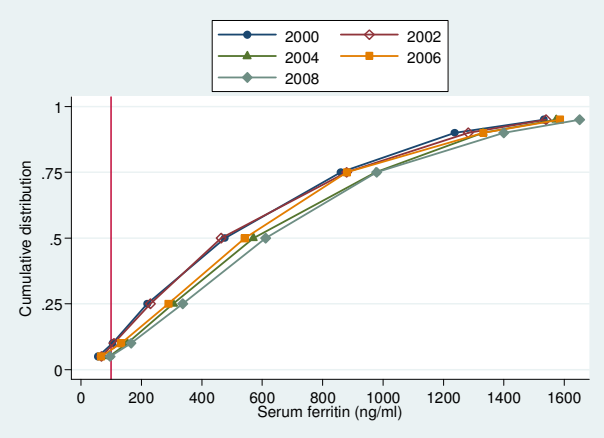


Figure 7.2.4: Cumulative distribution of Serum Ferritin on Erythropoietin, PD patients 1999-2008

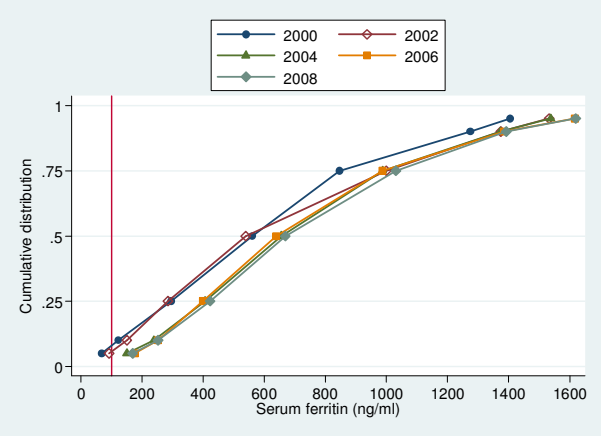


Table 7.2.4: Distribution of Serum Ferritin on Erythropoietin, PD patients 1999-2008

Year	No of subjects	Mean	Std_Dev	Median	LQ	UQ	% Patients ≥100 ng/ml
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	539	729	427.5	656.2	405.5	987.4	98
2005	765	734.3	433.2	660.5	406.5	997.5	97
2006	882	730.9	436.6	639	398.2	986.9	98
2007	1078	742.4	426.9	651.8	425.8	1017.7	98
2008	1306	758.2	445.8	668.6	422.1	1030.3	98

The median transferrin saturation has remained the same over the last decade, with the mean and median always greater than 30%. Up to 91% of all patients have transferrin saturation greater than 20% (Table 7.2.5 – 7.2.8)

Table 7.2.5: Distribution of transferrin saturation without Erythropoietin, HD patients, 1999-2008

Year	No of subjects	Mean	Std_Dev	Median	LQ	UQ	% Patients ≥20 %
1999	654	32.9	16.3	29.9	20.9	42.4	78
2000	801	32.7	16.9	28.6	20.9	41.3	78
2001	839	36.8	18.5	32.3	23.8	45.7	84
2002	811	36.5	18.9	32	22.9	45.7	83
2003	925	40.3	18.6	36	27.2	51.1	91
2004	1035	41.2	18.1	37.5	28.5	50.1	92
2005	1125	37.8	17.7	34.5	25.7	46.4	87
2006	1209	36.2	16.9	32.9	24.7	44.1	87
2007	1285	36.1	16.5	32.5	24.8	43.7	87
2008	1233	34.2	15.4	31.8	23.7	41.3	85

Figure 7.2.5: Cumulative distribution of transferrin saturation without Erythropoietin, HD patients 1999-2008

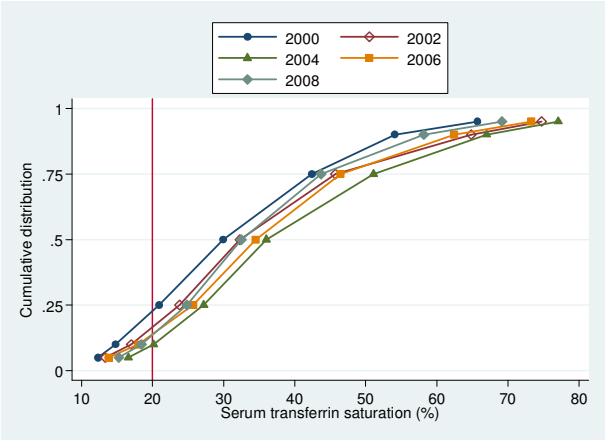


Figure 7.2.6: Cumulative distribution of transferrin saturation without Erythropoietin, PD patients 1999-2008

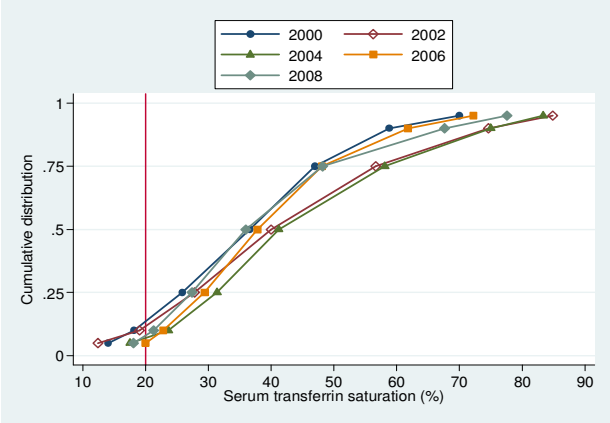


Table 7.2.6: Distribution of transferrin saturation without Erythropoietin, PD patients, 1999-2008

Year	No of subjects	Mean	Std_Dev	Median	LQ	UQ	% Patients ≥20 %
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	380	44.5	18.1	41.6	30.9	55.3	98
2005	288	40.6	16.2	37.8	29.4	48.1	95
2006	310	40.4	17.3	37.9	27.1	46.8	95
2007	359	40.1	18	36	27.4	48.2	92
2008	353	38.2	17.7	34.3	26.2	44.4	91

Table 7.2.7: Distribution of Transferrin saturation on Erythropoietin, HD patients, 1999-2008

Year	No of subjects	Mean	Std_Dev	Median	LQ	UQ	% Patients ≥20 %
1999	703	34.5	16	31.6	23.2	42	85
2000	1246	34.9	16.7	30.4	23	44	84
2001	1631	36.2	17.9	32.4	23.6	45.1	84
2002	1995	34.6	17.6	30.6	22.2	43.6	81
2003	2638	39.6	18.4	36	26.6	48.9	90
2004	3265	39.6	17	36.1	27.7	48.1	93
2005	4789	36.6	17.3	32.8	24.6	45	87
2006	6324	35.1	16.4	31.6	24.1	42.1	87
2007	7525	34.7	15.4	31.6	24.4	41.5	88
2008	9504	34.7	15.4	31.5	24	41.6	87

Figure 7.2.7: Cumulative distribution of transferrin saturation on Erythropoietin, HD patients 1999-2008

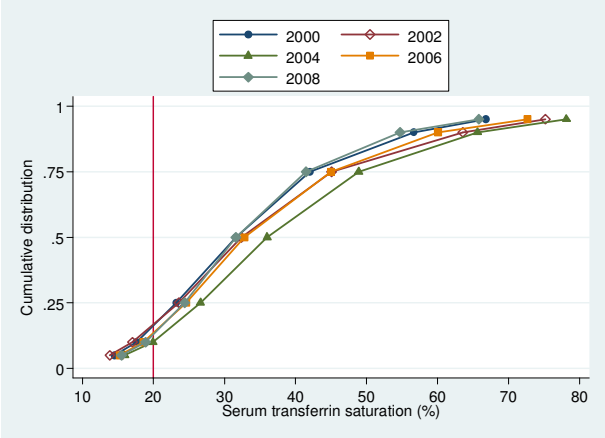


Figure 7.2.8: Cumulative distribution of transferrin saturation on Erythropoietin, PD patients 1999-2008

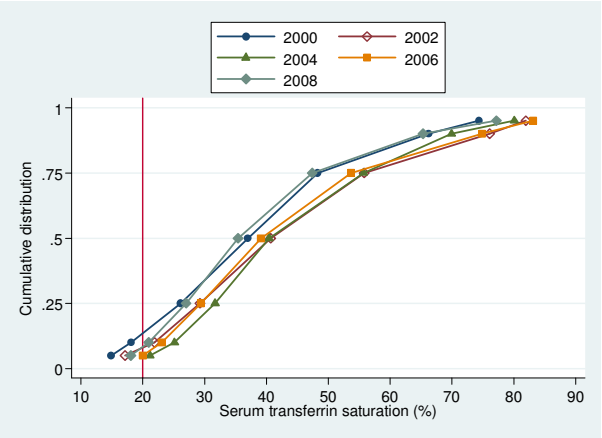


Table 7.2.8: Distribution of Transferrin saturation on Erythropoietin, PD patients, 1999-2008

Year	No of subjects	Mean	Std_Dev	Median	LQ	UQ	% Patients ≥20 %
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	696	44.7	18.7	40.8	30.8	54.5	96
2005	819	43.5	19.3	39.1	29.4	53.7	95
2006	905	41.7	17.5	38	29.4	50.7	95
2007	1069	39.3	17.6	35.4	27	47.4	92
2008	1261	38.6	17.9	34.4	26.2	47.1	90

From 1999 to 2008, the median for serum ferritin for all HD centres had increased from 400 to 600 ng/ml. There was a wide variation in median serum ferritin levels ranging from 295 to 941 ng/ml between HD centres in 2008. At the median, 96% of patients on EPO have a serum ferritin greater 100 ng/ml.

The median transferrin saturation of HD centres has been > 30% over the last 10 years. 89% of HD centres have patients with transferrin saturation greater than 20%. (Table 7.2.9)

A similar trend, but with higher level of ferritin and transferrin saturation was seen in the PD centres. (Table 7.2.10)

Table 7.2.9: Variation in iron status outcomes among HD centres, 2008

a) medium serum ferritin among patients on erythropoietin

Year	No of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
1999	22	169	189.5	354.5	406.9	524.5	890.1	945.3
2000	42	165	235.5	373	559	682	813.5	1087.5
2001	51	213.8	239.3	385	508	696.5	886.5	1191.3
2002	69	106.6	192	367	470	608.5	828	1070.8
2003	100	152.5	294.3	460.4	549.5	697.3	973.6	1742.8
2004	125	99.5	329.8	463.1	570	716.3	1000	2000
2005	163	1.6	258.5	459.3	616.3	725.4	920	2000
2006	210	1.5	234.5	414	555.8	682.5	875.5	2000
2007	237	85.5	250.5	427	563	689.8	880.5	1389.5
2008	275	82.4	294.7	475	599	719.3	941	2000

Figure 7.2.9(a): Variation in medium serum ferritin among patients on erythropoietin, HD centres 2008

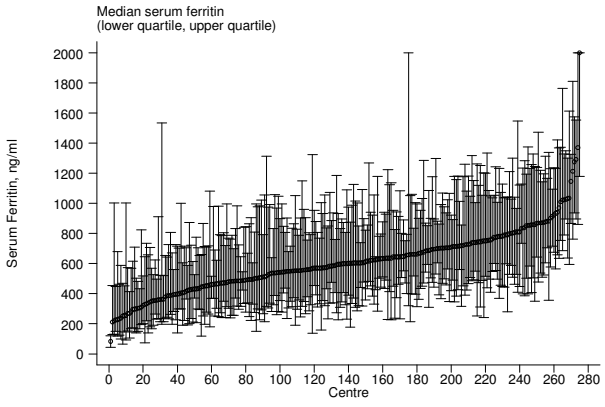
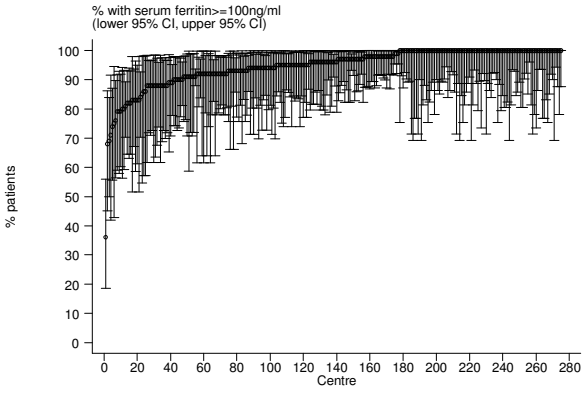


Figure 7.2.9(b): Variation in proportion of patients on erythropoietin with serum ferritin ≥ 100 ng/ml, HD centres 2008



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

Year	No of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
1999	22	70	76	92	96	100	100	100
2000	42	68	73	88	93	97	100	100
2001	51	67	73	86	93	97	100	100
2002	69	55	73	89	93	96	100	100
2003	100	57	76	90.5	96	100	100	100
2004	125	50	85	92	96	100	100	100
2005	163	5	79	90	95	100	100	100
2006	210	0	73	91	95	100	100	100
2007	237	43	77	91	96	100	100	100
2008	275	36	82	92	96	100	100	100

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

Year	No of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
1999	26	16.4	20.7	26.9	31.5	34.3	44.8	44.8
2000	43	16	23.2	27.9	31.3	37.1	44.1	57.5
2001	55	21	22.5	27.1	31	37	48.4	76.1
2002	61	14.7	21	26	29.7	36.5	51.1	60.2
2003	90	18.2	24.2	31.3	34.2	41.2	57.3	70.7
2004	112	22.7	26.4	32.6	36.1	41.5	52	67.6
2005	149	15.2	24.1	29.2	32.4	38.3	47.7	69.8
2006	186	13.7	22.9	27.5	31.5	35.4	45	78.7
2007	213	17.6	21.8	28	31.4	35.2	44	77.8
2008	261	14.8	23.5	28	31.5	34.4	46.5	76.8

Figure 7.2.9(c): Variation in median transferrin saturation among patients on erythropoietin HD centres, 2008

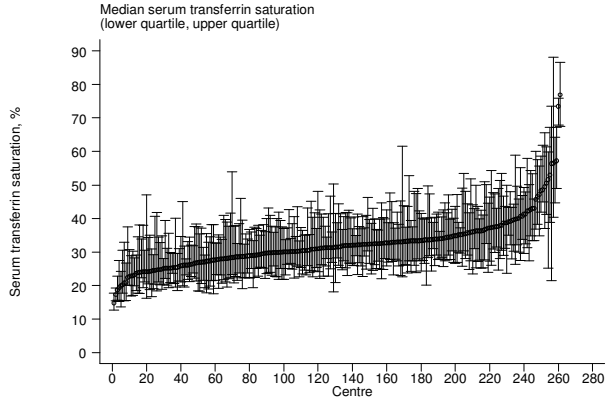
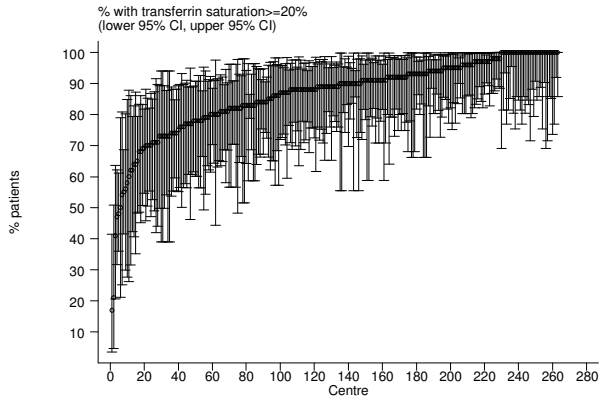


Figure 7.2.9(d): Variation in proportion of patients on erythropoietin with transferring saturation ≥ 20%, HD centres, 2008



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

Year	No of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
1999	26	30	57	83	86.5	94	100	100
2000	43	20	60	77	86	94	100	100
2001	55	53	59	75	88	95	100	100
2002	61	33	56	72	82	91	100	100
2003	90	45	70	86	92.5	100	100	100
2004	112	55	70	90	94	100	100	100
2005	150	30	71	83	91	95	100	100
2006	186	20	59	81	90	95	100	100
2007	214	27	60	83	91	96	100	100
2008	263	17	64	81	89	95	100	100

Table 7.2.10: Variation in iron status outcomes among PD centres, 2008

a) Medium serum ferritin among patients on erythropoietin

Year	No of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
1999	5	302.8	302.8	343.4	470	491.5	719.5	719.5
2000	6	335	335	437.3	632.6	770	773	773
2001	9	285.8	285.8	532.8	550.7	617.5	908	908
2002	10	372.2	372.2	437.4	477	606.5	826.5	826.5
2003	12	304	304	454.5	508.5	716.1	954.9	954.9
2004	13	317	317	529.5	610	706.5	860.3	860.3
2005	17	338.5	338.5	555.5	710	800.9	843	843
2006	19	399.9	399.9	535.3	634.6	787.4	968.4	968.4
2007	20	283.3	340.7	592.8	665	730.7	1005.1	1048.6
2008	21	211.3	385	495	658.9	697	970.1	979

Figure 7.2.10(a): Variation in medium serum ferritin among patients on erythropoietin, PD centres 2008

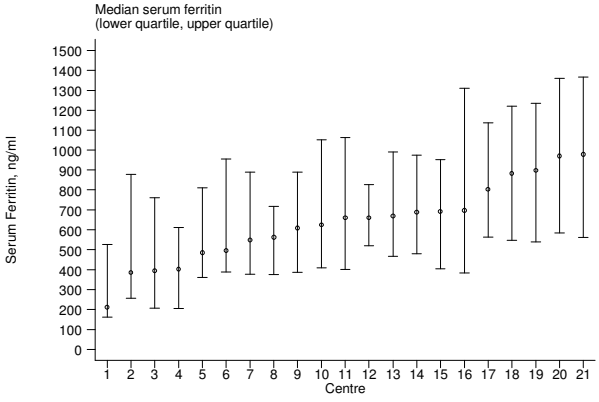
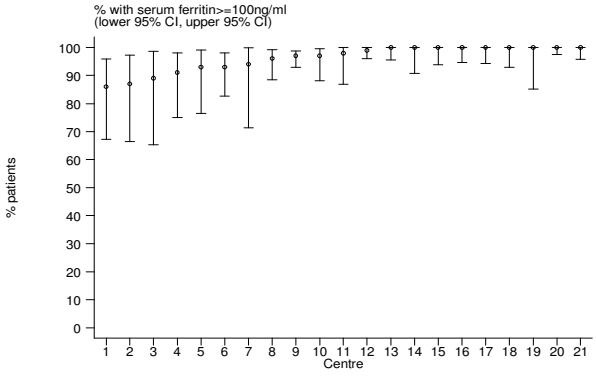


Figure 7.2.10(b): Variation in proportion of patients on erythropoietin with serum ferritin ≥ 100 ng/ml, PD centres 2008



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

Year	No of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
1999	5	85	85	92	95	100	100	100
2000	6	87	87	88	93	100	100	100
2001	9	80	80	85	94	100	100	100
2002	10	91	91	92	94.5	100	100	100
2003	12	85	85	95	96	98	100	100
2004	13	93	93	95	100	100	100	100
2005	17	86	86	96	97	100	100	100
2006	19	95	95	97	100	100	100	100
2007	20	86	88.5	96	98	100	100	100
2008	21	86	87	93	98	100	100	100

c) Median transferrin saturation among patients on erythropoietin, PD centres

Year	No of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
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	31.9	36.9	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	40.9	43.6	82.3	82.3
2005	17	30.3	30.3	35.6	38.5	43	74.9	74.9
2006	19	31.9	31.9	33.9	37.7	40.5	75.8	75.8
2007	19	25.9	25.9	29.6	37.7	45.7	83.2	83.2
2008	19	25.4	25.4	31.6	34.6	41	81.2	81.2

Figure 7.2.10 (c): Variation in median transferrin saturation among patients on erythropoietin, PD centres 2008

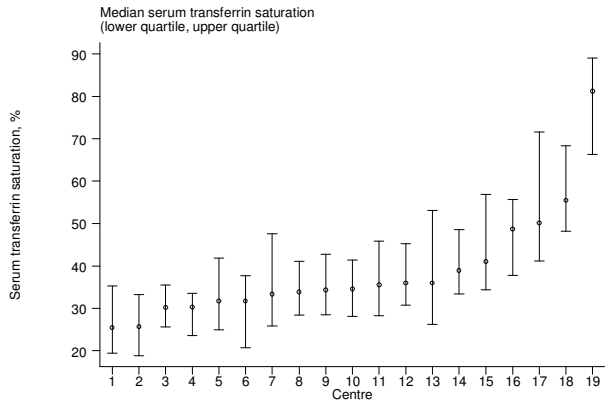
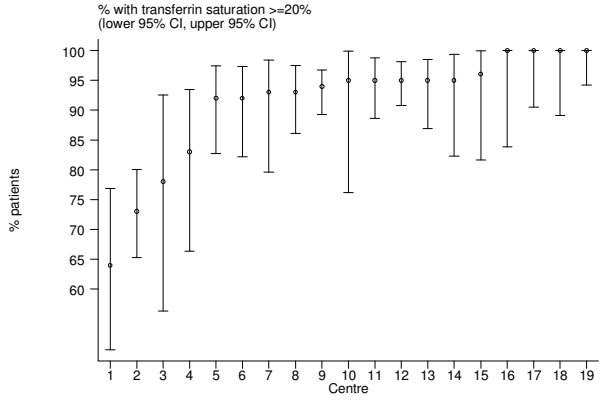


Figure 7.2.10 (d): Variation in proportion of patients on erythropoietin with transferrin saturation ≥ 20 %, PD centres 2008



d) Proportion of patients on erythropoietin with transferring saturation ≥ 20%, PD centres

Year	No of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
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	88	88	94	97	100	100	100
2006	19	83	83	93	95	98	100	100
2007	19	73	73	88	94	98	100	100
2008	19	64	64	92	95	96	100	100

SECTION 7.3: HAEMOGLOBIN OUTCOMES ON DIALYSIS

The mean and median haemoglobin concentrations in all dialysis patients with or without EPO were steadily increasing; in 2008 the mean and median haemoglobin ranged from 10.2 to 11.1g/dl. The percentage of patients with haemoglobin > 10 or > 11 gm/dl steadily increased for patients with or without EPO. (Table 7.3.1 – 7.3.4)

Table 7.3.1: Distribution of Haemoglobin Concentration without Erythropoietin, HD patients 1999-2008

Year	No of subject	Mean	Std Dev	Median	LQ	UQ	% Patients ≤10g/dL	% Patients >10g/dL	% Patients ≤11g/dL	% Patients >11g/dL
1999	1400	9.1	1.9	8.9	7.8	10.3	70	30	85	15
2000	1755	9.4	2.1	9.1	7.9	10.6	67	33	80	20
2001	1812	9.4	1.9	9.3	8	10.6	64	36	81	19
2002	1796	9.6	2.1	9.4	8.1	10.9	62	38	76	24
2003	1810	9.7	2.1	9.5	8.3	11	60	40	76	24
2004	1932	10.1	2.1	9.9	8.6	11.5	53	47	68	32
2005	1695	10.5	2.3	10.3	8.9	12	46	54	62	38
2006	1839	10.6	2.2	10.4	9	12.1	42	58	60	40
2007	1854	10.8	2.2	10.7	9.1	12.4	40	60	55	45
2008	1770	10.8	2.3	10.8	9.1	12.5	39	61	54	46

Figure 7.3.1: Cumulative distribution of haemoglobin concentration without Erythropoietin, HD patients 1999-2008

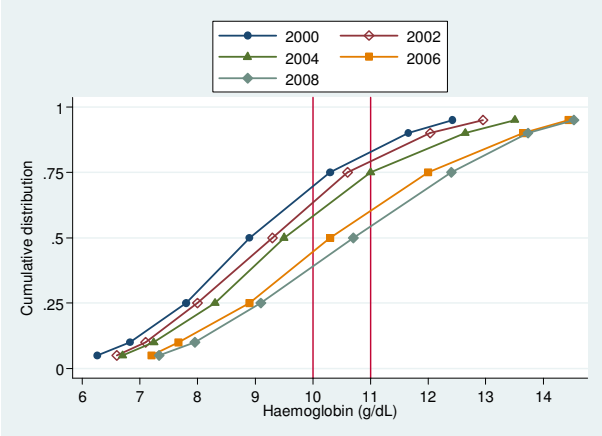


Figure 7.3.2: Cumulative distribution of haemoglobin concentration without Erythropoietin, PD patients 1999-2008

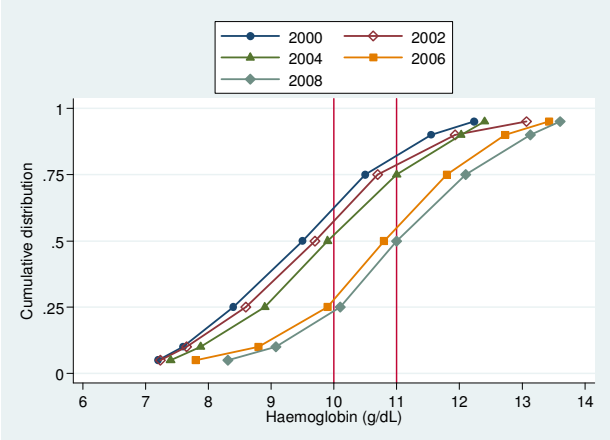


Table 7.3.2: Distribution of Haemoglobin Concentration without Erythropoietin, PD patients 1999-2008

Year	No of subject	Mean	Std Dev	Median	LQ	UQ	% Patients ≤10g/dL	% Patients >10g/dL	% Patients ≤11g/dL	% Patients >11g/dL
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	482	10.4	1.6	10.3	9.3	11.4	43	57	67	33
2005	378	10.8	1.6	10.8	9.9	11.8	28	72	60	40
2006	399	10.8	1.6	10.9	9.9	11.8	26	74	54	46
2007	452	11	1.6	11	10.1	12.1	24	76	51	49
2008	456	11.1	1.7	11.1	10.2	12.1	22	78	46	54

Table 7.3.3: Distribution of Haemoglobin Concentration on Erythropoietin, HD patients 1999-2008

Year	No of subject	Mean	Std Dev	Median	LQ	UQ	% Patients ≤10g/dL	% Patients >10g/dL	% Patients ≤11g/dL	% Patients >11g/dL
1999	1503	9.2	1.5	9.1	8.1	10.2	71	29	89	11
2000	2331	9.4	1.7	9.4	8.3	10.5	65	35	85	15
2001	3046	9.4	1.6	9.4	8.3	10.5	65	35	85	15
2002	3858	9.5	1.7	9.5	8.4	10.7	62	38	81	19
2003	4774	9.6	1.6	9.6	8.5	10.7	61	39	81	19
2004	5799	9.8	1.6	9.9	8.8	10.9	54	46	77	23
2005	7190	10	1.6	10	8.9	11.1	50	50	73	27
2006	9336	10.1	1.6	10	9	11.1	50	50	72	28
2007	10598	10.2	1.5	10.3	9.2	11.3	44	56	69	31
2008	12897	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 1999-2008

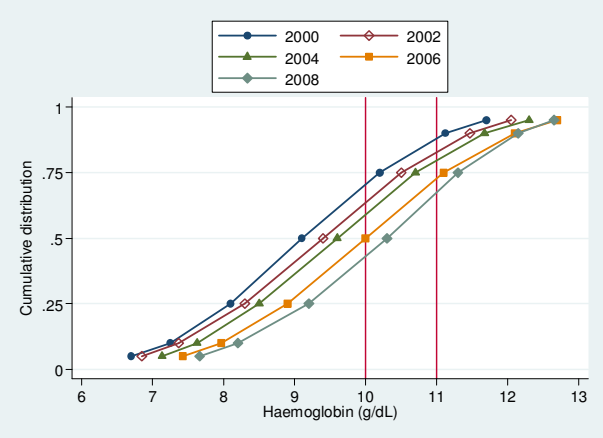


Figure 7.3.4: Cumulative distribution of Haemoglobin Concentration on Erythropoietin, PD patients 1999-2008

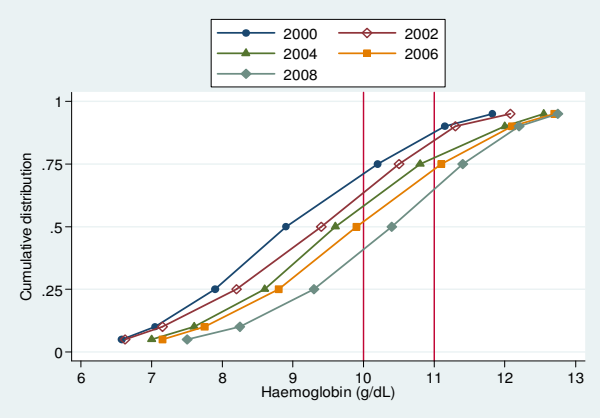


Table 7.3.4: Distribution of Haemoglobin Concentration on Erythropoietin, PD patients 1999-2008

Year	No of subject	Mean	Std Dev	Median	LQ	UQ	% Patients ≤10g/dL	% Patients >10g/dL	% Patients ≤11g/dL	% Patients >11g/dL
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	797	9.8	1.7	9.8	8.6	11	54	46	76	24
2005	967	9.9	1.7	9.9	8.8	11.1	53	47	73	27
2006	1106	10	1.6	10.1	9	11	49	51	75	25
2007	1303	10.3	1.6	10.4	9.3	11.4	41	59	66	34
2008	1571	10.4	1.5	10.4	9.4	11.3	39	61	66	34

In 2008, for HD patients on EPO, the median Hb in HD centres ranged 8.0 to 12.6 gm/dl with the median at 10.2 gm/dl. Similar trend was noted in the PD centres with lesser variation.

In 2008 for HD patients on EPO, the proportion of patients with Hb > 10 gm /dl varied between 0 to 100%, with median at 57%. Similarly for patients with Hb > 11gm/dl, the range was from 0 to 100% with the median at 31%. Lesser variation was seen in the PD patients.

Table 7.3.5: Variation in Haemoglobin outcomes among HD centres 2008

a) Median haemoglobin level among patients on Erythropoietin

Year	No of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
1999	52	7.7	8	8.7	9.1	9.6	10.2	10.4
2000	75	8.1	8.2	8.8	9.3	9.7	10.5	14.6
2001	93	8	8.3	8.9	9.5	9.9	10.6	12.2
2002	112	8.3	8.5	9	9.5	10	10.8	11.3
2003	143	7.8	8.5	9.1	9.6	10	10.7	11.5
2004	175	7.8	8.6	9.2	9.7	10.2	10.9	11.3
2005	209	8.4	8.8	9.5	10	10.5	11.1	11.7
2006	272	7.7	8.9	9.5	10	10.5	11.3	12.8
2007	298	8.6	9	9.8	10.2	10.6	11.3	12.8
2008	347	8	8.9	9.8	10.2	10.7	11.4	12.6

Figure 7.3.5(a): Variation in median haemoglobin level among patients on Erythropoietin, HD centres 2008

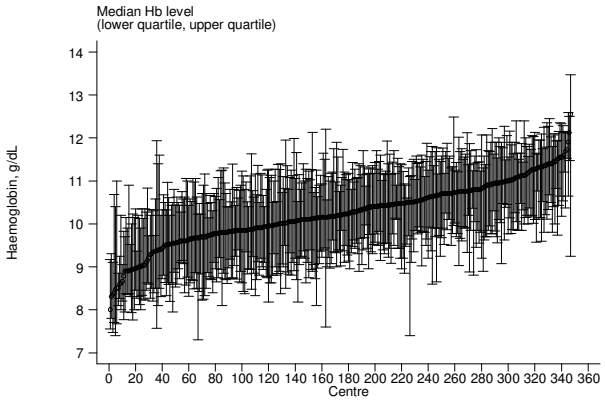
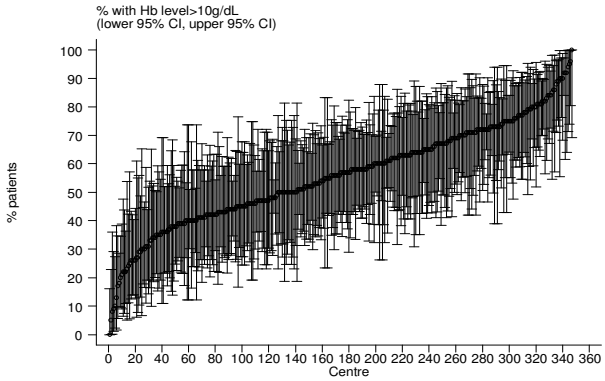


Figure 7.3.5(b): Variation in proportion of patients on erythropoietin with haemoglobin level > 10g/dL, HD centres 2008



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

Year	No of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
1999	52	0	4	15	28.5	38	59	61
2000	75	0	5	20	31	43	61	97
2001	93	4	10	24	33	48	69	100
2002	112	8	16	27.5	36	50	68	86
2003	143	0	14	28	36	50	69	100
2004	175	8	18	30	41	58	74	85
2005	209	0	20	33	49	63	78	100
2006	272	0	20	35.5	48	64	80	93
2007	298	13	24	42	55	68	86	100
2008	347	0	26	43	57	69	84	100

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

Year	No of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
1999	52	0	0	3	8	15.5	29	39
2000	75	0	0	6	13	20	32	92
2001	93	0	0	8	14	24	38	60
2002	112	0	6	12	17.5	27	47	71
2003	143	0	0	8	15	28	41	59
2004	175	0	0	11	19	29	47	58
2005	209	0	4	13	24	35	54	75
2006	272	0	6	17	25	37	58	75
2007	298	0	7	19	28	40	62	92
2008	347	0	8	20	31	41	60	100

Figure 7.3.5(c): Variation in proportion of patients on erythropoietin with haemoglobin level >11g/dL, HD centres 2008

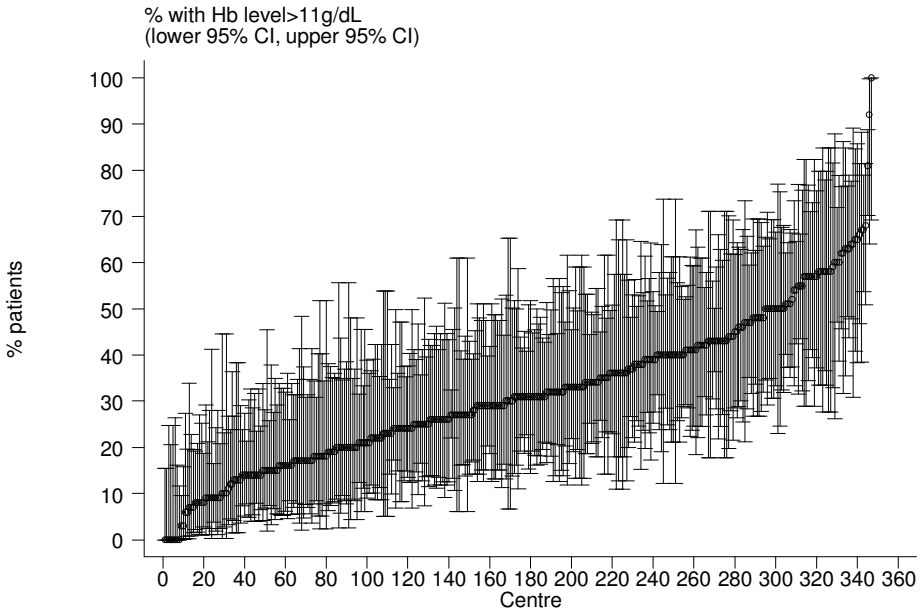


Table 7.3.6: Variation in Haemoglobin outcomes among PD centres 2008

a) Median haemoglobin level among patients on Erythropoietin

Year	No of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
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	9	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	9.3	9.5	10	11.2	11.2
2004	17	8.4	8.4	9.2	9.7	10.2	11.2	11.2
2005	18	8.9	8.9	9.5	9.9	10.3	11	11
2006	22	8.8	8.9	9.5	10	10.4	10.6	10.9
2007	22	9.5	9.5	10.1	10.4	10.8	11.1	11.3
2008	22	9.2	9.6	10.1	10.4	10.8	11.1	11.2

Figure 7.3.6(a): Variation in median haemoglobin level among patients on Erythropoietin, PD centres 2008

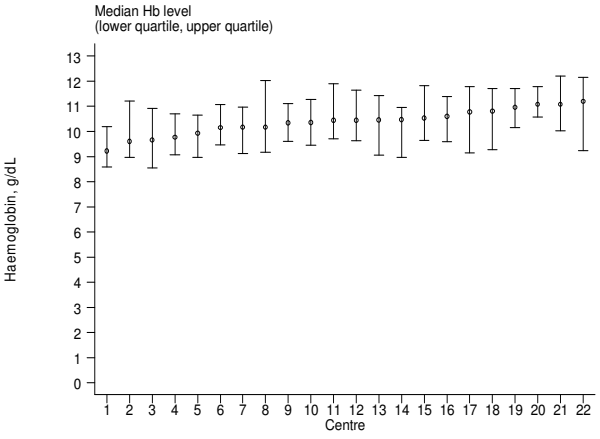
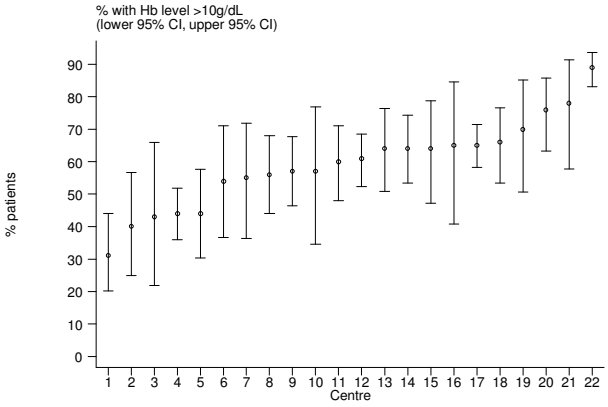


Figure 7.3.6(b): Variation in proportion of patients on erythropoietin with haemoglobin level > 10g/dL, PD centres, 2008



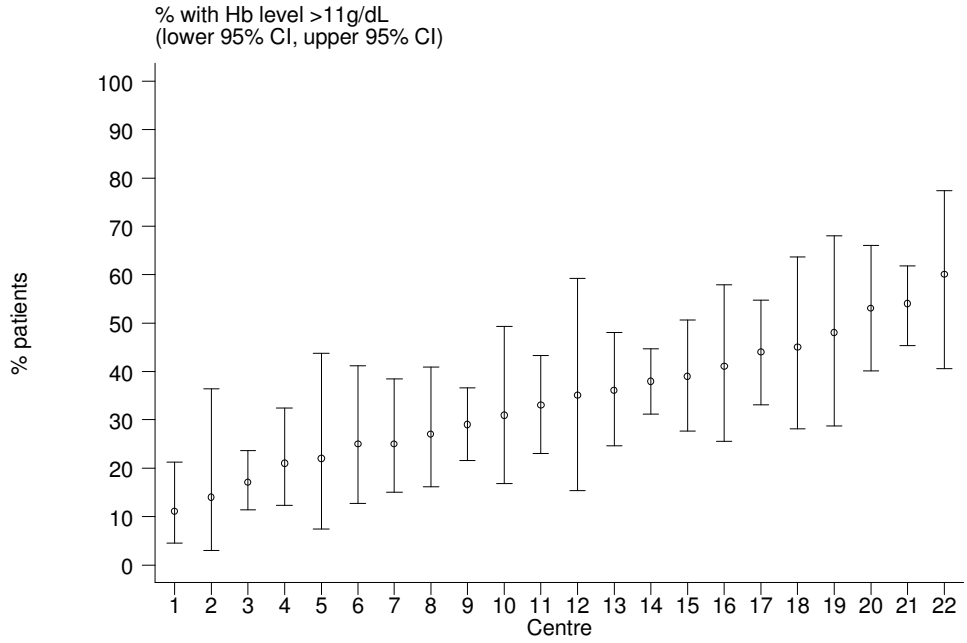
b) Proportion of patients on erythropoietin with haemoglobin level > 10g/dL, PD centres

Year	No of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
1999	7	7	7	20	25	36	40	40
2000	9	19	19	30	36	38	50	50
2001	11	25	25	31	38	42	47	47
2002	12	11	11	25	32	37.5	48	48
2003	16	0	0	28.5	35.5	50	75	75
2004	17	10	10	36	43	55	72	72
2005	18	21	21	34	48	56	76	76
2006	22	17	18	44	48	58	70	79
2007	22	36	38	53	60	63	72	73
2008	22	31	40	54	60.5	65	78	89

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

Year	No of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
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	12	15.5	22.5	52	52
2004	17	0	0	13	19	29	54	54
2005	18	7	7	20	28.5	34	52	52
2006	22	5	7	16	24.5	32	43	48
2007	22	13	14	22	35	44	53	54
2008	22	11	14	25	34	44	54	60

Figure 7.3.6(c): Variation in proportion of patients on erythropoietin with haemoglobin level >11g/dL, PD centres 2008



CHAPTER 8

Nutritional Status on Dialysis

Tilakavati Karupaiah
Winnie Chee Siew Swee
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SECTION 8.1: SERUM ALBUMIN LEVELS ON DIALYSIS

Patient numbers increased by 2115 for HD in 2008. Mean serum albumin levels in 2008 was 39.4 g/L, which is just below the borderline for mortality risk (<40 g/L). Though the overall trend for percentage distribution of patients for serum albumin is similar since 2003 some changes are occurring in the distribution of patients in the quartiles above 35g/L. The percentage of well-nourished patients (≥40g/L) was 50% whilst 36% of patients are in the 35-40g/L range. Compared to 2006, there is a 4% drop in patients above the safety margin based on Serum Albumin risk (≥40 g/L). This trend (2006 vs. 2008) is also reflected in the cumulative distribution graph of albumin in HD patients.

