17TH REPORT OF THE MALAYSIAN DIALYSIS & TRANSPLANT REGISTRY 2009

Edited by :
Y N Lim
T O Lim

With contributions from :
Zaki Morad, Wong H S, Liu W J, Lee M L, Philip N J, Fauzi M, Prasad M, Rozina G, Teo S M, Tan C C, Sunita B, Goh B L, Lee D G, Lena Yeap

Malaysian Society of Nephrology

Association of Dialysis Medical Assistants and Nurse

17TH REPORT OF THE MALAYSIAN DIALYSIS & TRANSPLANT REGISTRY 2009

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

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

September 2010

ISSN 1675-8862

Published by:

National Renal Registry
Malaysian Society of Nephrology
Suite 1604, Plaza Permata
6, Jalan Kampar
50400 Kuala Lumpur
Malaysia

Telephone. : (603) 4045 8636
Direct Fax : (603) 4042 7694
e-mail : nrr@msn.org.my
Web site : http://www.msn.org.my/nrr

Important information:

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

Disclaimer:

There is a potential that data for previous years printed in this report is different from what were printed in previous reports. This is because the analysis in this report is based on latest dataset in the MDTR database which may have been updated by SDP.

ACKNOWLEDGEMENT

The Malaysian Dialysis and Transplant Registry of the National Renal Registry would like to acknowledge the following:

The Nephrologists, physicians and staff of the Dialysis and Transplant follow-up centres: thank you for participating in the Registry. The success of the Registry depends on you.

The Ministry of Health, Malaysia for financial supports and other support seen and unseen,

For their generous support:-
AIN Medicare
Baxter Healthcare
Fresenius Medical Care
Roche

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

NRR ADVISORY BOARD MEMBERS 2008 - 2010

Chairman :	**Dr. Zaki Morad B Mohd Zaher**
Members :	**Dr. Lim Teck Onn** **Dr. Lim Yam Ngo** **Dr. T. Thiruventhiran** **Dr. Tan Hee Wu** **Dr. Wong Hin Seng**
Secretariat :	**Lee Day Guat**

MDTR STEERING COMMITTEE MEMBERS 2008 - 2010

Chairman:	**Dr. Zaki Morad B Mohd Zaher**
Members:	**Dr. Lim Teck Onn** **Dr. Lim Yam Ngo** **Dr. T. Thiruventhiran** **Dr. Tan Hee Wu** **Dr. Wong Hin Seng** **Mr. Tam Chong Chiang** **Ms. Fauziah Nizamudin**
Secretariat :	**Lee Day Guat**

NRR STAFF

CRM :	**Lee Day Guat**
CRA :	**Choo Cheh Loo** **Suhazelini Ali**

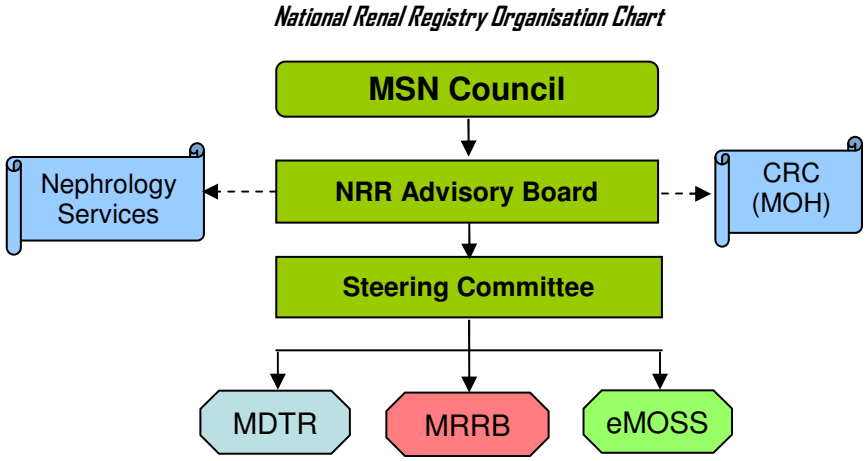
TECHNICAL SUPPORT STAFF OF CRC & VENDOR COMPANY

Director Network :	**Dr. Lim Teck Onn**
Epidemiologist :	**Dr. Jamaiyah Haniff**
IT Manager :	**Celine Tsai Pao Chien**
Database Administrator :	**Lim Jie Ying**
Network Administrators :	**Kevin Ng Hong Heng** **Adlan Ab Rahman** **Scott Huang Li Surin** **Andrew Chua**
Statistician :	**Lena Yeap** **Siti Haryanie Abdul Aziz**
Webmaster :	**Patrick Lum See Kai**
Desktop Publisher :	**Azizah Alimat**

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 Renal registries and databases. Members are appointed be the MSN Council for the same duration of the council. Interested parties including source data producers, NRR office and target groups or users are represented on this committee.
The board will be the liaison between Nephrology Services and the Clinical Research Centre of NIH.

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 that are in operation are as follows. :

- 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 MALAYSIAN DIALYSIS AND TRANSPLANT REGISTRY (MDTR)

The Malaysian Dialysis and Transplant Registry (MDTR) collects information on patients with end stage renal disease (ESRD) on renal replacement therapy (RRT) in Malaysia.

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:

- This registry is opened to all clinical sites that provide RRT services for patients with ESRD in Malaysia.
- Each site shall have a Principal Investigator who is also a licensed physician / Surgeon and a qualified professional experienced with ESRD management.
- 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).
- Each site shall accept responsibility for data collection, as well as for ensuring proper record keeping and registry document filing.
- 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/ co-morbidities, 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
I	Healthcare Provider characteristics	Sector providing dialysis treatment, (private, public or NGO),

PARTICIPATING HAEMODIALYSIS CENTRES 2009

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. Che Eng Khor Centre, HD Unit
11. Hospital Pakar Sultanah Fatimah (Muar), HD Unit
12. JB Lions MAA-Medicare Charity Dialysis Centre (1), HD Unit
13. JB Lions MAA-Medicare Charity Dialysis Centre (2), HD Unit
14. JJ Lions Dialysis Centre, HD Unit
15. Johor Quarries Association Dialysis Centre, HD Unit
16. Johor Specialist Hospital, HD Unit
17. Kluang Hospital, HD Unit
18. Kota Tinggi Hospital, HD Unit
19. Mersing Hospital, HD Unit
20. Mersing Rotary Centre, HD Unit
21. Muar Dialysis, HD Unit
22. Muar Lions Renal Centre, HD Unit
23. Persatuan Membaiki Akhlak-Che Luan Khor_NKF, HD Unit
24. Pertubuhan Hemodialisis Muhibbah Segamat (Labis), HD Unit
25. Pertubuhan Hemodialisis Muhibbah, HD Unit
26. Pontian Hospital, HD Unit
27. Pontian Rotary Haemodialysis Centre, HD Unit
28. Premier Renal Care, HD Unit
29. Prima Dialysis Kluang, HD Unit
30. Prima Dialysis Masai, HD Unit
31. Pusat Dialisis Nefro Utama (Johor Bahru), HD Unit
32. Pusat Dialisis Nefro Utama (Kota Tinggi), HD Unit
33. Pusat Dialisis Nefro Utama (Pontian), HD Unit
34. Pusat Dialisis Perbadanan Islam (Johor Bahru), HD Unit
35. Pusat Dialisis Perbadanan Islam (Pontian), HD Unit
36. Pusat Dialisis Waqaf An-nur (Batu Pahat), HD Unit
37. Pusat Dialisis Waqaf An-nur (Kota Raya), HD Unit
38. Pusat Dialisis Waqaf An-nur (Pasir Gudang), HD Unit
39. Pusat Dialysis Makmur, HD Unit
40. Pusat Haemodialisis Suria (Tangkak), HD Unit
41. Pusat Haemodialysis Amal Lexin, HD Unit
42. Pusat Hemodialisis Ar-Raudhah, HD Unit
43. Pusat Hemodialisis Bandar Mas, HD Unit
44. Pusat Hemodialisis Darul Takzim (Batu Pahat), HD Unit
45. Pusat Hemodialisis Darul Takzim (Parit Raja)
46. Pusat Hemodialisis Hidayah, HD Unit
47. Pusat Hemodialisis MAIJ, HD Unit
46. Pusat Hemodialisis Mawar (Yong Peng) HD Unit
47. Pusat Hemodialisis Muar, HD Unit
48. Pusat Hemodialisis Rotary Kota Tinggi, HD Unit
49. Pusat Hemodialisis Rotary Kulai, HD Unit
50. Pusat Hemodialisis Sejahtera (Batu Pahat), HD Unit
51. Pusat Hemodialisis Sejahtera Muar, HD Unit
52. Pusat Kesihatan Universiti (UTHO), HD Unit
53. Puteri Specialist Hospital, HD Unit
54. Segamat Hospital, HD Unit
55. Sinar Haemodialysis (Batu Pahat), HD Unit
56. Sultan Ismail Hospital (Paed), HD Unit
57. Sultan Ismail Hospital, HD Unit
58. Sultanah Aminah Hospital, HD Unit
59. Systemic Dialysis Centre, HD Unit
60. Tangkak Hospital, HD Unit
61. Tangkak Lions Renal Centre, HD Unit
62. Temenggong Seri Maharaja Tun Ibrahim Hospital, HD Unit
63. The Rotary HD Centre (Johor Bahru), HD Unit
64. Yayasan Pembangunan Keluarga Johor-NKF, HD Unit
65. Yayasan Rotary Kluang, HD Unit
66. Zhi En Dialysis Centre, HD Unit

Kedah Darul Aman

69. 807 Rumah Sakit Angkatan Tentera (Sg. Petani), HD Unit
70. Asia Renal Care (Penang) Kulim, HD Unit
71. Baling Hospital, HD Unit
72. Buddhist Tzu Chi (Jitra), HD Unit
73. Caring Dialysis (Gurun), HD Unit
74. Kuala Nerang Hospital, HD Unit
75. Kulim Hospital, HD Unit
76. Langkawi Hospital, HD Unit
77. Metro Specialist Hospital, HD Unit
78. Northern Dialysis Centre, HD Unit
79. Pantai Hospital Sungai Petani, HD Unit
80. Pertubuhan Bakti Fo En Bandar Kulim, HD Unit
81. Pusat Dialisis Albukhary, HD Unit
82. Pusat Dialysis K K Tan (Sg Petani), HD Unit
83. Pusat Haemodialisis Dr. Ismail, HD Unit
84. Pusat Hemodialisis Beng Siew, HD Unit
85. Pusat Hemodialisis Mergong, HD Unit
86. Pusat Hemodialisis Seroja, HD Unit
87. Pusat Kesihatan Jitra, HD Unit
88. Pusat Pakar Dialisis Traktif Sdn Bhd (Jitra), HD Unit
89. Pusat Rawatan Hemodialisis Yayasan Emkay & Sultanah Bahiyah, HD Unit
90. Putra Haemodialysis Centre, HD Unit
91. Putra Medical Centre, HD Unit

PARTICIPATING HAEMODIALYSIS CENTRES 2009

90. Rawatan Dialisis Amal Lion_NKF, HD Unit
91. Renal Care (Kedah), HD Unit
92. Renal Medicare, HD Unit
93. Sik Hospital, HD Unit
94. Sultan Abdul Halim Hospital, HD Unit
95. Sultanah Bahiyah Hospital, HD Unit
96. Superkids Trinity-NKF Dialysis Centre, HD Unit
97. Yan Hospital, HD Unit
98. Zaharah Dialisis Centre, HD Unit

Kelantan Darul Naim

101. Gua Musang Hospital, HD Unit
102. Hudaz Dialysis Centre, HD Unit
103. Jeli Hospital, HD Unit
104. KB Rotary-MAA Charity Dialysis, HD Unit
105. Kuala Krai Hospital, HD Unit
106. Machang Hospital, HD Unit
107. Nephrolife Haemodialysis Centre, HD Unit
108. Pakar Perdana Hospital, HD Unit
109. Pasir Mas Hospital, HD Unit
110. Pusat Dialisis Yayasan Buah Pinggang Kebangsaan (Kota Bharu), HD Unit
111. Pusat Hemodialisis Berkat Seroja (Machang), HD Unit
112. Pusat Hemodialysis Syifaq, HD Unit
113. Pusat Pakar Dialysis Traktif (Kota Bharu), HD Unit
114. Pusat Perubatan Tentera (Kota Bharu), HD Unit
115. Pusat Rawatan Dialisis Islah (Kota Bharu), HD Unit
116. Raja Perempuan Zainab II Hospital, HD Unit
117. Renal-Link (Kelantan), HD Unit
118. Tanah Merah Hospital, HD Unit
119. Tengku Anis Hospital, HD Unit
120. Tumpat Hospital, HD Unit
121. Universiti Sains Malaysia Hospital, HD Unit