Table 8.1.1: Distribution of serum albumin, HD patients, 1999- 2008

year	No. of subjects	Mean	SD	Median	LQ	UQ	% patients <30g/L	% patients 30-<35g/L	% patients 35-<40g/L	% patients ≥40g/L
1999	2755	39.7	6.1	39.7	36.3	43	4	13	35	49
2000	3733	38.6	7	39	36	42	5	11	41	43
2001	4666	39	5.6	38.5	36	41.8	3	15	44	38
2002	5568	39.2	5.6	39	36.5	42	3	12	42	43
2003	6524	39.9	5.4	40	37.3	42.5	3	9	35	52
2004	7581	39.9	5.3	40	37	42.8	3	10	34	53
2005	8706	40	5.2	40.3	37.5	42.8	3	9	33	56
2006	10928	39.8	5.4	40.3	37.3	42.8	3	10	33	54
2007	12315	39.7	5.3	40	37	42.5	3	10	35	52
2008	14430	39.4	5.1	40	37	42.3	3	10	36	50

Figure 8.1.1: Cumulative distribution of Albumin, HD patients 1999-2008

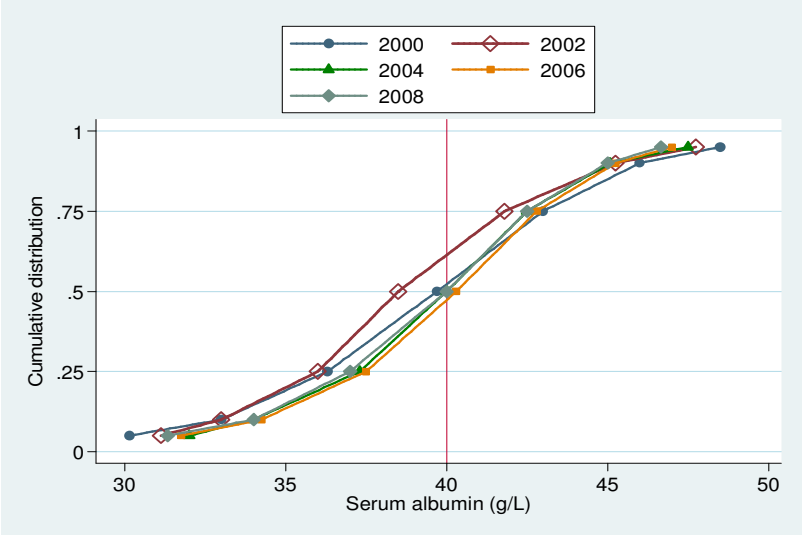
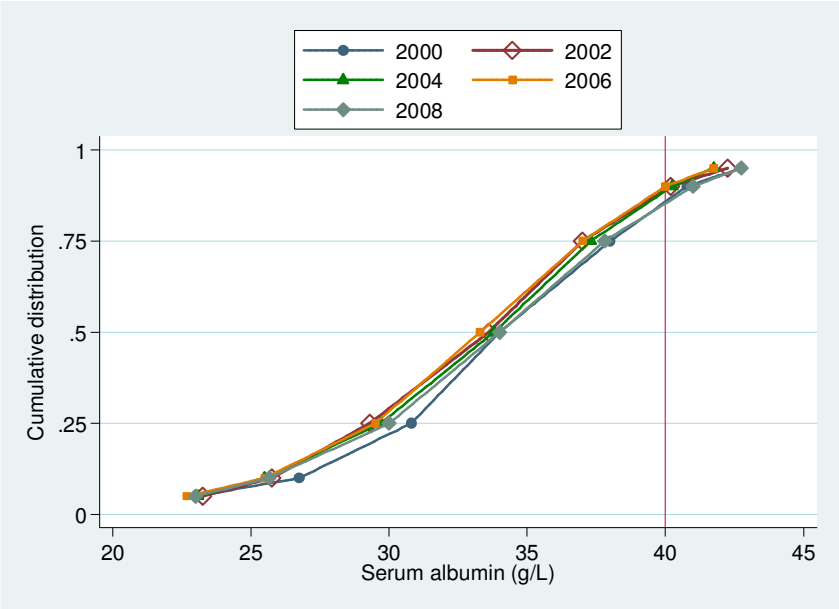


Table 8.1.2: Distribution of serum albumin, PD patients, 1999- 2008

year	No. of subjects	Mean	SD	Median	LQ	UQ	% patients <30g/L	% patients 30-<35g/L	% patients 35-<40g/L	% patients ≥40g/L
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
2008	2021	33.1	6.4	33.3	29.3	37.3	28	32	27	13

Figure 8.1.2: Cumulative distribution of Albumin, PD patients 1999-2008



The number of HD centres has almost doubled since 2003. A wide variation between HD centers was observed for those achieving serum albumin ≥ 40g/L (target albumin) for 2008. The median was 50% for the year 2008. The trend in the percent of HD centres achieving a median >50% is seen to be decreasing since 2003. The best centre had all (100%) patients achieving serum albumin ≥ 40g/L (target albumin), whilst the worst center had zero patients achieving this target. For all HD centres, 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 2008

year	No. of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1999	68	4	7	22	50.5	65	91	100
2000	94	0	4	24	43	62	82	91
2001	117	0	3	17	40	56	82	100
2002	140	0	9	27	43.5	62.5	86.5	100
2003	170	0	18	40	54.5	70	92	100
2004	198	0	11	35	57	73	89	100
2005	226	4	13	43	56	69	86	100
2006	280	0	9.5	37	54	70.5	87.5	100
2007	305	0	11	36	54	69	88	100
2008	346	0	6	34	50	67	85	100

Figure 8.1.3 indicates the wide variation amongst 346 HD centers reporting the proportion of patients able to achieve the target serum albumin ≥ 40g/L for the year 2008.

Figure 8.1.3: Variation in Proportion of patients with serum albumin ≥ 40g/L, HD centres 2008

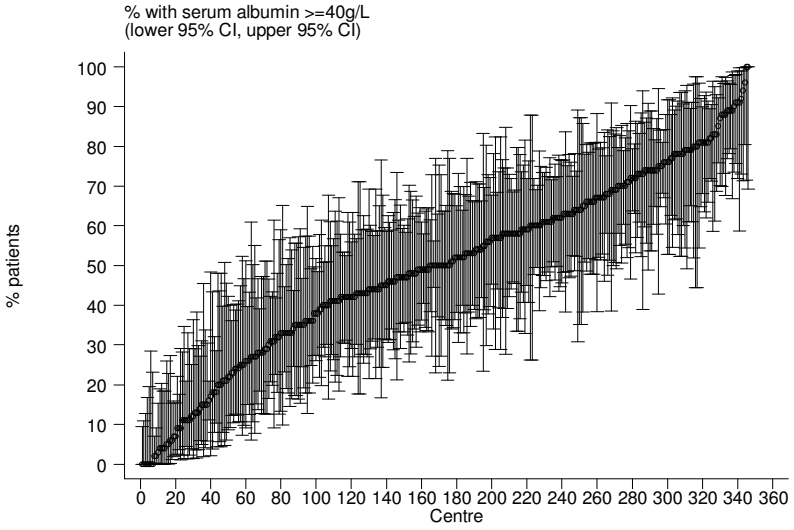
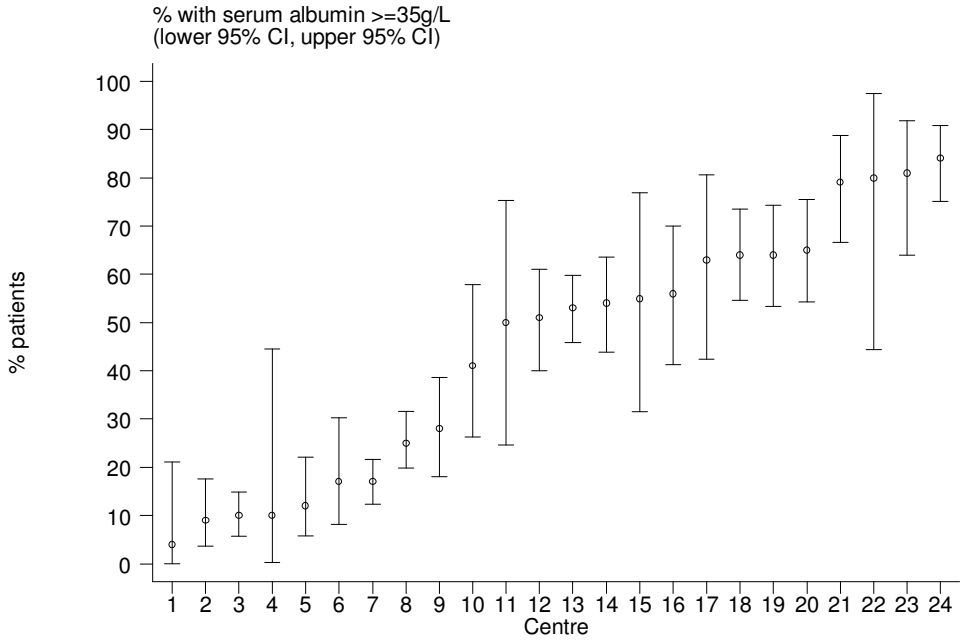


Table 8.1.4: Variation in Proportion of patients with serum albumin ≥ 35g/L among PD centres 2008

year	No. of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1999	10	12	12	33	44.5	64	75	75
2000	11	10	10	36	55	73	83	83
2001	12	9	9	28.5	46	62	75	75
2002	15	17	17	36	58	67	70	70
2003	19	14	14	39	48	64	81	81
2004	19	11	11	49	58	65	81	81
2005	20	11	13.5	32.5	57	68	80.5	82
2006	22	12	15	38	53.5	63	81	81
2007	23	0	14	25	55	64	77	84
2008	24	4	9	17	52	64	81	84

Figure 8.1.4: Variation in Proportion of patients with serum albumin ≥ 35g/L, PD centres 2008



SECTION 8.2: BODY MASS INDEX (BMI) ON DIALYSIS

Table 8.2.1 indicates the mean BMI for HD patients from 1999 to 2008. For the year 2008 the mean BMI is 23.5 ± 7.5 for a HD population of 12092. This indicates that overall mean BMI trend is stabilizing at 23 [23.5 in 1999 to 23.5 in 2008] despite a 4.5-fold increase in patient numbers from 1999 onwards. An increasing trend of improved BMI is observed for HD patients, with the percentage of HD patients with BMI $\geq$ 25 increasing from 21% in 1999 to 31% in 2008. 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 percentage of patients with BMI <18.5 remains at 14%. Figure 8.2.1 reflects the increasing BMI trend curve for 2008 continues to move right.

Table 8.2.1: Distribution of BMI, HD patients, 1999-2008

year	n	Mean	SD	Median	LQ	UQ	% patients <18.5	% patients 18.5-25	% patients >=25
1999	2711	23.5	15.9	21.4	19.2	24.4	18	61	21
2000	3859	22.9	11.7	21.6	19.3	24.5	18	60	22
2001	4551	23	11	21.9	19.3	24.7	18	59	23
2002	5103	23.2	10.6	22	19.5	24.9	16	59	24
2003	5989	23.1	9.7	22.1	19.5	25.1	16	58	26
2004	6774	23.3	9	22.4	19.8	25.4	14	58	28
2005	7836	23.4	9	22.5	19.8	25.6	14	57	29
2006	9782	23.3	7.9	22.6	19.9	25.7	14	56	29
2007	10498	23.4	7.9	22.7	19.9	25.8	14	56	30
2008	12092	23.5	7.5	22.8	20	26	14	55	31

Figure 8.2.1: Cumulative distribution of BMI, HD patients 1999-2008

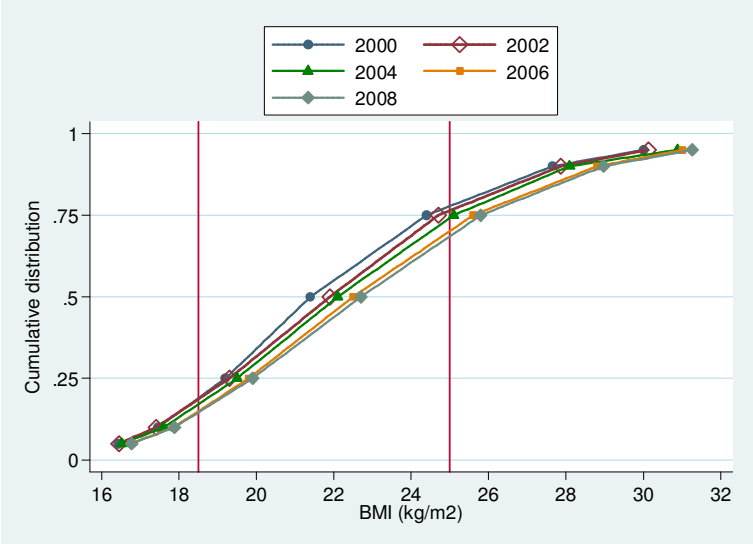
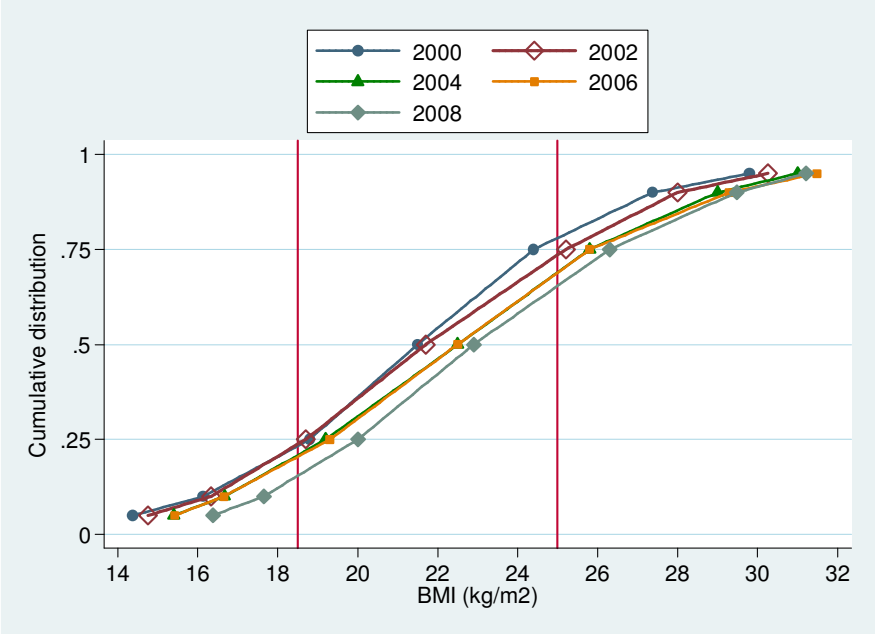


Table 8.2.2: Distribution of BMI, PD patients 1999-2008

year	n	Mean	SD	Median	LQ	UQ	% patients <18.5	% patients 18.5-25	% patients >=25
1999	552	21.7	4.5	21.5	18.8	24.4	23	56	22
2000	603	21.6	4.6	21.5	18.5	24.6	25	53	22
2001	665	22	5.1	21.7	18.7	25.2	24	50	27
2002	752	22.2	5	22.1	18.7	25.5	24	47	30
2003	1072	22.8	6.9	22.5	19.2	25.8	20	50	30
2004	1176	23.1	7.2	22.5	19.4	26	19	50	31
2005	1223	23	7.2	22.5	19.3	25.8	20	50	30
2006	1421	23.3	8.3	22.6	19.6	26.1	16	51	33
2007	1620	23.4	5.9	22.9	20	26.3	15	51	34
2008	1874	23.8	7.7	23.2	20.2	26.6	14	50	36

Figure 8.2.2: Cumulative distribution of BMI, PD patients 1999-2008



Less variation was observed for BMI measurements amongst 324 HD centers for 2008. The median of participating centres was 88%. The best centre had all (100%) patients achieving BMI ≥ 18.5 (target), while the worst center had 58% 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 2008

year	No. of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1999	70	55	62	78	83	90	94	100
2000	93	53	65	77	83	89	96	100
2001	113	60	68	78	84	88	92	100
2002	133	55	67	79	85	88	100	100
2003	156	60	69	79	84	91	100	100
2004	188	62	68	81	86	91	100	100
2005	206	64	70	81	88	93	100	100
2006	263	53	70	80	86	92	100	100
2007	277	56	70	81	87	92	100	100
2008	324	58	70	82	88	92	100	100

Figure 8.2.3 indicates the variation amongst 324 HD centers reporting the proportion of patients achieving the target BMI ≥ 18.5 for the year 2008. The centre with the least achievement recorded 58% of patients achieving this target.

Figure 8.2.3: Variation in Proportion of patients with BMI ≥ 18.5 among HD centres 2008

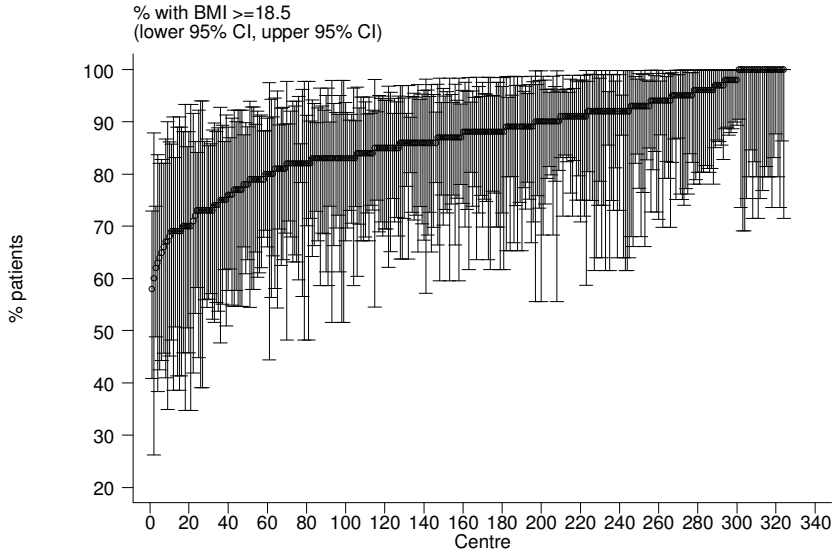


Table 8.2.4: Variation in Proportion of patients with BMI ≥ 18.5 among PD centres 2008

year	No. of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
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	15	15	63	81	85	87	87
2003	19	18	18	63	81	88	96	96
2004	19	26	26	71	82	89	94	94
2005	18	23	23	69	83.5	87	91	91
2006	22	19	25	78	84	91	92	93
2007	22	18	27	76	87	92	97	100
2008	22	25	34	78	88	91	95	100

Figure 8.2.4: Variation in Proportion of patients with BMI ≥ 18.5 among PD centres 2008

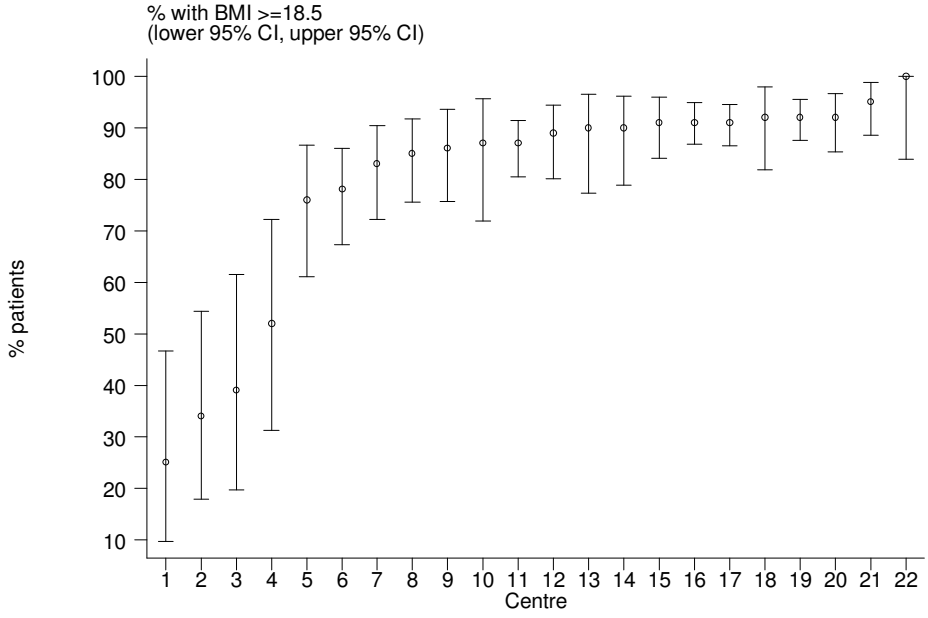


Table 8.2.5: Variation in Proportion of patients with BMI ≥18.5 and serum albumin ≥ 40 g/dL among HD centres 2008

year	No. of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1999	63	2	7	23	44	61	71	83
2000	83	0	8	20	36	50	73	81
2001	105	0	3	10	32	50	69	100
2002	124	0	6	25.5	37.5	55	73	100
2003	150	0	18	34	47	62	78	100
2004	181	3	10	34	51	64	79	100
2005	198	5	10	38	50	63	80	90
2006	251	0	9	35	47	64	77	92
2007	270	0	9	32	47	60	74	93
2008	311	0	4	30	45	60	76	93

Table 8.2.5 & Figure 8.2.5 indicate that of 311 centres returning data on targeted goals of BMI ≥ 18.5 and serum albumin ≥ 40 g/dL in 2008, the maximum achievement was by 93% of patients in one center whereas the lowest achievement was reported as 4% in another center. The median of participating centres was 45%. For all HD centres, there was 19-fold variation in meeting targeted goals (Table 8.2.5 & Figure 8.2.5). This wide variation indicates room for improving the nutritional status of HD patients.

Figure 8.2.5: Variation in Proportion of patients with BMI ≥ 18.5 and serum albumin ≥ 40 g/dL among HD centres 2008

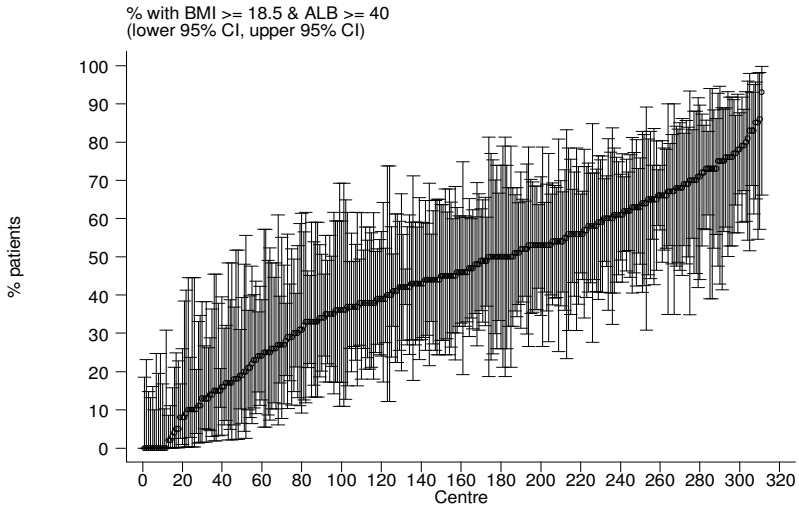
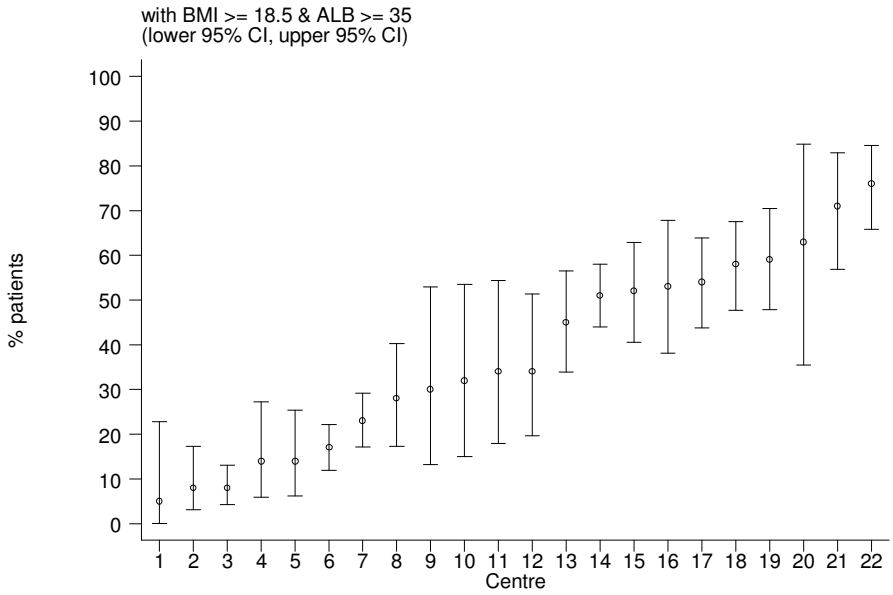


Table 8.2.6: Variation in Proportion of patients with BMI ≥ 18.5 and serum albumin ≥ 35 g/dL among PD centres 2008

year	No. of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
1999	9	0	0	31	34	38	55	55
2000	11	0	0	24	38	61	75	75
2001	11	5	5	22	36	46	71	71
2002	15	10	10	20	40	50	67	67
2003	19	10	10	21	35	47	77	77
2004	19	9	9	20	44	56	81	81
2005	18	8	8	22	33.5	54	67	67
2006	22	7	10	24	43.5	55	63	65
2007	22	11	13	18	45.5	58	70	76
2008	22	5	8	17	34	54	71	76

Figure 8.2.6: Variation in Proportion of patients with BMI ≥ 18.5 and serum albumin ≥ 35 g/dL among PD centres 2008



CHAPTER 9

Blood Pressure Control and Dyslipidaemia in Patients on Dialysis

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Lee Wan Tin

SECTION 9.1: BLOOD PRESSURE CONTROL ON DIALYSIS

Similar to the past 2 years, predialysis systolic blood pressure in haemodialysis patients remains suboptimally controlled with only 26% of haemodialysis patients achieving systolic BP < 140 mmHg in 2008 (Table 9.1.1). The mean and median predialysis systolic blood pressures in haemodialysis patients are still unacceptably high at 152 mmHg and 151.9 mmHg respectively in 2008.

Table 9.1.1: Distribution of pre dialysis systolic blood pressure, HD patients 1999-2008

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 ≥160 mmHg
1999	2965	148.7	20.8	148.5	135.3	162.2	8	25	38	23	6
2000	4310	148	20.6	147.8	134.8	161.7	9	25	38	23	6
2001	5147	148.8	20.9	148.8	134.9	162.6	8	25	37	23	7
2002	5911	149.2	20.6	149	135.8	163.3	8	24	38	24	6
2003	6834	149.7	20.2	149.8	136.4	162.9	7	24	39	23	7
2004	7937	149.7	20	150	136.6	163.1	7	23	39	25	6
2005	9221	149.9	19.4	149.6	137	162.8	6	24	40	24	6
2006	11526	151.4	19.3	151.1	138.8	164	5	22	41	25	7
2007	12830	152.1	19.1	151.9	139.3	164.7	5	21	40	27	7
2008	15195	152	19	151.9	139.4	164.6	4	22	40	27	7

In contrast to haemodialysis patients, predialysis systolic blood pressure was better controlled in CAPD patients in 2008, with 51% of CAPD patients having predialysis systolic BP < 140 mmHg (Table 9.1.2). The mean and median predialysis systolic BP in CAPD patients were also lower than haemodialysis patients at 139.4 mmHg and 139.5 mmHg respectively.

Table 9.1.2: Distribution of pre dialysis systolic blood pressure, PD patients 1999-2008

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 ≥160 mmHg
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
2008	2049	139.4	18.7	139.5	126.7	151.4	15	36	35	12	2

In 2008, predialysis diastolic blood pressure in haemodialysis patients was better controlled than the predialysis systolic blood pressure, with 84% of such patients achieving diastolic BP < 90 mmHg (Table 9.1.3). Similarly, predialysis diastolic blood pressure in CAPD patients is satisfactorily controlled with 85% of CAPD patients achieving diastolic BP < 90mmHg (Table 9.1.4).

Table 9.1.3: Distribution of pre dialysis diastolic blood pressure, HD patients 1999-2008

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
1999	2965	83.5	10.5	83.5	77.1	90	10	24	40	21	6
2000	4309	82.2	10.4	82.3	75.7	89	11	28	39	18	4
2001	5146	81.6	10.4	81.7	75	88.3	12	30	37	17	4
2002	5907	81.2	10.4	81.3	74.5	88.1	13	30	37	16	3
2003	6832	80.6	10.2	80.8	73.9	87.2	14	32	37	14	3
2004	7935	80.3	10.2	80.3	73.6	86.9	15	33	36	14	3
2005	9221	80.3	10.6	80.4	73.5	87	15	32	36	14	3
2006	11525	80.4	11.1	80.4	73.3	87.1	16	32	35	14	3
2007	12830	80.4	11.1	80.2	73.1	87	16	32	34	14	4
2008	15193	79.8	11.2	79.6	72.5	86.7	18	33	33	13	3

Table 9.1.4: Distribution of pre dialysis diastolic blood pressure, PD patients 1999-2008

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
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
2008	2049	79.7	10.1	80	73	86.3	16	32	36	13	2

The mild variation in predialysis median systolic blood pressure and predialysis median diastolic blood pressure among haemodialysis centers were similar to that in previous years (Table 9.1.5 and Table 9.1.5b).

Table 9.1.5: Variation in BP control among HD centers 2008

(a) Median systolic blood pressure among HD patients, HD centers

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	74	134.2	139	144	148.7	154.4	163.4	167.3
2000	106	130.6	137.1	142.5	147.5	153.1	162.8	167.7
2001	126	127.5	135.6	143.3	149.1	154.9	161.8	180.5
2002	147	126.7	136.7	144.5	149.2	154.5	162	169.7
2003	176	126.7	136.3	144.7	150.7	155.7	161.3	173.7
2004	209	120	137.7	145.2	149.8	155.4	162.5	168.3
2005	237	119.6	136.7	143.7	150.3	155.2	161	172.9
2006	291	125.3	138	146.4	151.2	156.3	162.7	180.1
2007	313	132.2	140.1	147.5	151.5	156.7	164.5	173.7
2008	356	129.3	140.7	147.5	152.3	157	164.3	169.6

Figure 9.1.5 (a): Variation in median systolic blood pressure among HD patients, HD centers 2008

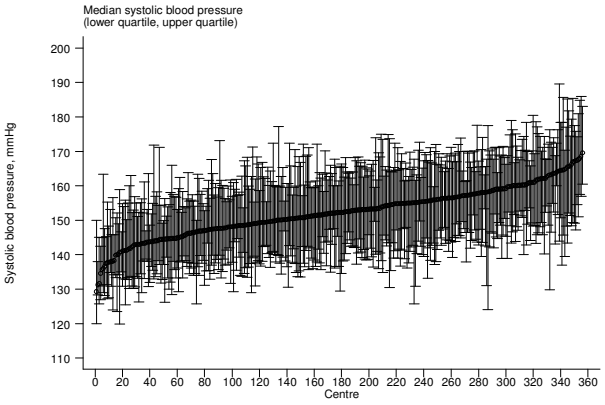


Figure 9.1.5 (b): Variation in median diastolic blood pressure among HD patients, HD centers 2008

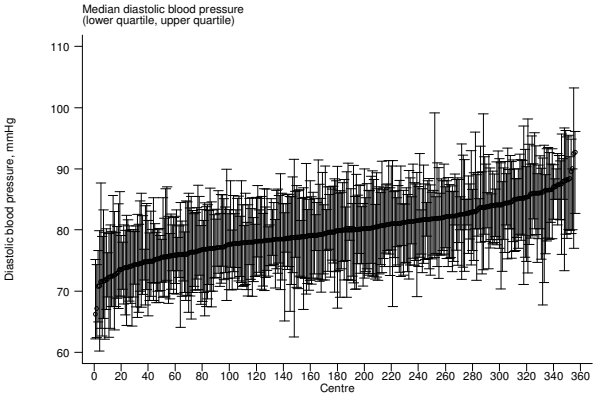


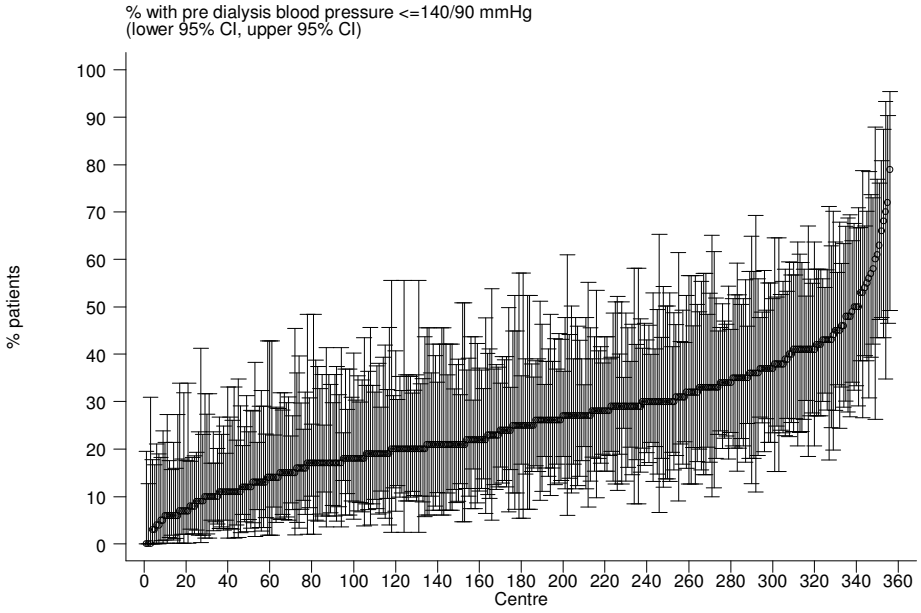
Table 9.1.5 (b): Median diastolic blood pressure among HD patients, HD centers

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	74	76.9	78.6	82	83.8	85.8	88.8	91.8
2000	106	75.1	76.7	80	82.2	84.7	89.3	92.4
2001	126	73.5	75.9	79.7	81.8	83.7	87.5	91.3
2002	147	72.3	75.8	79.3	81.2	83.6	87.4	92
2003	176	73.4	75.3	78.4	80.8	83.7	86.8	93.3
2004	209	70.3	74	78.2	80.8	82.5	86	89.1
2005	237	67.4	73.5	78.1	80.5	82.8	86.7	89.6
2006	291	67.3	74.5	78.2	80.6	83	87.3	110.2
2007	313	70	73.8	77.7	80.3	82.9	87.1	124.5
2008	356	66.3	73.1	77	79.8	82.3	86.6	92.7

Table 9.1.5 (c): Proportion of HD patients with pre dialysis blood pressure < 140/90 mmHg, HD centers

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	74	3	11	23	31	40	55	67
2000	106	4	13	23	32	44	60	73
2001	126	0	10	20	31.5	43	60	69
2002	147	0	10	21	29	39	57	71
2003	176	5	11	20	28	39	58	80
2004	209	0	9	20	29	38	56	90
2005	237	4	10	21	27	40	59	87
2006	291	0	8	17	25	35	52	71
2007	313	0	7	17	26	33	50	73
2008	356	0	7	17	25	33	50	79

Figure 9.1.5 (c): Variation in proportion of HD patients with pre dialysis blood pressure < 140/90 mmHg, HD centers 2008



The mild variation in predialysis median systolic blood pressure and predialysis median diastolic blood pressure among CAPD centers were similar to that in previous years (Table 9.1.6 and Table 9.1.6b).

Table 9.1.6: Variation in BP control among PD centers 2008

(a) Median systolic blood pressure among PD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	9	117	117	132.5	137.8	140	152.8	152.8
2000	11	116.2	116.2	131.3	134.9	137.7	149.1	149.1
2001	11	119.6	119.6	130.7	137.5	138.8	149	149
2002	15	123.2	123.2	134.5	140	144.5	148.2	148.2
2003	19	123.8	123.8	131.9	142	144.3	151.8	151.8
2004	19	119.7	119.7	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	117.5	131.3	136.4	140.4	146	154.9
2007	23	114.6	115.1	130.8	137.8	141.8	147.7	153.5
2008	22	115.1	118.1	136.1	138.2	141.6	147.7	147.9

Figure 9.1.6 (a): Variation in median systolic blood pressure among PD patients, PD centers 2008

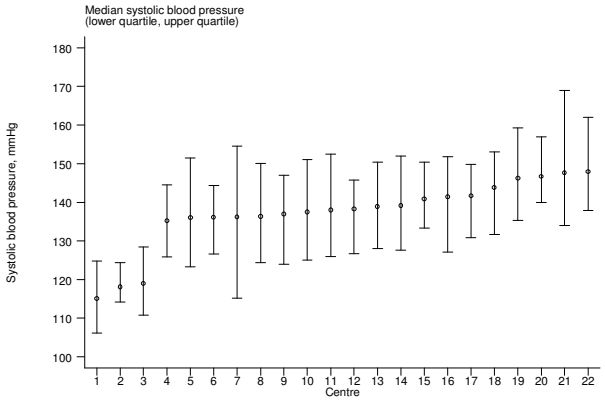


Figure 9.1.6 (b): Variation in median diastolic blood pressure among PD patients, PD centers 2008

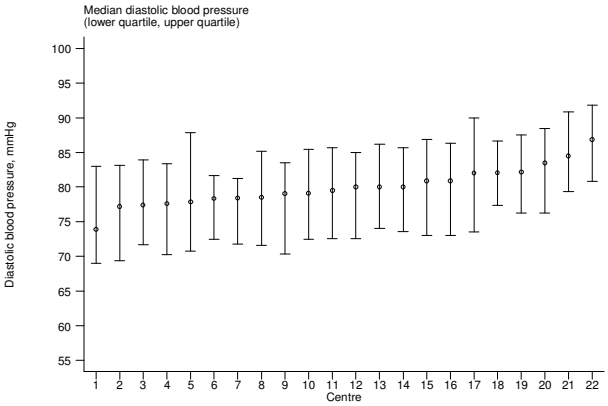


Table 9.1.6 (b): Median diastolic blood pressure among PD patients, PD centers

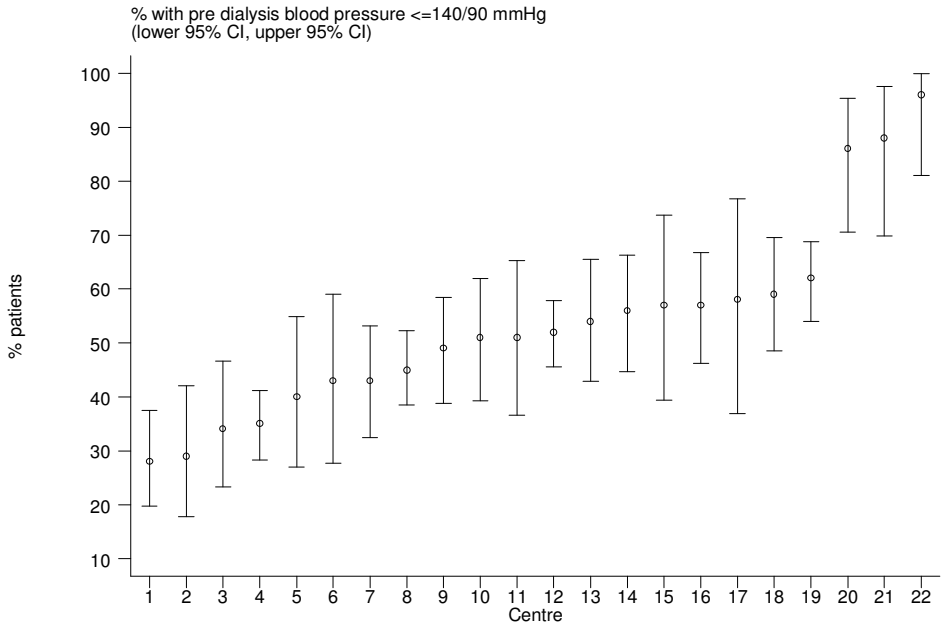
Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	9	76.8	76.8	84.1	84.3	85	86.8	86.8
2000	11	73.1	73.1	80	83	84.4	88	88
2001	11	78	78	80.9	83.4	84.8	88	88
2002	15	76.8	76.8	81.8	83.3	85.7	89.5	89.5
2003	19	77.2	77.2	80.8	82.9	84.4	88	88
2004	19	76.7	76.7	80.5	83.2	84.2	87.5	87.5
2005	20	74.8	75.1	80.3	82.6	84	85.9	86
2006	22	71.5	73.5	80	81.4	82.3	86.5	88.4
2007	23	69.5	72.5	79.1	80.2	82.3	83.2	87
2008	22	73.9	77.2	78.3	79.8	82	84.5	86.8

Similar to haemodialysis centers, there also is a wide variation amongst CAPD centers in the proportion of patients achieving BP < 140/90 (Table 9.1.6c and Figure 9.1.6c). This pattern has been prevalent for the past few years.

Table 9.1.6 (c): Proportion of PD patients with pre dialysis blood pressure < 140/90 mmHg, PD centers

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	9	30	30	42	52	60	100	100
2000	11	24	24	52	58	63	95	95
2001	11	36	36	48	52	63	87	87
2002	15	19	19	33	47	56	91	91
2003	19	28	28	38	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	58.5	69	100	100
2007	23	27	29	44	53	67	91	92
2008	22	28	29	43	51.5	58	88	96

Figure 9.1.6 (c): Variation in proportion of PD patients with pre dialysis blood pressure ≤140/90 mmHg, PD centers 2008



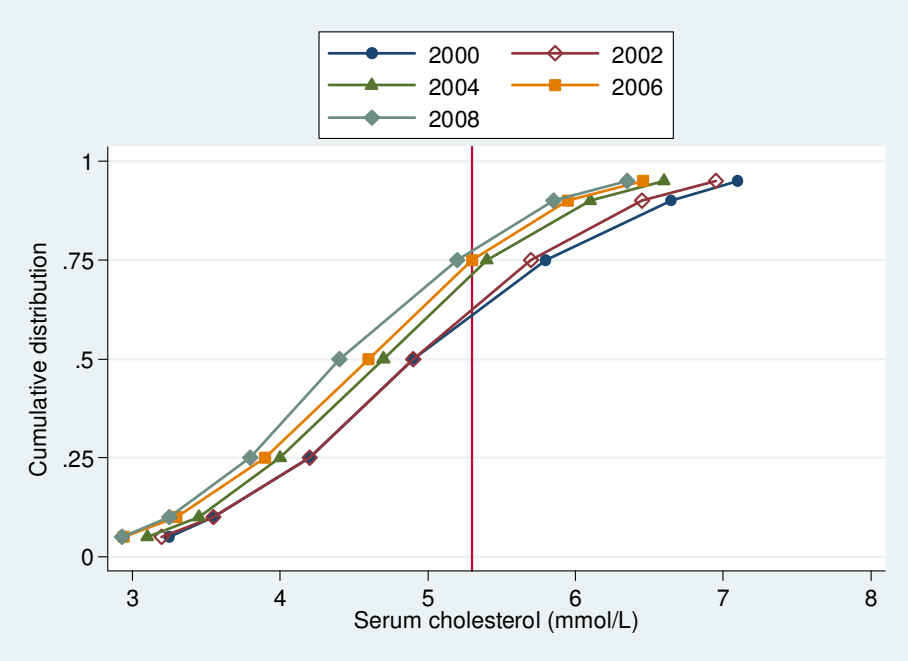
SECTION 9.2: DYSLIPIDEMIA IN DIALYSIS PATIENTS

The trend towards improving total cholesterol levels in HD patients continued in 2008, with 78% of HD patients achieving total cholesterol < 5.3 mmol/L (Table 9.2.1 and Figure 9.2.1) The mean and median serum cholesterol levels in HD patients were 4.5 mmol/L and 4.4 mmol/L respectively.