Negeri Melaka

143. 94 Hospital Angkatan Tentera (Terendak), HD Unit
144. Alor Gajah Hospital, HD Unit
145. Amitabha Centre (Melaka), HD Unit
146. Damai Medical & Heart Clinic, HD Unit
147. Mahkota Medical Centre, HD Unit
148. Melaka Hospital, HD Unit
149. Pantai Air Keroh Hospital, HD Unit
150. Pertubuhan Kebajikan Hemodialisis Hospital Pakar Putra Melaka
151. Pusat Dialisis Giat Kurnia (Masjid Tanah), HD Unit
152. Pusat Dialisis Giat Kurnia (Merlimau), HD Unit
132. Pusat Dialisis Kenanga, HD Unit
132. Pusat Dialysis Comfort, HD Unit
133. Pusat Haemodialysis Suria (Jasin), HD Unit
134. Pusat HD SJAM Bacang Melaka, HD Unit
135. Pusat Hemodialisis Aman, HD Unit
136. Pusat Hemodialisis Krisda, HD Unit
137. Pusat Hemodialisis SJAM Pulau Sebang, HD Unit
138. Sinar Hemodialisis, HD Unit
139. Tenang Haemodialysis Centre, HD Unit
140. Tenang Haemodialysis Jasin, HD Unit
141. Yakin Jaya Haemodialysis, HD Unit

Negeri Sembilan Darul Khusus

143. D'kasih Hemodialysis, HD Unit
144. Giat Kurnia Dialysis Centre (Nilai), HD Unit
145. Haemodialysis Mawar Gemas, HD Unit
146. Jelebu Hospital, HD Unit
147. Port Dickson Hospital, HD Unit
148. Pusat Dialisis Suria (Tampin), HD Unit
149. Pusat Haemodialisis Renalife, HD Unit
150. Pusat Haemodialysis Suria (Senawang), HD Unit
151. Pusat Hemodialisis Bayu, HD Unit
152. Pusat Hemodialisis Berkat Seroja (Kuala Pilah), HD Unit
153. Pusat Hemodialisis Gemencheh, HD Unit
154. Pusat Hemodialisis Mawar (Mantin)
155. Pusat Hemodialisis Mawar N. Sembilan (Bahau), HD Unit
156. Pusat Hemodialisis Mawar N. Sembilan (Lukut), HD Unit
157. Pusat Hemodialisis Mawar N. Sembilan (Rantau), HD Unit
158. Pusat Hemodialisis Mawar N. Sembilan (Seremban), HD Unit
159. Pusat Pakar Dialisis Traktif (Kuala Pilah), HD Unit
160. Pusat Waqaf An-nur (Senawang), HD Unit
161. Seremban Specialist Hospital, HD Unit
162. Tampin Hospital, HD Unit
163. Tuanku Ampuan Najihah Hospital, HD Unit
164. Tuanku Ja'afar Hospital (Paed), HD Unit
165. Tuanku Ja'afar Hospital, HD Unit

Pahang Darul Makmur

166. Bentong Hospital, HD Unit
167. Caring Dialysis (Jerantut), HD Unit
168. Fitra Med, HD Unit
169. Jengka Hospital, HD Unit
170. Jerantut Hospital, HD Unit
171. Kuala Lipis Hospital, HD Unit
172. Kuantan Clinical Diagnostic Centre, HD Unit
173. Kuantan Medical Centres, HD Unit

174. Kuantan Specialist Centre, HD Unit
175. Lipis Dialysis Centre, HD Unit
176. MAA-Medicare Charity (Mentakab), HD Unit
177. Mentakab Haemodialysis Unit, HD Unit
178. Muadzam Shah Hospital, HD Unit
179. Pahang Buddhist Association, HD Unit
180. Pekan Hospital, HD Unit
181. Pusat Hemodialisis Islam Makmur, HD Unit
182. Pusat Hemodialisis Jerantut, HD Unit
183. Pusat Hemodialysis (Bentong), HD Unit
184. Pusat Rawatan Dialisis Tun Abdul Razak-NKF Kuantan, HD Unit
185. Pusat Rawatan Hemodialisis Sang Riang Bera, HD Unit
186. Raub Hospital, HD Unit
187. SJAM-KPS Haemodialysis Centre 9 (Raub), HD Unit
188. Sultan Haji Ahmad Shah Hospital, HD Unit
189. Suria Dialysis Centre (Temerloh), HD Unit
190. Suria Hemodialisis Jerantut, HD Unit
191. Tengku Ampuan Afzan Hospital (Paed), HD Unit
192. Tengku Ampuan Afzan Hospital, HD Unit

Perak Darul Ridzuan

193. 96 Hospital Angkatan Tentera (Lumut), HD Unit
194. Batu Gajah Hospital, HD Unit
195. Berchaam Dialysis Centre, HD Unit
196. C. S. Loo Kidney & Medical Specialist Centre, HD Unit
197. Caring Dialysis Centre (Batu Gajah), HD Unit
198. Caring Dialysis Centre (Sg Siput), HD Unit
199. Caring Dialysis Centre (Teluk Intan), HD Unit
200. Changkat Melintang Hospital, HD Unit
201. Fatimah Hospital, HD Unit
202. Gerik Hospital, HD Unit
203. Hope Haemodialysis Society Ipoh, HD Unit
204. Kampar Hospital, HD Unit
205. Kuala Kangsar Hospital, HD Unit
206. MAA-Medicare Charity (Teluk Intan), HD Unit
207. MB Star Rawatan Dialisis, HD Unit
208. Neesum-Nee Healthcare, HD Unit
209. Nur Dialysis Centre, HD Unit
210. Parit Buntar Hospital, HD Unit
211. Persatuan Amal Chin Malaysia Barat, HD Unit
212. Pertubuhan Perkhidmatan Haemodialisis Ar-Ridzuan, HD Unit
213. Pertubuhan Perkhidmatan Hemodialisis AIXIN Kerian, HD Unit
214. PMA Chan Meng Khor-MAA Medicare Charity Dialysis Centre, HD Unit
215. Pulau Pangkor Hospital, HD Unit
216. Pusat Dialisis Darul Iltizam Taiping, HD Unit
217. Pusat Dialisis Ehsan Perak (Parit Buntar), HD Unit
218. Pusat Dialisis Intan, HD Unit
219. Pusat Dialisis Kuala Kangsar, HD Unit
220. Pusat Dialisis Mutiara, HD Unit
221. Pusat Dialisis Penawar Permai, HD Unit
222. Pusat Dialisis Setia (Ipoh), HD Unit
223. Pusat Dialisis Taiping (Kamunting), HD Unit
224. Pusat Dialisis Taiping (Kuala Kangsar), HD Unit
225. Pusat Dialisis Taiping (Parit Buntar), HD Unit
226. Pusat Dialisis Taiping, HD Unit
227. Pusat Dialysis Setia, HD Unit
228. Pusat Hemodialisis Darul Iltizam (Ipoh), HD Unit
229. Pusat Hemodialisis Darul Iltizam Tapah, HD Unit
230. Pusat Hemodialisis Kampar Yayasan Nanyang-SJAM, HD Unit
231. Pusat Hemodialisis Manjung, HD Unit
232. Pusat Hemodialysis Nyata Segar, HD Unit
233. Pusat Rawatan Dialisis Wan Nong, HD Unit
234. Putri Haemodialysis Centre (Ipoh), HD Unit
235. Raja Permaisuri Bainun Hospital (Home), HD Unit
236. Raja Permaisuri Bainun Hospital, HD Unit
237. Renal Care (Ipoh Specialist), HD Unit
238. Selama Hospital, HD Unit
239. Seri Manjung Hospital, HD Unit
240. Sg Siput Hospital, HD Unit
241. Slim River Hospital (Tanjong Malim), HD Unit
242. Taiping Hospital, HD Unit
243. Tapah Hospital, HD Unit
244. Teluk Intan Hospital, HD Unit
245. Woh Peng Cheang Seah, HD Unit
246. Yayasan Akhlak-NKF Taiping, HD Unit
247. Yayasan Dialysis Pendidikan Akhlak Perak-NKF Ipoh, HD Unit

Perlis Indera Kayangan

248. Tuanku Fauziah Hospital, HD Unit
249. Tuanku Syed Putra_NKF Kangar Haemodialysis Centre, HD Unit

Penang

250. Alkom Bakti Dialysis, HD Unit
251. AMD Rotary (Penang), HD Unit
252. Asia Renal Care (Penang) BM, HD Unit
253. Balik Pulau Hospital, HD Unit
254. Buddhist Tzu Chi Dialysis Centre (Butterworth), HD Unit
255. Buddhist Tzu Chi HD Centre (Penang), HD Unit
256. Bukit Mertajam Hospital, HD Unit
257. Bukit Mertajam Specialist Hospital, HD Unit
258. Fo Yi NKF Dialysis Centre (1), HD Unit
259. Fo Yi NKF Dialysis Centre (2), HD Unit
260. Gleneagles Medical Centre, HD Unit

PARTICIPATING HAEMODIALYSIS CENTRES 2009

261. Island Hospital, HD Unit
262. K K Tan Specialist (BM), HD Unit
263. Kepala Batas Hospital, HD Unit
264. Lam Wah Ee Hospital, HD Unit
265. Loh Guan Lye Specialist Centre, HD Unit
266. MAA-Medicare Charity (Butterworth), HD Unit
267. NEPH Sdn Bhd, HD Unit
268. Nucare Dialysis Centre, HD Unit
269. Pantai Hospital Penang, HD Unit
270. Penang Adventist Hospital, HD Unit
271. Penang Caring Dialysis Society, HD Unit
272. Persatuan Kebajikan Haemodialysis St Anne BM, HD Unit
273. Pertubuhan Dialisis Rotary-Satu Hati, HD Unit
274. Pertubuhan Hemodialisis SPS, HD Unit
275. Province Wellesley Renal Medifund, HD Unit
276. Pulau Pinang Hospital (Home), HD Unit
277. Pulau Pinang Hospital (Paed), HD Unit
278. Pulau Pinang Hospital, HD Unit
279. Pusat Dialisis BMC, HD Unit
280. Pusat Dialisis Ehsan Perak (Pedar), HD Unit
281. Pusat Haemodialisis Zakat (Jawi), HD Unit
282. Pusat Hemodialisis Zakat (Balik Pulau), HD Unit
283. Pusat Hemodialisis Zakat (Bukit Mertajam), HD Unit
284. Pusat Hemodialisis Zakat (Butterworth), HD Unit
285. Pusat Hemodialisis Zakat (Kepala Batas), HD Unit
286. Pusat Hemodialisis Zakat (P. Pinang), HD Unit
287. PWRM (BM) Dialysis Centre, HD Unit
288. Renal Link (Penang), HD Unit
289. Seberang Jaya Hospital (Butterworth), HD Unit
290. Seberang Perai (Bagan), HD Unit
291. SJ Dialysis Centre, HD Unit
292. Sungai Bakap Hospital, HD Unit
293. The Penang Community HD Society, HD Unit
294. TSC Renal Care, HD Unit