Table 9.2.1: Distribution of serum cholesterol, HD patients 1999-2008

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
1999	1871	5	1.3	4.9	4.1	5.7	10	54	20	15
2000	2956	5	1.2	4.9	4.2	5.8	8	53	23	16
2001	3898	5.1	1.3	4.9	4.2	5.8	8	52	24	16
2002	4751	5	1.2	4.9	4.2	5.7	9	55	24	13
2003	5806	4.8	1.1	4.8	4.1	5.5	9	59	21	11
2004	6710	4.7	1.1	4.7	4	5.4	11	60	21	8
2005	7906	4.7	1.1	4.6	4	5.3	12	61	19	8
2006	10139	4.6	1.1	4.6	3.9	5.3	14	62	17	7
2007	11347	4.6	1.1	4.5	3.8	5.2	14	63	17	6
2008	13705	4.5	1.1	4.4	3.8	5.2	15	64	16	6

Figure 9.2.1: Cumulative distribution of cholesterol, HD patients 1999-2008

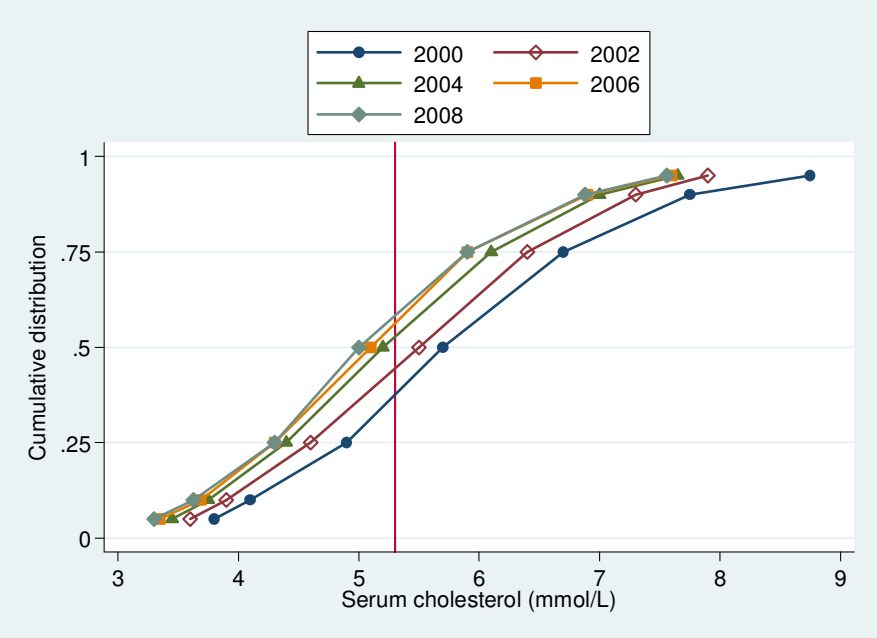


In 2008, as in previous years, total cholesterol levels in CAPD patients was less optimally controlled in comparison with HD patients, with 59% of CAPD patients achieving total cholesterol < 5.3 mmol/L (Table 9.2.2 and Figure 9.2.2). The mean and median serum cholesterol levels in CAPD patients were 5.2 mmol/L and 5.0 mmol/L respectively

Table 9.2.2: Distribution of serum cholesterol, PD patients 1999-2008

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
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
2008	1902	5.2	1.4	5	4.3	5.9	7	51	23	18

Figure 9.2.2: Cumulative distribution of cholesterol (mmol/L), PD patients 1999-2008



In 2008, serum triglyceride control was better in HD patients than CAPD patients, with 76% of HD patients achieving serum triglyceride levels < 2.3 mmol/L (Table 9.2.3 and Figure 9.2.3) compared to 66% of CAPD patients achieving serum triglyceride level < 2.3 mmol/L (Table 9.2.4 and Figure 9.2.4). This trend of better control of triglyceride levels in HD patients has been present for the past 10 years.

Table 9.2.3: Distribution of serum triglyceride, HD patients 1999-2008

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
1999	1633	2.1	1.3	1.7	1.2	2.5	49	21	18	11
2000	2393	2.1	1.4	1.7	1.3	2.6	48	22	19	12
2001	3162	2.1	1.4	1.7	1.2	2.5	48	22	17	13
2002	3861	2.1	1.4	1.8	1.2	2.5	47	22	18	12
2003	4710	2	1.3	1.7	1.2	2.5	48	23	18	11
2004	5607	2	1.2	1.7	1.2	2.4	51	23	17	10
2005	6950	2	1.3	1.7	1.2	2.4	50	22	18	10
2006	9522	2	1.3	1.6	1.2	2.3	54	21	16	9
2007	10882	1.9	1.2	1.6	1.1	2.3	55	21	16	8
2008	12815	1.9	1.2	1.6	1.1	2.3	56	20	15	8

Figure 9.2.3: Cumulative distribution of serum triglyceride, HD patients 1999-2008

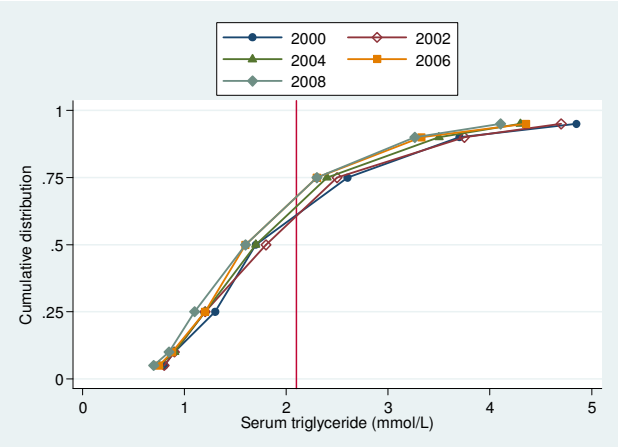


Figure 9.2.4: Cumulative distribution of serum triglyceride, PD patients 1999-2008

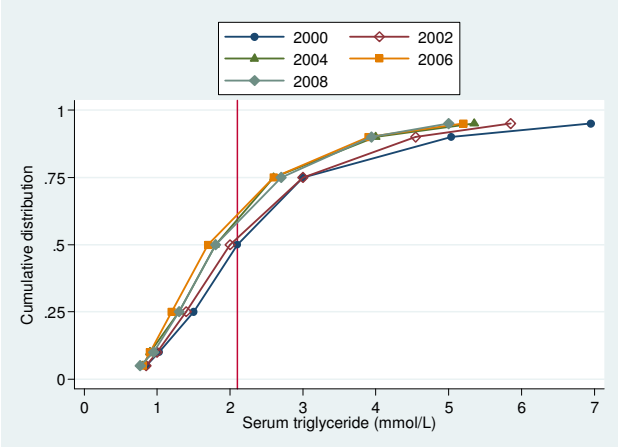


Table 9.2.4: Distribution of serum triglyceride, PD patients 1999-2008

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
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
2008	1907	2.2	1.5	1.8	1.3	2.7	45	21	20	14

The mild variation in median serum cholesterol levels and proportion of HD patients with serum cholesterol levels < 5.3mmol/L in HD centers were similar to previous years (Table 9.2.5a and Table 9.2.5b). It is noted that the median of the proportion of patients with serum cholesterol level < 5.3 mmol/L in HD centers has significantly increased from 57% in 1999 to 79% in 2008 (Table 9.2.5b).

Table 9.2.5: Variation in dyslipidaemia among HD centers 2008

(a) Median serum cholesterol level among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	9	117	117	132.5	137.8	140	152.8	152.8
2000	11	116.2	116.2	131.3	134.9	137.7	149.1	149.1
2001	11	119.6	119.6	130.7	137.5	138.8	149	149
2002	15	123.2	123.2	134.5	140	144.5	148.2	148.2
2003	19	123.8	123.8	131.9	142	144.3	151.8	151.8
2004	19	119.7	119.7	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	117.5	131.3	136.4	140.4	146	154.9
2007	23	114.6	115.1	130.8	137.8	141.8	147.7	153.5
2008	22	115.1	118.1	136.1	138.2	141.6	147.7	147.9

Figure 9.2.5 (a): Variation in median serum cholesterol level among HD patients, HD centers 2008

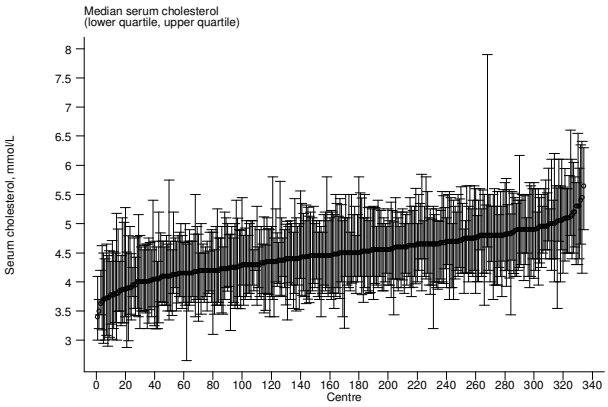
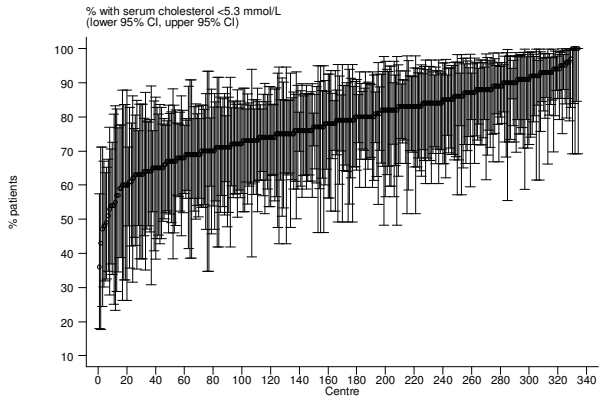


Figure 9.2.5 (b): Variation in proportion of patients with serum cholesterol < 5.3 mmol/L, HD centers 2008



(b) Proportion of patients with serum cholesterol < 5.3 mmol/L, HD centers 2008

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	46	37	38	57	64.5	77	86	89
2000	76	35	40	51	61	69	86	94
2001	94	14	36	54	60	67	78	89
2002	122	28	46	58	63.5	71	79	93
2003	150	40	48	60	68	76	83	92
2004	179	38	48	62	70	78	91	94
2005	212	33	53	66	74	81	91	95
2006	264	29	53	69	75	83	92	100
2007	283	33	58	69	77	84	94	100
2008	334	36	60	71	79	86	94	100

In 2008, the mild variation in median serum triglyceride levels and proportion of patients with triglyceride < 2.1 mmol/L in HD centers were similar to previous years (Table 9.2.5c and Table 9.2.5d). In contrast to HD centers, the proportion of patients with triglyceride level < 2.1 mmol/L in HD centers has only mildly increased from 67% in 1999 to 72% in 2008 (Table 9.2.5d).

Table 9.2.5(c) Median serum triglyceride level among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	41	1.2	1.3	1.5	1.7	1.9	2.1	2.5
2000	59	1.2	1.4	1.5	1.8	2	2.6	2.8
2001	80	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	2.3	3.2
2003	129	1.2	1.3	1.5	1.7	1.9	2.2	2.5
2004	155	1	1.3	1.5	1.7	1.9	2.2	2.9
2005	193	0.9	1.3	1.5	1.7	1.9	2.2	2.8
2006	253	0.9	1.2	1.5	1.6	1.8	2.2	4.1
2007	272	0.8	1.2	1.4	1.6	1.8	2.2	3.5
2008	313	1	1.2	1.4	1.6	1.7	2.1	2.3

Figure 9.2.5 (c): Variation in median serum triglyceride level among HD patients, HD centers 2008

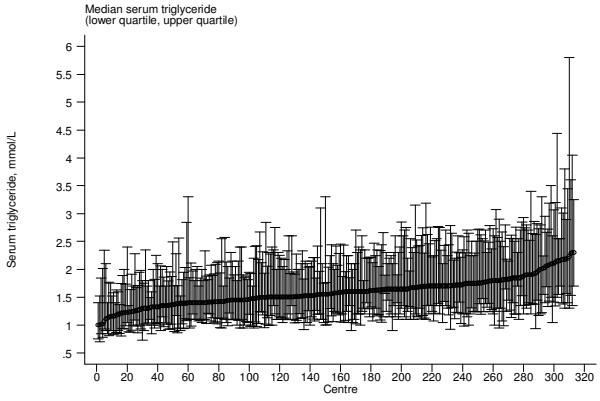
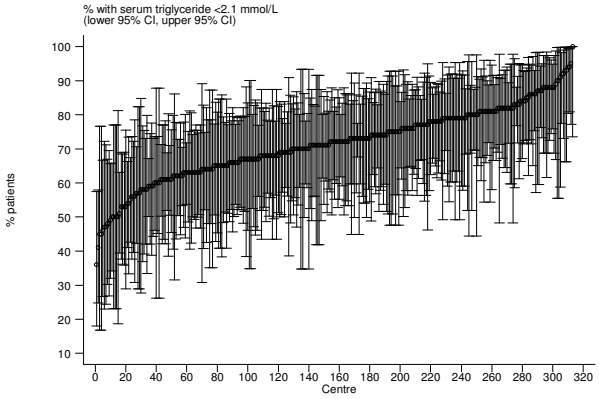


Figure 9.2.5 (d): Variation in proportion of patients with serum triglyceride < 2.1mmol/L, HD centers 2008



(d) Proportion of patients with serum triglyceride < 2.1mmol/L, HD centers 2008

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	41	41	50	61	67	73	87	92
2000	59	23	27	57	66	74	83	86
2001	80	38	44.5	57	65	76	85	90
2002	98	27	44	55	65	73	81	93
2003	129	27	43	58	67	75	90	100
2004	155	15	47	60	68	79	85	94
2005	193	30	44	59	66	73	83	100
2006	253	0	50	64	70	76	90	100
2007	272	36	48	63	70.5	78	88	100
2008	313	36	51	65	72	79	88	100

The mild variation in medium cholesterol levels among PD patients is similar to previous years (Table 9.2.6a and Figure 9.2.6a). The median of the proportion of patients with serum cholesterol < 5.3 mmol/L has gradually increased from 39.5% in 1999 to 58% in 2008, reflecting better control of serum cholesterol levels in recent years (Table 9.2.6b and Figure 9.2.6b).

Table 9.2.6: Variation in dyslipidaemia among PD centers 2008

(a) Median serum cholesterol level among PD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	6.2	6.2
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	5.5	6.1	6.2
2008	22	4.3	4.5	4.8	5	5.4	5.6	6.2

Figure 9.2.6 (a): Variation in median serum cholesterol level among PD patients, PD centers 2008

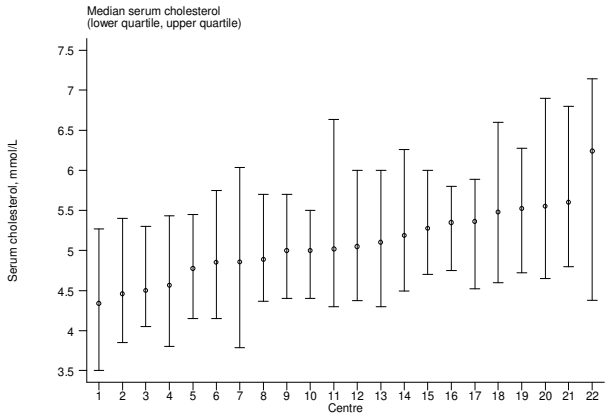
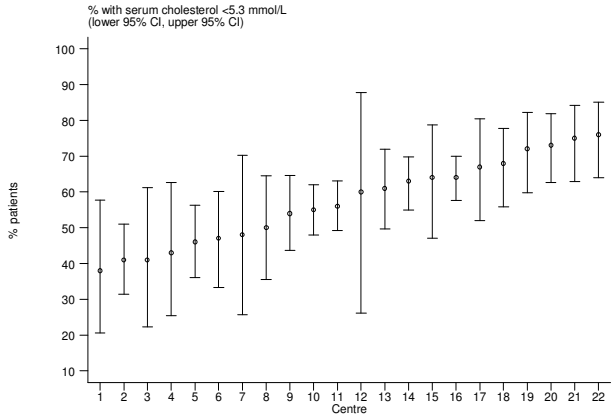


Figure 9.2.6 (b): Variation in proportion of patients with serum cholesterol < 5.3 mmol/L, PD centers 2008



(b) Proportion of patients with serum cholesterol < 5.3 mmol/L, PD centers 2008

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	17	17	39	48.5	59	83	83
2004	19	10	10	40	51	60	71	71
2005	19	27	27	49	60	70	77	77
2006	21	19	26	48	59	66	75	80
2007	23	27	30	44	53	67	77	87
2008	22	38	41	47	58	67	75	76

As in previous years, there is only mild variation among CAPD centers of the median triglyceride levels in PD patients as well as the proportion of patients with serum triglyceride levels < 2.1 mmol/L (Table 9.2.6c and Table 9.2.6d).

(c) Median serum triglyceride level among PD patients, PD centers 2008

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	1.7	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	1.8	2	2.6
2007	23	1.2	1.5	1.7	1.8	1.9	2.1	2.7
2008	23	1.3	1.5	1.6	1.8	2	2.2	2.3

Figure 9.2.6 (c): Variation in median serum triglyceride level among PD patients, PD centers 2008

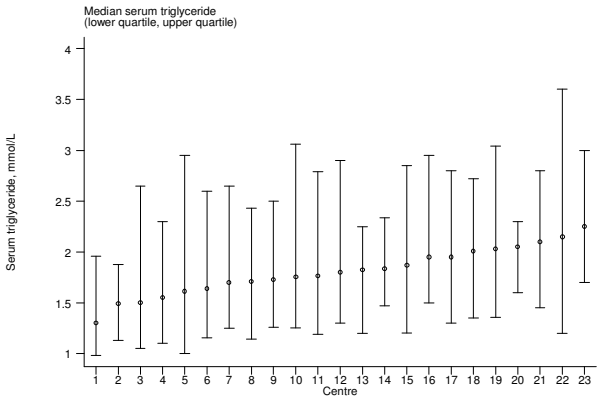
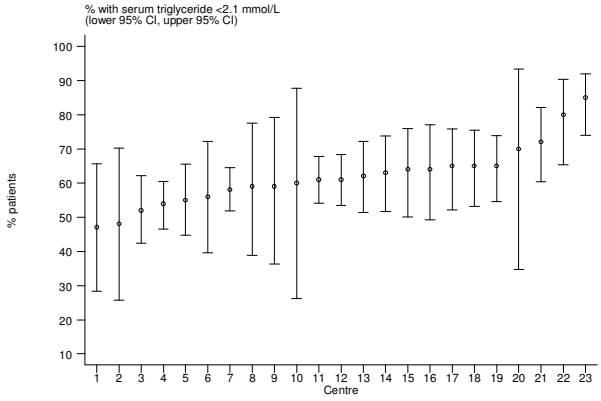


Figure 9.2.6 (d): Variation in proportion of patients with serum triglyceride < 2.1mmol/L, PD centers 2008



(d) Proportion of patients with serum triglyceride < 2.1mmol/L, PD centers 2008

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	49	49	52	59	62	92	92
2004	19	47	47	60	62	67	89	89
2005	19	36	36	55	59	69	92	92
2006	21	31	52	56	61	63	78	83
2007	23	40	50	59	64	68	80	82
2008	23	47	48	56	61	65	80	85

CHAPTER 10

Management of Renal Bone Disease in Patients on Dialysis

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SECTION 10.1: TREATMENT OF RENAL BONE DISEASE

Calcium carbonate remained the main phosphate binder among both HD patients (92%) and PD patients (86%) over the last decade. The percentage of patients on aluminium based phosphate binders has decreased steadily for both HD and PD patients from 8.1% and 5.9% in 1999 to 0.5% and 0.4% in 2008 respectively. On the other hand, the use of lanthanum as phosphate binder has increased from 0.13% and 0.18% in 2006 to 0.56% and 1.0% in 2008 for both HD and PD patients. However the number is still very small since its first use in 2006. There was a higher percentage of PD patients taking lanthanum compared to HD patients. Calcitriol remained the main Vitamin D used in treatment of renal bone disease for both HD and PD patients. The percentage of patients on calcitriol therapy has increased in both HD and PD patients since 2001 but it remained static for year 2007 and 2008. Paricalcitriol was first used in Malaysia in 2006 and the percentage of usage has remained static for both HD (0.29%) and PD patients (0.2%). Twice as many patients underwent parathyroidectomy in 2008 compared to 2005 for both HD (1.1% vs. 0.5%) and PD patients (0.6% vs. 0.4%) and more HD patients underwent parathyroidectomy compared to PD patients. (Tables 10.1.1 & 10.1.2)

Table 10.1.1: Treatment for renal bone disease, HD patients, 1999- 2008

Year	No. of subjects	No. of subjects on $CaCO_3$	% on $CaCO_3$	No. on subjects on $Al(OH)_3$	No. of subjects on Lanthanum	No. of subjects on calcitriol	% on calcitriol	No. of subjects on Paricalcitriol	No. of subjects had Parathyroi-dectomy
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	7018	6425	92	118	0	1690	24	0	0
2004	8164	7408	91	106	0	2029	25	0	0
2005	9351	8568	92	98	0	2556	27	0	43
2006	11682	10776	92	71	15	3817	33	34	152
2007	12907	11868	92	57	37	4927	38	58	181
2008	15280	14025	92	72	86	5879	38	43	174

Table 10.1.2: Treatment for renal bone disease, PD patients, 1999- 2008

Year	No. of subjects	No. of subjects on $CaCO_3$	% on $CaCO_3$	No. on subjects on $Al(OH)_3$	No. of subjects on Lanthanum	No. of subjects on calcitriol	% on calcitriol	No. of subjects on Paricalcitriol	No. of subjects had Parathyroi-dectomy
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	1543	1306	85	15	0	311	20	0	0
2004	1842	1552	84	24	0	439	24	0	0
2005	2207	1862	84	21	0	534	24	0	8
2006	2787	2373	85	14	5	658	24	6	27
2007	3577	3142	88	8	22	1019	28	9	22
2008	4044	3495	86	14	42	1148	28	6	26

SECTION 10.2: SERUM CALCIUM AND PHOSPHATE CONTROL

The median corrected serum calcium level has remained stable for the last decade for both HD and PD patients. However, more HD patients had normal range calcium level (2.1 to 2.37 mmol/L) compared to PD patients (53% vs. 38%) in 2008. (Tables and Figures 10.2.1 and 10.2.2)

Table 10.2.1: Distribution of corrected serum calcium, HD patients, 1999- 2008

Year	No of subjects	Mean	SD	Median	LQ	UQ	%patients ≥2.1& ≤2.37 mmol/L
1999	2732	2.3	0.3	2.3	2.2	2.5	39
2000	3703	2.4	0.3	2.3	2.2	2.5	42
2001	4618	2.4	0.2	2.4	2.2	2.5	40
2002	5485	2.3	0.3	2.3	2.2	2.5	43
2003	6466	2.3	0.2	2.3	2.2	2.4	46
2004	7536	2.3	0.2	2.3	2.2	2.4	47
2005	8630	2.3	0.2	2.3	2.2	2.4	49
2006	10881	2.3	0.2	2.3	2.1	2.4	50
2007	12275	2.2	0.2	2.2	2.1	2.4	52
2008	14360	2.3	0.2	2.3	2.1	2.4	53

Figure 10.2.1 Cumulative distribution of corrected serum calcium, HD patients, 1999-2008

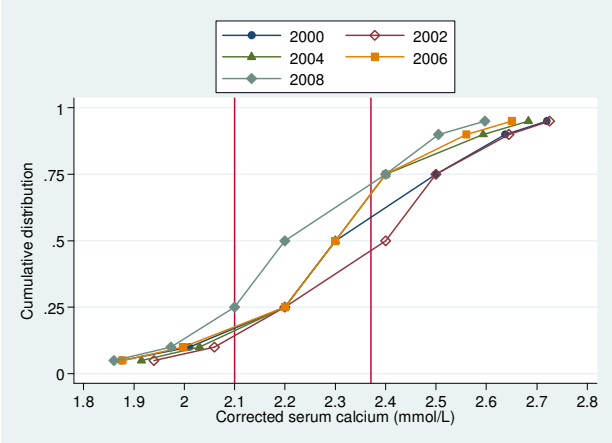


Figure 10.2.2: Cumulative distribution of corrected serum calcium, PD patients, 1999-2008

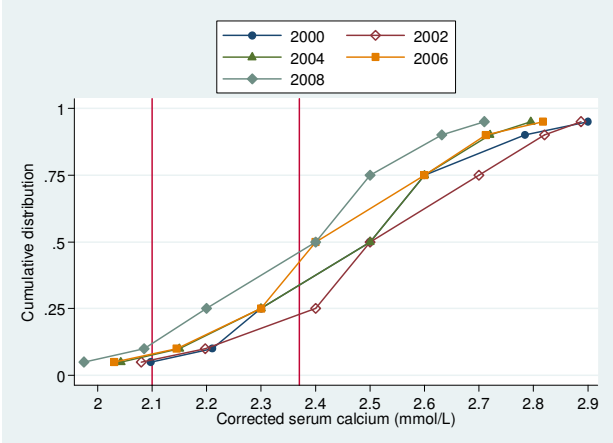


Table 10.2.2: Distribution of corrected serum calcium, PD patients, 1999-2008

Year	No of subjects	Mean	SD	Median	LQ	UQ	%patients 2.1& ≤2.37 mmol/L
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
2008	2017	2.4	0.2	2.4	2.3	2.5	38

PD patients had better phosphate control compared to HD patients (median level 1.5 vs. 1.7mmol/L) and larger percentage of PD patients had normal range phosphate level (1.13-1.78mmol/L) as opposed to HD patients (55 vs. 48%). (Tables and Figures 10.2.3 and 10.2.4)

Table 10.2.3: Distribution of serum phosphate, HD patients, 1999- 2008

Year	No of subjects	mean	SD	Median	LQ	UQ	%patients <1.13 mmol/L	%patients ≥1.13&<1.78 mmol/L	%patients ≥1.78 &≤2.6 mmol/L	%patients >2.6 mmol/L
1999	2861	1.9	0.5	1.9	1.5	2.2	7	37	47	9
2000	4080	1.9	0.6	1.8	1.5	2.2	8	37	46	9
2001	4765	1.9	0.5	1.8	1.5	2.2	7	40	45	8
2002	5679	1.9	0.5	1.8	1.5	2.2	7	38	45	10
2003	6588	1.8	0.5	1.8	1.5	2.2	7	41	43	9
2004	7620	1.8	0.5	1.8	1.5	2.2	8	42	42	7
2005	8834	1.8	0.5	1.7	1.4	2.1	9	45	40	6
2006	11129	1.8	0.5	1.7	1.4	2.1	9	46	39	6
2007	12424	1.8	0.5	1.7	1.4	2.1	9	47	39	5
2008	14755	1.7	0.5	1.7	1.4	2	9	48	37	5

Figure 10.2.3: Cumulative distribution of serum phosphate, HD patients, 1999-2008

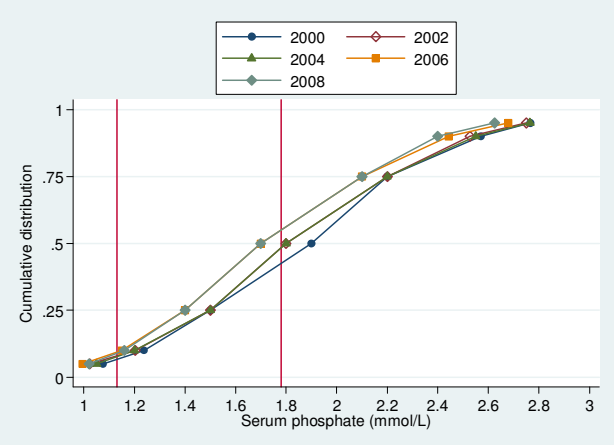


Figure 10.2.4: Cumulative distribution of serum phosphate, PD patients, 1999-2008

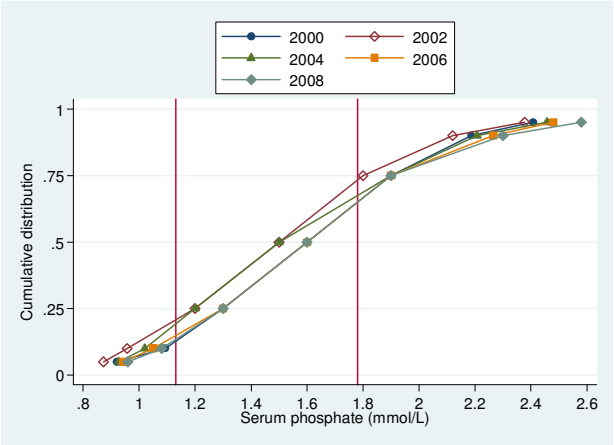


Table 10.2.4: Distribution of serum phosphate, PD patients, 1999- 2008

Year	No of subjects	mean	SD	Median	LQ	UQ	%patients <1.13 mmol/L	%patients ≥1.13&<1.78 mmol/L	%patients ≥1.78&≤2.6 mmol/L	%patients >2.6 mmol/L
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
2008	2022	1.6	0.5	1.5	1.3	1.9	15	55	25	4

The corrected calcium phosphate product had remained the same for both HD and PD patients (median 3.8 and 3.6 mmol/L respectively) for 2007 and 2008. About 47% of PD patients had corrected calcium phosphate product <3.5 $mmol^2/L^2$ compared to 39% in HD patients. Overall there was a positive trend in calcium phosphate product with higher percentage of HD and PD patients with corrected calcium phosphate product <3.5 $mmol^2/L^2$ and fewer patients with corrected calcium phosphate product ≥5.5 $mmol^2/L^2$. (Tables and Figures 10.2.5 and 10.2.6)

Table 10.2.5: Distribution of corrected calcium x phosphate product, HD patients 1999- 2008

Year	No. of subjects	mean	SD	Median	LQ	UQ	Percent patients with calcium phosphate product: <3.5 $mmol^2/L^2$	≥3.5 & <4.5 $mmol^2/L^2$	≥4.5 & <5.5 $mmol^2/L^2$	≥5.5 $mmol^2/L^2$
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	6383	4.2	1.3	4.1	3.3	5.1	30	31	23	16
2004	7414	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	12172	3.9	1.2	3.8	3.1	4.6	38	33	19	10
2008	14242	3.9	1.2	3.8	3.1	4.6	39	33	19	9

Figure 10.2.5: Cumulative distribution of corrected calcium x phosphate product, HD patients 1999- 2008

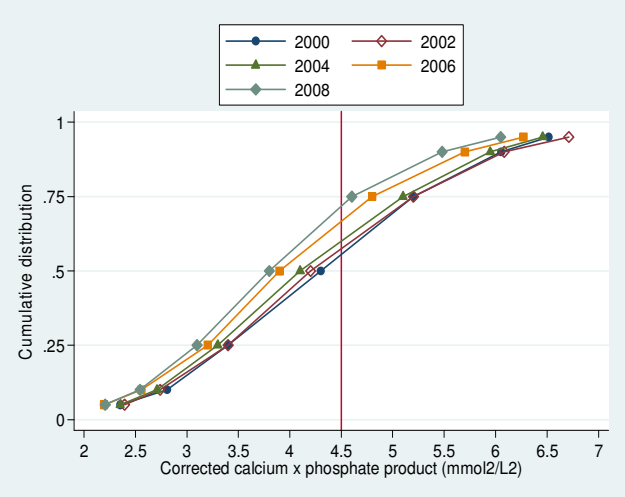


Figure 10.2.6: Cumulative distribution of corrected calcium x phosphate product, PD patients 1999- 2008

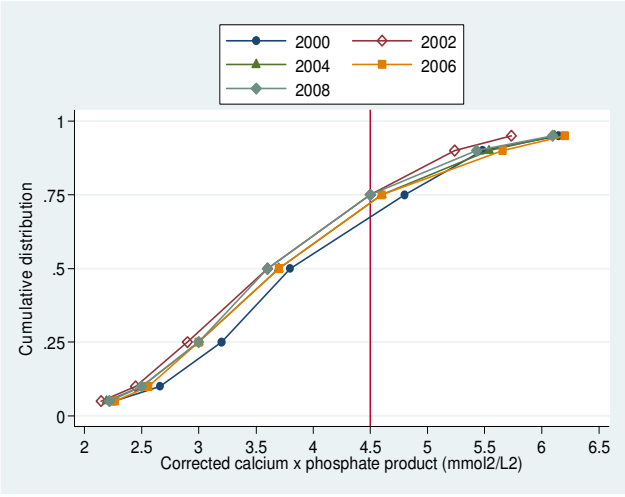


Table 10.2.6: Distribution of corrected calcium x phosphate product, PD patients 1999- 2008

Year	No. of subjects	mean	SD	Median	LQ	UQ	Percent patients with calcium phosphate product: <3.5 $mmol^2/L^2$	≥3.5 & <4.5 $mmol^2/L^2$	≥4.5 & <5.5 $mmol^2/L^2$	≥5.5 $mmol^2/L^2$
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
2008	2009	3.8	1.2	3.6	3	4.5	47	28	15	10

There was wide variation in corrected serum calcium level among both HD and PD centres. The median corrected serum calcium level among 346 HD centres was 2.2 mmol/L (ranged from 1.9 to 2.6 mmol/L) in 2008 and these figures had remained quite stable for the last 10 years. (Table 10.2.7 and Figure 10.2.7a) The median corrected serum calcium level among 24 PD centres was 2.4mmol/L (ranged from 2.4 to 2.6 mmol/L) and again this range is relatively stable. (Table 10.2.8 and Figure 10.2.8a) PD patients seemed to have higher range of median corrected serum calcium level compare to HD patients.

Table 10.2.7: Variation in corrected serum calcium level among HD centres, 2008
a) median serum calcium level among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	67	1.9	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	117	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	226	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	304	1.7	2	2.2	2.2	2.3	2.4	2.5
2008	346	1.9	2.1	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, 2008

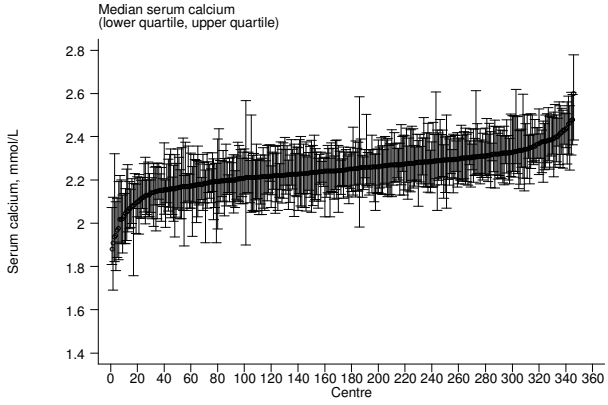


Figure 10.2.8(a): Variation in median serum calcium level among PD patients, PD centres, 2008

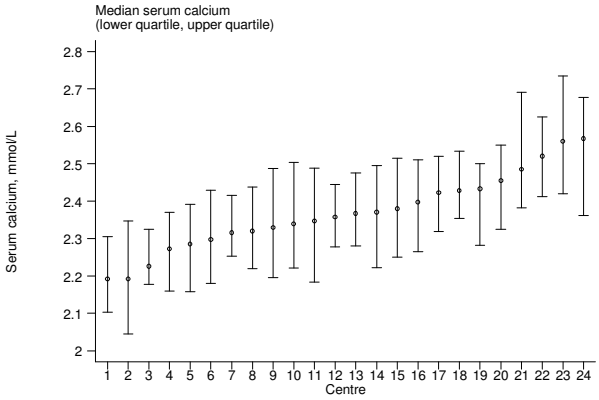


Table 10.2.8: Variation in corrected serum calcium level among PD centres, 2008
a) median serum calcium level among PD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	2.5	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	2.4	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
2008	24	2.2	2.2	2.3	2.4	2.4	2.6	2.6

There was great variation among the HD and PD centres with regards to the proportion of patients achieving the normal range of corrected calcium level of 2.1 to 2.37 mmol/L; it ranged from 12 to 91% for HD centers and 13-65% for PD centers. The median was 53% for HD centres (Table & Figure 10.2.7b) and 42% for PD centres (Table & Figure 10.2.8b).

Table 10.2.7(b): Proportion of patients with serum calcium 2.1 to 2.37 mmol/L, HD centres, 2008

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	67	0	9	25	39	48	58	79
2000	93	0	13	30	41	50	65	96
2001	117	7	11	30	39	50	64	87
2002	138	5	15	33	44	53	64	73
2003	169	13	24	36	47	54	70	85
2004	198	8	22	38	47	58	70	82
2005	226	0	19	38	50	57	70	83
2006	278	12	30	42	51	59	71	86
2007	304	8	29	45	52	61	75	89
2008	346	15	28	45	53	61	73	91

Figure 10.2.7(b): Variation in proportion of patients with serum calcium 2.1 to 2.37 mmol/L, HD centres, 2008

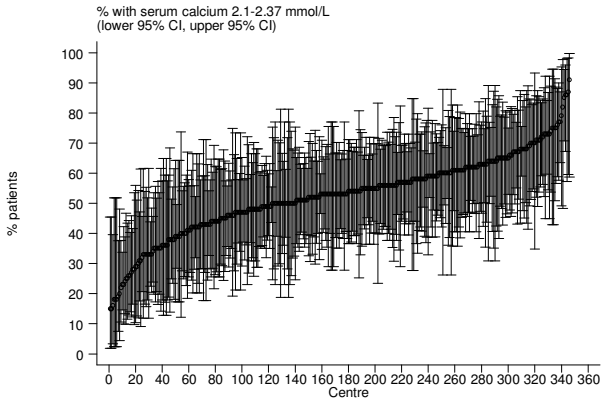


Figure 10.2.8(b): Variation in proportion of patients with serum calcium 2.1 to 2.37 mmol/L, PD centres, 2008

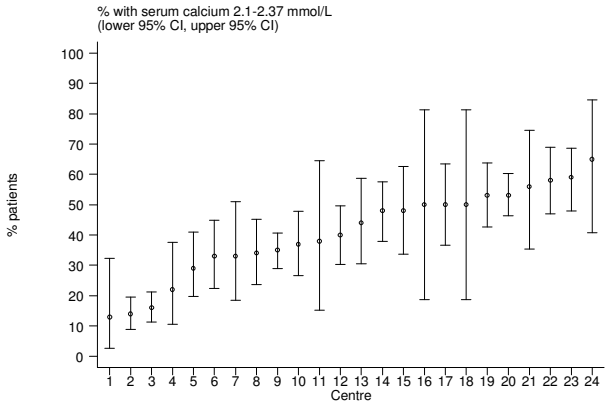


Table 10.2.8(b): Proportion of patients with serum calcium 2.1 to 2.37 mmol/L, PD centres

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	10	5	5	22	27.5	31	42	42
2000	11	14	14	18	24	33	48	48
2001	12	12	12	17	23.5	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	25	31	53	53
2005	20	16	17	25.5	34.5	40	48	51
2006	22	16	23	35	43	49	61	76
2007	23	19	29	31	44	50	62	63
2008	24	13	14	33	42	51.5	59	65

There was also wide variation in serum phosphate level among HD centers and PD centers (Tables and Figures 10.2.9a and 10.2.10a). PD patients seemed to have better phosphate control compared to HD patients. 52% of PD centers achieved the recommended target of serum phosphate level 1.13 – 1.78 mmol/ L. compared to 46% of HD centres. There was 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 12 to 88% while the range is narrower in PD centers (30-71%) (Tables and Figures 10.2.9b and 10.2.10b).

Table 10.2.9: Variation in serum phosphate level among HD centres, 1999-2008
a) Median serum phosphate level among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	69	1.1	1.6	1.8	1.9	2	2.1	2.1
2000	101	1.4	1.6	1.7	1.9	1.9	2.2	3.8
2001	118	1.3	1.5	1.7	1.8	1.9	2.1	2.4
2002	146	1.3	1.5	1.8	1.9	2	2.3	2.4
2003	176	0.8	1.5	1.7	1.8	1.9	2.2	2.4
2004	198	1.3	1.5	1.7	1.8	1.9	2.1	2.3
2005	228	0.8	1.4	1.6	1.7	1.9	2.1	2.4
2006	283	0.9	1.5	1.6	1.7	1.8	2	2.3
2007	309	0.9	1.5	1.6	1.7	1.8	2	2.4
2008	351	1.2	1.4	1.6	1.7	1.8	2	2.5

Figure 10.2.9(a): Variation in median serum phosphate level among HD patients, HD centres, 2008

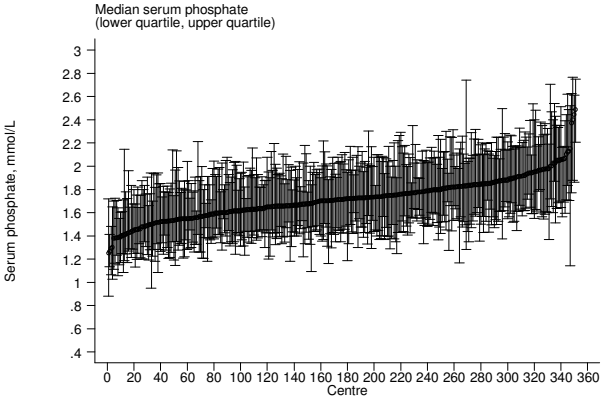
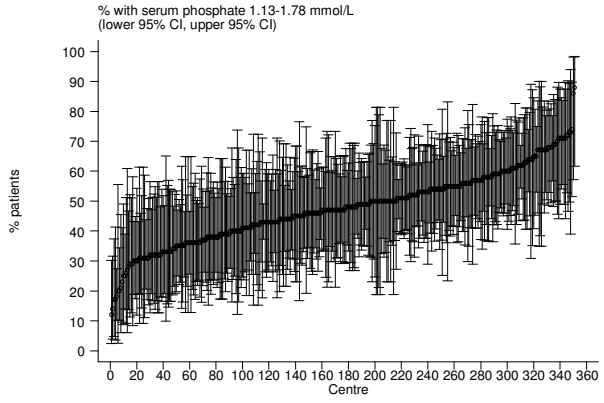


Figure 10.2.9(b): Variation in proportion of patients with serum phosphate 1.13-1.78 mmol/L, HD centres, 2008



(b) proportion of patients with serum phosphate 1.13-1.78 mmol/L, HD centres, 1999-2008

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	69	8	14	27	36	44	59	65
2000	101	9	18	30	36	44	57	73
2001	118	0	19	32	39	47	62	67
2002	146	6	14	29	37	46	64	91
2003	176	9	20	31	40	48	67	93
2004	198	0	18	31	40	51	65	92
2005	228	10	23	36	43	53	68	90
2006	283	7	27	38	45	54	68	93
2007	309	19	28	39	46	55	68	92
2008	351	12	30	39	47	55	68	88

Table 10.2.10: Variation in serum phosphate levels among PD centres, 1999-2008
a) Median serum phosphate level among PD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	2.1	2.1
2003	19	1.2	1.2	1.4	1.5	1.6	1.7	1.7
2004	19	1.3	1.3	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	1.8
2007	23	1.3	1.4	1.5	1.6	1.7	1.9	2.4
2008	24	1.3	1.3	1.5	1.6	1.8	2	2.1

Figure 10.2.10(a): Variation in median serum phosphate level among PD patients, PD centres 2008

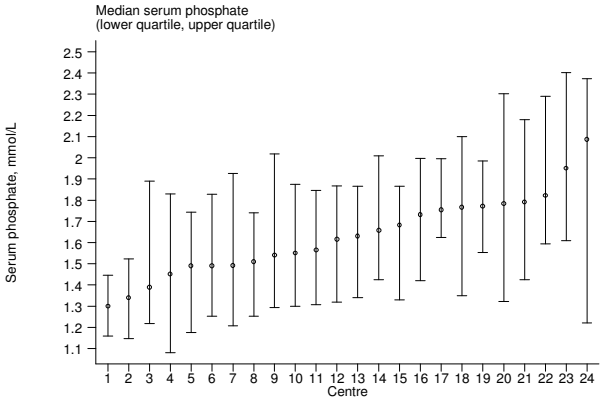


Figure 10.2.10(b): Variation in proportion of patients with serum phosphate 1.13-1.78 mmol/L, PD centres 2008

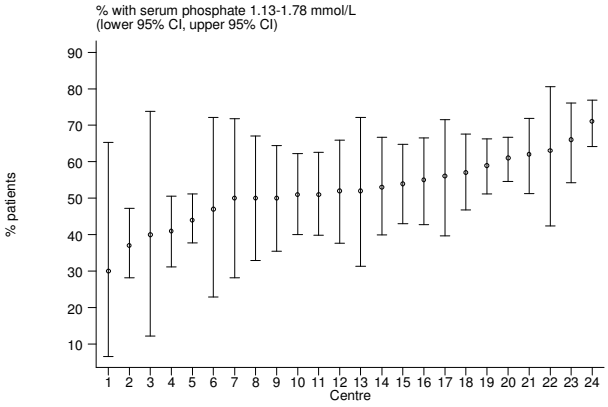


Table 10.2.10(b): Proportion of patients with serum phosphate 1.13-1.78 mmol/L, PD centres 1999-2008

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	9	45	45	51	58	66	68	68
2000	11	43	43	48	53	61	64	64
2001	12	42	42	48.5	54	58	77	77
2002	15	43	43	47	53	60	83	83
2003	19	40	40	47	54	61	77	77
2004	19	37	37	49	52	66	76	76
2005	20	36	38.5	46	53	58	73	76
2006	22	39	44	48	52.5	58	66	68
2007	23	39	40	48	53	59	73	78
2008	24	30	37	48.5	52	58	66	71

In 2008, the corrected serum calcium phosphate product among 342 HD centers ranged from 2.7 to 6.0 with median of 4.1mmol/L (Table 10.2.11 and Figure 10.2.11a). The median corrected serum calcium phosphate product among 24 PD centres ranged from 3.1 to 5.1 mmol/L with median of 3.7 mmol/L (Table 10.2.12 and Figure 10.2.12a). There was not much difference between HD and PD centers.

Table 10.2.11: Variation in corrected calcium x phosphate product HD centres, 1999-2008
a) median corrected calcium x phosphate product among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	66	2.3	3.2	4	4.3	4.7	5.1	5.2
2000	92	3.1	3.5	4	4.3	4.6	5.1	6.2
2001	114	2.9	3.6	3.9	4.3	4.6	5	6
2002	138	2.9	3.5	4	4.3	4.5	5.2	5.9
2003	169	2	3.3	3.8	4.1	4.4	5	5.5
2004	196	2.9	3.4	3.8	4.1	4.3	4.9	5.6
2005	219	2.1	3.2	3.6	3.9	4.2	4.7	5.6
2006	276	1.8	3.2	3.6	3.9	4.2	4.7	5.2
2007	302	2.2	3.2	3.6	3.9	4.1	4.5	5.4
2008	342	2.7	3.1	3.6	3.8	4.1	4.5	6

Figure 10.2.11(a): Variation in median corrected calcium x phosphate product among HD patients, HD centres, 2008

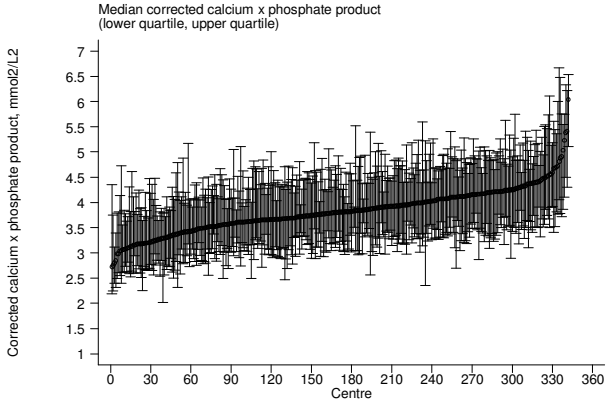


Figure 10.2.12(a): Variation in median corrected calcium x phosphate product among PD centres, to 2008

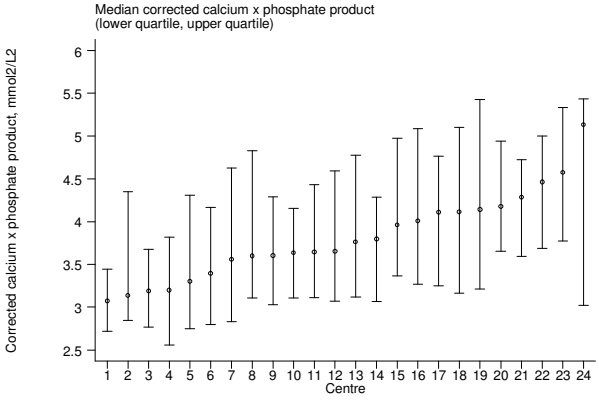


Table 10.2.12: Variation in corrected calcium x phosphate product among PD centres, 1999-2008
a) median corrected calcium x phosphate product among PD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	4.9	4.9
2003	19	2.9	2.9	3.4	3.6	3.9	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	4.2	4.4
2007	23	3.1	3.2	3.5	3.8	4.1	4.3	4.6
2008	24	3.1	3.1	3.5	3.7	4.1	4.6	5.1

With regards to the proportion of patients with calcium phosphate product less than 4.5 $mmol^2/L^2$, the median was 73% for HD centres (Table & Figure 10.2.11b) and 69.5% for PD centres (Table & Figure 10.2.12 b). This figure was the lowest ever achieved in PD centers for the last 10 years. There was 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 21% to 100%.(Table 10.2.11b) Among the PD centres, the proportion of patients with calcium phosphate product less than 4.5 $mmol^2/L^2$, ranged from 40% to 97% (Table 10.2.12b).

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
1999	66	18	31	47	55	65	91	100
2000	92	13	27	47.5	56	65.5	80	88
2001	114	18	38	47	57	70	82	91
2002	138	11	32	48	57	68	89	100
2003	169	25	33	52	62	72	88	100
2004	196	18	36	54.5	64	72.5	90	100
2005	219	23	45	58	69	77	93	100
2006	276	32	46	60.5	69	79	91	100
2007	302	30	48	62	72	81	92	100
2008	342	21	50	63	73	82	92	100

Figure 10.2.11(b): Variation in propotion of patients with corrected calcium x phosphate product < 4.5 $mmol^2/L^2$, HD centres 2008

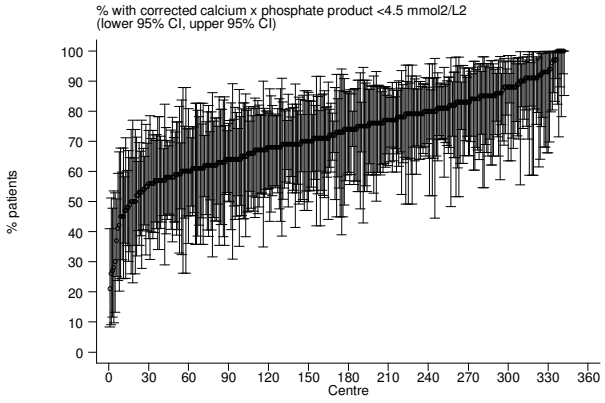


Figure 10.2.12(b): Variation in proportion of patients with corrected calcium x phosphate product < 4.5 $mmol^2/L^2$, PD centres, 2008

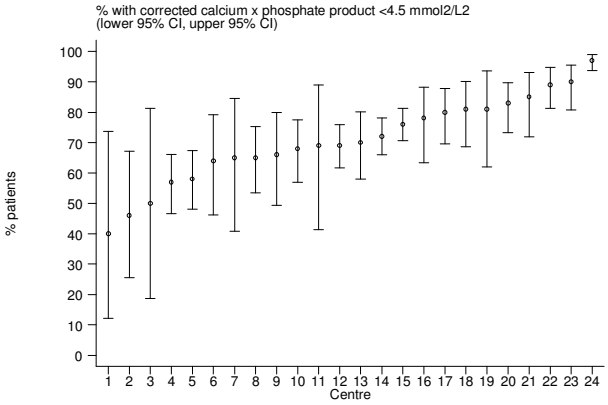


Table 10.2.12(b): Proportion of patients with corrected calcium x phosphate < 4.5 $mmol^2/L^2$, PD centres

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	9	59	59	65	72	77	79	79
2000	11	64	64	70	73	81	85	85
2001	12	50	50	71.5	75	81.5	84	84
2002	15	43	43	65	78	82	88	88
2003	19	61	61	64	75	82	100	100
2004	19	57	57	66	72	79	90	90
2005	20	55	55.5	65	73.5	78	84.5	85
2006	22	55	57	65	72	78	88	96
2007	23	50	51	63	73	79	89	98
2008	24	40	46	64.5	69.5	81	90	97

SECTION 10.3: SERUM PARATHYROID HORMONE CONTROL

Current trend showed that for the last 10 years, the intact parathyroid hormone (iPTH) level was on the rise in both HD and PD patients. PD patients had relatively higher level of iPTH compared to HD patients. The mean iPTH level for HD patients was 260.1ng/ml with the median of 126.2ng/ml (Table and Figure 10.3.1a). For PD patients, the mean iPTH level was 264.2ng/ml with the median of 170.3ng/ml. (Table and Figure 10.3.2a). There was higher percentage of HD patients with iPTH level less than 150 ng/ml (54%) compared to PD patients (46%). Diabetic patients had lower iPTH level than non diabetic patients in both HD and PD populations, with the mean of 208.4ng/ml vs. 300.4ng/ml for HD patients and 209.2ng/ml vs. 309.4ng/ml for PD patients. (Tables and Figures 10.3.1b, 10.3.1c, 10.3.2b and 10.3.2c)

Table 10.3.1(a): Distribution of iPTH, HD patients, 1999-2008

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
1999	1533	185.6	260.7	78.9	23.5	240	64	16	10	10
2000	2244	149.3	230	58	17.6	178.3	72	13	8	7
2001	2760	141.2	219.5	57	18	164.8	73	15	6	7
2002	3391	161.6	248	64	19	191	70	14	8	8
2003	4068	219.1	328.8	79	24.3	263.3	64	14	9	14
2004	4748	212.1	325.6	74.3	22.6	257.3	65	13	9	13
2005	5826	221.6	312.5	83.8	26.5	297	61	14	11	14
2006	7744	219.1	307.2	88	29	292	61	14	11	13
2007	9151	245.8	332.7	105	30.4	335.5	58	15	12	16
2008	10710	260.1	330.2	126.2	36	360	54	17	13	17

Figure 10.3.1(a): Cumulative distribution of iPTH, HD, 1999- 2008

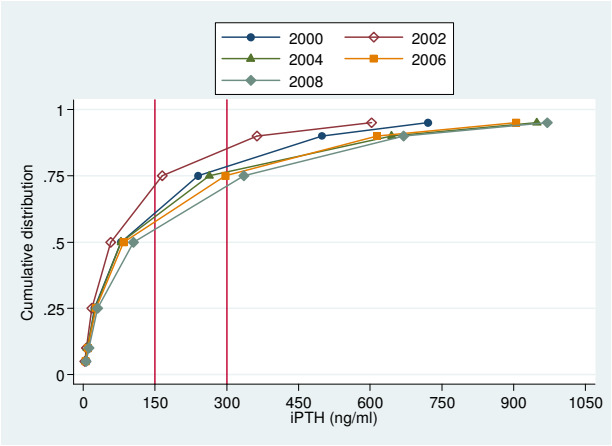


Figure 10.3.1(b): Cumulative distribution of iPTH, diabetic HD patients, 1999- 2008

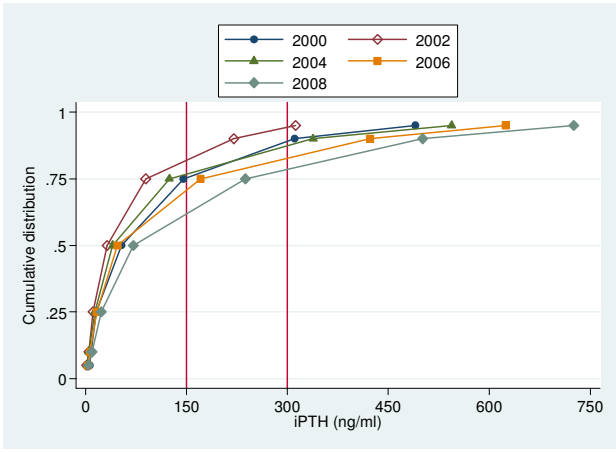


Table 10.3.1(b): Distribution of iPTH, diabetic HD patients, 1999- 2008

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
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	1581	113.4	196.3	38	14	118	80	10	5	5
2005	2164	150.7	248	47.5	16.3	171	72	12	8	8
2006	3146	154.6	252.1	54.3	20.9	173	72	12	8	7
2007	3804	184.4	269.5	71.1	23	237.8	65	14	10	10
2008	4692	208.4	275	98.2	29.1	286.3	59	17	12	12

Table 10.3.1(c): Distribution of iPTH, non diabetic HD patients, 1999- 2008

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
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	2819	262	361	108.5	33.6	331	57	16	10	17
2004	3167	261.3	363.9	102.8	31	341	58	14	12	17
2005	3662	263.5	338.1	115	36	365	55	15	13	17
2006	4598	263.3	332.7	125.3	39.6	366	54	16	13	17
2007	5347	289.5	364.9	135.8	39	406	52	15	13	20
2008	6018	300.4	362.5	156	43	423	49	17	14	21

Figure 10.3.1(c): Cumulative distribution of iPTH, non diabetic HD patients, 1999- 2008

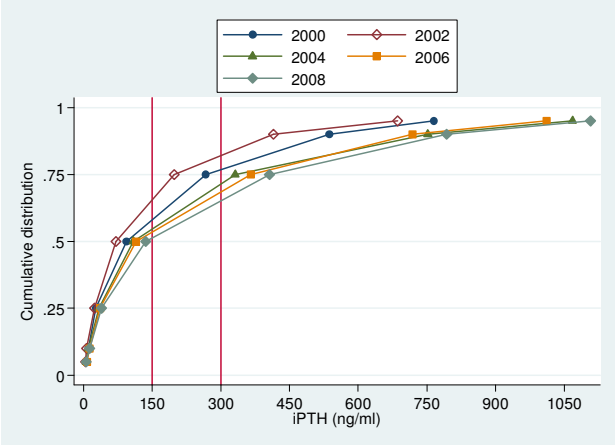


Figure 10.3.2(a): Cumulative distribution of iPTH, PD patients, 1999- 2008

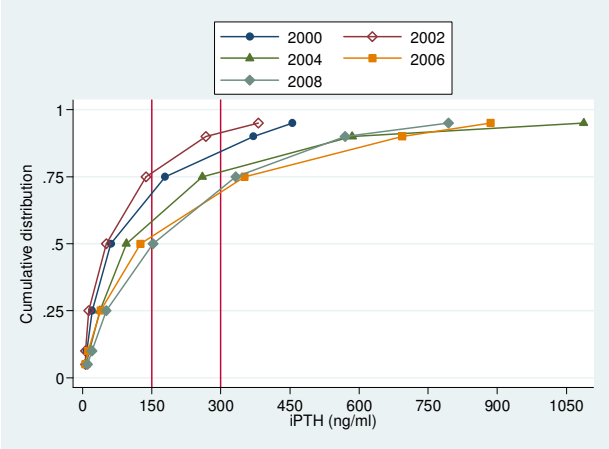


Table 10.3.2(a): Distribution of iPTH, PD patients, 1999- 2008

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
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
2008	1608	264.2	295.3	170.3	57.3	357.7	46	22	18	15

Table 10.3.2(b): Distribution of iPTH, diabetic PD patients, 1999-2008

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
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	166	65.4	87.4	32.8	7.5	82.5	87	10	2	1
2002	208	100.4	154.6	59.5	16	131.5	80	14	3	2
2003	330	122.9	176.2	68	29	154.3	74	16	6	4
2004	385	131.3	190.8	65.5	24.8	151	75	15	4	5
2005	372	162.4	237.8	73.1	24.5	197.3	70	16	8	7
2006	467	152.5	198.6	92	33	190	67	19	8	5
2007	575	177.2	204	113	42	239	58	25	11	6
2008	726	209.2	225.9	141.3	56	292.5	51	25	16	8

Figure 10.3.2(b): Cumulative distribution of iPTH, diabetic PD patients, 1999- 2008

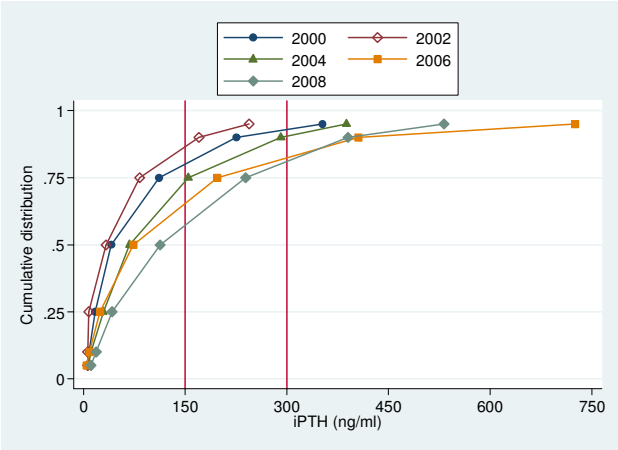


Figure 10.3.2(c): Cumulative distribution of iPTH, non diabetic PD patients, 1999- 2008

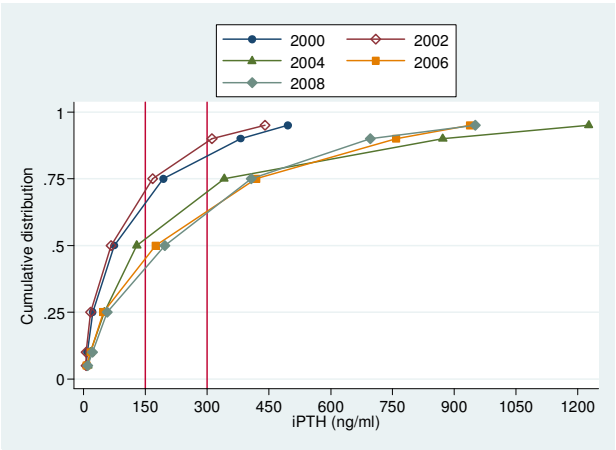


Table 10.3.2(c): Distribution of iPTH, non diabetic PD patients, 1999- 2008

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
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	365	127.4	175.1	67	17	168	72	18	7	4
2002	473	187.1	237.5	100	33	242	62	19	10	10
2003	608	288.6	390.1	129	50.5	341.5	54	18	10	17
2004	730	261.3	339.4	140.3	50	329	52	21	12	15
2005	699	292.1	328.6	174.5	48	419	46	19	16	19
2006	798	266.8	298.9	166.8	50	390	47	21	17	16
2007	861	296	337.4	197	57.7	407	44	20	18	18
2008	882	309.4	335.5	213.9	58	431	41	20	18	21

There was wide variation in iPTH among HD and PD centers and the degree of variation seemed to become wider since 1999. The variation also was noted to be greater among HD centers compared to PD centers. With regards to the proportion of patients with serum iPTH level in the range 150-300 ng/ml, the median was only 16% for HD centres (Table & Figure 10.3.3b) and 19.5% for PD centres (Table & Figure 10.3.4b).

Table 10.3.3(a): Variation in iPTH among HD centres 1999-2008
a) median iPTH among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	42	10	19.7	36.3	76	145.2	250	443.5
2000	59	5.6	15.5	30	51.5	94.1	355	487.5
2001	68	7.2	10.4	26.3	52.3	87	225.8	566.5
2002	93	1.4	10.8	27.9	46.5	136.5	309	660.3
2003	113	4	10.8	37.7	96.3	195.2	344.3	624.5
2004	134	3.6	12.4	30.5	76	203.5	412	702
2005	164	5.8	14.3	36.8	95.8	228.3	369.2	612.3
2006	220	7.7	16.5	41.7	89.9	208.3	377.5	681.3
2007	245	9.5	19.6	46	123	240.2	440.4	615
2008	286	8.5	22	55.6	131.2	255.8	399	716.9

Figure 10.3.3(a): Variation in median iPTH among HD patients, HD centres 2008

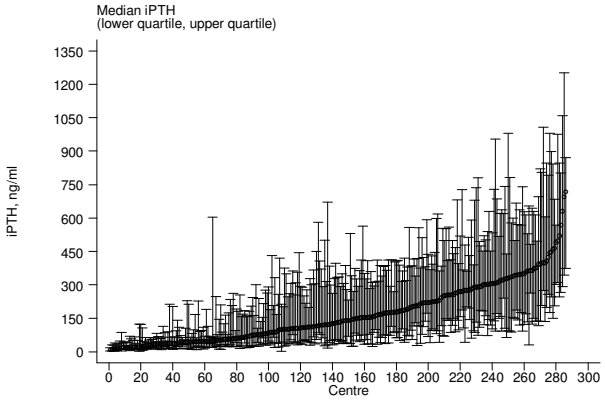


Figure 10.3.3(b): Variation in proportion of patients with iPTH 150-300ng/ml, HD centres, 2008

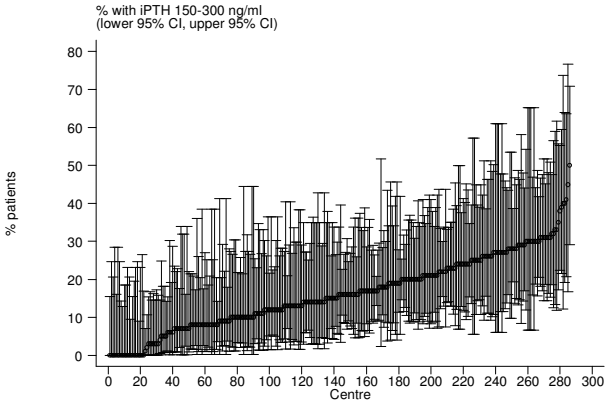


Table 10.3.3(b): Proportion of patients with iPTH 150-300ng/ml, HD centres, 1999-2008

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	42	0	0	9	16	23	33	37
2000	59	0	0	5	10	16	33	45
2001	68	0	0	5	10	20.5	31	40
2002	93	0	0	2	10	20	33	45
2003	113	0	0	7	14	21	38	43
2004	134	0	0	5	11	20	35	50
2005	164	0	0	6	13	19.5	33	47
2006	220	0	0	7	14	21	29	45
2007	245	0	0	8	15	21	30	53
2008	286	0	0	9	16	23	31	50

Table 10.3.4: Variation in iPTH among PD centres, 1999-2008
a) Median iPTH among PD patients

	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	8	16.5	16.5	49.9	75.2	87.5	200.9	200.9
2000	9	16	16	33	46.5	63.5	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	136	175	298.5	298.5
2004	18	41.5	41.5	74.5	138.8	169.3	329.1	329.1
2005	19	25	25	87.5	179.1	321.5	496.9	496.9
2006	21	34.5	36.9	101	177.5	233	386	429
2007	22	26.3	32	108.8	203.7	290.5	440	504
2008	22	34.5	62	144	206.6	310.9	352.3	454.5

Figure 10.3.4(a): Variation in median iPTH among PD patients, PD centres 2008

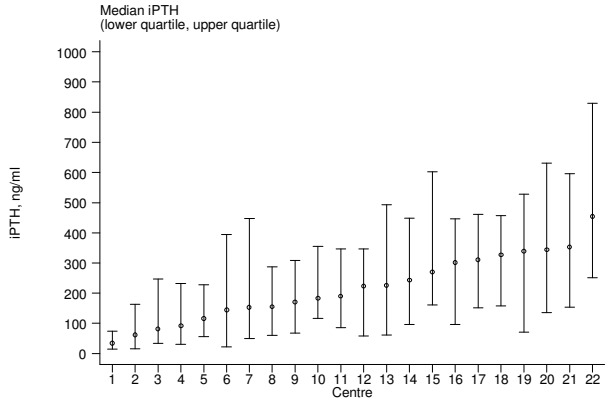


Figure 10.3.4(b): Variation in proportion of patients with iPTH 150-300ng/ml, PD centres 2008

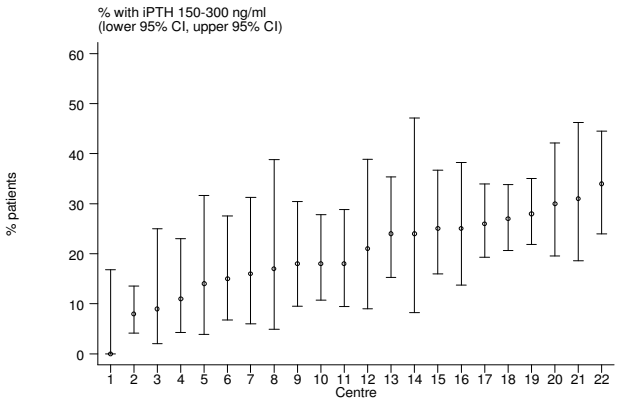


Table 10.3.4(b): Proportion of patients with iPTH 150-300ng/ml, PD centres 1999-2008

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	19	30	30
2002	14	0	0	10	15.5	21	24	24
2003	17	2	2	12	18	22	33	33
2004	18	7	7	14	20	25	30	30
2005	19	0	0	9	18	23	31	31
2006	21	5	6	14	20	26	32	42
2007	22	0	3	17	21	27	31	38
2008	22	0	8	15	19.5	26	31	34

Conclusion

There were no major changes in the type of phosphate binders used for both HD and PD patients. About 92% of HD patients and 86% of PD patients were still taking calcium carbonate as their phosphate binder in 2008. The use of lanthanum as phosphate binder has increased slowly since 2006 whereas the aluminium based phosphate binder continued to decrease. Calcitriol remained the main vitamin D used in both HD and PD patients and its use continued to rise. Paracalcitol was first introduced in Malaysia in 2006 and its usage remained around 0.2-0.3% in 2008. The percentage of patients who underwent parathyroidectomy has doubled in 2008 compared to 2005 among those HD and PD patients. This may be due to the increased availability of endocrine surgery services in more government hospitals in Malaysia and also due to a better awareness and understanding of the associated morbidity and mortality secondary to hyperparathyroidism.

The mean corrected serum calcium remained slightly lower in the HD patients (2.3 mmol/L) compared to PD patients (2.4 mmol/L). Phosphate control continued to be better in PD patients. The proportion of PD patients achieving target serum phosphate 1.13-1.78 mmol/L was 52% compared to 47% of HD patients. However, HD patients had shown an improved trend in phosphate control since 1998. More HD patients achieved the target serum calcium phosphate product of less than 4.5 $mmol^2/L^2$ (73%) compared with PD patients (69.5%) for year 2008.

The intact parathyroid hormone (iPTH) level seemed to be on increasing trend among both HD and PD patients. PD patients had relatively higher level of iPTH compared to HD patients. Interestingly, diabetic patients had lower iPTH level than non diabetic patients in both HD and PD populations. There was wide variation in iPTH level among HD and PD centers and the degree of variation seemed to become wider for the last 10 years. The variation was also greater among HD centers compared to PD centers.

There was consistently wide variation among HD and PD centres in achieving various target reflecting the differences in management of renal bone disease among dialysis centres.

CHAPTER 11

Hepatitis on Dialysis

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Clare Tan Hui Hong
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The prevalence of hepatitis C in HD patients continues to decline annually by 2-3%. This implies that there is greater awareness among dialysis staffs concerning the importance of stringent infection control measures in the prevention of hepatitis transmission within the dialysis facility. Prevalence of hepatitis B though low, is also declining annually. This may be due to the wider usage of hepatitis B vaccination in the dialysis and predialysis patients.

Prevalence of hepatitis B and C remains low in PD patients.

Table 11.1: Prevalence of positive HBsAg and positive Anti-HCV at annual survey, HD patients 1999-2008

Year	No. of subjects	Prevalence of HBsAg+ (%)	Prevalence of Anti-HCV+ (%)
1999	2991	6	23
2000	4386	6	25
2001	5187	6	23
2002	6106	5	20
2003	6977	5	19
2004	7618	5	17
2005	8957	4	14
2006	11295	5	12
2007	12496	5	11
2008	14832	4	9

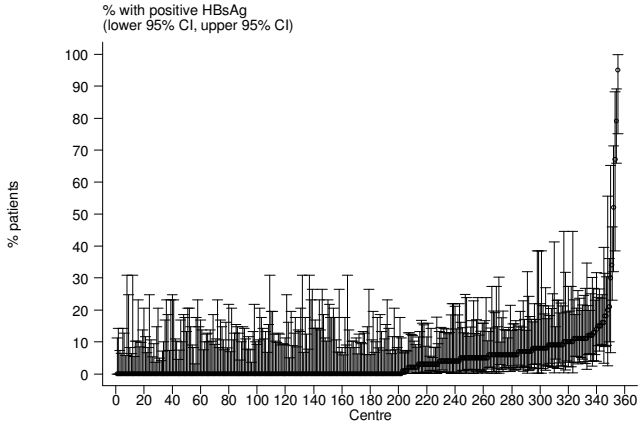
Table 11.2: Prevalence of positive HBsAg and positive Anti-HCV at annual survey, PD patients 1999-2008

Year	No. of subjects	Prevalence of HBsAg+ (%)	Prevalence of Anti-HCV+ (%)
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	1494	5	4
2007	1731	5	4
2008	2017	4	3

Table 11.3: Variation in Proportion of patients with positive HBsAg at annual survey among HD centres, 1999-2008

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	76	0	0	0	4	10	18	30
2000	108	0	0	0	4	9	14	80
2001	127	0	0	0	5	9	16	90
2002	152	0	0	0	3	8	13	26
2003	179	0	0	0	3	8	17	67
2004	203	0	0	0	3	8	15	92
2005	235	0	0	0	2	7	15	100
2006	289	0	0	0	0	6	16	94
2007	312	0	0	0	0	6.5	15	100
2008	355	0	0	0	0	6	13	95

Figure 11.3: Variation in Proportion of patients with positive HBsAg among HD centres, 2008



In terms of the proportion of hepatitis B patients, larger center to center variation is present among HD compared to PD centers, as some smaller HD centers may practice the policy of not accepting Hepatitis B patients while larger HD centers may be the referral centers for Hepatitis B patients.

Table 11.4: Variation in Proportion of patients with positive HBsAg at annual survey among PD centres, 1999-2008

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	4	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
2008	23	0	0	1	4	5	10	13

Figure 11.4: Variation in Proportion of patients with positive HBsAg among PD centres, 2008

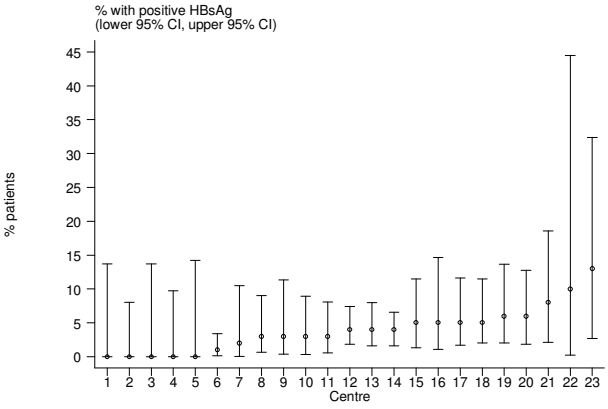


Figure 11.5: Variation in Proportion of patients with positive anti-HCV among HD centres, 2008

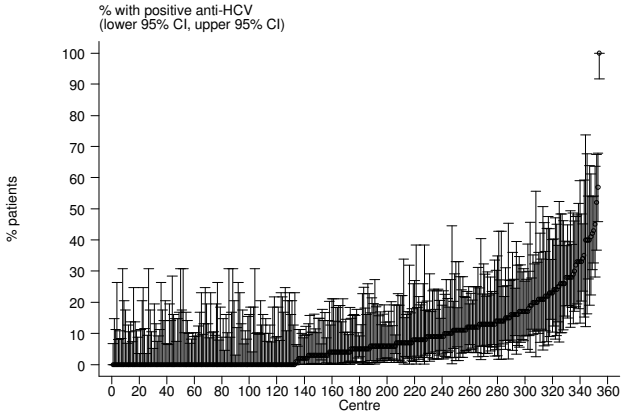


Table 11.5: Variation in Proportion of patients with positive anti-HCV at annual survey among HD centres, 1999-2008

Year	No. of centre	Min	5th cen-tile	LQ	Median	UQ	95th cen-tile	Max
1999	76	0	0	7	20	32.5	62	79
2000	108	0	0	9	19	32.5	67	87
2001	127	0	0	7	17	32	65	88
2002	152	0	0	5	14	26	54	96
2003	179	0	0	6	14	25	50	94
2004	205	0	0	4	11	25	50	100
2005	236	0	0	1	10	21	40	98
2006	289	0	0	0	8	17	43	98
2007	311	0	0	0	7	14	35	100
2008	354	0	0	0	5	12	32	100

The median proportion of HCV infected HD patients continue to decline annually even though there is still a wide center to center variation in the prevalence of HCV infection. There should be continuing measures to implement and standardize strict infection control policies in HD facilities in order to reduce this center to center variation. Regular audits should also be performed to ensure that centers adhere to these infection control policies and that the incidence of new seroconversion to hepatitis C within the HD facility does not continue to rise.

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

Table 11.6: Variation in Proportion of patients with positive anti-HCV among PD centres, 1999-2008

Year	No. of centre	Min	5th centile	LQ	Median	UQ	95th centile	Max
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	7	9	9
2004	19	0	0	0	4	7	10	10
2005	20	0	0	2	4	7.5	10	10
2006	22	0	0	1	2.5	6	8	11
2007	23	0	0	0	2	6	8	9
2008	23	0	0	0	3	4	5	9

Figure 11.6: Variation in Proportion of patients with positive anti-HCV among PD centres, 2008

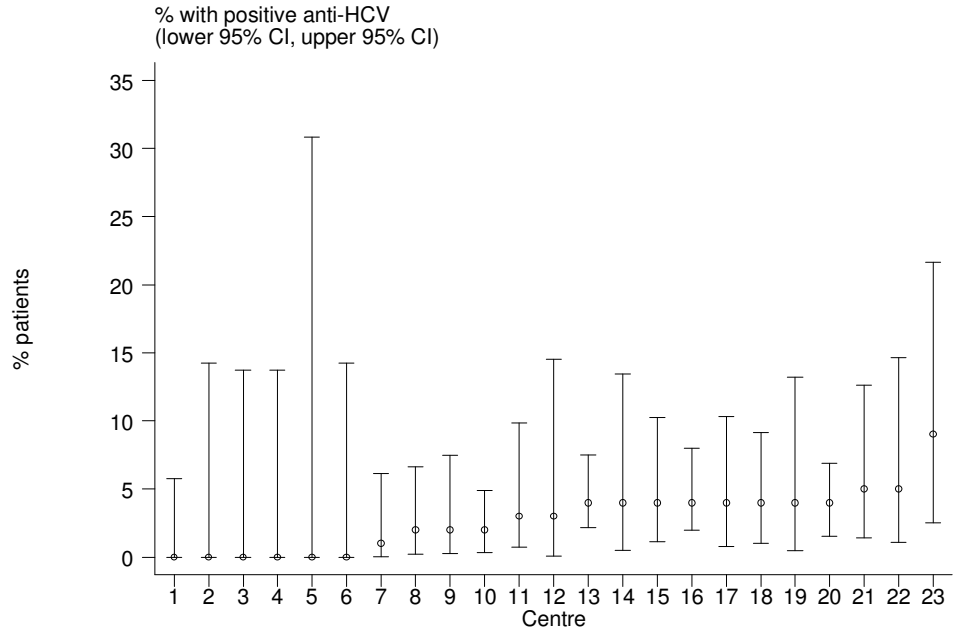


Table 11.7a: Risk factors in relation to HD practices for seroconversion to anti-HCV positive among sero-negative patients

Risk factor	Number of patients	Risk Ratio	95% CI	p-value
Assistance to Perform HD				
(1) Self care (ref)	175	1.00		
(2) Partial self care	140	0.70	(0.56, 0.87)	0.002
(3) Completely assisted	361	0.45	(0.37, 0.54)	0.000
Dialyzer Reuse				
(1) less than 10 (ref)	310	1.00		
(2) more than 10	392	0.85	(0.73, 0.99)	0.041
Dialyzer Reprosessing System				
(1) Fully Auto (ref)	369	1.00		
(2) Semi Auto	47	0.77	(0.57, 1.05)	0.095
(3) Manual	37	0.82	(0.59, 1.16)	0.269
Age				
(1) <=20 (ref)	40	1.00		
(2) 21-40	235	0.80	(0.57, 1.13)	0.209
(3) 41-60	330	0.42	(0.30, 0.59)	0.000
(4) >60	97	0.18	(0.12, 0.26)	0.000
Gender				
(1) Female (ref)	281	1.00		
(2) Male	421	1.16	(1.00, 1.35)	0.056
Diabetes				
(1) No (ref)	522	1.00		
(2) Yes	180	0.36	(0.30,0.42)	0.000
Previous Renal Transplant				
(1) No (ref)	584	1.00		
(2) Yes	118	4.95	(4.02, 6.10)	0.000
History of Blood Transfusion				
(1) No (ref)	395	1.00		
(2) Yes	307	1.40	(1.21,1.63)	0.000

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 had a lower risk of acquiring HCV infection, and interestingly diabetic patients had lower seroconversion risks. Completely assisted patients are fully assisted by trained staffs and thus more stringent infection control measures may be practiced with these patients compared to self assisted and partially assisted patients. Completely assisted patients also tend to have more co morbidities such as diabetes, and as such this may explain why there is a lower tendency to acquire HCV infection among diabetics.

Table 11.7b: Risk factors for seroconversion to anti-HCV positive among sero-negative patients in PD

Risk factor	Number of patients	Risk Ratio	95% CI	p-value
Age				
(1) <=20 (ref)	4	1.00		
(2) 21-40	22	3.54	(1.21, 10.32)	0.021
(3) 41-60	26	1.99	(0.69, 5.72)	0.202
(4) >60	3	0.35	(0.08, 1.58)	0.172
Gender				
(1) Female (ref)	28	1.00		
(2) Male	27	0.97	(0.57, 1.65)	0.900
Diabetes				
(1) No ref	46	1.00		
(2) Yes	9	0.23	(0.11, 0.47)	0.000
Switch from PD to HD				
(1) No (ref)	35	1.00		
(2) Yes	20	6.81	(3.89, 11.93)	0.000
Previous Renal Transplant				
(1) No (ref)	48	1.00		
(2) Yes	7	2.50	(1.12, 5.58)	0.026
History of Blood Transfusion				
(1) No (ref)	23	1.00		
(2) Yes	32	2.29	(1.33, 3.92)	0.003

Similar to HD, previous renal transplant and blood transfusion were risk factors for seroconversion. CAPD patients who were switched from HD also tended to have a higher risk. This may be due to previous exposure to Hepatitis C while they were on HD. Similar to HD, there was also a trend for increased risk of seroconversion in younger patients. This finding need further studies looking into other factors for acquiring hepatitis C which may be more prevalent in younger patients such as sexual promiscuity, use of recreational drugs etc.

Conclusion

Nosocomial transmission in HD has been implicated for the higher HCV prevalence in HD compared to PD. Even though our efforts to reduce the overall prevalence of HCV in HD have been successful, a wide center to center variation still remains, especially for HCV infection. The challenges for the future would be to prevent new seroconversion within the HD facility and for this we will need to look into aspects of our current HD practices such as dialyzer reuse practices, degree of infection control measures practiced as well as 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, 1999-2008

Access types	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
Wrist AVF	2406	81	3561	82	4049	79	4680	78	5249	75
BCF*	431	14	655	15	897	17	1068	18	1359	19
Venous graft	8	0	11	0	19	0	14	0	23	0
Artificial graft	34	1	31	1	64	1	78	1	113	2
Permanent CVC	17	1	19	0	25	0	43	1	61	1
Temporary CVC*	77	3	77	2	90	2	138	2	179	3
Temporary FVC*	0	0	0	0	0	0	0	0	0	0
TOTAL	2973	100	4354	100	5144	100	6021	100	6984	100

Access types	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
Wrist AVF	5891	73	6405	69	7798	68	8309	65	9417	62
BCF*	1693	21	2169	23	2856	25	3421	27	4366	29
Venous graft	41	1	30	0	22	0	37	0	19	0
Artificial graft	149	2	221	2	284	2	305	2	349	2
Permanent CVC	99	1	179	2	235	2	261	2	297	2
Temporary CVC*	233	3	266	3	298	3	424	3	575	4
Temporary FVC*	0	0	4	0	19	0	25	0	59	0
TOTAL	8106	100	9274	100	11512	100	12782	100	15082	100

*CVC = central venous catheter BCF = brachiocephalic fistula
*FVC = femoral venous catheter

There proportion of patients with native vascular access was 91% in 2008. Dialysis catheter usage has increased to 6% in 2008 compared to 5% in 2007.