Sabah

295. B. Braun Avitum (Tawau) Dialysis Centre, HD Unit
296. Beaufort Hospital, HD Unit
297. Beluran Hospital, HD Unit
298. Caring Dialysis Centre (Tawau), HD Unit
299. Caring Dialysis Centre Kota Kinabalu, HD Unit
300. Duchess of Kent Hospital, HD Unit
301. Keningau Hospital, HD Unit
302. Kota Belud Hospital, HD Unit
303. Kota Kinabatangan Hospital, HD Unit
304. Kota Marudu Hospital, HD Unit
305. Kudat Hospital, HD Unit
306. Labuan Hospital, HD Unit
306. Lahad Datu Hospital, HD Unit
307. Likas Hospital (Paed), HD Unit
308. Likas Hospital, HD Unit
309. MAA-Medicare Charity (Kota Kinabalu), HD Unit
310. Nobel Dialysis Centre, HD Unit
311. Papar Hospital, HD Unit
312. Persatuan Buah Pinggang Sabah, HD Unit
313. Persatuan Hemodialysis Kinabalu Sabah, HD Unit
314. Pusat Rawatan Dialisis MUIS-NKF, HD Unit
315. Queen Elizabeth Hospital, HD Unit
316. Ranau Hospital, HD Unit
317. Rotary Tawau Tanjung, HD Unit
318. Sabah Medical Centre, HD Unit
319. Sandakan Kidney Society, HD Unit
320. Semporna Hospital, HD Unit
321. Sipitang Hospital, HD Unit
322. Tambunan Hospital, HD Unit
323. Tawau Hospital, HD Unit
324. Tenom Hospital, HD Unit

Sarawak

326. 801 Rumah Sakit Angkatan Tentera (Kuching), HD Unit
327. Bau Hospital, HD Unit
328. Betong Hospital, HD Unit
329. Bintulu Hospital, HD Unit
330. CHKMUS-MAA Medicare Charity, HD Unit
331. Hospital Daerah Daro, HD Unit
332. Kanowit Hospital, HD Unit
333. Kapit Hospital, HD Unit
334. KAS-Rotary-NKF, HD Unit
335. Kuching Specialist Hospital, HD Unit
336. Lawas Hospital, HD Unit
337. Limbang Hospital, HD Unit
338. Lundu Hospital, HD Unit
339. Marudi Hospital, HD Unit
340. Miri Hospital, HD Unit
341. Miri Red Crescent Dialysis Centre, HD Unit
342. Mukah Hospital, HD Unit
343. Normah Medical Specialist Centre, HD Unit
344. Pusat Dialisis Waqaf An Nur (Sarawak), HD Unit
345. Rejang Medical Centre, HD Unit
346. Renal Life Dialysis Centre, HD Unit
347. Renal Therapy Services Sdn Bhd
348. Saratok Hospital, HD Unit
349. Sarawak General Hospital, HD Unit
350. Sarikei Hospital, HD Unit
351. Serian Hospital, HD Unit

352. Sibu Hospital, HD Unit
353. Sibu Kidney Foundation, HD Unit
354. Simunjan Hospital, HD Unit
355. SJAM-KPS 10 (Bintulu), HD Unit
356. SJAM-KPS Haemodialysis Centre 8 (Sibu), HD Unit
357. Sri Aman Hospital, HD Unit
358. Timberland Medical Centre, HD Unit

Selangor Darul Ehsan

359. 819 Rumah Sakit Angkatan Tentera, HD Unit
360. Ampang Hospital, HD Unit
361. Apex Club of Klang-NKF Charity Dialysis Centre, HD Unit
362. Assunta Hospital, HD Unit
363. Bakti-NKF Dialysis Centre, HD Unit
364. Bangi Dialysis Centre, HD Unit
365. Banting Hospital, HD Unit
366. BBA (Puchong) Dialysis Centre, HD Unit
367. Berjaya NKF Dialysis Centre, HD Unit
368. Caring Dialysis Centre (Cheras), HD Unit
369. Caring Dialysis Centre (Sabak Bernam), HD Unit
370. Caring Dialysis Centre (Sg. Besar), HD Unit
371. Caring Dialysis Centre Andalas (Klang), HD Unit
372. Damansara Specialist Hospital, HD Unit
373. EAM Dialysis Centre, HD Unit
374. Haemodialysis Association Klang, HD Unit
375. Harmoni Dialysis (Kajang), HD Unit
376. Healthcare Dialysis Centre, HD Unit
377. Hemodialisis Yayasan Veteran ATM, HD Unit
378. Jerteh Dialysis Centre, HD Unit
379. Kajang Hospital, HD Unit
380. Kelana Jaya Medical Centre, HD Unit
381. KPJ Ampang Puteri Specialist Hospital, HD Unit
382. KPJ Kajang Specialist Hospital, HD Unit
383. KPJ Selangor Specialis Hospital, HD Unit
384. Kuala Kubu Bharu Hospital, HD Unit
385. MAA-Medicare Charity (Kajang), HD Unit
386. MB Star Rawatan Dialisis (Kelana Jaya), HD Unit
387. Persatuan Dialisis Kurnia PJ, HD Unit
388. Persatuan Dialisis Touch, HD Unit
389. Pertubuhan Hemodialisis Pasar Besar Meru, HD Unit
390. Ping Rong-NKF, HD Unit
391. PNSB Dialisis Centre, HD Unit
392. Pusat Dialisis Aiman (Shah Alam), HD Unit
393. Pusat Dialisis LZS (Kapar), HD Unit
394. Pusat Dialisis LZS (Sg. Besar), HD Unit
395. Pusat Dialisis LZS (Shah Alam), HD Unit
396. Pusat Dialisis Mesra (Kuala Selangor), HD Unit
397. Pusat Dialisis Pakar Medi-Nefro, HD Unit
398. Pusat Dialisis Putra Jaya (Kajang), HD Unit
399. Pusat Dialisis Putra Jaya (UNITEN), HD Unit
400. Pusat Dialisis Sijangkang, HD Unit
401. Pusat Dialysis Mesra (Kapar), HD Unit
402. Pusat Dialysis Mesra (Rahman Putra), HD Unit
403. Pusat Dialysis Mesra (Shah Alam), HD Unit
404. Pusat Dialysis Mesra KKB, HD Unit
405. Pusat Dialysis Putra Jaya (Semenyih), HD Unit
406. Pusat Haemodialysis Nilam, HD Unit
407. Pusat Hemodialisis Fasa (Kg Medan), HD Unit
408. Pusat Hemodialisis Fasa, HD Unit
409. Pusat Hemodialisis Kau Ong Yah Ampang, HD Unit
410. Pusat Hemodialisis Mawar N. Sembilan (Sepang), HD Unit
411. Pusat Hemodialisis Mawar N. Sembilan (Seri Kembangan), HD Unit
412. Pusat Hemodialisis Permata, HD Unit
413. Pusat Hemodialisis Syifa, HD Unit
414. Pusat Perubatan Dialisis, HD Unit
415. Pusat Perubatan Primier HUKM, HD Unit
416. Pusat Rawatan Dialisis Hidayah, HD Unit
417. Pusat Rawatan Dialisis Islah (Batu Caves), HD Unit
418. Pusat Rawatan Dialisis Mukmin, HD Unit
419. Pusat Rawatan Dialisis Nefro Utama (Puchong Jaya), HD Unit
420. Pusat Rawatan Hemodialisis Ampang Jaya, HD Unit
421. Pusat Rawatan Hemodialisis Felina, HD Unit
422. Putrajaya Hospital, HD Unit
423. Rawatan Dialysis Bukit Tinggi, HD Unit
424. Renal Associates, HD Unit
425. Renal Care Dialysis Services, HD Unit
426. S.P. Menon Dialysis Centre (Klang), HD Unit
427. S.P. Menon Dialysis Centre (Petaling Jaya), HD Unit
428. Selayang Hospital (Paed), HD Unit
429. Selayang Hospital, HD Unit
430. Serdang Hospital, HD Unit
431. Sime Darby Medical Centre Subang Jaya, HD Unit
432. SJAM-KPS Haemodialysis Centre 1 (Raja Muda Musa), HD Unit
433. SJAM-KPS Haemodialysis Centre 11 (Shah Alam), HD Unit
434. SJAM-KPS Haemodialysis Centre 12 (Balakong), HD Unit
435. SJAM-KPS Haemodialysis Centre 2 (Klang), HD Unit
436. SJAM-KPS Haemodialysis Centre 3 (Banting), HD Unit
437. SJAM-KPS Haemodialysis Centre 5 (Rawang), HD Unit
438. SJAM-KPS Haemodialysis Centre 6 (Kuala Selangor), HD Unit
439. SJAM-KPS Pusat Hemodialisis Tasik Puteri, HD Unit