Table 12.1.2: Difficulties report with Vascular Access, 1999-2008

Access difficulty	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
Difficulty with needle placement	133	5	146	4	217	5	215	4	217	3
Difficulty in obtaining desired blood flow rate	112	5	136	4	239	5	235	4	243	4
Other difficulties	55	2	32	1	39	1	57	1	60	1
No difficulties	2155	88	3402	92	4276	90	5073	91	5970	92
TOTAL	2455	100	3716	100	4771	100	5580	100	6490	100

Access difficulty	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
Difficulty with needle placement	255	3	319	4	394	3	478	4	409	3
Difficulty in obtaining desired blood flow rate	301	4	354	4	356	3	368	3	419	3
Other difficulties	67	1	58	1	45	0	57	0	81	1
No difficulties	6957	92	8339	92	10592	93	11577	93	13967	94
TOTAL	7580	100	9070	100	11387	100	12480	100	14876	100

Table 12.1.3: Complications reported with Vascular Access, 1999-2008

Complication	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
Thrombosis	129	5	148	4	209	4	202	3	220	3
Bleed	23	1	30	1	62	1	66	1	54	1
Aneurysmal dilatation	159	6	208	5	212	4	211	4	199	3
Swollen limb	51	2	44	1	67	1	56	1	55	1
Access related infection, local/ systemic	34	1	52	1	49	1	52	1	43	1
Distal limb ischaemia	9	0	26	1	22	0	17	0	13	0
Venous outflow obstruction	71	3	78	2	123	2	101	2	119	2
Carpal tunnel	35	1	42	1	41	1	44	1	63	1
Others	64	2	37	1	74	1	118	2	118	2
No complications	2119	79	3237	83	4204	83	4988	85	5963	87
TOTAL	2694	100	3902	100	5063	100	5855	100	6847	100

Complication	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
Thrombosis	284	4	289	3	317	3	405	3	436	3
Bleed	67	1	73	1	69	1	58	0	75	1
Aneurysmal dilatation	193	2	179	2	246	2	385	3	386	3
Swollen limb	77	1	84	1	89	1	101	1	98	1
Access related infection, local/ systemic	70	1	63	1	78	1	97	1	92	1
Distal limb ischaemia	37	0	35	0	30	0	27	0	31	0
Venous outflow obstruction	151	2	170	2	202	2	196	2	239	2
Carpal tunnel	49	1	55	1	48	0	46	0	46	0
Others	133	2	109	1	116	1	152	1	164	1
No complications	6896	87	8113	88	10154	89	11052	88	13419	90
TOTAL	7957	100	9170	100	11349	100	12519	100	14986	100

Complication rates have remained similar for the past few years despite an increase in intake of elderly and diabetic patients onto dialysis in recent years.

SECTION 12.2: HD PRESCRIPTION

There was no further increase in proportion of patients with blood flow rate above 250ml/min in 2008 compared to 2007. Sixty two percent of patients had blood flow rates of ≥ 300mls/min in 2008. About 1% of patients have a blood flow rate of < 200mls/min.

Table 12.2.1: Blood Flow Rates in HD centres, 1999-2008

Blood flow rates	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
<150 ml/min	6	0	9	0	7	0	9	0	4	0
150-199 ml/min	65	2	85	2	69	1	69	1	84	1
200-249 ml/min	962	33	1282	30	1233	25	973	17	882	13
250-299 ml/min	1367	47	1938	46	2229	44	2692	46	2865	42
300-349 ml/min	455	16	814	19	1276	25	1590	27	2241	33
>=350 ml/min	31	1	94	2	216	4	505	9	690	10
TOTAL	2886	100	4222	100	5030	100	5838	100	6766	100

Blood flow rates	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
<150 ml/min	11	0	7	0	5	0	10	0	10	0
150-199 ml/min	86	1	94	1	103	1	87	1	119	1
200-249 ml/min	879	11	814	9	923	8	929	7	927	6
250-299 ml/min	3112	40	3523	39	3818	34	3821	31	4591	31
300-349 ml/min	2711	35	3226	36	4529	40	5214	42	6063	41
>=350 ml/min	1020	13	1328	15	1920	17	2451	20	3089	21
TOTAL	7819	100	8992	100	11298	100	12512	100	14799	100

Figure 12.2.1: Blood Flow Rates in HD centres, 1999-2008

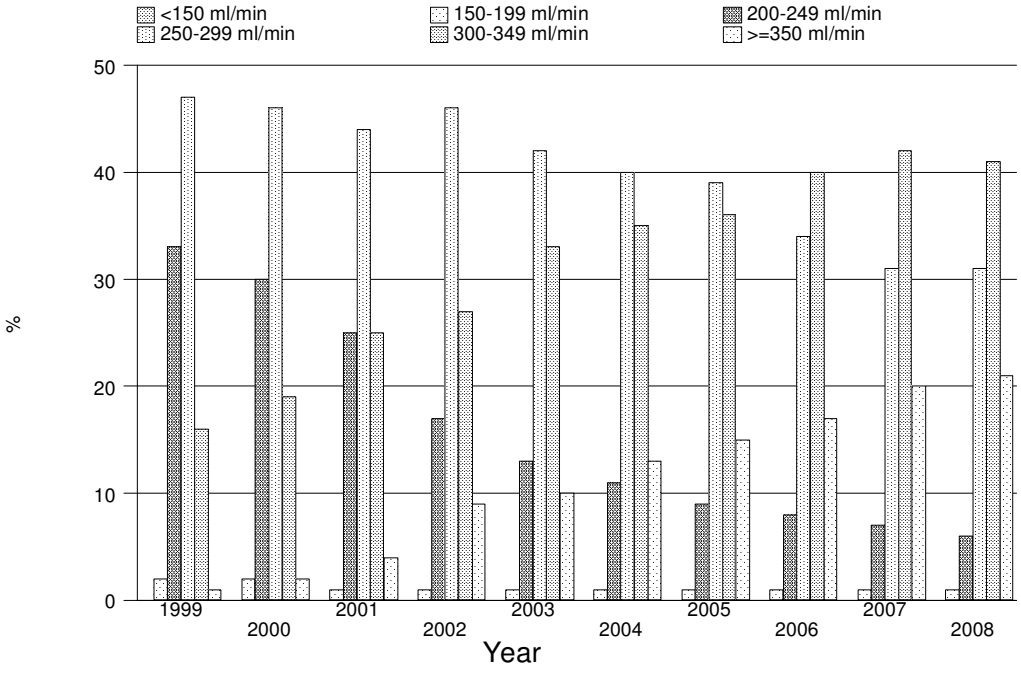


Table 12.2.2: Number of HD Sessions per week, 1999-2008

HD sessions per week	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
1	4	0	8	0	8	0	10	0	15	0
2	153	5	341	8	337	7	369	6	343	5
3	2811	95	3982	92	4761	92	5603	93	6585	95
4	3	0	10	0	50	1	18	0	9	0
TOTAL	2971	100	4341	100	5156	100	6000	100	6952	100

HD sessions per week	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
1	11	0	7	0	25	0	14	0	5	0
2	281	3	265	3	273	2	256	2	259	2
3	7751	96	9011	97	11326	97	12602	98	14935	98
4	30	0	31	0	34	0	31	0	61	0
TOTAL	8073	100	9314	100	11658	100	12903	100	15260	100

The majority of patients (98%) were on 3 dialysis sessions per week. Two percent of patients were still reported to be on 2 only dialysis sessions per week. In 2008, 61 patients have been prescribed 4 dialysis sessions per week.

Table 12.2.3: Duration of HD, 1999-2008

Duration of HD per session	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
<=3 hours	4	0	10	0	8	0	18	0	14	0
-3.5 hours	9	0	12	0	12	0	15	0	3	0
-4 hours	2738	92	4088	94	4988	97	5854	98	6798	98
-4.5 hours	157	5	154	4	93	2	60	1	66	1
-5 hours	61	2	75	2	59	1	47	1	63	1
>5 hours	0	0	13	0	0	0	0	0	0	0
TOTAL	2969	100	4352	100	5160	100	5994	100	6944	100

Duration of HD per session	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
<=3 hours	25	0	31	0	28	0	37	0	54	0
-3.5 hours	11	0	9	0	6	0	11	0	10	0
-4 hours	7885	98	9175	99	11507	99	12792	99	15081	99
-4.5 hours	106	1	46	0	66	1	23	0	74	0
-5 hours	45	1	52	1	42	0	31	0	42	0
>5 hours	3	0	0	0	1	0	1	0	0	0
TOTAL	8075	100	9313	100	11650	100	12895	100	15261	100

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

Table 12.2.4: Dialyser membrane types in HD centres, 1999-2008

Dialyser membrane	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
Modified Cellulose	1224	41	1611	37	1666	37	1377	24	1150	17
Regenerated Cellulose	1017	34	1190	27	890	20	1474	26	1599	24
Hydrophobic/Hypdrophilic	754	25	1589	36	1944	43	2828	50	3841	58
Hydrophilized copolymers	1	0	0	0	0	0	1	0	35	1
TOTAL	2996	100	4390	100	4500	100	5680	100	6625	100

Dialyser membrane	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
Modified Cellulose	1719	22	1974	22	2489	22	2890	23	3389	23
Regenerated Cellulose	1150	15	930	10	997	9	699	5	486	3
Hydrophobic/Hypdrophilic	4846	62	6020	66	7860	68	8984	71	10621	72
Hydrophilized copolymers	74	1	150	2	161	1	137	1	286	2
TOTAL	7789	100	9074	100	11507	100	12710	100	14782	100

The use of synthetic membrane (hydrophobic/ hydrophilic and hydrophilised copolymer) has increased from 25% in 1999 to 74% in 2008. Regenerated cellulose membrane usage has progressively declined from 34% in 1999 to 3% in 2008. The use of modified cellulose membrane has remained the same at about 23% for the past few years.

Figure 12.2.4: Dialyser membrane types in HD centres, 1999-2008

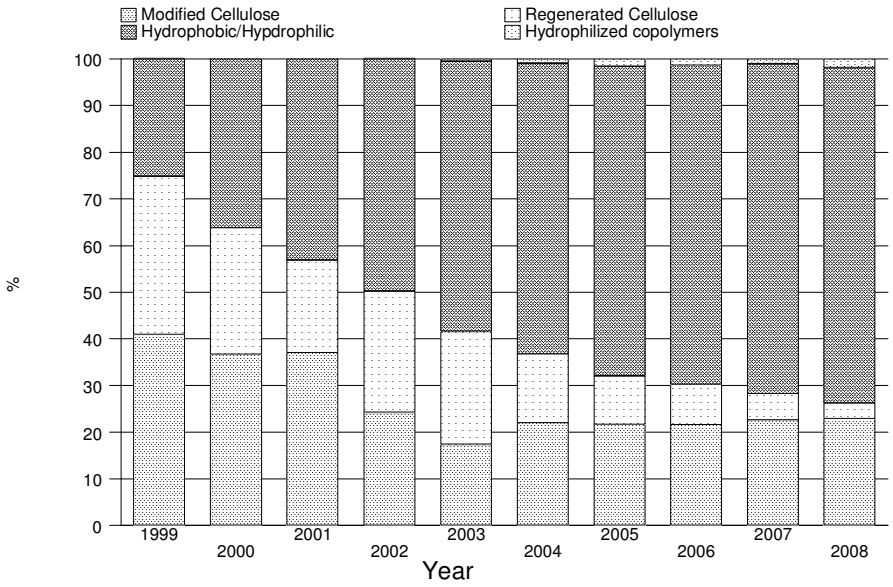


Table 12.2.5: Dialyser Reuse Frequency in HD centres, 1999-2008

Dialyser Reuse Frequency	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
1	65	2	116	3	152	3	197	4	251	4
2	13	0	17	0	15	0	41	1	19	0
3	191	7	205	5	232	5	316	6	349	5
4	250	9	477	12	416	9	337	6	339	5
5	264	10	312	8	357	7	318	6	267	4
6	1414	51	1730	43	1413	29	1216	22	915	14
7	46	2	69	2	85	2	124	2	71	1
8	122	4	357	9	793	16	866	16	852	13
9	179	6	101	2	132	3	59	1	87	1
10	96	3	246	6	400	8	538	10	880	14
11	6	0	4	0	43	1	36	1	25	0
12	118	4	333	8	470	10	879	16	1511	24
≥ 13	0	0	91	2	331	7	644	12	819	13
TOTAL	2764	100	4058	100	4839	100	5571	100	6385	100

Dialyser Reuse Frequency	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
1	319	4	196	4	400	5	568	5	810	5
2	42	1	1	0	5	0	24	0	29	0
3	194	3	81	2	36	0	117	1	87	1
4	192	3	85	2	75	1	151	1	120	1
5	192	3	137	3	190	3	128	1	168	1
6	806	11	555	10	593	8	809	7	673	5
7	89	1	44	1	63	1	141	1	156	1
8	809	11	477	9	422	6	797	7	842	6
9	50	1	46	1	115	2	107	1	236	2
10	1160	16	770	15	959	13	1530	13	1994	13
11	42	1	12	0	100	1	94	1	101	1
12	1916	26	1353	26	2243	30	4075	36	5254	35
≥ 13	1644	22	1548	29	2191	30	2830	25	4422	30
TOTAL	7455	100	5305	100	7392	100	11371	100	14892	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 their dialysers.

Table 12.2.6: Dialyser Buffer used in HD centres, 1999-2008

Dialyser Buffer	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
Acetate	552	19	393	9	240	5	138	2	76	1
Bicarbonate	2429	81	3969	91	4920	95	5880	98	6815	99
TOTAL	2981	100	4362	100	5160	100	6018	100	6891	100

Dialyser Buffer	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
Acetate	33	0	24	0	12	0	40	0	3	0
Bicarbonate	7957	100	9268	100	11640	100	12853	100	15216	100
TOTAL	7990	100	9292	100	11652	100	12893	100	15219	100

In 2008, 3 patients were still using acetate as a buffer. Almost all patients were on bicarbonate dialysate buffer in 2008 compared to 70% in 1998.

Table 12.2.7(a): Distribution of prescribed Kt/V, HD patients 1999-2008

Year	No. of subject	Mean	SD	Median	LQ	UQ	% patients ≥ 1.3
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	6525	1.6	0.4	1.6	1.3	1.8	79
2004	7457	1.6	0.4	1.6	1.4	1.8	81
2005	8749	1.6	0.4	1.6	1.4	1.8	81
2006	11092	1.6	0.4	1.6	1.3	1.8	77
2007	12354	1.6	0.4	1.6	1.3	1.8	78
2008	14635	1.6	0.4	1.6	1.3	1.8	79

The mean and median prescribed Kt/V was 1.6. The percentage of patients with Kt/V ≥ 1.3 in 2008 was 79%. This was a slight drop compared to 81% in 2005.

Figure 12.2.7(a): Cumulative distribution of prescribed Kt/V, HD patients 1999-2008

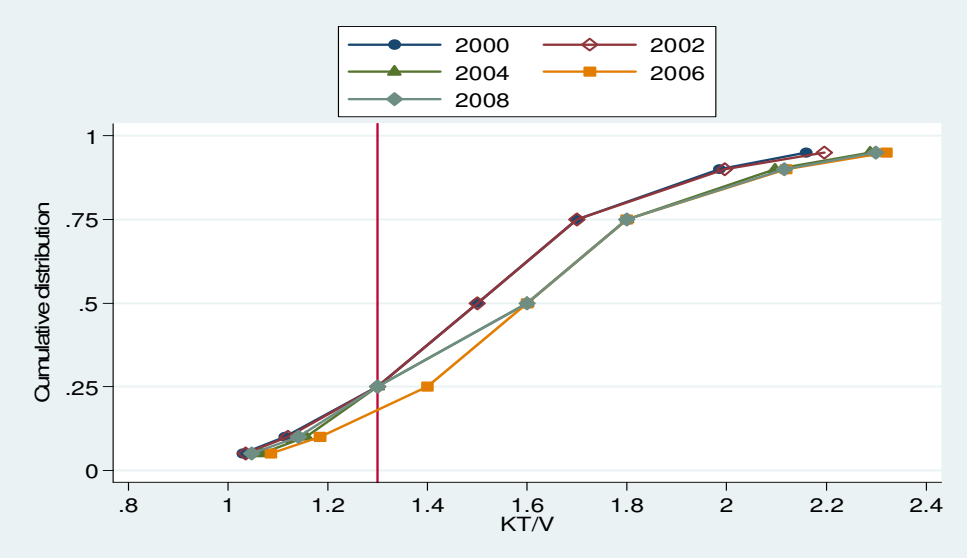


Table 12.2.7(b): Distribution of delivered Kt/V, HD patients 2005-2008

Year	No. of subject	Mean	SD	Median	LQ	UQ	% patients ≥ 1.2	% patients ≥ 1.3	Variance*
2005	1673	1.6	2.7	1.4	1.2	1.7	80	61	0
2006	5389	1.4	2.4	1.4	1.2	1.6	75	57	0
2007	6171	1.4	0.6	1.4	1.2	1.6	78	60	0
2008	7855	1.4	0.4	1.4	1.2	1.6	78	58	0

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

The prescribed median Kt/V was 1.6 but the delivered median Kt/V was only 1.4. The percentage of patients with a delivered Kt/V ≥ 1.3 was only 58% and has decreased compared to 60% in 2007. The percentage of patients with URR ≥ 65 was 79% and has remained the same since 2005. The median URR was 71.7 for 2008. It has remained relatively stable since 2005.

Figure 12.2.7 (b): Cumulative distribution of delivered Kt/V, HD patients 2005-2008

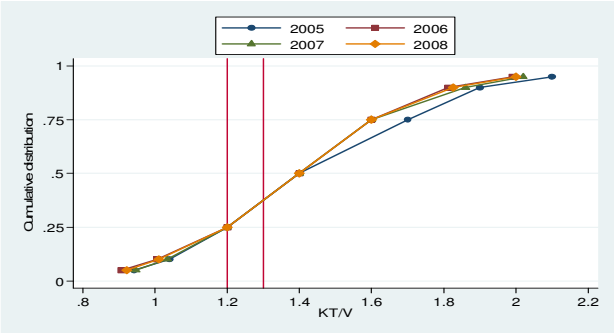


Figure 12.2.7 (c): Cumulative distribution of URR, HD patients 2005-2008

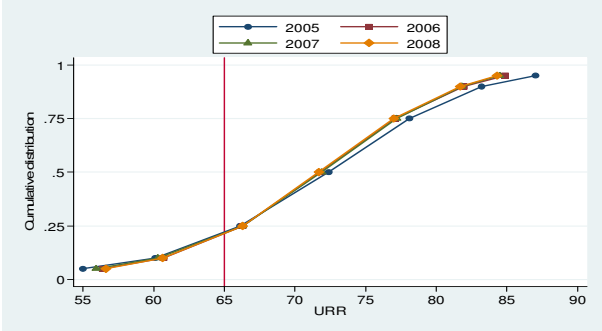


Table 12.2.7(c): Distribution of URR, HD patients 2005-2008

Year	No. of subject	Mean	SD	Median	LQ	UQ	% patients ≥ 65
2005	2543	71.8	10.3	72.4	66.1	78.1	79
2006	8267	71.4	9.2	71.8	66.3	77.1	79
2007	9945	71.3	9.2	71.9	66.3	77.2	79
2008	12484	71.3	8.7	71.7	66.3	77	79

Table 12.2.8: Variation in HD prescription among HD centres 2008

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

Year	No. of centers	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	302	200	250	280	300	300	350	400
2008	352	200	250	280	300	300	350	400

The median blood flow rates among centres had increased from 250 mls/min in 1999 to 300 mls/min in 2008. There was still a wide variation in practices among centres. The median blood flow rates among centres ranges from 200 mls/min to 400 mls/min.

Figure 12.2.8 (a): Variation in medical blood flow rates in HD patients among centres 2008

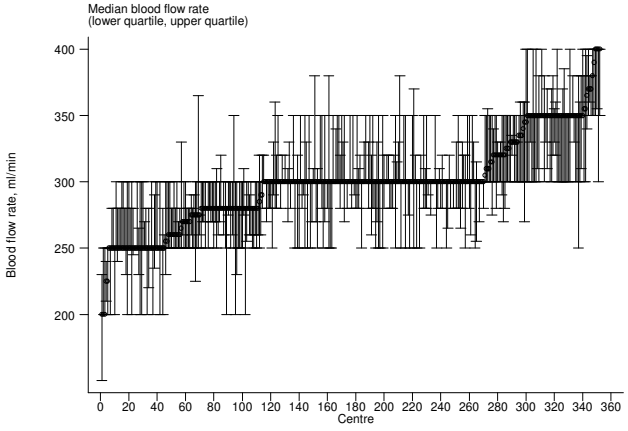
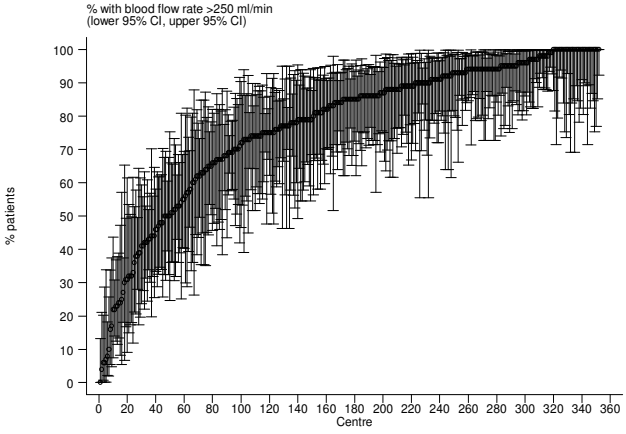


Figure 12.2.8 (b): Variation in Proportion of patients with blood flow rates > 250 ml/min among HD centres 2008



(b) Proportion of patients with blood flow rates > 250 ml/min, HD centres 2008

Year	No. of centers	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	302	0	22	65	83	93	100	100
2008	352	0	30	68	85	94	100	100

There was an increase in the proportion of patients with blood flow rates > 250 mls/min. in 2008. Fifty percent of centres had 85% of their patients with blood flow rates of > 250 mls/min compared to only 28% in 1999.

There was still a wide variation in the proportion of patients with blood flow rate > 250 mls/min among centres. There was one centre that had no patients with blood flow rates of > 250 mls/min in 2008.

Table 12.2.8 (c): Proportion of patients with 3 HD sessions per week, HD centres 2008

Year	No. of centers	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	309	51	87	98	100	100	100	100
2008	356	51	89	98	100	100	100	100

The majority of centres had 100% of their patients with 3 HD sessions/ week. There was one centres with 50% 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 2008

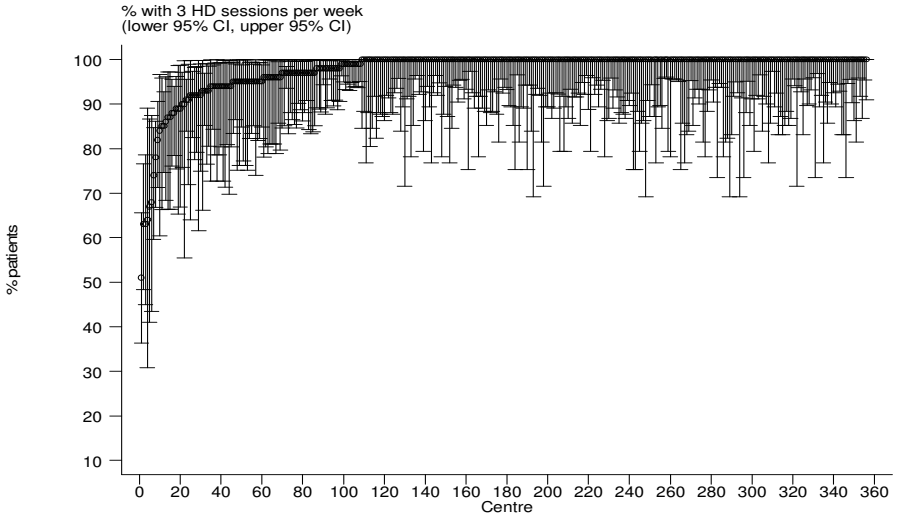


Table 12.2.8 (d): Median prescribed Kt/V in HD patients, HD centres

Year	No. of centers	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	1.4	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	302	1.1	1.3	1.4	1.6	1.7	1.8	2.1
2008	350	1.1	1.3	1.4	1.6	1.7	1.9	2.1

The median prescribed Kt/V in HD patients was 1.6 in 2008. The minimum prescribed Kt/V was 1.1 and maximum Kt/V was 2.1.

Figure 12.2.8 (d): Variation in median prescribed Kt/V in HD patients among HD centres 2008

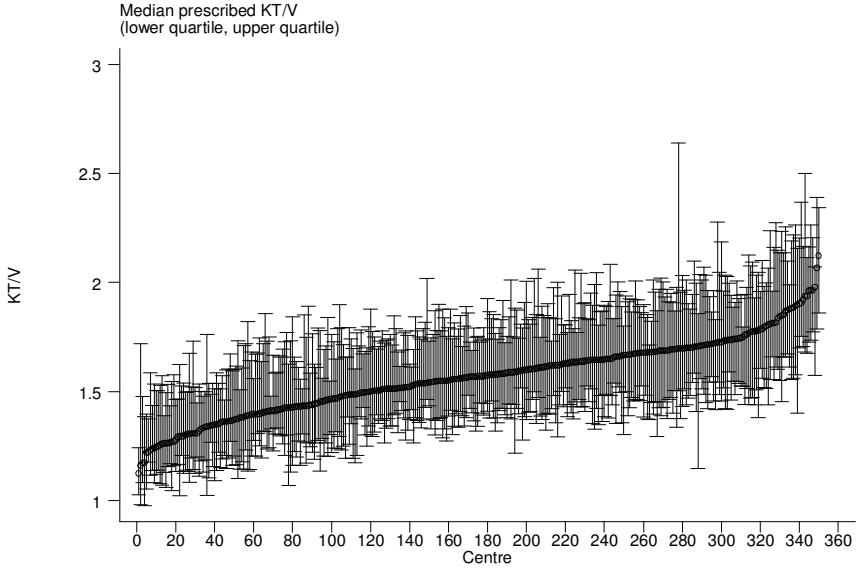


Table 12.2.8 (e): Proportion of patients with prescribed Kt/V ≥ 1.3

Year	No. of centers	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
1999	67	29	45	64	73	84	94	100
2000	99	26	43	64	78	84	94	100
2001	114	33	42	67	75	83	93	100
2002	132	26	43	65	74.5	83	92	98
2003	150	30	48	71	81	89	96	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	302	21	50	67	80	89	96	100
2008	350	14	47	68	83	89	97	100

In 2008, half the centres had 83% 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. One centre was noted to have less than 20% of their patients with prescribed Kt/V ≥ 1.3.

Figure 12.2.8 (e): Variation in proportion of patients with prescribed Kt/V ≥ 1.3 among HD centres 2008

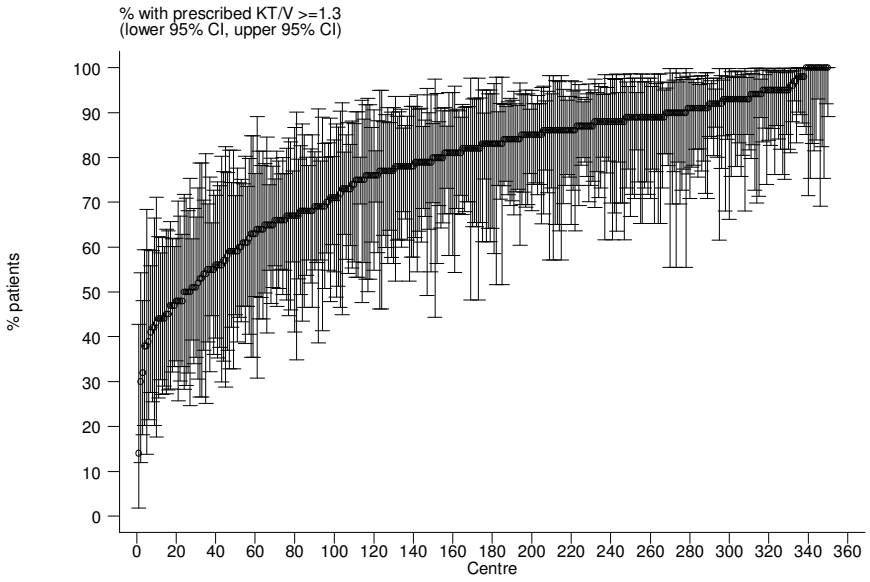


Table 12.2.8 (f): Median delivered Kt/V in HD patients, HD centres

Year	No. of centers	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2005	49	1.2	1.2	1.3	1.4	1.5	1.7	1.7
2006	142	1	1.1	1.3	1.4	1.5	1.6	1.8
2007	157	1.1	1.2	1.3	1.4	1.5	1.7	1.8
2008	191	1	1.2	1.3	1.4	1.5	1.6	1.8

The median delivered Kt/V of HD centres was 1.4. The variation of median delivered Kt/V ranged from 1 to 1.8 in 2008

Figure 12.2.8 (f): Variation in median delivered Kt/V in HD patients among HD centres 2008

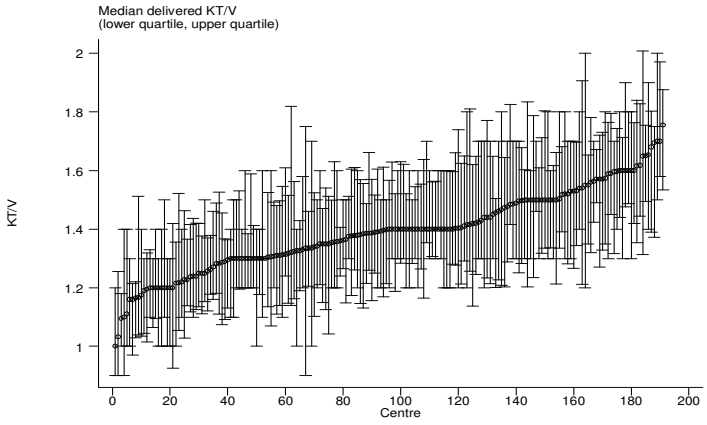


Table 12.2.8 (g): Proportion of patients with delivered Kt/V ≥ 1.2

Year	No. of centers	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2005	49	50	55	70	82	88	100	100
2006	142	0	44	64	75	85	93	100
2007	157	27	49	68	79	88	96	100
2008	191	25	49	69	80	87	98	100

In 2008, 50% of centres had 80% of their patients with a delivered Kt/V ≥ 1.2. There were 8 centres with < 40% of their patients with a delivered Kt/V ≥ 1.2 in 2008 compared to only 3 in 2007.

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

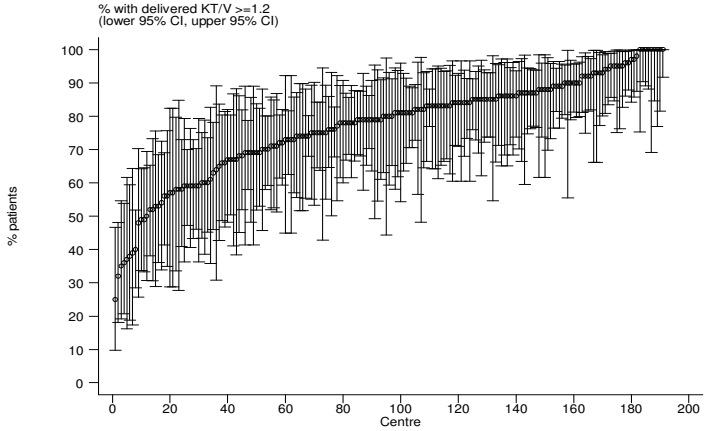


Table 12.2.8 (h): Median URR among HD patients, HD centres 2005-2008

Year	No. of centers	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2005	73	61.3	65.5	69.9	72	74.4	85.9	96.2
2006	214	55.4	64.2	68.9	71.5	74.3	78.2	94.4
2007	245	56.1	65.3	69.6	71.8	74.8	78	95.5
2008	307	57.6	63.5	68.5	71.7	74.4	77.9	93.6

The median URR for 2008 was 71.7%. The number of centres reporting URR has increased from 73 in 2005 to 307 centres in 2008. The variation of URR ranged from 57.6 to 77.9 in 2008.

Figure 12.2.8 (h): Variation in median URR among HD patients, HD centres 2008

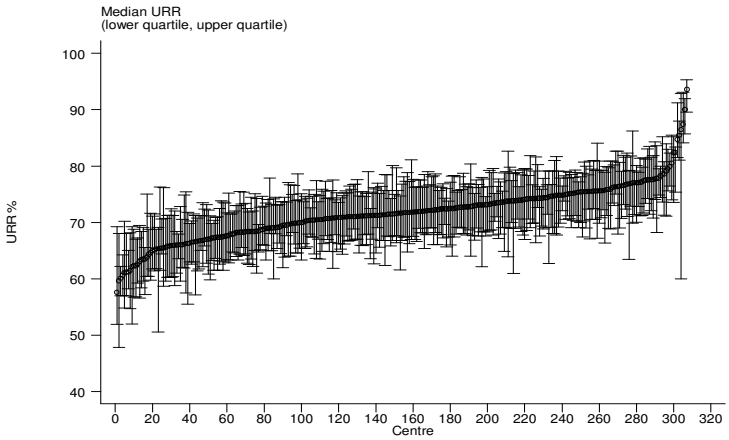
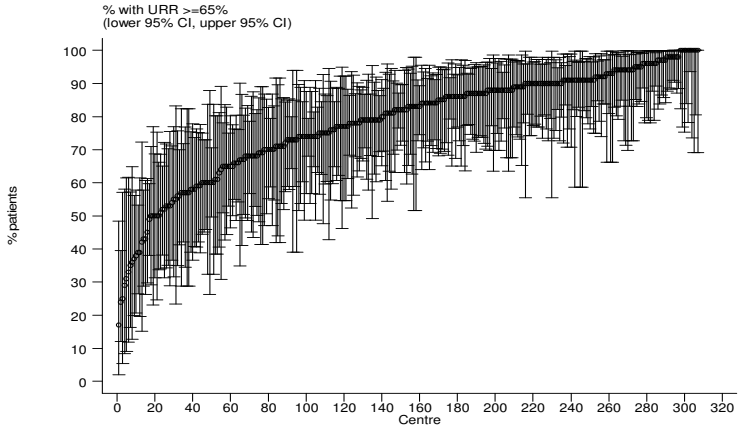


Table 12.2.8 (i): Proportion of HD patients with URR ≥ 65%, HD centres 2005-2008

Year	No. of centers	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2005	73	40	53	70	81	88	100	100
2006	214	0	50	69	79.5	88	97	100
2007	245	15	51	71	82	89	97	100
2008	307	17	45	69	83	90	98	100

In 2008, 50% of centres had 83% of their patients with URR ≥65%. There were 12 centres with less than 40% of their patients with URR ≥ 65%.

Figure 12.2.8 (i): Variation in proportion of patients with URR ≥ 65% among HD centres 2008



SECTION 12.3: TECHNIQUE SURVIVAL ON DIALYSIS

Table 12.3.1: Unadjusted technique survival by Dialysis modality, 1999-2008

Dialysis modality	PD			HD			All Dialysis		
Interval (month)	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
0	3934	100	.	25469	100	.	29403	100	.
6	3284	91	1	22373	94	0	25657	94	0
12	2634	81	1	19142	88	0	21776	87	0
24	1645	63	1	13975	79	0	15620	77	0
36	997	47	1	10115	70	0	11112	67	0
48	630	36	1	7175	63	0	7805	59	0
60	398	29	1	4919	56	0	5317	53	0
72	225	23	1	3271	50	1	3496	47	0
84	108	17	1	2015	45	1	2123	41	0
96	44	12	1	1108	40	1	1152	37	1
108	11	10	1	481	37	1	492	34	1

The unadjusted HD technique survival at 1 year, 5 years and 9 years was 88%, 56% and 37% respectively. The PD unadjusted technique survival was 81% at 1year, 29% at 5 years and 10% at 9 years.

Figure 12.3.1: Unadjusted technique survival by Dialysis modality, 1999-2008

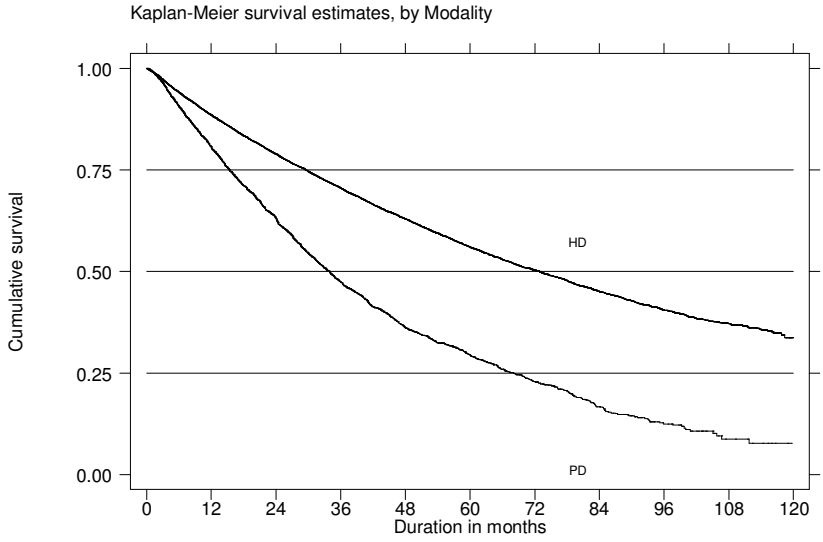


Table 12.3.2: Unadjusted technique survival by year of entry, 1999-2008

Year Interval (month)	1999 No.	1999 % Survival	1999 SE	2000 No.	2000 % Survival	2000 SE	2001 No.	2001 % Survival	2001 SE
0	1413	100	.	1718	100	.	1900	100	.
6	1324	95	1	1603	94	1	1769	93	1
12	1239	90	1	1483	89	1	1623	87	1
24	1100	82	1	1279	79	1	1405	77	1
36	963	73	1	1126	71	1	1235	69	1
48	840	64	1	982	63	1	1096	61	1
60	740	57	1	852	55	1	959	54	1
72	667	52	1	752	49	1	853	48	1
84	596	47	1	656	43	1	763	43	1
96	528	41	1	580	38	1	.	.	.
108	481	38	1	.	.	.	.	.	.

Year Interval (month)	2002 No.	2002 % Survival	2002 SE	2003 No.	2003 % Survival	2003 SE	2004 No.	2004 % Survival	2004 SE	2005 No.	2005 % Survival	2005 SE
0	2148	100	.	2336	100	.	2734	100	.	2933	100	.
6	2014	94	1	2167	94	1	2558	94	0	2696	93	0
12	1885	89	1	2007	88	1	2366	88	1	2493	87	1
24	1619	78	1	1769	79	1	2070	79	1	2165	77	1
36	1436	70	1	1562	70	1	1804	69	1	1951	70	1
48	1272	62	1	1388	63	1	1602	62	1	.	.	.
60	1123	55	1	1242	57	1	.	.	.	.	.	.
72	995	49	1	.	.	.	.	.	.	.	.	.

Year Interval (month)	2006 No.	2006 % Survival	2006 SE	2007 No.	2007 % Survival	2007 SE	2008 No.	2008 % Survival	2008 SE
0	3353	100	.	3492	100	.	3442	100	.
6	3070	93	0	3261	94	0	1923	95	0
12	2855	88	1	3039	88	1	.	.	.
24	2525	78	1	.	.	.	.	.	.

There was no apparent difference in the unadjusted HD technique survival by year of starting dialysis for the years 1999 to 2008.

Figure 12.3.2: Unadjusted technique survival by year of entry, 1999-2008

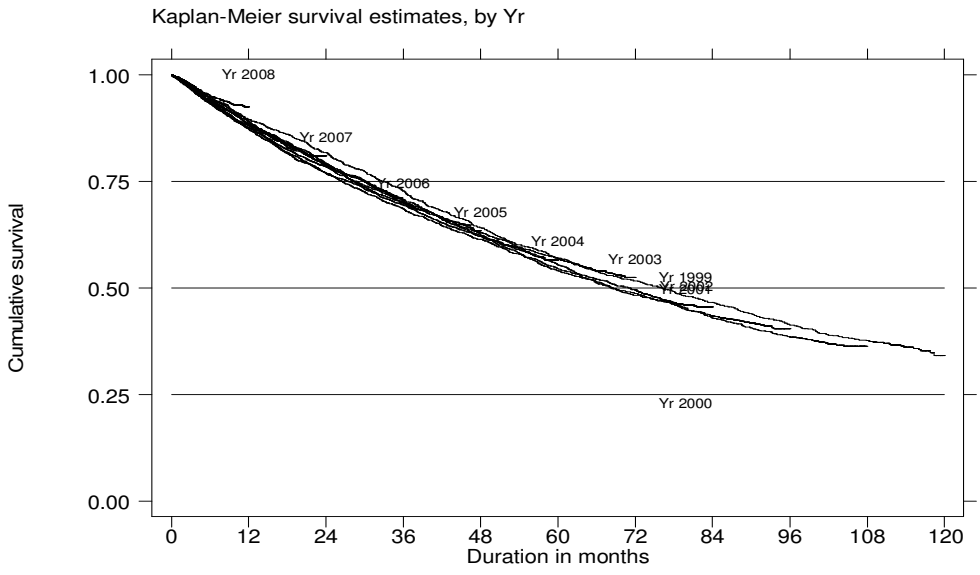


Table 12.3.3: Unadjusted technique survival by age, 1999-2008

Age group (year) Interval (month)	≤ 14 No.	≤ 14 % Survival	≤ 14 SE	15-24 No.	15-24 % Survival	15-24 SE	25-34 No.	25-34 % Survival	25-34 SE	35-44 No.	35-44 % Survival	35-44 SE
0	106	100	.	884	100	.	1818	100	.	3227	100	.
6	95	96	2	805	96	1	1636	97	0	2871	96	0
12	76	91	3	710	93	1	1433	94	1	2476	91	1
24	56	82	4	532	87	1	1100	89	1	1962	86	1
36	41	77	5	411	84	1	866	85	1	1541	82	1
48	28	74	5	319	81	2	693	83	1	1196	77	1
60	18	74	5	237	80	2	540	80	1	890	73	1
72	14	74	5	173	78	2	391	77	1	658	69	1
84	9	74	5	116	75	2	261	75	2	439	64	1
96	6	74	5	69	72	3	175	71	2	258	61	1
108	4	74	5	34	65	4	88	70	2	107	60	2

Age group (year) Interval (month)	45-54 No.	45-54 % Survival	45-54 SE	55-64 No.	55-64 % Survival	55-64 SE	≥ 65 No.	≥ 65 % Survival	≥ 65 SE
0	6438	100	.	7199	100	.	5797	100	.
6	5754	95	0	6304	93	0	4910	91	0
12	4964	90	0	5406	88	0	4078	84	1
24	3719	82	1	3859	77	1	2748	69	1
36	2731	75	1	2730	67	1	1796	57	1
48	1978	68	1	1873	58	1	1099	46	1
60	1384	61	1	1195	49	1	659	38	1
72	937	55	1	721	41	1	380	31	1
84	596	50	1	410	35	1	191	25	1
96	324	44	1	207	30	1	74	19	1
108	141	40	1	89	27	1	27	15	1

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 <14, 15-24, 25-34, 35-44, 44-54, 55-64 and > 65 years old was 74%, 65%, 70%, 60 %, 40%, 27% and 15% respectively

Figure 12.3.3: Unadjusted technique survival by age, 1999-2008

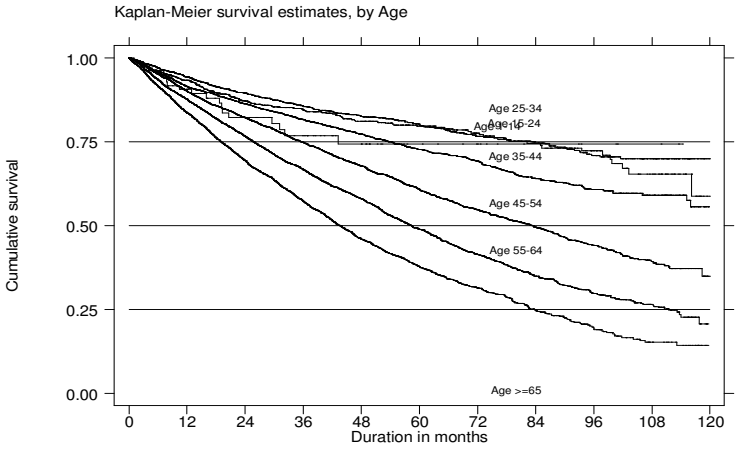
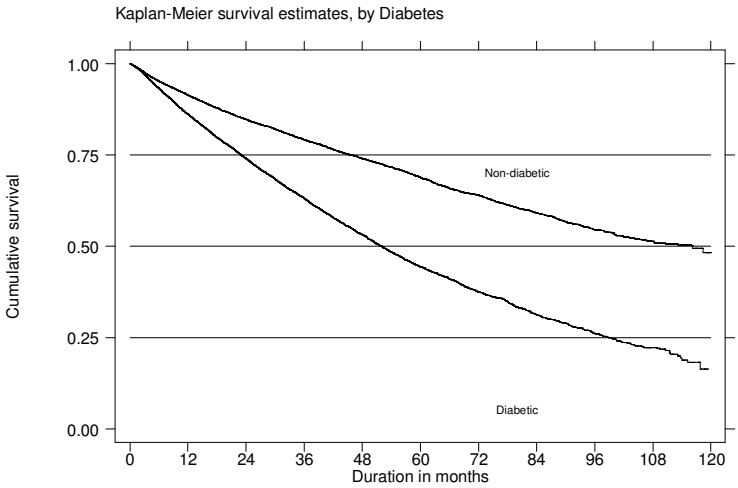


Table 12.3.4: Unadjusted technique survival by Diabetes status, 1999-2008

Diabetis status		Non-Diabetic			Diabetic	
Interval (month)	No.	% Survival	SE	No.	% Survival	SE
0	11736	100	.	13733	100	.
6	10394	95	0	11979	93	0
12	9078	91	0	10064	86	0
24	6924	85	0	7051	74	0
36	5381	79	0	4734	63	1
48	4118	74	1	3057	53	1
60	3040	69	1	1879	44	1
72	2164	64	1	1107	37	1
84	1423	59	1	592	31	1
96	827	54	1	281	26	1
108	388	51	1	95	22	1

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; 86% at 1 year, 44% at 5 years and only 22% at 9 years.

Figure 12.3.4: Unadjusted technique survival by Diabetes status, 1999-2008



CHAPTER 13

Chronic Peritoneal Dialysis Practices

Sunita Bavanandan
Lily Musharha

SECTION 13.1: PD PRACTICES

13.1: Mode of PD (Tables 13.1.1 -13.1.4)

Peritoneal dialysis utilization in Malaysia has been on the slow rise over the years. In 2008, there is a 15% increment of PD utilization compared to year 2007 with a total number of 2083 patients. The percentage of APD penetration has also been favorable although the number is still small compared to CAPD ((12% vs 88% respectively). DAPD prescription has been static at 6%.

Majority of PD patients are on Baxter disconnect system (94%), and on 4 exchanges per day (86%). The number of patients performing 5 exchanges has increased by 11% compared to the previous year and incremental dialysis practice of initiating 3 exchanges also has slightly increased by 1% in 2008. There is no change in the dwell volume compared to previous year with 2 liter as the common prescription.

Table 13.1.1: Chronic Peritoneal Dialysis Regimes, 1999-2008

PD regime	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
Standard CAPD	588	96	641	97	762	98	861	97	1192	97
DAPD	16	3	16	2	17	2	24	3	34	3
Automated PD/ CCPD	6	1	5	1	2	0	3	0	5	0
TOTAL	610	100	662	100	781	100	888	100	1231	100
PD regime	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
Standard CAPD	1266	96	1303	93	1397	90	1547	86	1717	82
DAPD	39	3	45	3	67	4	115	6	121	6
Automated PD/ CCPD	12	1	50	4	88	6	144	8	245	12
TOTAL	1317	100	1398	100	1552	100	1806	100	2083	100

Table 13.1.2: CAPD Connectology, 1999-2008

CAPD Connectology	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
Baxter disconnect	354	100	237	100	439	100	726	99	1048	87
Fresenius disconnect	0	0	0	0	0	0	11	1	154	13
Others	0	0	0	0	1	0	0	0	3	0
TOTAL	354	100	237	100	440	100	737	100	1205	100
CAPD Connectology	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
Baxter disconnect	1147	89	1286	92	1425	92	1675	94	1955	94
Fresenius disconnect	145	11	111	8	119	8	116	6	124	6
Others	0	0	0	0	5	0	0	0	4	0
TOTAL	1292	100	1397	100	1549	100	1791	100	2083	100

Table 13.1.3: PD Number of Exchanges per day, 1999-2008

No. of Exchanges/ day	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
2	0	0	2	0	1	0	0	0	4	0
3	4	1	1	0	5	1	11	1	14	1
4	579	97	624	96	735	95	834	96	1136	96
5	13	2	23	4	31	4	28	3	32	3
TOTAL	596	100	650	100	772	100	873	100	1186	100
No. of Exchanges/ day	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
2	6	0	3	0	4	0	2	0	3	0
3	12	1	25	2	55	4	40	2	54	3
4	1225	95	1280	94	1359	91	1566	90	1729	86
5	52	4	48	4	76	5	123	7	215	11
TOTAL	1295	100	1356	100	1494	100	1731	100	2001	100

Table 13.1.4: PD Volume per Exchange, 1999– 2008

Volume per Exchange (L)	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
<1.5	19	3	25	4	32	4	37	4	41	4
1.5-1.9	0	0	0	0	0	0	0	0	0	0
2.0	557	96	595	95	711	95	793	94	1088	94
>2.0	2	0	5	1	9	1	14	2	31	3
TOTAL	578	100	625	100	752	100	844	100	1160	100

Volume per Exchange (L)	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
<1.5	42	3	55	4	50	3	46	3	56	3
1.5-1.9	0	0	0	0	0	0	0	0	0	0
2.0	1154	92	1195	89	1315	88	1508	88	1756	88
>2.0	60	5	92	7	135	9	167	10	189	9
TOTAL	1256	100	1342	100	1500	100	1721	100	2001	100

SECTION 13.2: ACHIEVEMENT OF SOLUTE CLEARANCE AND PERITONEAL TRANSPORT

Generally, achievement of solute clearance has dropped by 1% compared to previous year with 82% of total patients achieving Kt/V of ≥ 1.7 per week (Tables and figures 13.2.1). Comparison between PD centers according to the percentage of patients in each centre achieving this target Kt/V has shown a 1.8-fold variation between the highest and lowest-performing centers (93.5% vs 50.5%). The median for achievement of targeted Kt/V for all centers is 80% (Tables and figures 13.2.2).

There was variation in the baseline peritoneal transport characteristic among the cohort of PD patients (13% L, 42% LA, 35% HA and 10% H) (Tables 13.2.3). However, longitudinally a proportion of patient developed changes in their peritoneal membrane characteristic over time resulting in an increment in the number of high transporters from 45% to 54% (Table 13.2.4). There is no apparent association between co-morbidity such as cardiovascular disease and diabetes with the peritoneal transport status (Table 13.2.5).

Table 13.2.1: Distribution of delivered KT/V, PD patients 2003-2008

Year	No. of Subjects	Mean	SD	Median	LQ	UQ	% patients ≥ 1.7 per week
2003	763	2.1	0.5	2.1	1.8	2.5	83
2004	1038	2.1	0.5	2.1	1.8	2.4	85
2005	1092	2.1	0.5	2.1	1.8	2.4	83
2006	1266	2.1	0.5	2.1	1.8	2.4	84
2007	1412	2.1	0.5	2.1	1.8	2.4	83
2008	1679	2.1	0.5	2	1.8	2.4	82

Figure 13.2.1: Cumulative distribution of delivered KT/V, PD patients 2003-2008

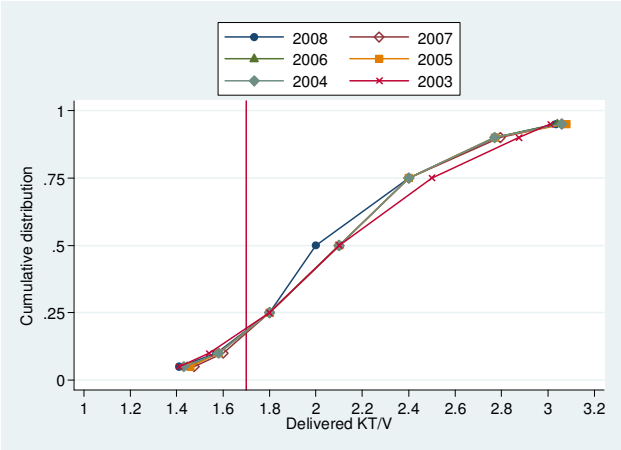


Table 13.2.2: Variation in proportion of patients with KT/V ≥1.7 per week among PD centres 2008

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	89	96	96
2006	20	66	66	78	82.5	91.5	100	100
2007	21	25	69	78	85	89	93	93
2008	20	33	50.5	76.5	80	89	93.5	96

Figure 13.2.2: Variation in proportion of patients with KT/V ≥ 1.7 per week among PD centres 2008

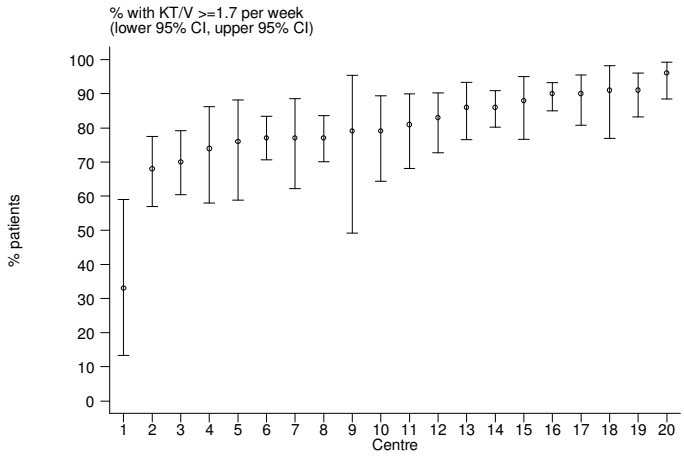


Table 13.2.3: Peritoneal transport status by PET D/P creatinine at 4 hours, new PD patients 2003-2008

Year	2003		2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Low	10	6	67	15	69	12	105	12	106	10	151	13
Low average	85	51	187	41	246	41	359	42	429	42	500	42
High average	62	37	176	38	227	38	315	37	392	38	415	35
High	11	7	29	6	58	10	75	9	95	9	114	10
TOTAL	168	100	459	100	600	100	854	100	1022	100	1180	100

Table 13.2.4: Peritoneal transport status by PET D/P creatinine at 4 hours, prevalent PD patients 2003-2008

Year	2003		2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Low	10	3	39	9	44	13	23	8	19	10	19	14
Low average	174	44	180	42	130	39	106	38	65	34	43	31
High average	171	43	168	39	118	35	106	38	78	41	50	36
High	39	10	41	10	42	13	41	15	28	15	25	18
TOTAL	394	100	428	100	334	100	276	100	190	100	137	100

Table 13.2.5: Association between peritoneal membrane characteristic and co-morbidity, 2003 – 2008

Co morbidity	Low		Low Average		High Average		High	
	No.	%	No.	%	No.	%	No.	%
No CVD	429	12.5	1438	42	1262	36.9	295	8.6
CVD	79	9.2	368	42.8	321	37.4	91	10.6
No DM	324	13.2	1043	42.6	879	35.9	205	8.4
DM	184	10	763	41.6	704	38.4	181	9.9

SECTION 13.3: TECHNIQUE SURVIVAL ON PD

Technique survival on PD is poor compared to haemodialysis (HD) modality. The Kaplan-Meir cumulative survival curves diverge as early as 6 months. One-, three- and five-year technique survival for PD and HD was 81% vs 94%, 47% vs 88% and 29% vs 56% respectively. Median technique survival time for PD was less than 36 months. The possible reason for this disparity in technique survival for the two dialysis modalities is that HD patient can continue on HD even when native vascular access is problematic due to availability of temporary catheters. This is not the case with PD.

Overall trends in technique survival are unchanged by year of entry (Tables and figures 13.3.1 and 13.3.2). The best technique survival was seen in the age group less than 14 years while the elderly (>65 years) consistently had the worst technique survival (Table and figure 13.3.3). There were no gender differences (Table and figure 13.3.4). Patients with diabetes had poorer technique survival (Table and figure 13.3.5). In relation to solute clearance, there was a clear separation in the survival curve after 24 months. As expected, those who had Kt/V >2.0 had better technique survival compared to Kt/v < 1.7 (Table and figure 13.3.6).

The risk factors associated with poor PD technique survival are older age, diabetes, peritonitis episodes, cardiovascular disease, low BMI, hypoalbuminemia, abnormal lipid profile, serum haemoglobin less than 11g/dL, high calcium phosphate level and assisted PD (Table 13.3.7).

Table 13.3.1: Unadjusted technique survival by Dialysis modality, 1999-2008

Year Interval (month)	PD			HD			All dialysis		
	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
0	3934	100	-	25469	100	-	29403	100	-
6	3284	91	0	22373	94	0	25657	94	0
12	2634	81	1	19142	88	0	21776	87	0
24	1645	63	1	13975	79	0	15620	77	0
36	997	47	1	10115	70	0	11112	67	0
48	630	36	1	7175	63	0	7805	59	0
60	398	29	1	4919	56	0	5317	53	0
72	225	23	1	3271	50	0	3495	47	0
84	108	17	1	2015	45	1	2123	41	0
96	44	12	1	1108	40	1	1151	37	1
108	11	9	1	481	37	1	491	34	1
120	-	-	-	-	-	-	-	-	-

Figure 13.3.1: Unadjusted technique survival by Dialysis modality, 1999-2008

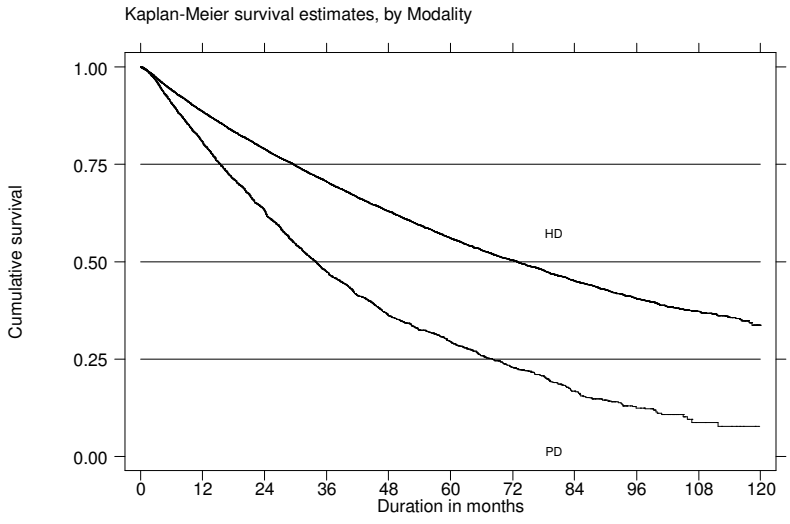


Table 13.3.2: Unadjusted technique survival by year of entry, 1999-2008

Year Interval (month)	1999			2000			2001			2002		
	No	% Survival	SE	No	% Survival	SE	No	% Survival	SE	No	% Survival	SE
0	210	100	-	227	100	-	337	100	-	373	100	-
6	189	90	2	206	91	2	303	90	2	342	92	1
12	175	84	3	185	81	3	266	80	2	293	80	2
24	117	58	3	138	63	3	198	61	3	228	64	3
36	78	39	3	101	46	3	152	47	3	165	47	3
48	57	29	3	78	36	3	108	34	3	126	37	3
60	50	25	3	67	31	3	79	26	2	96	29	2
72	37	19	3	47	22	3	65	21	2	79	24	2
84	27	15	3	36	18	3	47	15	2	-	-	-
96	17	9	2	28	14	2	-	-	-	-	-	-
108	11	6	2	-	-	-	-	-	-	-	-	-
120	-	-	-	-	-	-	-	-	-	-	-	-

Year Interval (month)	2003			2004			2005			2006		
	No	% Survival	SE	No	% Survival	SE	No	% Survival	SE	No	% Survival	SE
0	418	100	-	340	100	-	362	100	-	463	100	-
6	369	89	2	302	89	2	322	89	2	428	93	1
12	332	80	2	267	79	2	280	79	2	372	81	2
24	254	63	2	213	65	3	220	63	3	282	63	2
36	182	45	2	162	51	3	163	48	3	-	-	-
48	141	36	2	125	39	3	-	-	-	-	-	-
60	110	28	2	3	-	-	-	-	-	-	-	-
72	-	-	-	-	-	-	-	-	-	-	-	-

Year Interval (month)	2007			2008		
	No	% Survival	SE	No	% Survival	SE
0	591	100	-	613	100	-
6	529	90	1	301	93	1
12	469	80	2	-	-	-
24	-	-	-	-	-	-

Figure 13.3.2: Unadjusted technique survival by year of entry, 1999-2008

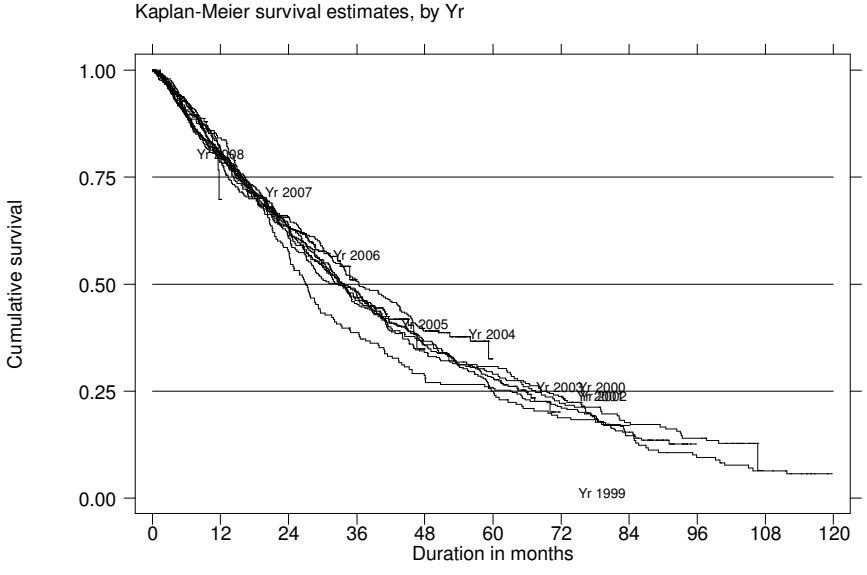


Table 13.3.3: Unadjusted technique survival by age, 1999-2008

Age group (years) Interval (month)	<=14			15-24			25-34			35-44		
	No	% Survival	SE	No	% Survival	SE	No	% Survival	SE	No	% Survival	SE
0	275	100	-	353	100	-	329	100	-	496	100	-
6	252	97	1	306	94	1	279	93	1	442	93	1
12	224	94	1	258	86	2	229	85	2	367	85	2
24	159	83	2	172	72	3	154	72	3	248	71	2
36	108	70	3	120	59	3	108	61	3	166	58	3
48	83	64	4	84	50	3	66	45	4	114	47	3
60	58	56	4	54	42	4	47	39	4	76	37	3
72	40	46	4	31	36	4	21	28	4	53	33	3
84	18	40	5	17	28	4	10	17	4	29	28	3
96	9	29	6	6	22	5	5	15	4	14	24	3
108	-	-	-	3	22	5	3	15	4	5	22	4
120	-	-	-	-	-	-	-	-	-	-	-	-

Age group (years) Interval (month)	45-54			55-64			>=65		
	No	% Survival	SE	No	% Survival	SE	No	% Survival	SE
0	880	100	-	935	100	-	666	100	-
6	746	92	1	773	90	1	495	82	2
12	612	82	1	606	79	1	342	67	2
24	401	62	2	346	58	2	170	45	2
36	241	46	2	185	39	2	75	26	2
48	148	34	2	106	27	2	37	16	2
60	92	29	2	61	20	2	17	11	2
72	46	21	2	30	13	2	10	8	2
84	24	14	2	12	7	2	4	5	2
96	9	9	2	5	4	2	2	3	2
108	3	6	2	-	-	-	-	-	-
120	-	-	-	-	-	-	-	-	-

Figure 13.3.3: Unadjusted technique survival by age, 1999-2008

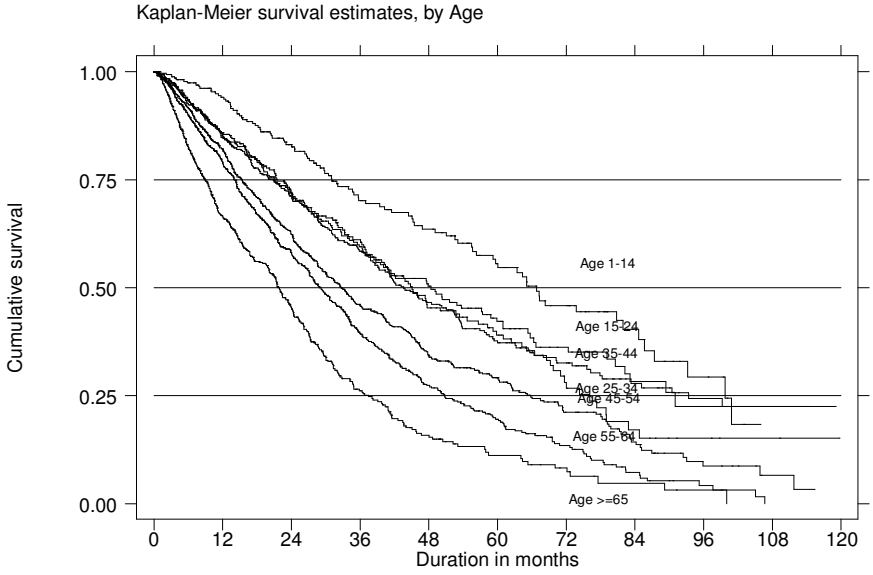


Table 13.3.4: Unadjusted technique survival by Gender, 1999-2008

Gender Interval (months)	Male			Female		
	No	% survival	SE	No	% survival	SE
0	1985	100	-	1946	100	-
6	1660	91	1	1627	90	1
12	1316	80	1	1319	81	1
24	804	62	1	841	64	1
36	488	46	1	510	49	1
48	291	33	1	340	39	1
60	179	25	1	220	33	1
72	100	20	1	126	26	2
84	45	14	1	64	20	2
96	15	8	1	30	16	2
108	3	3	2	9	14	2
120	-	-	-	-	-	-

Figure 13.3.4: Unadjusted technique survival by Gender, 1999-2008

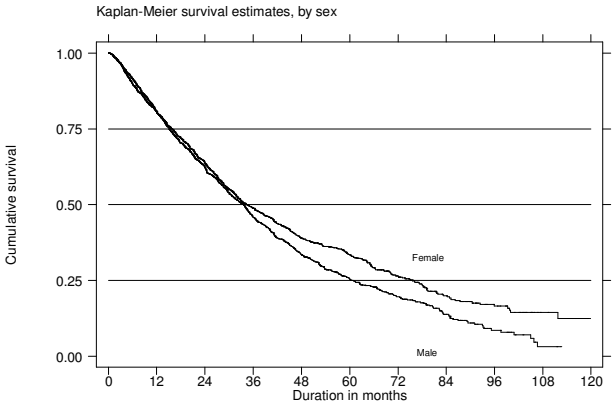


Figure 13.3.5: Unadjusted technique survival by Diabetes status, 1999-2008

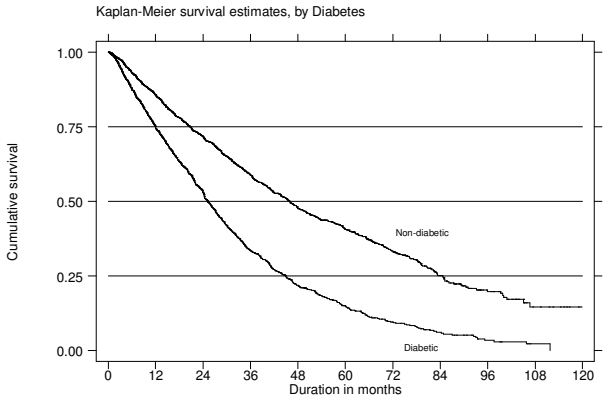


Table 13.3.5: Unadjusted technique survival by Diabetes status, 1999-2008

Diabetes status Interval (month)	Non-Diabetic			Diabetic		
	No	% survival	SE	No	% survival	SE
0	2062	100	-	1872	100	-
6	1782	93	1	1502	88	1
12	1495	86	1	1139	75	1
24	1032	72	1	613	53	1
36	697	59	1	302	33	1
48	476	48	1	155	22	1
60	319	41	1	80	15	1
72	186	33	2	40	10	1
84	88	25	2	21	6	1
96	37	20	2	8	3	1
108	10	15	2	2	2	1
120	-	-	-	-	-	-

Table 13.3.6 Unadjusted technique survival by Kt/V, 1999-2008

KT/V	<1.7			1.7-2.0			>2.0		
Interval (months)	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
0	1142	100	-	1598	100	-	3506	100	-
6	1115	99	0	1561	99	0	3417	99	0
12	1049	96	1	1472	96	0	3200	96	0
24	870	89	1	1247	89	1	2659	89	1
36	671	77	1	993	79	1	2028	78	1
48	506	65	2	747	67	1	1562	69	1
60	334	53	2	564	59	1	1134	62	1
72	197	41	2	368	52	2	792	56	1
84	109	32	2	224	42	2	522	48	1
96	64	25	2	116	34	2	334	41	1
108	47	21	2	73	27	2	211	35	1
120	32	19	2	45	19	2	135	27	2

Figure 13.3.6 Unadjusted technique survival by Kt/V, 1999 -2008

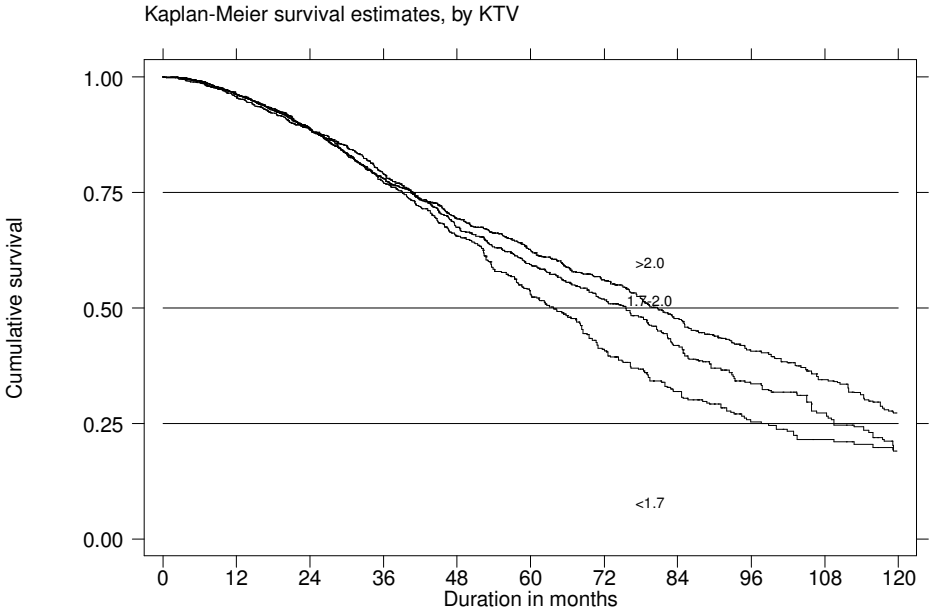


Table 13.3.7: Adjusted hazard ratio for technique survival, 1999-2008

Factors	N	Hazard Ratio	95% CI		p value
Age (years):					
Age 1-14 (ref)	276	1.00			
Age 15-24	352	1.90	(1.43;	2.51)	0.000
Age 25-34	329	2.21	(1.65;	2.95)	0.000
Age 35-44	496	2.15	(1.63;	2.84)	0.000
Age 45-54	880	2.52	(1.93;	3.30)	0.000
Age 55-64	935	2.80	(2.15;	3.65)	0.000
Age >=65	666	3.80	(2.89;	4.99)	0.000
Peritonitis					
No (ref)	3,662	1.00			
Yes	272	2.30	(2.01;	2.63)	0.000
Diabetes Mellitus					
Non-diabetic (ref)	2,062	1.00			
Diabetic	1,872	1.52	(1.35;	1.70)	0.000
Gender					
Male (ref)	1,985	1.00			
Female	1,949	0.81	(0.73;	0.89)	0.000
Year start dialysis:					
Year 1999-2000 (ref)	437	1.00			
Year 2001-2002	710	1.06	(0.93;	1.22)	0.371
Year 2003-2004	758	1.07	(0.93;	1.24)	0.336
Year 2005-2006	825	1.02	(0.87;	1.20)	0.789
Year 2007-2008	1,204	0.97	(0.80;	1.17)	0.723
Cardiovascular Disease:					
No CVD (ref)	3,009	1.00			
CVD	925	1.27	(1.14;	1.42)	0.000
BMI:					
<18.5	575	1.23	(1.06;	1.43)	0.007
18.5-<25 (ref)	2,074	1.00			
>=25	1,285	0.88	(0.79;	0.97)	0.014
Serum Albumin:					
<30	1,012	1.84	(1.61;	2.09)	0.000
30-<35	1,496	1.33	(1.18;	1.50)	0.000
35-<45 (ref)	1,053	1.00			
>=45	373	1.05	(0.84;	1.31)	0.657
Serum Cholesterol:					
<3.2	78	1.65	(1.22;	2.24)	0.001
3.2-<5.2 (ref)	1,928	1.00			
>=5.2	1,928	1.16	(1.05;	1.27)	0.003
Diastolic BP:					
<70	483	1.06	(0.91;	1.24)	0.455
70-<80	1,294	0.93	(0.84;	1.04)	0.224
80-<90 (ref)	1,610	1.00			
90-<100	469	1.29	(1.11;	1.51)	0.001
>=100	78	1.94	(1.43;	2.62)	0.000
Hemoglobin:					
<8	221	1.99	(1.60;	2.47)	0.000
8-<9	458	1.88	(1.58;	2.23)	0.000
9-<10	937	1.45	(1.24;	1.68)	0.000
10-<11	1,248	1.23	(1.07;	1.42)	0.004
11-<12 (ref)	690	1.00			
>=12	380	1.09	(0.90;	1.33)	0.388
Serum Calcium:					
<2.2	1,311	0.98	(0.88;	1.10)	0.776
2.2-<2.6 (ref)	2,483	1.00			
>=2.6	140	1.85	(1.47;	2.33)	0.000
Calcium Phosphate product:					
<3.5	2,157	1.42	(1.21;	1.66)	0.000
3.5-<4.5 (ref)	1,172	1.00			
4.5-<5.5	456	0.84	(0.68;	1.03)	0.099
>=5.5	149	0.57	(0.38;	0.86)	0.007

Table 13.3.7: Adjusted hazard ratio for technique survival, 1999-2008 *(cont.)*

Factors	N	Hazard Ratio	95% CI		p value
Serum Phosphate:					
<1.6 (ref)	2,326	1.00			
1.6-<2.0	1,057	1.06	(0.90;	1.25)	0.494
2.0-<2.2	253	1.31	(0.99;	1.75)	0.061
2.2-<2.4	142	1.48	(1.03;	2.11)	0.033
2.4-<2.6	81	1.98	(1.27;	3.10)	0.003
>=2.6	75	2.66	(1.56;	4.52)	0.000
KT/V					
<=1.7 (ref)	487	1.00			
>1.7	3,447	1.47	(1.27;	1.70)	0.000
Assisted PD					
Selfcare (ref)	2,218	1.00			
Assisted	1,625	1.34	(1.20;	1.49)	0.000

Table 13.3.8 Reasons for change of dialysis modality to HD, 1999-2008

Cause	No.	Percentage
Peritonitis	330	39
Catheter related infection	27	3
Membrane failure	152	18
Technical problem	60	7
Patient preference	157	19
Others	76	9
Unknown	40	5
Total	842	100

Peritonitis remained the commonest cause for PD drop-out (39%), followed by membrane failure (18%) and patient preference (19%).

SECTION 13.4: Patient Survival on PD

Analyzing patient survival by dialysis modalities as per ITT (disregarding change of dialysis modality) (Table 13.4.1and Fig 13.4.1), the overall unadjusted 5 years and 10 years patient survival on CAPD versus haemodialysis was 56% vs 61% and 43% vs 41% respectively.

Older age, diabetes, cardiovascular disease, low BMI, low serum albumin, diastolic BP > 100 mmHg, serum haemoglobin <11 g/dL, hypercalcaemia, peritonitis episodes and assisted PD are associated with an increased mortality risk (Table 13.4.1).

Table 13.4.1: Patient survival by dialysis modality (not censored for change of modality)

Dialysis modality	PD			HD			All		
Interval (month)	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	4619	100	-	30221	100	-	34840	100	-
6	4061	94	0	27022	94	0	31080	94	0
12	3513	88	1	23891	89	0	27404	89	0
24	2592	77	1	18727	81	0	21319	81	0
36	1948	67	1	14638	74	0	16586	73	0
48	1493	60	1	11429	67	0	12922	66	0
60	1188	56	1	8876	61	0	10063	60	0
72	927	52	1	6938	56	0	7863	56	0
84	704	49	1	5356	51	0	6060	51	0
96	528	46	1	4165	47	0	4691	47	0
108	404	44	1	3237	44	0	3640	44	0
120	316	43	1	2487	41	0	2803	41	0

Figure 13.3.6 Patient survival by dialysis modality analysis (not censored for change of modality)

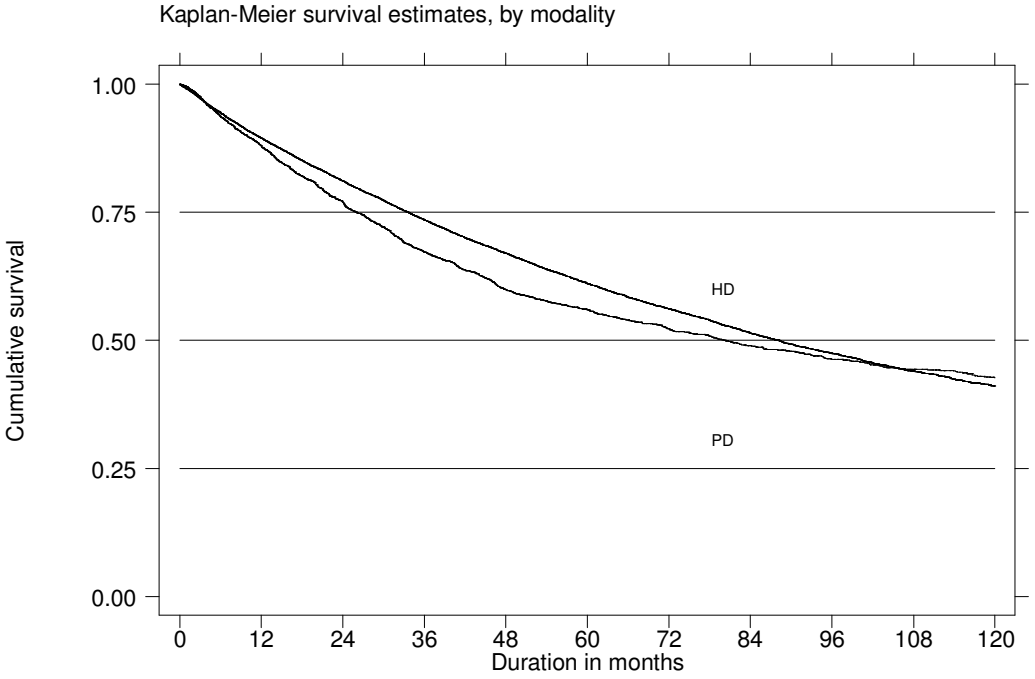


Table 13.4.2: Adjusted Hazard Ratio for patient mortality

Factors	N	Hazard Ratio	95% CI		p value
Age (years):					
Age 1-14 (ref)	276	1.00			
Age 15-24	352	2.23	(1.40;	3.56)	0.001
Age 25-34	329	2.24	(1.37;	3.67)	0.001
Age 35-44	496	2.90	(1.86;	4.52)	0.000
Age 45-54	880	4.53	(2.98;	6.90)	0.000
Age 55-64	935	4.82	(3.18;	7.33)	0.000
Age >=65	666	7.00	(4.59;	10.67)	0.000
Diabetes Mellitus					
Non-diabeti c (ref)	2,062	1.00			
Diabetic	1,872	1.57	(1.35;	1.82)	0.000
Gender					
Male (ref)	1,985	1.00			
Female	1,949	0.85	(0.76;	0.97)	0.011
Year start dialysis:					
Year 1999-2000 (ref)	437	1.00			
Year 2001-2002	710	1.11	(0.93;	1.33)	0.246
Year 2003-2004	758	1.16	(0.97;	1.40)	0.111
Year 2005-2006	825	1.36	(1.10;	1.67)	0.004
Year 2007-2008	1,204	1.79	(1.39;	2.29)	0.000
Cardiovascular Disease:					
No CVD (ref)	3,009	1.00			
CVD	925	1.44	(1.26;	1.64)	0.000
BMI:					
<18.5	575	1.25	(1.02;	1.54)	0.032
18.5-<25 (ref)	2,074	1			
>=25	1,285	0.91	(0.80;	1.04)	0.150
Serum Albumin:					
<30	1,012	2.15	(1.81;	2.55)	0.000
30-<35	1,496	1.35	(1.15;	1.59)	0.000
35-<45 (ref)	1,053	1.00			
>=45	373	1.19	(0.88;	1.61)	0.271
Diastolic BP:					
<70	483	1.15	(0.95;	1.39)	0.144
70-<80	1,294	0.94	(0.81;	1.08)	0.369
80-<90 (ref)	1,610	1.00			
90-<100	469	1.19	(0.95;	1.48)	0.134
>=100	78	2.21	(1.43;	3.41)	0.000
Hemoglobin:					
<8	221	2.26	(1.69;	3.02)	0.000
8-<9	458	1.71	(1.36;	2.17)	0.000
9-<10	937	1.56	(1.30;	1.88)	0.000
10-<11	1,248	1.29	(1.09;	1.54)	0.004
11-<12 (ref)	690	1.00			
>=12	380	1.15	(0.90;	1.46)	0.268
Serum Calcium:					
<2.2	1,311	0.99	(0.86;	1.14)	0.889
2.2-<2.6 (ref)	2,483	1.00			
>=2.6	140	1.79	(1.35;	2.37)	0.000

Table 13.4.2: Adjusted Hazard Ratio for patient mortality *(cont.)*

Factors	N	Hazard Ratio	95% CI		p value
Calcium Phosphate product:					
<3.5	2,157	1.22	(0.99;	1.52)	0.066
3.5-<4.5 (ref)	1,172	1.00			
4.5-<5.5	456	1.01	(0.76;	1.34)	0.945
>=5.5	149	1.16	(0.66;	2.02)	0.607
Serum Phosphate:					
<1.6 (ref)	2,326	1.00			
1.6-<2.0	1,057	0.89	(0.71;	1.11)	0.296
2.0-<2.2	253	1.19	(0.81;	1.75)	0.373
2.2-<2.4	142	1.01	(0.61;	1.69)	0.961
2.4-<2.6	81	1.26	(0.69;	2.31)	0.456
>=2.6	75	0.84	(0.35;	1.97)	0.680
KT/V					
<=1.7	487	1.00			
>1.7 (ref)	3,447	1.35	(1.12;	1.63)	0.001
Peritonitis episode					
No (ref)	940	1.00			
Yes	2,994	0.24	(0.21;	0.27)	0.000
Assisted PD					
No (ref)	2,218	1.00			
Yes	1,625	1.62	(1.41;	1.86)	0.000

SECTION 13.5: PERITONITIS

The median peritonitis rate dropped to 28.4 pt-months per episode compared from the previous year (Table 13.5.1). This could be explained by the recent adoption of a revised standardized definition of peritonitis by all our PD centers. However, despite this, there is still a wide inter-centre variation with the highest and lowest peritonitis rates of 12 and 132.2 pt-months per episode.