440. Smartcare Dialysis Centre (Subang Jaya), HD Unit
441. Sri Kota Medical Centre, HD Unit
442. Sungai Buloh Hospital, HD Unit
443. Sunway Medical Centre (2), HD Unit
444. Sunway Medical Centre, HD Unit
445. Suriya Dialysis Centre, HD Unit
446. Syarikat Perubatan D'vet, HD Unit
447. Syukur Elit Sdn Bhd, HD Unit
448. Tanjung Karang Hospital, HD Unit
449. Tengku Ampuan Jemaah Hospital, HD Unit
450. Tengku Ampuan Rahimah Hospital, HD Unit
451. Universiti Kebangsaan Malaysia Bangi, HD Unit
452. Yayasan Kebajikan SSL Puchong, HD Unit
453. Yayasan Kebajikan SSL, HD Unit

Terengganu Darul Iman

454. Besut Hospital, HD Unit
455. Dungun Hospital, HD Unit
456. Hulu Terengganu Hospital, HD Unit
457. Kemaman Hospital, HD Unit
458. Pusat Dialisis Terengganu/NKF, HD Unit
459. Pusat Hemodialisis Nabilah, HD Unit
460. Pusat Pakar Dialisis Traktif Sdn Bhd (Besut), HD Unit
461. Pusat Rawatan Dialisis Islah (Kuala Terengganu), HD Unit
462. Sultanah Nur Zahirah Hospital, HD Unit
463. YKN Dialisis (Terengganu), HD Unit

Wilayah Persekutuan Kuala Lumpur

464. Aiman Dialysis Centre, HD Unit
465. Caring Dialysis (Wangsa Maju), HD Unit
466. Charis-NKF Dialysis Centre, HD Unit
467. Cheras Dialysis Centre, HD Unit
468. Kampong Baru Medical Centre, HD Unit
469. Kuala Lumpur Hospital (Home), HD Unit
470. Kuala Lumpur Hospital (Paed.), HD Unit
471. Kuala Lumpur Hospital (Unit 1), HD Unit
472. Kuala Lumpur Hospital (Unit 3), HD Unit
473. Kuala Lumpur Hospital (Unit 4), HD Unit
474. Kuala Lumpur Lions Renal Centre, HD Unit
475. MAA-Medicare Charity (Cheras), HD Unit
476. MAA-Medicare Charity (Kuala Lumpur), HD Unit
477. National Kidney Foundation Dialysis Centre (KL), HD Unit
478. Pantai ARC Dialysis Services, HD Unit
479. Pantai Indah Hospital, HD Unit
480. Poliklinik Komuniti Tanglin, HD Unit
481. Prince Court Medical Centre, HD Unit
482. Pusat Dialisis Falah, HD Unit
483. Pusat Dialisis Pusat Punggutan Zakat (Kuala Lumpur), HD Unit
484. Pusat Hemodialisis Dato' Lee Kok Chee, HD Unit
485. Pusat Hemodialisis Harmoni (Shamelin), HD Unit
486. Pusat Hemodialisis Harmoni, HD Unit
487. Pusat Hemodialisis KEMENTAH, HD Unit
488. Pusat Hemodialisis Mawar N. Sembilan (Seputih), HD Unit
489. Pusat Hemodialisis PUSRAWI, HD Unit
490. Pusat Hemodialisis Waz Lian, HD Unit
491. Pusat Hemodialisis Yayasan Felda, HD Unit
492. Pusat Hemodialysis Medipro Alliance, HD Unit
493. Pusat Pakar Tawakal, HD Unit
494. Pusat Perubatan Universiti Kebangsaan Malaysia, HD Unit
495. Pusat Rawatan Dialisis Fungates Superflow-NKF, HD Unit
496. Pusat Rawatan Dialisis Islah (KL), HD Unit
497. Pusat Rawatan Dialisis Nefro Utama (Setapak), HD Unit
498. Renal Dialysis Centre, HD Unit
499. Rotary Damansara-NKF Dialysis, HD Unit
500. S.P. Menon Dialysis Centre (Kuala Lumpur), HD Unit
501. Sentosa Medical Centre, HD Unit
502. Smartcare Dialysis Clinic (Cheras), HD Unit
503. The Kidney Dialysis Centre (1), HD Unit
504. The Kidney Dialysis Centre (2), HD Unit
505. The Nayang-NKF Dialysis Centre, HD Unit
506. Tung Shin Hospital & Yayasan Nanyang Press, HD Unit
507. Tung Shin Hospital, HD Unit
508. YKN Dialisis (Kuala Lumpur), HD Unit