Gram-positive organisms accounted for 27% of peritonitis episodes while 34% were due to gram negative organisms. Staphylococcus aureus (12%) and staphylococcus coagulase negative (11%) were the commonest gram positive organisms. Pseudomonas (15%) was the commonest gram negative. Fungal organisms accounted for 11% of cases. The culture negative rate has been reduced to 29% compared to the previous year (Table 13.5.2).

A total of 73 deaths related to peritonitis were reported in 2008. Catheter removal rate was highest in gram negative infections, with Klebsiella (36%) being the commonest cause. No statistically significant risk factors for peritonitis were identified.

Table 13.5.1 Variation in peritonitis rate (pt-month/epi) among PD centres, 2000- 2008

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	10.7	10.7	19.9	22.8	39.6	60.3	60.3
2002	14	12.6	12.6	20.4	30.5	42.5	219.2	219.2
2003	13	18.3	18.3	21	32.9	39.6	312.1	312.1
2004	15	0	0	23.5	32.6	36.6	41.5	41.5
2005	15	18	18	25.7	35.3	43	57.1	57.1
2006	21	14.8	18.5	27.2	37	49.7	62.2	97.7
2007	23	12	15.3	30.7	41.5	56.9	71.8	106.7
2008	25	12	13.4	21.6	28.4	43.8	73.9	132.2

Figure 13.5.1 Variation in peritonitis rate among PD centres, 2008

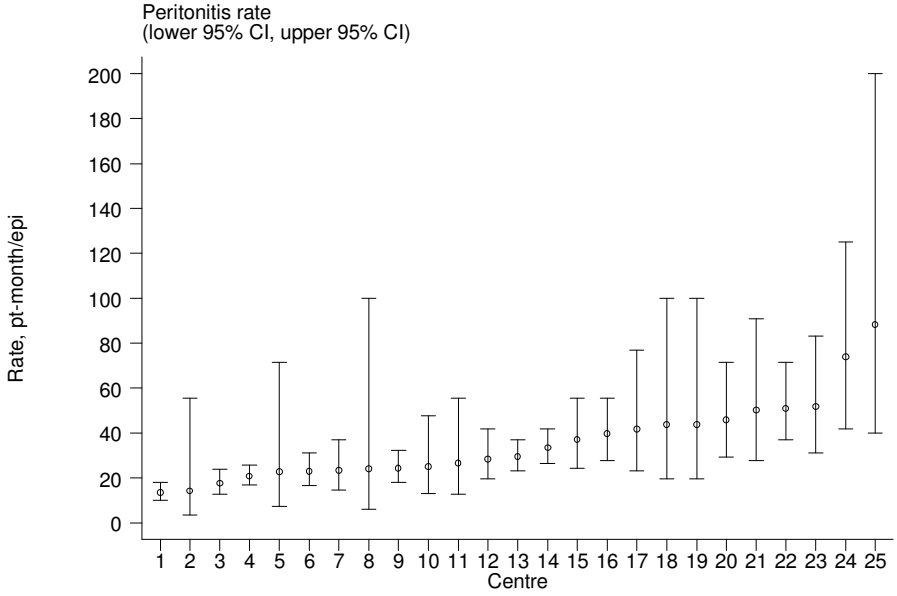


Table 13.5.2: Causative organism in PD peritonitis, 2000-2008

Microorganism	2000		2001		2002		2003		2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
(A) Gram Positives																		
Staph. Aureus	35	11	40	13	62	17	45	12	52	14	39	12	51	14	47	13	73	12
Staph Coagulase Neg.	34	11	30	10	39	11	47	13	41	11	43	13	32	9	29	8	69	11
Strep	17	6	18	6	12	3	16	4	13	3	10	3	17	5	14	4	19	3
Others	4	1	10	3	8	2	16	4	4	1	8	2	14	4	11	3	9	1
(B) Gram Negatives																		
Pseudomonas	19	6	14	4	23	6	20	5	28	8	27	8	23	6	30	8	94	15
Acinetobacter	0	0	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	21	7	8	2	21	6	24	4
Enterobacter	11	4	16	5	11	3	13	4	19	5	19	6	20	5	17	5	24	4
E.Coli	15	5	16	5	23	6	20	5	23	6	30	9	15	4	32	9	42	7
Others	9	3	17	5	15	4	15	4	16	4	17	5	14	4	14	4	22	4
(C) Polymicrobial	9	3	11	4	8	2	3	1	2	1	0	0	1	0	0	0	0	0
(D) Others																		
Fungal	19	6	21	7	12	3	12	3	15	4	7	2	16	4	20	5	29	5
Mycobacterium	6	2	4	1	1	0	3	1	4	1	2	1	4	1	1	0	4	1
Others	2	1	9	3	11	3	12	3	8	2	3	1	10	3	12	3	30	5
(E) No growth	119	39	99	32	118	33	115	32	123	33	96	30	142	39	122	33	179	29
TOTAL	309	100	312	100	361	100	364	100	373	100	322	100	367	100	370	100	618	100

Table 13.5.3: Outcome of peritonitis by Causative organism, 2000-2008

Causative Organism	Outcome							
	Resolved		Not resolved, catheter removed		Death		Total	
	No.	%	No.	%	No.	%	No.	%
(A) Gram Positives								
Staph. Aureus	223	53	60	15	136	32	419	100
Staph Coagulase Neg.	200	59	25	7	115	34	340	100
Strep	66	52	8	6	53	42	127	100
Others	32	43	7	9	36	48	75	100
(B) Gram Negatives								
Pseudomonas	108	42	76	30	73	28	257	100
Acinetobacter	0		0		0		0	100
Klebsiella	67	45	32	21	50	34	149	100
Enterobacter	55	38	36	25	53	37	144	100
E.Coli	92	45	44	22	68	33	204	100
Others	57	46	33	26	35	28	125	100
(C) Polymicrobial	6	18	6	18	22	64	34	100
(D) Others								
Fungal	10	7	96	64	44	29	150	100
Mycobacterium	1	4	12	43	15	53	28	100
Others	36	41	21	24	31	35	88	100
(E) No growth	546	52	142	13	363	35	1051	100

Table 13.5.4: Adjusted Risk factor influencing peritonitis rate, 2000 -2008

Factors	N	Incidence Risk Ratio	95% CI		P value
Age (years):					
<=14	191	0.91	(0.77;	1.08)	0.299
15-24	258	0.97	(0.83;	1.13)	0.691
25-34 ref	227	1.00			
35-44	360	1.03	(0.90;	1.18)	0.675
45-54	592	1.00	(0.88;	1.15)	0.979
55-64	592	0.98	(0.85;	1.14)	0.831
>=65	354	1.02	(0.87;	1.20)	0.806
Gender:					
Male ref	1291	1.00			
Female	1283	0.99	(0.92;	1.06)	0.685
Diabetes:					
No ref	1415	1.00			
Yes	1,159	1.07	(0.99;	1.16)	0.095
Income:					
RM 0-999 ref	1,081	1.00			
RM 1000-1999	866	0.94	(0.87;	1.02)	0.132
RM 2000-2999	373	0.94	(0.84;	1.04)	0.204
>=3000	254	0.99	(0.88;	1.12)	0.903
Education:					
Nil	236	1.02	(0.89;	1.17)	0.754
Primary	892	1.04	(0.96;	1.13)	0.301
Secondary ref	1,224	1.00			
Tertiary	222	0.87	(0.76;	0.99)	0.038
Assistance to perform CAPD:					
Self care ref	1567	1.00			
Partially assisted	331	0.96	(0.86;	1.07)	0.446
Completely assisted	676	1.03	(0.94;	1.12)	0.564

CHAPTER 14

RENAL TRANSPLANTATION

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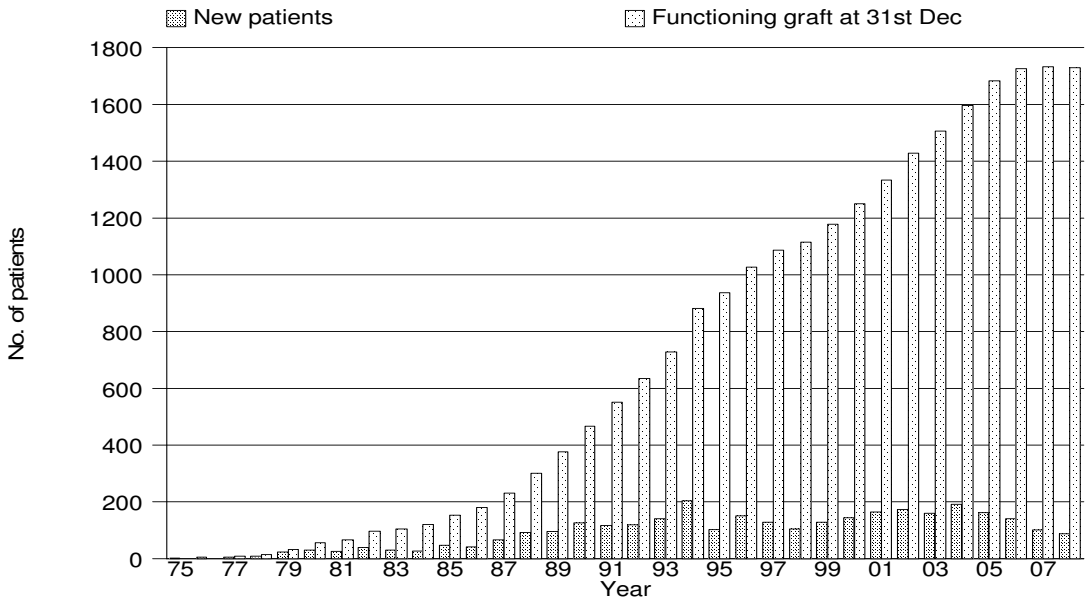
SECTION 14.1: STOCK AND FLOW

The number of new renal transplant patients shows an initial rise from 127 transplants per year in 1998 to a peak of 190 transplants in 2004. This is a rise of nearly 50% but the number declined subsequently to only 38 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. There may be an increase post 2008 Beijing Olympic Games and this is supported by 48 transplants in year 2008. The number of functioning renal transplants reported to the National Transplant Registry (NTR) had increased from 1178 in 1999 to 1730 in 2008 (Table 14.1.1).

Table 14.1.1: Stock and Flow of Renal Transplantation, 1999-2008

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
New transplant patients	127	143	163	172	160	190	162	141	100	88
Died	25	30	37	33	37	42	43	50	39	48
Graft failure	37	32	40	39	42	44	21	38	37	32
Lost to Follow up	1	9	3	5	4	14	10	10	18	10
Functioning graft at 31st December	1178	1250	1333	1428	1505	1595	1683	1726	1732	1730

Figure 14.1.1: Stock and Flow of Renal Transplantation, 1975-2008



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 52 per million in 1999 to 64 per million population in 2007 (Table 14.1.3), an increase of 23% over the 1999 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. In fact, the incidence rate and prevalence rate seem to reduce in year 2008 (3 and 62 per million population respectively (Table 14.1.2 and 14.1.3).

Table 14.1.2: New transplant rate per million population (pmp), 1999-2008

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
New transplant patients	127	143	163	172	160	190	162	141	100	88
New transplant rate, pmp	6	6	7	7	6	7	6	5	4	3

Figure 14.1.2: New transplant rate, 1975-2008

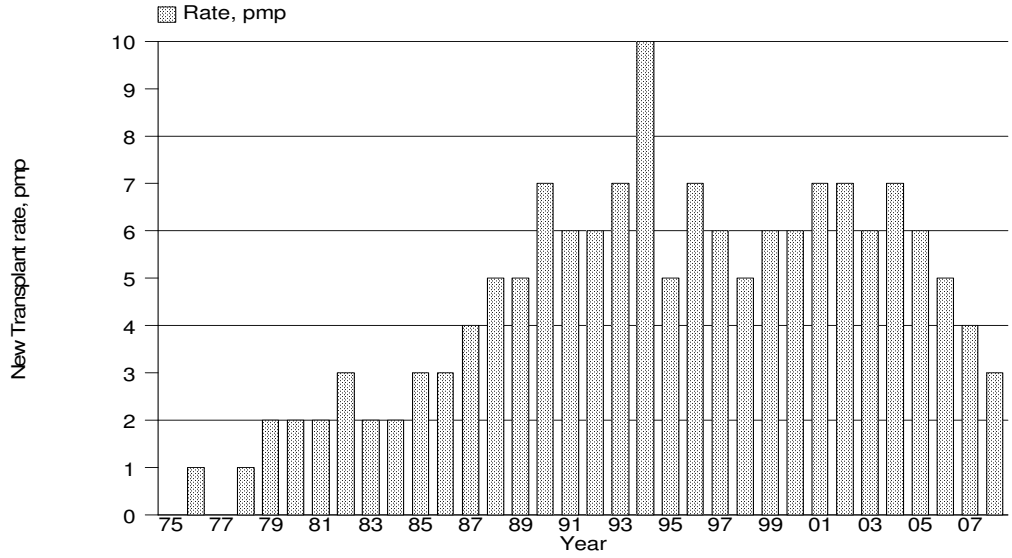


Table 14.1.3: Transplant prevalence rate per million population (pmp), 1999-2008

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Functioning graft at 31st Dec	1178	1250	1333	1428	1505	1595	1683	1726	1732	1730
Transplant prevalence rate, pmp	52	53	56	58	60	62	64	65	64	62

Figure 14.1.3: Transplant prevalence rate, 1975-2008

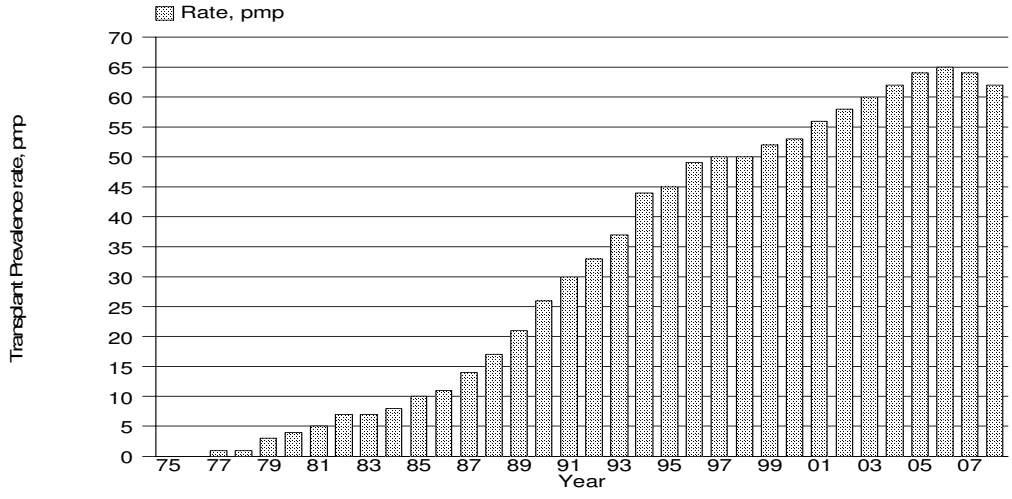


Table 14.1.4: Place of transplantation, 1999-2008

Year	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
HKL	36	28	28	20	33	20	30	17	26	16
UMMC	16	13	19	13	23	14	15	9	6	4
Selayang Hospital	0	0	4	3	11	7	11	6	11	7
Other local	1	1	3	2	4	2	1	1	1	1
China	63	50	80	56	83	51	103	60	111	69
India	5	4	9	6	8	5	12	7	4	3
Other overseas	2	2	0	0	1	1	0	0	1	1
Unknown	4	3	0	0	0	0	0	0	0	0
TOTAL	127	100	143	100	163	100	172	100	160	100

Year	2004		2005		2006		2007		2008		TOTAL	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
HKL	20	11	31	19	35	25	36	36	32	36	307	21
UMMC	7	4	7	4	5	4	0	0	0	0	98	7
Selayang Hospital	11	6	5	3	9	6	14	14	7	8	83	6
Other local	2	1	5	3	2	1	3	3	7	8	29	2
China	137	72	108	67	81	57	41	41	41	47	848	59
India	11	6	5	3	7	5	1	1	1	1	63	4
Other overseas	2	1	1	1	2	1	5	5	0	0	14	1
Unknown	0	0	0	0	0	0	0	0	0	0	4	0
TOTAL	190	100	162	100	141	100	100	100	88	100	1446	100

In terms of place of transplantation, transplantation within local centres has remained the quite same from 1999 to 2007, with 52 to 53 cases (51% of all renal transplants), but has decreased to 46 in 2008. 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 2008 comprised 47% of all of renal transplant recipients with 41 patients.

SECTION 14.2: RECIPIENTS' CHARACTERISTICS

In terms of renal transplant recipients' characteristics, age at transplant has been stable at 34 to 42 years. Between 58% and 70% of recipients were males over the last 10 years. There has been an increase in the proportion of diabetic patients undergoing transplantation from 11% in 1998 to 21% in 2006 (Table 14.2.1). However, there is a drastic drop in number of diabetic patients who underwent transplantation in 2007 and 2008 (14% and 15% respectively). 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 4-8%. 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 majority of these patients presented late.

Table 14.2.1: Renal Transplant Recipients' Characteristics, 1999-2008

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
New Transplant Patients	127	143	163	172	160	190	162	141	100	88
Age at transplant (years), Mean	37	39	41	41	42	41	38	37	36	34
Age at transplant (years), SD	13	14	13	13	13	13	14	15	16	15
% Male	62	64	63	58	66	62	70	67	63	58
% Diabetic (co-morbid/ primary renal disease)	11	15	18	15	22	22	20	21	14	15
% HBsAg positive	4	5	5	7	8	5	4	7	5	4
% Anti-HCV positive	11	8	15	8	10	8	2	8	10	4

Table 14.2.2: Primary causes of end stage renal failure, 1999-2008

Year	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
New transplant patients	127	100	143	100	163	100	172	100	160	100
Glomerulonephritis	41	32	50	35	44	27	54	31	54	34
Diabetes Mellitus	10	8	16	11	23	14	16	9	26	16
Hypertension	7	6	20	14	17	10	24	14	25	16
Obstructive uropathy	4	3	3	2	3	2	2	1	2	1
ADPKD	1	1	3	2	1	1	3	2	5	3
Drugs/ toxic nephropathy	0	0	0	0	0	0	0	0	2	1
Hereditary nephritis	0	0	0	0	0	0	0	0	0	0
Unknown	62	49	54	38	61	37	70	41	58	36
Others	6	5	12	8	23	14	16	9	12	8

Year	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
New transplant patients	190	100	162	100	141	100	100	100	88	100
Glomerulonephritis	62	33	44	27	52	37	29	29	21	24
Diabetes Mellitus	32	17	29	18	22	16	9	9	10	11
Hypertension	51	27	39	24	31	22	24	24	15	17
Obstructive uropathy	4	2	3	2	4	3	1	1	0	0
ADPKD	5	3	3	2	1	1	1	1	0	0
Drugs/ toxic nephropathy	2	1	0	0	1	1	0	0	2	2
Hereditary nephritis	1	1	0	0	0	0	0	0	0	0
Unknown	83	44	50	31	44	31	37	37	40	45
Others	27	14	17	10	16	11	14	14	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 20% of transplants (28 recipients) in the same year which was down from 45 cases (37%) in 1999 and 40 cases (24%) in 2005. Since 2006, the number of life donor has remained low - 31 in 2007 and 25 in 2008. 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 where there were more local transplantations (57%) compared to commercial transplantations in oversea (41%).

Table 14.3.1: Type of Renal Transplantation, 1999-2008

Year	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial cadaver	64	52	80	56	83	51	103	60	112	70
Commercial live donor	4	3	9	6	7	4	11	6	3	2
Live donor (genetically related)	40	33	21	15	32	20	33	19	25	16
Live donor (emotionally related)	5	4	6	4	4	2	3	2	5	3
Cadaver	10	8	27	19	37	23	22	13	15	9
Total	123	100	143	100	163	100	172	100	160	100

Year	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial cadaver	143	76	105	65	82	58	41	41	40	45
Commercial live donor	6	3	8	5	5	4	2	2	1	1
Live donor (genetically related)	21	11	37	23	24	17	20	20	22	25
Live donor (emotionally related)	2	1	3	1	4	3	11	12	3	4
Cadaver	17	9	9	6	26	18	25	25	22	25
Total	189	100	162	100	141	100	99	100	88	100

*Commercial Cadaver (China, India, other oversea) *Commercial live donor (living unrelated) *Cadaver (local)

Table 14.3.2: Biochemical data, 2006-2008

Biochemical parameters	Summary	2006	2007	2008
Creatinine, umol/L	N	1592	1686	1499
	Mean	135.7	131.8	131
	SD	81.3	77.6	80.2
	Median	120	116	113
	Minimum	21.7	36	29
	Maximum	1152	1186	1181
Hb, g/dL	N	1592	1686	1499
	Mean	12.7	12.8	12.9
	SD	1.9	1.9	1.9
	Median	12.8	12.8	12.9
	Minimum	3.3	4.4	6.2
	Maximum	19.8	18.7	18.6
Albumin, g/L	N	1592	1686	1499
	Mean	40	40	40
	SD	0.7	0.8	0.8
	Median	40	40	40
	Minimum	29	29	30
	Maximum	48	48	50
Calcium, mmol/L	N	1592	1686	1499
	Mean	2.3	2.3	2.3
	SD	0.2	0.2	0.2
	Median	2.3	2.3	2.3
	Minimum	1.1	1.4	1
	Maximum	3.1	3.2	3.5

Biochemical parameters	Summary	2006	2007	2008
Phosphate, mmol/L	N	1592	1686	1499
	Mean	1.1	1.1	1.1
	SD	0.2	0.3	0.3
	Median	1.1	1.1	1.1
	Minimum	0.5	0.5	0.5
	Maximum	3.5	3.9	3.2
Alkaline Phosphate (ALP), U/L	N	1592	1686	1499
	Mean	79.1	79.4	78.4
	SD	43.2	39.8	47.9
	Median	71	72	70
	Minimum	24	22	20
	Maximum	700	508	985
ALT, U/L	N	1592	1686	1499
	Mean	29.8	29.8	28.6
	SD	30.4	25.7	31
	Median	22	23	22
	Minimum	4	4	4
	Maximum	433	356	733
Total cholesterol, mmol/L	N	1592	1686	1499
	Mean	5.3	5.2	5.2
	SD	1	1	1
	Median	5.3	5.3	5.3
	Minimum	1.5	1.7	2
	Maximum	11.1	11.4	11.2
LDL cholesterol, mmol/L	N	1592	1686	1499
	Mean	3	3	2.9
	SD	0.8	0.8	0.8
	Median	3	3	3
	Minimum	1	1	0.9
	Maximum	11.1	8.9	7.7
HDL cholesterol, mmol/L	N	1592	1686	1499
	Mean	1.6	1.5	1.6
	SD	0.5	0.4	0.5
	Median	1.6	1.6	1.6
	Minimum	0.4	0.4	0.5
	Maximum	5.8	7.5	7.5
Systolic Blood Pressure, mmHg	N	1592	1686	1499
	Mean	130.7	131.6	129.4
	SD	15.9	15.7	16.1
	Median	130	130	130
	Minimum	66	80	80
	Maximum	210	210	245
Diastolic Blood Pressure, mmHg	N	1592	1686	1499
	Mean	78.9	78.8	77.5
	SD	9.8	9.4	9.7
	Median	80	80	80
	Minimum	30	20	20
	Maximum	120	116	133

Table 14.3.3: Medication data, 2006-2008

Medication data	Single drug treatment						Combined drug treatment					
	2006		2007		2008		2006		2007		2008	
	N	%	N	%	N	%	N	%	N	%	N	%
All	1482	100	1664	100	1359	100	1482	100	1664	100	1359	100
(i) Immunosuppressive drug(s) treatment												
Prednisolone	8	1	9	1	6	0	1444	97	1610	97	1321	97
Azathioprine	0	0	0	0	0	0	497	34	479	29	374	28
Cyclosporin A	5	0	8	0	2	0	1119	76	1190	72	938	69
Tacrolimus (FK506)	0	0	4	0	3	0	254	17	348	21	327	24
Mycophenolate Mofetil (MMF)	0	0	1	0	2	0	708	48	906	54	721	53
Rapamycin	0	0	0	0	1	0	7	0	33	2	30	2
Others	0	0	0	0	0	0	18	1	4	0	1	0
(ii) Non-Immunosuppressive drug(s) treatment												
Beta blocker	77	5	90	5	87	6	597	40	735	44	609	45
Calcium channel blocker	199	13	184	11	137	10	787	53	904	54	680	50
ACE inhibitor	39	3	38	2	29	2	292	20	384	23	282	21
AIIRB	27	2	18	1	17	1	141	10	210	13	137	10
Anti-lipid	156	11	95	6	87	6	679	46	731	44	616	45
Other anti-hypertensive	11	1	6	0	24	2	159	11	140	8	188	14

In 2008, Cyclosporine based regimes remained the mainstay of immunosuppressive therapy with 69% of patients receiving it. This showed a gradual declining trend from 80% of all immunosuppression used since 2004 which coincided with increasing trend in Tacrolimus usage. Tacrolimus based regimes accounted for 24%. There has been continuous increase in the use of Mycophenolate Mofetil as the second immunosuppressive agent in 53% of patients in 2008 compared to 37% of patients in 2004. During the same period, the use of Azathioprine declined from 43% in 2004 to 28% in 2008. Monotherapy of immunosuppresion is mostly not noted except in a small number of patients. Sirolimus was used in 2% of all transplant recipients in 2008.

In terms of non immunosuppressive medications, in year 2008 only 31% of patients were on ACE inhibitors or Angiotensin II receptor blockers (AIIRB) or both and this trend has been relatively static since 2004. Calcium Channel blockers appeared to be the mainstay of antihypertensive therapy in 50% of patients whilst Beta Blockers use was reported in 45% of patients. Other antihypertensives were reported in 14% 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.

SECTION 14.4: TRANSPLANT OUTCOMES

14.4.1 Post-transplant complications

In the year 2008, sixty-two 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. These trends have been quite the same since 2006. In terms of cardiovascular and cerebrovascular disease 4% had either or both prior to transplant whereas 5% developed these post transplantation.

Table 14.4.1: Post-transplant complications, 2006-2008

Post transplant complications	Complication developed before transplant (regardless of complication after transplantation)						Complication developed only after transplantation					
	2006		2007		2008		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
All patients	1592	100	1686	100	1499	100	1592	100	1686	100	1499	100
Diabetes (either as Primary Renal Disease or co-morbid)	216	14	230	14	204	14	125	8	112	7	112	7
Cancer	2	0	3	0	2	0	20	1	21	1	26	2
Cardiovascular disease + cerebrovascular disorder	73	5	72	4	61	4	45	3	54	3	70	5
Hypertension	1035	65	1062	63	927	62	354	22	450	27	400	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 2008, 48 transplant recipients died and 32 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 26% and 13% respectively. Another 23% 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, 17% in 2004 and 19% in 2008. Death due to liver disease has remained relatively static at 5-9% from 2003 to 2006.

In terms of graft loss, 72% were due to rejection with 6% apiece for vascular causes and infections in 2008 and these figures have remained relatively stable for the last 4 years.

Table 14.4.2: Transplant Patients Death Rate and Graft Loss, 1999-2008

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
No. at risk	1145	1213	1291	1380	1466	1549	1638	1704	1728	1730
Transplant death	25	30	37	33	37	42	43	50	39	48
Transplant death rate %	2	2	3	2	3	3	3	3	2	3
Graft loss	37	32	40	39	42	44	21	38	37	32
Graft loss rate %	3	3	3	3	3	3	1	2	2	2
Acute rejection	0	0	0	0	3	19	14	18	12	0
Acute rejection rate %	0	0	0	0	0	1	1	1	1	0
All losses	62	62	77	72	79	86	64	88	76	80
All losses rate %	5	5	6	5	5	6	4	5	4	5

*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, 1977-2008

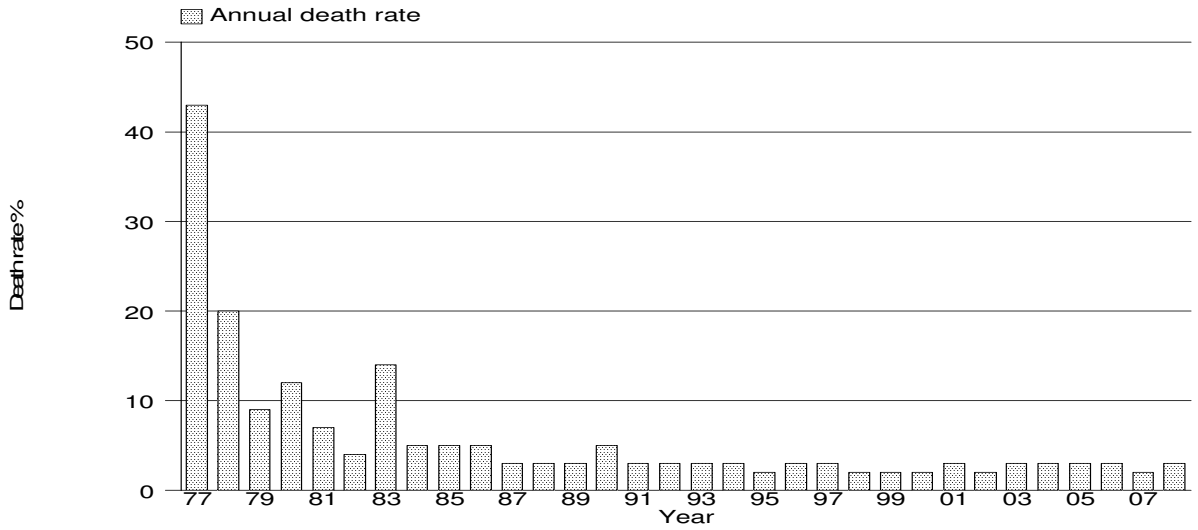


Figure 14.4.2(b): Transplant Recipient Graft Loss Rate, 1977-2008

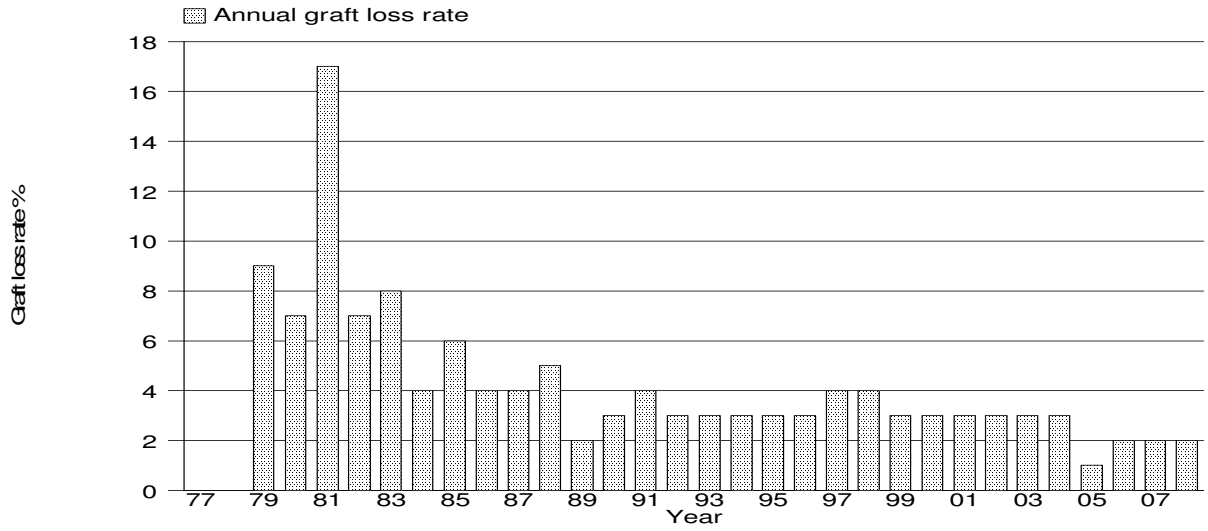


Table 14.4.3: Causes of Death in Transplant Recipients, 1999-2008

Year	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
Cardiovascular	4	13	10	29	7	16	5	15	9	23
Died at home	6	19	1	3	5	12	5	15	5	13
Infection	7	23	12	35	20	47	10	30	11	28
Graft failure	0	0	2	6	0	0	0	0	0	0
Cancer	3	10	2	6	6	14	4	12	6	15
Liver disease	3	10	1	3	1	2	3	9	2	5
Accidental death	1	3	1	3	1	2	1	3	0	0
Others	5	16	3	9	2	5	3	9	5	13
Unknown	2	6	2	6	1	2	2	6	2	5
TOTAL	31	100	34	100	43	100	33	100	40	100

Year	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
Cardiovascular	4	9	5	11	10	18	7	16	7	13
Died at home	6	13	5	11	7	13	5	11	12	23
Infection	11	24	22	50	22	40	15	34	14	26
Graft failure	3	7	0	0	0	0	4	9	1	2
Cancer	8	17	5	11	4	7	6	14	10	19
Liver disease	3	7	3	7	5	9	0	0	0	0
Accidental death	0	0	0	0	0	0	0	0	0	0
Others	10	22	3	7	4	7	3	7	8	15
Unknown	1	2	1	2	3	5	4	9	1	2
TOTAL	46	100	44	100	55	100	44	100	53	100

Table 14.4.4: Causes of Graft Failure, 1999-2008

Year	1999		2000		2001		2002		2003	
	No.	%	No.	%	No.	%	No.	%	No.	%
Rejection	23	62	19	59	25	61	23	56	21	47
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	0	0	1	3	2	5	0	0	2	4
Vascular causes	1	3	3	9	1	2	0	0	3	7
Recurrent/ de novo renal disease	0	0	0	0	2	5	2	5	2	4
Others	0	0	2	6	0	0	4	10	1	2
Unknown	13	35	7	22	11	27	12	29	16	36
TOTAL	37	100	32	100	41	100	41	100	45	100

Year	2004		2005		2006		2007		2008	
	No.	%	No.	%	No.	%	No.	%	No.	%
Rejection	33	70	18	75	28	65	26	68	26	72
Calcineurin toxicity	0	0	0	0	1	2	0	0	0	0
Other drug toxicity	1	2	0	0	0	0	0	0	0	0
Ureteric obstruction	0	0	0	0	0	0	1	3	0	0
Infection	1	2	1	4	3	7	1	3	2	6
Vascular causes	4	9	2	8	4	9	1	3	2	6
Recurrent/ de novo renal disease	1	2	0	0	1	2	0	0	0	0
Others	0	0	1	4	3	7	4	11	2	6
Unknown	7	15	2	8	3	7	5	13	4	11
TOTAL	47	100	24	100	43	100	38	100	36	100

14.5: PATIENT AND GRAFT SURVIVAL

Overall patient survival rates from 1995 to 2008 have been 95%, 91%, 88% and 81% at year 1, 3, 5 and 10 respectively. Overall graft survival rate has been 91%, 85%, 80% and 66% at year 1, 3, 5 and 10 respectively.

Table 14.5.1: Patient survival, 1995-2008

Interval (years)	No.	% Survival	SE
0	1925	100	-
1	1689	95	1
3	1351	91	1
5	971	88	1
10	296	81	1
12	125	75	2

*No.=Number at risk SE=standard error

Figure 14.5.1: Patient survival, 1995-2008

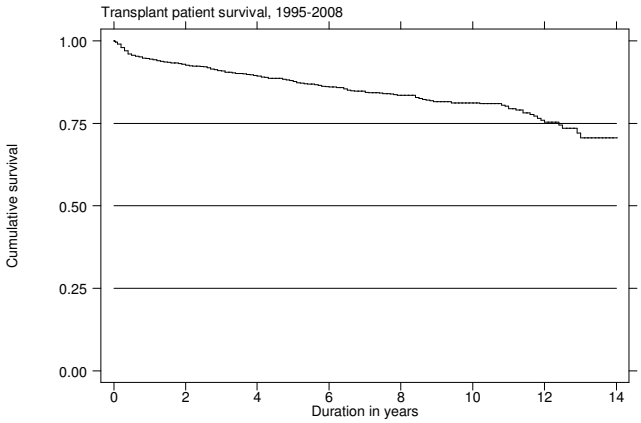
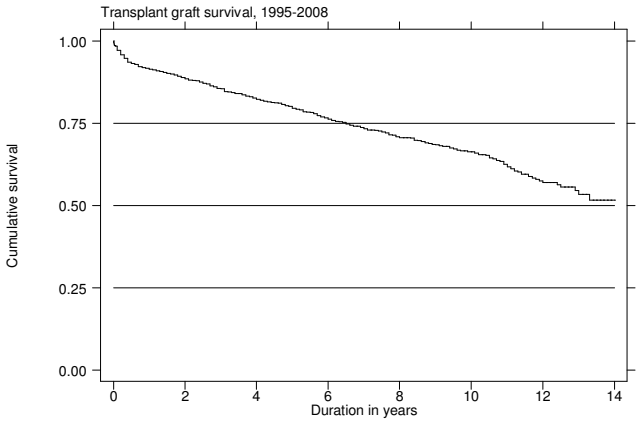


Table 14.5.2: Graft survival, 1995-2008

Interval (years)	No.	% Survival	SE
0	1925	100	-
1	1689	91	1
3	1351	85	1
5	971	80	1
10	296	66	1
12	125	57	2

*No.=Number at risk SE=standard error

Figure 14.5.2: Graft survival, 1995-2008



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 good survival rates with 96%, 95%, 94% and 89% 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%, 84% and 68% for the same intervals for live donor grafts.

Table 14.5.3: Patient survival by type of transplant, 1995-2008

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
0	1125	100	-	89	100	-	454	100	-	235	100	-
1	1022	96	1	85	98	2	395	96	1	168	85	2
3	843	92	1	64	89	3	320	95	1	110	78	3
5	576	88	1	46	85	4	249	94	1	90	75	3
10	177	81	2	16	67	7	83	89	2	15	71	4
12	74	75	3	5	58	10	44	85	3	4	63	8

*No.=Number at risk SE=standard error

Figure 14.5.3: Patient survival by type of transplant, 1995-2008

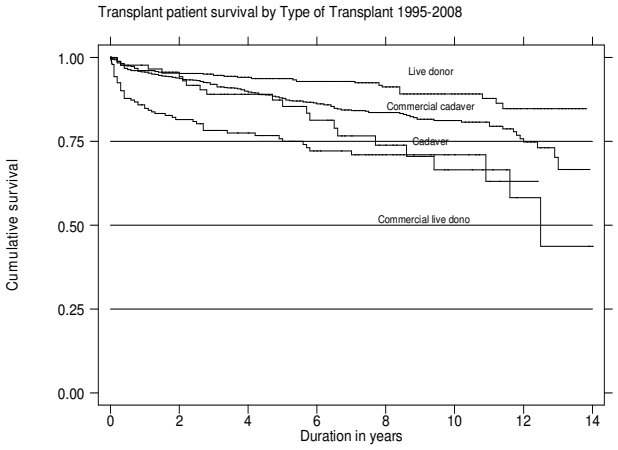


Figure 14.5.4: Graft survival by type of transplants, 1995-2008

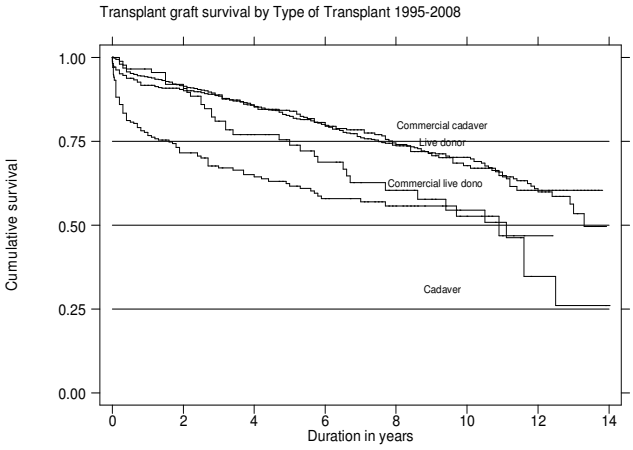


Table 14.5.4: Graft survival by type of transplant, 1995-2008

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
0	1125	100	-	89	100	-	454	100	-	235	100	-
1	1022	94	1	85	97	2	395	92	1	168	77	3
3	843	89	1	64	81	4	320	88	2	110	67	3
5	576	82	1	46	74	5	249	84	2	90	62	3
10	177	70	2	16	54	7	83	68	3	15	53	5
12	74	60	3	5	35	9	44	60	4	4	47	7

*No.=Number at risk SE=standard error

Patient and graft survival for living related transplants were compared for two cohorts. The 1995-2000 cohort and the 2001-2008 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 2001-2008 cohort even from the outset probably due to increased usage of newer immunosuppressive agents.

Table 14.5.5: Patient survival by year of transplant (Living related transplant, 1995-2008)

Year of Transplant	1995-2000			2001-2008		
Interval (years)	No.	% Survival	SE	No.	% Survival	SE
0	206	100	-	248	100	-
1	184	97	1	212	95	1
3	175	96	1	146	94	2
5	164	95	2	86	93	2
7	155	94	2	27	92	2

*No.=Number at risk SE=standard error

Figure 14.5.5: Patient survival by year of transplant (Living related transplant, 1995-2008)

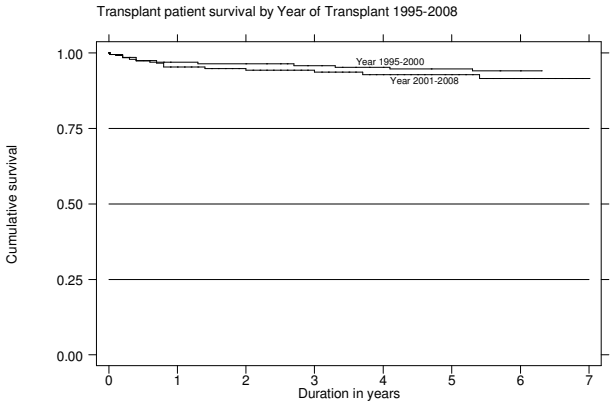


Figure 14.5.6: Graft survival by year of transplant (Living related transplant, 1995-2008)

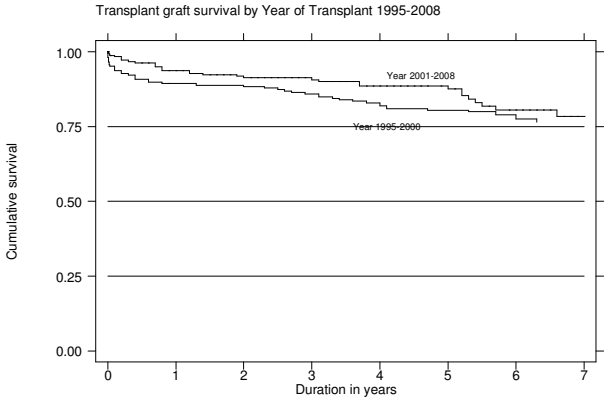


Table14.5.6: Graft survival by year of transplant (Living related transplant, 1995-2008)

Year of Transplant	1994-1999			2000-2007		
Interval (years)	No.	% Survival	SE	No.	% Survival	SE
0	206	100	-	248	100	-
1	184	89	2	212	94	2
3	175	86	2	146	91	2
5	164	80	3	86	87	2
7	155	76	3	27	78	4

*No.=Number at risk SE=standard error

In terms of commercial cadaveric transplantation, the comparison between the 1995-2000 cohort and 2001 – 2008 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, 1995-2008)

Year of Transplant	1995-2000			2001-2008		
Interval (years)	No.	% Survival	SE	No.	% Survival	SE
0	417	100	-	708	100	-
1	394	96	1	630	95	1
3	373	93	1	473	91	1
5	336	88	2	240	87	1
7	305	85	2	57	82	2

*No.=Number at risk SE=standard error

Figure 14.5.7: Patient survival by year of transplant (Commercial cadaver transplant, 1995-2008)

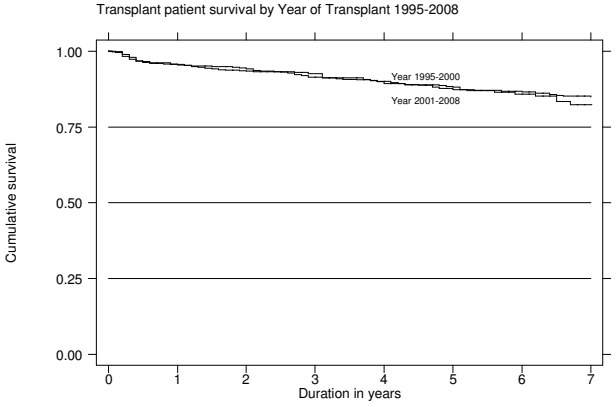


Figure 14.5.8: Graft survival by year of transplant (Commercial cadaver transplant, 1995-2008)

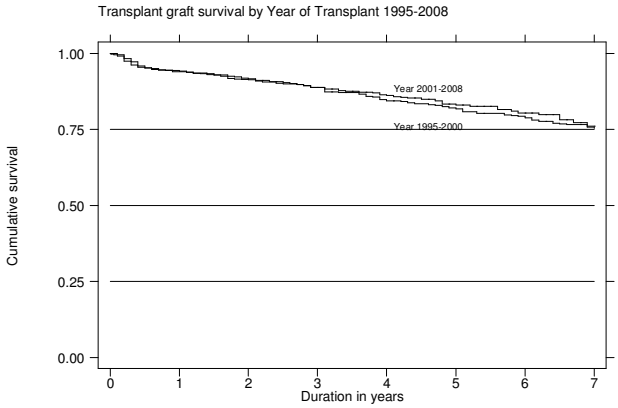


Table 14.5.8: Graft survival by year of transplant (Commercial cadaver transplant, 1995-2008)

Year of Transplant	1995-2000			2001-2008		
Interval (years)	No.	% Survival	SE	No.	% Survival	SE
0	417	100	-	708	100	-
1	394	94	1	630	94	1
3	373	89	2	473	89	1
5	336	82	2	240	83	2
7	305	75	2	57	76	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 2008, 85.2% of patients were hypertensive, 23.2% were diabetic and 56.8% had renal insufficiency fulfilling CKD III and above. Forty-five percent of patients had 2 cardiovascular risk factors while 10% had all 3 major risk factors.

Table 14.6.1: Risk factors for IHD in renal transplant recipients at year 2006, 2007 and 2008

	2006	2007	2008
Diabetes	21 (1.4)	25 (1.6)	17 (1.2)
Hypertension**	455 (31.1)	590 (37.5)	514 (36.8)
CKD	177 (12.1)	127 (8.1)	116 (8.3)
Diabetes + Hypertension**	155 (10.6)	174 (11.0)	172 (12.3)
Diabetes + CKD	18 (1.2)	11 (0.7)	21 (1.5)
CKD + Hypertension**	490 (33.5)	516 (32.8)	451 (32.3)
Diabetes + CKD + Hypertension**	147 (10.0)	132 (8.4)	106 (7.6)

**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 2006

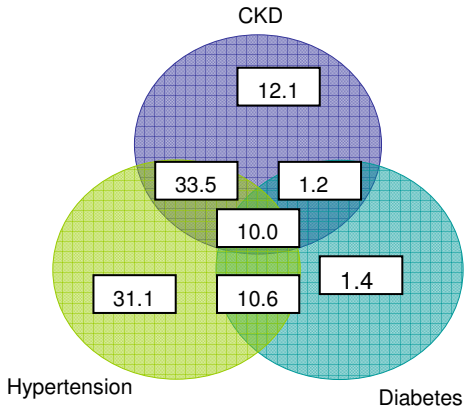


Figure 14.6.1(b); Venn Diagram for Pre and Post Transplant Complications (in %) at year 2007

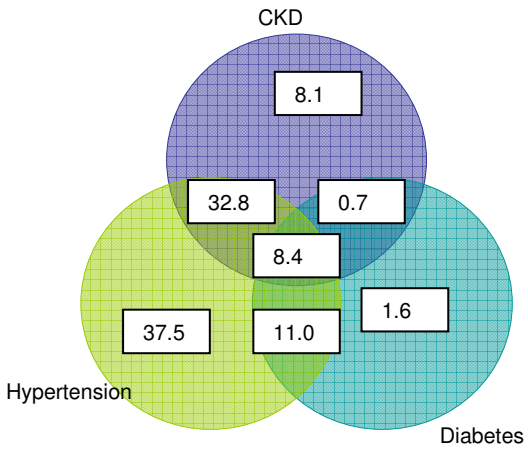
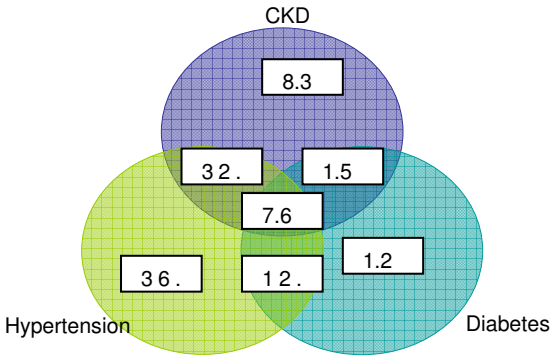


Figure 14.6.1 (c): Venn Diagram for Pre and Post Transplant Complications (in %) at year 2008



14.6.2 Blood Pressure classification according to JNC VI criteria, 2006, 2007, and 2008

In 2008, 22% of renal transplant recipients had stage I hypertension whereas 5% had stage II hypertension and 0.7% had stage III hypertension despite being on treatment. In terms of diastolic hypertension 13% had stage I hypertension, 1.4% of patients had stage II diastolic hypertension and 0.33% of patients had stage III diastolic hypertension despite being on treatment.

Table 14.6.2(a): Systolic BP, 2006-2008

Year	2006		2007		2008	
	No.	(%)	No.	(%)	No.	(%)
Systolic BP<120	249	(15.64)	240	(14.23)	279	(18.61)
Systolic BP <130	395	(24.81)	392	(23.25)	367	(24.48)
Systolic BP 130-139	483	(30.34)	529	(31.38)	441	(29.42)
Systolic BP 140-159	353	(22.17)	409	(24.26)	329	(21.95)
Systolic BP 160-179	93	(5.84)	99	(5.87)	73	(4.87)
Systolic BP >=180	19	(1.19)	17	(1.01)	10	(0.67)

Figure 14.6.2(a): Systolic BP, 2006-2008

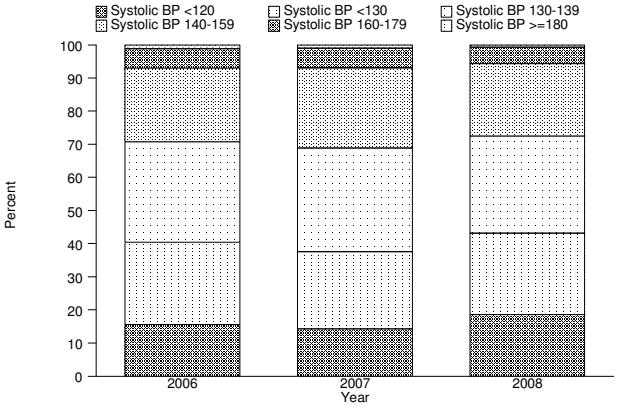


Figure 14.6.2(b): Diastolic BP, 2006-2008

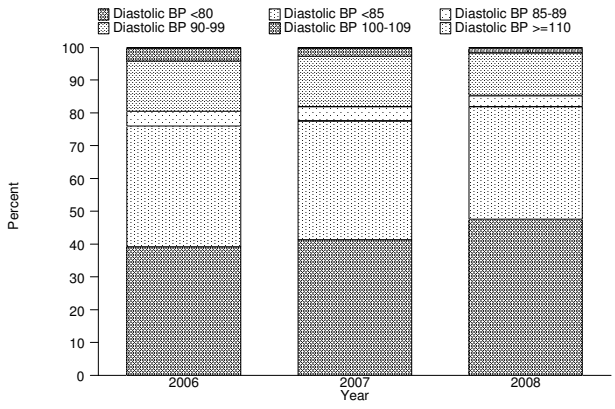


Table 14.6.2(b): Diastolic BP, 2006-2008

Year	2006		2007		2008	
	No.	(%)	No.	(%)	No.	(%)
Diastolic BP<80	624	(39.20)	698	(41.40)	714	(47.63)
Diastolic BP <85	586	(36.81)	609	(36.12)	514	(34.29)
Diastolic BP 85-89	73	(4.59)	74	(4.39)	50	(3.34)
Diastolic BP 90-99	244	(15.33)	261	(15.48)	195	(13.01)
Diastolic BP 100-109	61	(3.83)	39	(2.31)	21	(1.40)
Diastolic BP >=110	4	(0.25)	5	(0.30)	5	(0.33)

Table 14.6.3: CKD stages, 2006-2008

Year	2006		2007		2008	
	No.	(%)	No.	(%)	No.	(%)
CKD stage 1	116	(7.33)	180	(10.79)	145	(9.82)
CKD stage 2	533	(33.67)	592	(35.49)	561	(37.98)
CKD stage 3	805	(50.85)	760	(45.56)	642	(43.47)
CKD stage 4	107	(6.76)	113	(6.77)	106	(7.18)
CKD stage 5	22	(1.39)	23	(1.38)	23	(1.56)

Table 14.6.3 shows the CKD Stage classification by year and in 2008, 43.5% of renal transplant recipients had CKD Stage III whilst another 7.2% had CKD Stage IV. CKD Stage V (impending renal replacement therapy) was found in 1.6% of renal transplant recipients.

Figure 14.6.3: CKD stages by year

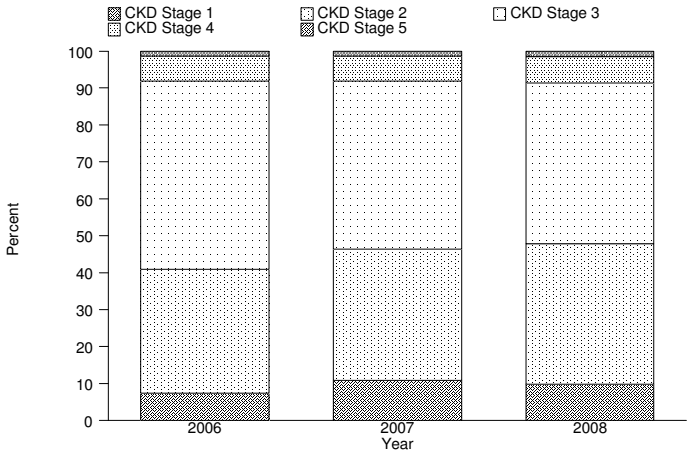


Table 14.6.4: BMI, 2006-2008

Year	2006		2007		2008	
	No.	(%)	No.	(%)	No.	(%)
BMI <20	242	(15.20)	253	(15.01)	244	(16.28)
BMI 20-25	647	(40.64)	658	(39.03)	588	(39.23)
BMI 25-30	498	(31.28)	533	(31.61)	455	(30.35)
BMI > 30	205	(12.88)	242	(14.35)	212	(14.14)

In terms of BMI for 2008, 55.5% of renal transplant recipients had BMIs of 25 or below. However 30.1% were overweight and another 14% were obese. There seems to be a slow but steady increase in numbers of obese patients over the last few years.

Figure 14.6.4: BMI by year

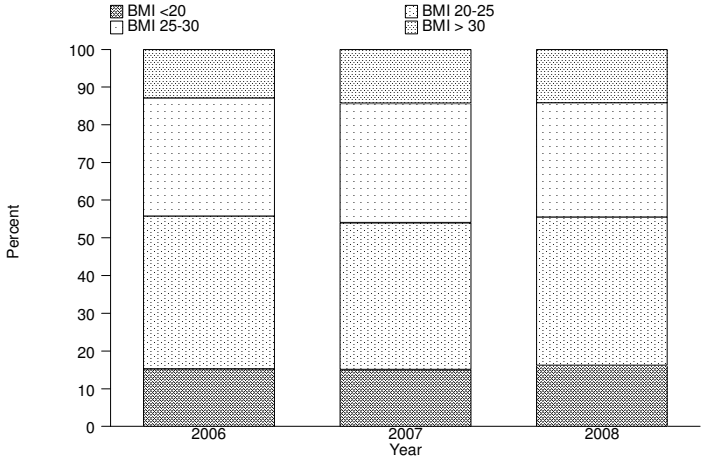
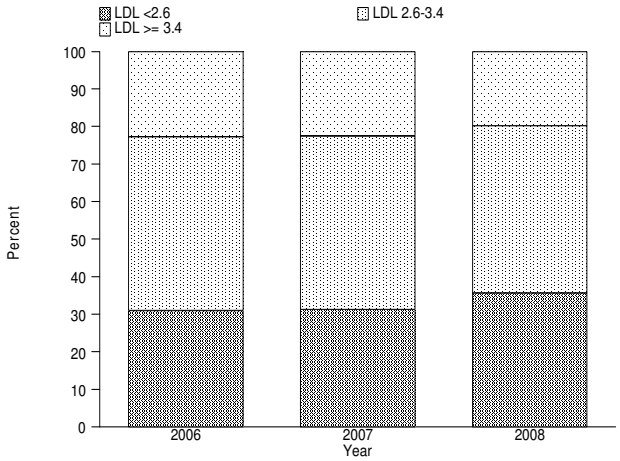


Table 14.6.5(a): LDL, 2006-2008

Year	2006		2007		2008	
	No.	(%)	No.	(%)	No.	(%)
LDL < 2.6	492	(30.90)	527	(31.26)	534	(35.62)
LDL 2.6-3.4	738	(46.36)	778	(46.14)	669	(44.63)
LDL >= 3.4	362	(22.74)	381	(22.60)	296	(19.75)

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 2008 35.6% have LDL levels below 2.6 mol/l and this shows an increasing trend from 18.1% in 2004, possibly due to the more widespread and aggressive 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 also demonstrated downward trend over the last few years.

Figure 14.6.5(a): LDL, 2006-2008



In terms of other cholesterol parameters for 2008, 56% had total cholesterol levels >= 5.2 and 6.2% had HDL cholesterol levels <1.0 .

Table 14.6.5(b): Total Cholesterol, 2006-2008

Year	2006		2007		2008	
	No.	(%)	No.	(%)	No.	(%)
Total Cholesterol <4.1	160	(10.05)	210	(12.46)	184	(12.27)
Total Cholesterol 4.1-5.1	490	(30.78)	539	(31.97)	476	(31.75)
Total Cholesterol 5.1-6.2	700	(43.97)	719	(42.65)	629	(41.96)
Total Cholesterol 6.2- 7.2	173	(10.87)	159	(9.43)	143	(9.54)
Total Cholesterol > 7.2	69	(4.33)	59	(3.50)	67	(4.47)

Figure 14.6.5(b): Total Cholesterol, 2006-2008

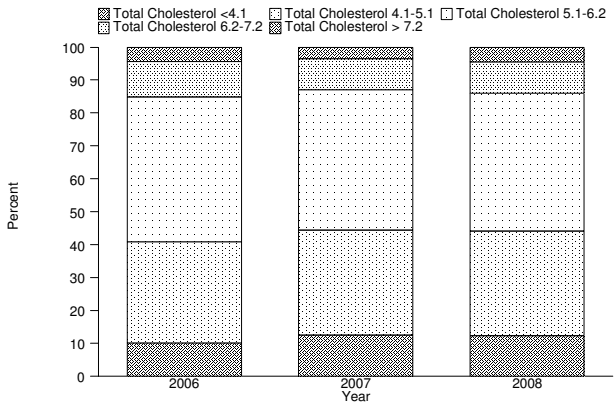
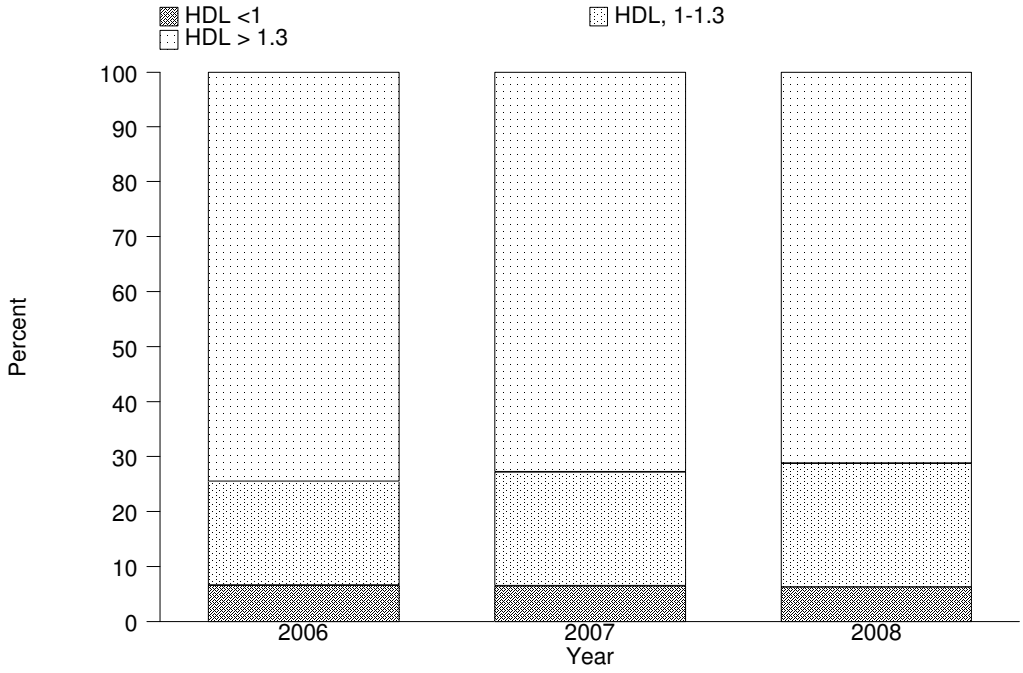


Table 14.6.5(c): HDL, 2006-2008

Year	2006		2007		2008	
	No.	(%)	No.	(%)	No.	(%)
HDL <1	104	(6.53)	108	(6.41)	93	(6.20)
HDL 1-1.3	302	(18.97)	350	(20.76)	338	(22.55)
HDL >1.3	1186	(74.50)	1228	(72.84)	1068	(71.25)

Figure 14.6.5(c): HDL by year



Eighty-six percent of patients in 2008 were on antihypertensives and the majority were on more than 1 antihypertensive drug with 31% on 2 antihypertensives and 21% on 3 antihypertensives. Six percent of patients still had systolic BP of > 160 mmHg and 17% had diastolic BP of > 90 mmHg despite being given antihypertensive(s), however, this is an improvement from previous years.

Table 14.6.6(a): Treatment for hypertension, 2006-2008

Year	No.	% on anti-hypertensives	% no 1 anti-hypertensive drug	% on 2 anti-hypertensives	% on 3 anti-hypertensives
2006	1592	86	34	26	17
2007	1686	85	25	31	21
2008	1499	86	27	31	21

Table 14.6.6(b): Distribution of Systolic BP without anti-hypertensives, 2006-2008

Year	No.	Mean	SD	Median	LQ	UQ	% Patients ≥ 160mmHg
2006	189	123.8	14.4	120	117	130	4
2007	196	125.2	16.5	120	113	134	4
2008	171	124	15.6	120	110	130	4

Table 14.6.6(c): Distribution of Diastolic BP without anti-hypertensives, 2006-2008

Year	No.	Mean	SD	Median	LQ	UQ	% patients ≥ 90mmHg
2006	189	76.4	10.3	80	70	80	11
2007	196	76.6	10	80	70	80	12
2008	170	75.2	10.2	80	70	80	11

Table 14.6.6(d): Distribution of Systolic BP on anti-hypertensives, 2006-2008

Year	No.	Mean	SD	Median	LQ	UQ	% Patients ≥ 160mmHg
2006	1334	131.7	16.3	130	120	140	8
2007	1388	132.6	16	130	120	140	8
2008	1241	129.9	16.6	130	120	140	6

Table 14.6.6(e): Distribution of Diastolic BP on anti-hypertensives, 2006-2008

Year	No.	Mean	SD	Median	LQ	UQ	% Patients ≥ 90 mmHg
2006	1334	79.2	9.9	80	70	86	22
2007	1387	79.1	9.6	80	70	85	20
2008	1227	77.6	9.9	80	70	80	17

SECTION 14.7: QOL INDEX SCORE IN RENAL TRANSPLANT RECIPIENTS

1179 patients who were transplanted between 1999-2008 were analysed for QoL index score. They reported median QoL index score of 10 (Table 14.7.1 and Figure 14.7.1). It was interesting to note that for those who underwent renal transplantation between this period, diabetics and non-diabetics had the same median QoL index score of 10 (Table 14.7.2 and Figure 14.7.2), and this is in contrast to HD and CAPD patients where diabetics reported lower QoL index score than non-diabetics. There was also no difference seen between gender (Table 14.7.3 and Figure 14.7.3) and age (Table 14.7.4 and Figure 14.7.4). It is worth while to note that those above 60 year-old also enjoyed the same QoL index score (10) as their younger counterpart (Table 14.7.4 and Figure 14.7.4). This trend of high QoL index score among renal transplant patients was maintained over the last 10 years (Table 14.7.5 and Figure 14.7.5).

Table 14.7.1: Cumulative distribution of QoL-Index score in Transplant recipients 1999 - 2008

	QoL score
Number of patients	1179
Centile	
0	0
0.05	9
0.1	9
0.25 (LQ)	10
0.5 (median)	10
0.75 (UQ)	10
0.9	10
0.95	10
1	10

Figure 14.7.1: Cumulative distribution of QoL-Index score in Transplant recipients, 1999 - 2008

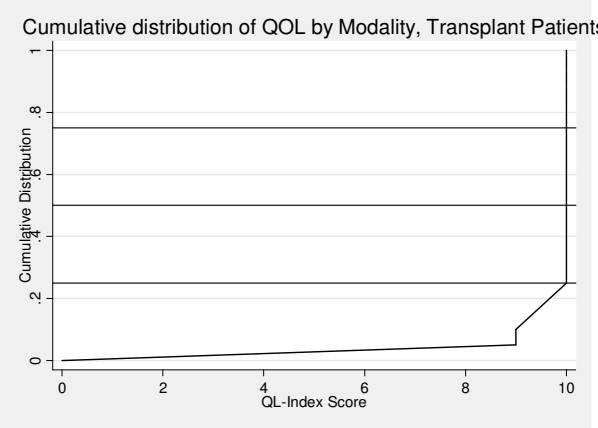


Table 14.7.2: Cumulative distribution of QoL-Index score in relation to Diabetes mellitus, Transplant recipients 1999 - 2008

Diabetes mellitus	No	Yes
Number of patients	1054	125
Centile		
0	0	0
0.05	9	7
0.1	10	8
0.25 (LQ)	10	9
0.5 (median)	10	10
0.75 (UQ)	10	10
0.9	10	10
0.95	10	10
1	10	10

Figure 14.7.2: Cumulative distribution of QoL-Index score in relation to Diabetes mellitus, Transplant recipients 1999 – 2008

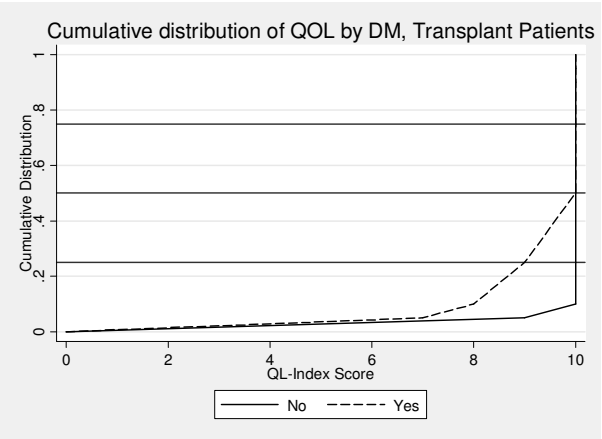


Table 14.7.3: Cumulative distribution of QoL-Index score in relation to Gender, Transplant recipients 1999-2008

Gender	Male	Female
Number of patients	730	449
Centile		
0	0	0
0.05	9	9
0.1	10	9
0.25 (LQ)	10	10
0.5 (median)	10	10
0.75 (UQ)	10	10
0.9	10	10
0.95	10	10
1	10	10

Figure 14.7.3: Cumulative distribution of QoL-Index score in relation to Gender, Transplant recipients 1999 – 2008

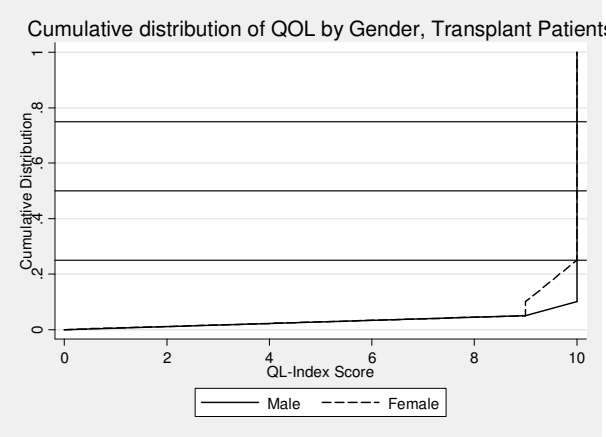


Table 14.7.4: Cumulative distribution of QoL-Index score in relation to Age, Transplant recipients 1999-2008

Age group (years)	<20	20-39	40-59	≥60
Number of patients	117	472	515	75
Centile				
0	0	0	0	0
0.05	9	9	8	7
0.1	10	10	9	8
0.25 (LQ)	10	10	10	9
0.5 (median)	10	10	10	10
0.75 (UQ)	10	10	10	10
0.9	10	10	10	10
0.95	10	10	10	10
1	10	10	10	10

Figure 14.7.4: Cumulative distribution of QoL-Index score in relation to Age, Transplant recipients 1999-2008

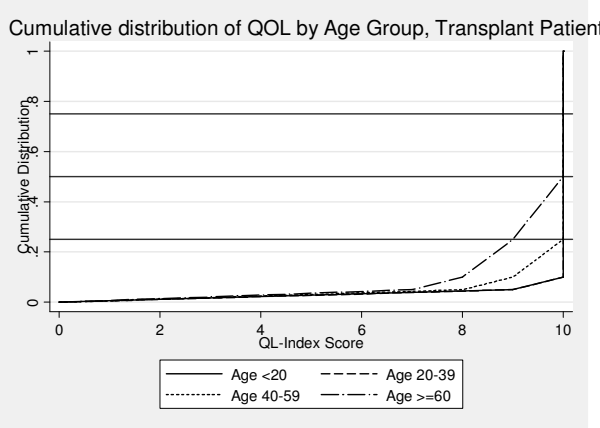
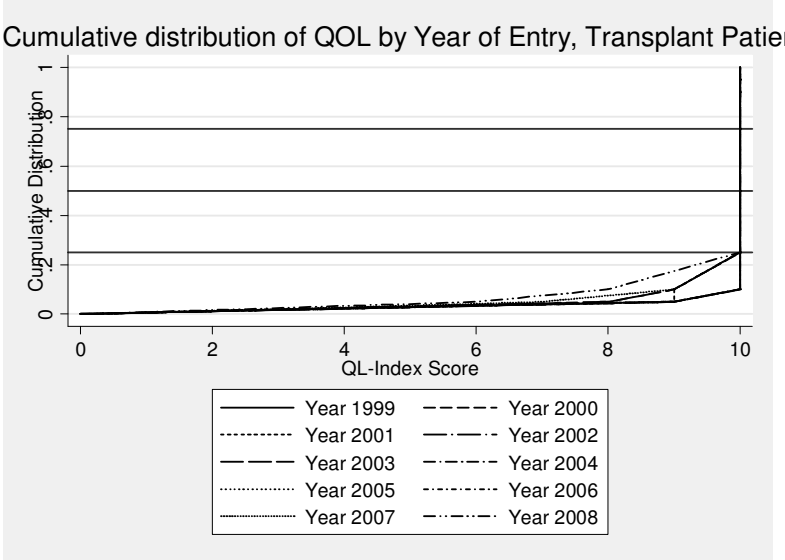


Table 14.7.5: Cumulative distribution of QoL-Index score in relation to Year of entry, Transplant recipients 1999-2008

Year of Entry	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number of patients	101	110	126	143	136	167	137	128	76	55
Centile										
0	0	0	0	0	0	0	0	0	0	0
0.05	9	8	9	9	8	9	9	9	7	6
0.1	10	9	9	10	9	10	10	10	9	8
0.25 (LQ)	10	10	10	10	10	10	10	10	10	10
0.5 (median)	10	10	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

Figure 14.7.5: Cumulative distribution of QoL-Index score in relation to Year of entry, Transplant recipients 1999 – 2008



APPENDIX I

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 clinical trail data. Caution should be used when interpreting the results.

Data source

The initial phase of the data collected in the Malaysian Dialysis and Transplant Registry (MDTR) 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.

MDTR continues to actively ascertain new RRT centres in the country. The mechanism of ascertainment is through feedback from the dialysis related companies, 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.

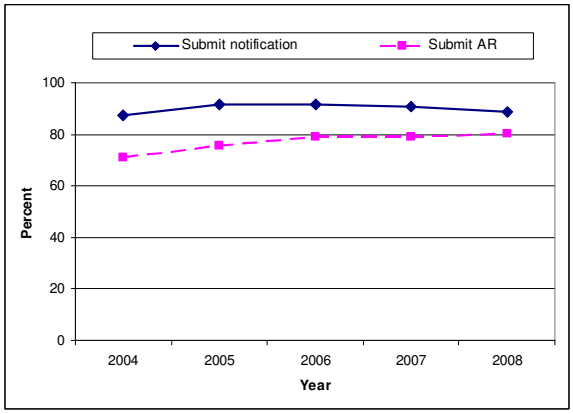
Participation in the MDTR which was entirely voluntary prior to 2006 is now made compulsory by the Private Health Care Facilities and Services Act 1998 and its Regulations 2006 which was implemented on 1st May 2006. This however only applies to private and NGO centres and data submission from centres managed by the Ministry of Health, Defence or the Universities is still voluntary. RRT centres which have expressed interest in participating will be recruited as SDP.

In the year 2008, there were 42 new known haemodilaysis centres in Malaysia, i.e. an average of 3.5 new centres per month. One centre ceased operation. The data submission compliance rate for Ministry of Health centres was 100%. The annual treatment data submission has improved among centres with the enforcement of the Act and we hope to see full participation in the coming years. Over all the data submission rate remains good accept for renal transplant.

Table Data submission, 2008

	At December 2008 Known centres (N)	Agreed to Participate (N)	Submitting data in 2008 (N)	Submitting annual returns (N)	Submitted data (%)
Haemodialysis	502	489	446	404	91.2
Chronic PD	33	33	32	29	97.0
Transplant	70	70	42	38	60.0
All modality	605	592	520	471	87.8

Figure Data submission, 2005-2008



Data collection
MDTR is a paper base data submission. The case reporting forms are designed to facilitate the data transcription and the information required are readily available in the patient's case note. All the SDPs are provided with instructions on data collection and submission to the Register. The standard data collection forms are colour coded by modality and case report form (CRF) types. The notification forms are submitted periodically or whenever there is an incident. Annual return forms for the assess year should reach the NRR coordinating office not later than January the following year. The CRFs are:

- Patient notification form
- Outcome notification form
- HD annual return form
- PD annual return form
- Transplant annual return form
- Work related rehabilitation and quality of life assessment form – annual assessment

MDTR collects patients' demographic details, clinical data, dialysis treatment data, transplant data, peritonitis data and outcome data. MDTR 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 until their death. For those patients who were lost to follow-up, MDTR 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 transmittal in the registry.

MDTR 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 2.33GHz with dual processors, with a total of 8GB RAM memory and 800GB of RAID-5 (Redundant Array of Independent Disks, level 5). In view of high volume of data accumulated throughout these years, capacity ability, performance and security issues of Microsoft Access, it was subsequently migrated to Microsoft SQL Server 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 forms. 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 will 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). Sixteenth Report of the Malaysian Dialysis and Transplant Registry 2008. Kuala Lumpur 2009

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 centres are now able to down load their own centre 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 patient notification between 1999 and 2008*
   This analysis set consists of patients commencing dialysis between 1999 and 2008. This analysis set was used for the analysis in Chapter 1, 2 and 4.

   Patients who were less than 20 years old age at the start of dialysis between 1999 and 2008 were used for the analysis in Chapter 6.

   Since 1993, the NRR conducted an annual survey on all dialysis patients to collect data on dialysis and drug treatment, clinical and laboratory measurements. All available data were used to describe the trends in these characteristics. However, in the early years, the data collected from annual survey were relatively incomplete. Hence, for any analysis in relation to these characteristics, we used only data from 1999 onwards when the data were more complete. Remaining missing data in this analysis set was imputed. The raw variables that have been imputed were albumin, calcium, phosphate, hemoglobin, transferring saturation, cholesterol, ferritin, diastolic blood pressure, BMI and year of birth. This analysis set was used for the analysis in Chapters 7 to 13. However, the generated variable that has been imputed is prescribed Kt/V for HD patients. Prescribed Kt/V which generated are considered the below formula:

   Kt/V=kdx x hd_time x 60/(0.58 x post weight x 1000)
   where
   kdx = [1-exp(-ex)] x HD flow rate x 500/[500 – HD flow rate x exp(-ex)]
   and
   ex=(500 – HD flow rate) x ka/(500 x HD flow rate).

   This variable is considered in Chapter 12.

2. *New Dialysis Patients*
   The number of new dialysis patients was based on the first dialysis treatment of the patients. Patients who convert from one dialysis modality to another (from HD to PD or vice versa) are not counted as new patients. If transplant is the 1st RRT treatment and patient's kidney transplant failed and he received dialysis, then for RRT count, the patient will be counted twice. However, if the patient receive transplant in between the dialysis, then the dialysis after transplant will be counted if the transplant last for more than 90 days while if it is last for less than or equal to 90 days, then the dialysis after the transplant will not be counted. This analysis set definition was used in chapters 1,2 and 6.

3. *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 (2007).

   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).

International dialysis pricing data was obtained from Harris A. The organization and funding of the treatment of end-stage renal disease in Australia. . Int J Health Care Finance Econ. 7(2-4): 113-132, Hirth RA. The organization and financing of kidney dialysis and transplant care in the United States of America. Int J Health Care Finance Econ. 7(4): 301-318, Nicholson T and Roderick P. International Study of Health Care Organization and Financing of renal services in England and Wales. Int J Health Care Finance Econ. 7(4): 283-299.

International household income data was obtained from Jones F, The effects of taxes and benefits on household income, 2005/06, Office of National Statistics (2007), DeNavas-Walt C, Proctor BD, Hill Lee C. Income, Poverty, and Health Insurance Coverage in the United States: 2005 U.S. Census Bureau (August 2006), Commonwealth of Australia. 6523.0 – Household Income and Income Distribution, Australia, 2005-6. Australian Bureau of Statistics (August 2007)

4. *Rehabilitation outcomes*
   Analysis is confined to the relevant population. Hence we excluded the following groups.
   i. Age less than or equal to 21 years
   ii. Age more than or equal to 55 years
   iii. Homemaker
   iv. Full time student
   v. Retired
   This analysis set was used for the analysis in Chapter 5.

5. *Centre Survey data*
   Section 2.2 in the report was based on annual centre survey data from 1999 to 2008 rather than individual patient data reported to the Registry.

6. *Peritonitis data*
   Analysis was confined to peritoneal dialysis patients from 1999-2008. This analysis set was used for the analysis in Chapter 13.

7. *Renal transplantation data*
   This analysis set was confined to patients who had under gone renal transplantation from 1999-2008. This data was obtained from National Transplant Registry (NTR). This analysis set was used for the analysis in Chapter 14.

8. *Diabetes Mellitus*
   The patient is considered with to have diabetes mellitus (DM) if the primary cause of ESRD is DM or the comorbid is DM.

STATSTICAL 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.

Primary Renal disease

Those patients who the primary cause is unknown, pyelonephrithis, gouty nephropathy, hypertension or failed transplant, their primary cause will be consider as diabetes mellitus (DM) if their comorbid condition is DM.
Apply in: Chapter 2, 4 & 14

Adjusted Mortality of dialysis patients

Cox propotional hazards model was considered for the mortality of the patients adjusted with demographic and lab variables. This analysis was used in Chapter 4 and 13.

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 by year. Cumulative distribution plot shows a listing of the sample values of a variable on the X axis and the proportion of the observations less than or greater than each value on the Y axis. An accompanying table gives the Median (50% of values are above or below it), upper quartile (UQ, 25% of values above and 75% below it), lower quartile (LQ, 75% of values above and 25% below it). Other percentiles can be read directly off the cumulative distribution plot. The table also shows percent of observations above or below a target value, or with an interval of values; the target value or interval obviously vary with the type of laboratory data. For example, interval of values for prescribed Kt/V is >1.3 and that for haemoglobin is <10, 10-11 and >11 g/l. The choice of target value is guided by published clinical practice guidelines, for example, the DOQI guideline; or otherwise they represent consensus of the local dialysis community. This analysis was used for Chapter 5, 7, 8, 9, 10, 12 & 13

Centre survey data

In contrast to other results reported in this report, Section 2.2 was based on centre survey data rather than individual patient data reported to the Registry. This is to provide up-to-date information on patient and centre census in the country and thus overcome the inevitable time lag between processing individual patient data and subsequent reporting of results. The survey was conducted in the month of December 2008. Centre response rate to survey was almost 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 2007 census projection. It is very difficult to estimate the amount of cross boundary patient flow; this source of error is therefore not accounted for in computing states estimates. However, we minimize the bias by combining states (Selangor and Wilayah Persekutuan Putrajaya, Sabah and Wilayah Persekutuan Labuan) 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. This analysis was used in Chapter 2.

Centre variation

To compare the variation of the intermediate results between centres, graph describing intermediate results in each centre are presented. The 95% confidence intervals have been calculated using the normal approximation of the Poisson to show the variation of proportion in centres. Lower quartile and upper quartile are instead plotted in comparison of variation in median among centres. In the analysis, centres

with less than ten patients were combined in a pooled centre. An accompanying table gives the summary statistics like minimum, 5th percentile, lower quartile, median, upper quartile, 95th percentile and maximum value among centres by year.
Centres with intermediate results for <10 patients were combined into one composite centre.
This analytical method was used in Chapters 7, 8, 9, 10, 11, 12 & 13

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

Incidence rate ratio
The incidence rate is determined by dividing the number of new cases of a diseases or condition in a specific population over a given period of time by the total population. Therefore incidence rate ratio is the comparison of two groups in terms of incidence rates. Poisson regression model was considered to estimate the independent effect of each factor, expressed as incidence rate ratio. An incidence rate ratio of 3 means that group 2 have the rate 3 times higher than group 1 when group 1 is the reference group.

Odds ratio and variation in odds ratio 2007
The cohort considered for this analysis was patients who were on dialysis in 2005 and new patients in 2005.

The odds of an event is the probability of having the event divided by the probability of not having it. The odds ratio is used for comparing the odds of 2 groups. If the odds in group 1 is 1 and group 2 is 2, then 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 such as dialysis center, age, sex, modality, albumin, hemoglobin, calcium, cardiovascular and cholesterol, logistic regression model was used to estimate the independent effect of each factor, expressed as odds ratio, on the event of interest and the variation is odds ratio. This method was used in chapter 4.

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 adjusted for age, gender, primary diagnosis and time on RRT. 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.

Patient survival was considered in two ways:

i. Survival censored for change of modality based on the first modality. Duration of change modality or transplant will not be considered.
ii. Survival not censored for change of modality. Duration survival for patients will be accumulated from the first till last treatment received. The duration of treatment with any change of dialysis modality or with transplant will be considered.

Survival of incident patients by centre

1 year survival

The cohort consider for this analysis was considered from 1999-2007. Many patients commencing dialysis in 2008 would still not have completed one year.

5 years survival

The cohort consider for this analysis was considered from 1999-2003. This is due to those commence from 2004 onwards still not able to have 5 year survivals analysis.

Funnel plot

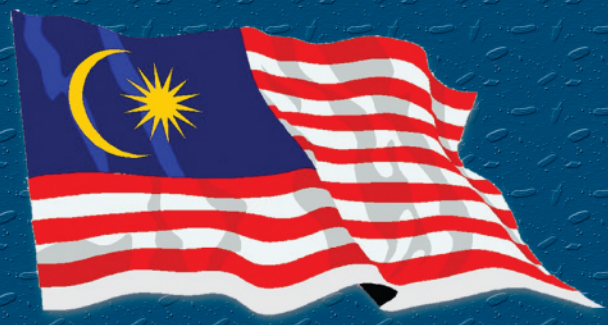
This analysis was confined to new dialysis patients from year 2000-2007. The figure is included to assess whether survival probability adjusted to age 60 and diabetes for each centre is likely to be different from the national average. Centres with patients less 10 will be excluded from the analysis. This plot was used in Chapter 4.

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.

NATIONAL RENAL REGISTRY

PROMOTING THE QUALITY OF DIALYSIS CARE



Thank You !

Your data is contributing to a higher standard of dialysis care in MALAYSIA