PARTICIPATING PD CENTRES 2009

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

Negeri 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

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 2009

Johor Darul Takzim

Batu Pahat Hospital

Kluang Hospital

Mersing Hospital

Pakar Sultanah Fatimah Muar Hospital

Pontian Hospital

Segamat Hospital

Sultan Ismail Hospital (Paed)

Sultan Ismail Pandan 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

Sabah

Duchess of Kent Hospital

Labuan Hospital

Likas Hospital

Queen Elizabeth Hospital

Sabah Medical Centre

Tawau Hospital

Sarawak

Bintulu Hospital

Miri Hospital

Sarawak General Hospital

Sibu Hospital

Timberland Medical Centre

Selangor Darul Ehsan

Assunta Hospital

KPJ Ampang Puteri Specialist Hospital

Selayang Hospital

Serdang Hospital

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 (Paed)

Kuala Lumpur Hospital

Pusat Perubatan Universiti Kebangsaan Malaysia (PPUKM)

University Malaya Medical Centre

CONTRIBUTING EDITORS

Chapter	Title	Editors	Institutions
1	Renal Replacement Therapy in Malaysia	Lim Yam Ngo	Kuala Lumpur Hospital
		Lim Teck Onn	Clinical Research Centre, HKL
		Lee Day Guat	National Renal Registry
2	Dialysis in Malaysia	Lim Yam Ngo	Kuala Lumpur Hospital
		Lim Teck Onn	Clinical Research Centre, HKL
		Lee Day Guat	Kuala Lumpur Hospital
3	Death & Survival on Dialysis	Wong Hin Seng	Selayang Hospital
		Ong Loke Meng	Pulau Pinang Hospital
		Wan Sha'ariah Md Yusuf	Tuanku Ja'afar Hospital, Seremban
4	QoL and Work Rehabilitation on Dialysis	Liu Wen Jiun	Sultanah Aminah Hospital, Johor
		Chew Thian Fook	Seremban Specialist Hospital
		Alinda Chiu Sze Fung	University Putra Malaysia
		Zaki Morad b Mohd Zaher	KPJ Ampang Puteri Specialist Hospital
5	Paediatric Renal Replacement Therapy	Lee Ming Lee	Tuanku Ja'afar Hospital, Seremban
		Lynster Liaw	Pulau Pinang Hospital
		Susan Pee	Sultan Ismail Hospital, Johor
		Wan Jazilah Wan Ismail	Selayang Hospital
		Lim Yam Ngo	Kuala Lumpur Hospital
6	Treatment of Anaemia in Dialysis Patients	Philip N. Jeremiah	KPJ Ampang Puteri Specialist Hospital
		Bee Boon Cheak	Selayang Hospital
7	Nutritional Status on Dialysis	Winnie Chee Siew Swee	International Medical University
		Tilakavati Karupaiah	Faculty of Allied Health Sciences UKM
		Ahmad Fauzi Abdul Rahman	Puteri Specialist Hospital
8	Blood Pressure Control and Dyslipidemia	Prasad Menon	Sime Darby Medical Centre, Subang Jaya
		Lee Wan Tin	Sime Darby Medical Centre, Subang Jaya
9	Renal Bone Disease	Rozina Bt Ghazalli	Pulau Pinang Hospital
		Fan Kin Sing	Gleneagle Intan Medical Centre
		Ching Chen Hua	Sultanah Bahiyah Hospital, Alor Setar
		Liew Yew Fong	Pulau Pinang Hospital
10	Hepatitis on Dialysis	Teo Sue Mei	Pantai Hospital Ipoh
		Claire Tan Hui Hong	Sarawak Hospital
		Foo Sui Mei	Pantai Hospital Kuala Lumpur
11	Haemodialysis Practices	Tan Chwee Choon	Tengku Ampuan Rahimah Hospital, Klang
		Shahnaz Shah Firdaus Khan	Tengku Ampuan Rahimah Hospital, Klang
		Rafidah Abdullah	Selayang Hospital
		Norleen Bt Zulkarnain Sim	Tengku Ampuan Rahimah Hospital, Klang
12	Chronic Peritoneal Dialysis Practices	Sunita Bavanandan	Kuala Lumpur Hospital
		Lily Mushahar	Tuanku Ja'afar Hospital, Seremban
13	Renal Transplantation	Goh Bak Leong	Serdang Hospital
		Zaki Morad b Mohd Zaher	KPJ Ampang Puteri Specialist Hospital
		Fan Kin Sing	Gleneagle Intan Medical Centre
		Lily Mushahar	Tuanku Ja'afar Hospital, Seremban
		Rohan Malek	Selayang Hospital
		S. Prasad Menon	Sime Darby Medical Centre, Subang Jaya
		Tan Si Yen	Prince Court Medical Centre

FOREWORD

The 17th Malaysian Dialysis and Transplant Registry report documents a trend in Renal Replacement Therapy that has come to be expected and almost taken for granted. The continued growth in incident and prevalent dialysis patients has been unbroken for more than ten years. In fact the growth has been impressive with the incident rate doubling over a period of 8 years from 79 per million population in the year 2000 to 161 in 2008. While the gap between the different geographical areas has narrowed there are still differences in provision of dialysis. The rapid growth in dialysis population in the urban areas ensured the gap remains; nonetheless all providers should make serious efforts to minimize the difference in treatment provision. Renal transplantation rates done in the country has not improved significantly; at the same time the number of transplants done overseas especially that of commercial deceased done in China has decreased. The local transplantation scene showed for the first time that deceased donors has outnumbered the live related donation. The " Peritoneal Dialysis" first approach adopted by the Ministry of Health nephrology services showed an impact with increased number of patients accepted on that modality.

The centre survey report showed that new HD centres are being opened up at a rate of more than four a year in 2009 reflecting the increasing demand for the treatment. What is of some concern is that many of these centres are small. Without the economies of scale of the bigger centres, the smaller ones may be hard-pressed to maintain the minimum standards of care. This can be seen in the wide variation in several parameters studied between the centres. The variation in patient survival, corrected for age and diabetes is particularly worrying. Many of the newer centres are manned by young staff with little experience. Staff movement between established centres and the new ones also occur frequently leading to some compromise in the continuity of care. A day may come when the dialysis provider service will see a rationalization exercise when the bigger centres will "absorb" the smaller ones. This may be good for the patients.

Like all the other disease registries in the country, the National Renal Registry recently faced some budget cuts following reduced allocation by the government. This has come at the most critical moment as the NRR is now poised to move from a paper based registry to a full web-based one. At the same time the NRR plans to set up other renal related registries such as CKD registry. The Ministry of Health has given a special allocation for development of the web-based data submission application but as these applications are expensive, the NRR has to delve into its reserve to finance the project

In recent years there has also been some interest by researchers to use data from the registry. The registry has a huge repository of data going back to nearly twenty years. More studies should be done using data from the registry.

Dr. Zaki Morad B Mohd Zaher
Chairman
National Renal Registry

CONTENTS

CONTENTS

CONTENTS

LIST OF TABLES

LIST OF TABLES *(Cont.)*

LIST OF TABLES *(Cont.)*

LIST OF TABLES *(Cont.)*

LIST OF TABLES *(Cont.)*

LIST OF TABLES *(Cont.)*

LIST OF TABLES *(Cont.)*

LIST OF FIGURES

LIST OF FIGURES *(Cont.)*

LIST OF FIGURES *(Cont.)*

REPORT SUMMARY

- The intake of new dialysis patients increased linearly from 1855 in 2000 to 4468 in 2008 corresponding to 79 per million population (pmp) in 2000 to 161 pmp in 2008.

- The number of prevalent dialysis patients increased from 6689 in 2000 to at least 21 thousand in 2009. Dialysis prevalence rate was 699 pmp in 2008 and at least 747 pmp in 2009.

- Transplant incident rate remained at 4 per million and prevalence at 63 pmp in 2009.

- There is still disparity between the economically advantaged and disadvantaged states in dialysis provision rate despite the increase in provision seen in all states.

- Centre survey report: The number of haemodialysis (HD) centres increased from 484 in 2008 to 538 in 2009, peritoneal dialysis (PD) centres increased from 31 to 36 in the same period. 19607 patients were reported to be on HD, and 1936 on PD giving a total of 21543 dialysis patients at year end 2009. The Ministry of Health (MOH) provided dialysis to 31.3% of patients, non-governmental organizations (NGO) 28.29% and the private sector 38.8%.

- Dialysis treatment rates for those $\geq$65 years continued to increase.

- 87% of new patients were accepted into centre haemodialysis.

- The government continued to fund about 56% of new dialysis treatment, NGO funding was 10% in 2009, and self funding 24%.

- The proportion of new ESRD patients with diabetes mellitus was 58% in 2009.

- The annual death rate for those on PD in 2009 was 15.0% while that for haemodialysis patients was 10.3%.

- Proportion of dialysis patients dying from cardiovascular disease was increasing over the last few years and in 2009 accounted for 34%. Second commonest cause of death was death at home followed by sepsis.

- The overall unadjusted 5 years and 10 years patient survival on dialysis censored for change in RRT modality were 57% and 34% respectively. HD patients had better survival compared to PD patients.

- 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 96.2% and PD centres 89.4%.

- Analysing adjusted hazard ratio for mortality, there were positive correlation between age of patient, diastolic BP, serum calcium, and phosphate with mortality while negative correlation was noted between BMI, serum albumin, haemoglobin concentration and calcium phosphate product with mortality. Patients commencing dialysis in 2007-2009 had 11% lower adjusted hazard ratio for mortality when compared to those started dialysis from 2000-2001. Patients with diabetes mellitus had the highest mortality when compared to other causes of end stage renal failure.

- Median QoL index scores are satisfactory in both HD and CAPD patients (score of 9). Diabetes mellitus and older age group were associated with lower median QoL index scores.

- The proportion of patients on employment was 70% in both HD and PD patients.

- There was an increasing percentage of patients receiving erythropoietin (EPO); 89% of HD patients were on EPO compared to 76% in PD. The percentage of patients requiring blood transfusion has remained at about 15% for both HD and PD patients. HD patients on iv iron therapy has increased to 26% in 2009. Wide variations were seen in the use of EPO especially in HD centres, blood transfusion rates, and hemoglobin levels in HD and PD centres. The median usage of EPO was 92% compared to 56% a decade ago.

- Mean serum albumin levels in 2009 stood at 39.4 g/L in HD and 32.7 g/L in PD patients in 2009. There were wide variations in the proportion of patients with serum albumin of at least 40g/L in HD and PD centres.

- Body mass index for HD patients has stabilized at 23.6 but increased from 21.6 in 2000 to 24.1 in 2009 in PD patients.

- Predialysis systolic BP in HD patients in 2009 remained sub-optimally controlled while diastolic BP in HD patients was better controlled. Both systolic and diastolic BP were well controlled in the majority of PD patients.

- Control of total serum cholesterol and serum triglyceride levels were poorer in PD patients compared to haemodialysis in 2009. Control of total cholesterol and triglyceride levels has improved over this past decade.

- Calcium carbonate remained as the main phosphate binder for both HD (92%) and PD (85%) patients in 2009. Use of aluminium based phosphate binder continued to decrease, accompanied by a steady rise in the use of Lanthanum.

- Calcitriol remained the main vitamin D used in both HD and PD patients. Paricalcitol usage remained small. Twice as many HD patients who underwent parathyroidectomy in 2009 compared to PD patients.

- HD patients have slightly lower serum calcium levels compared to PD patients but higher serum phosphate levels. More PD patients achieved the target serum calcium phosphate product of less than 4.5 $mmol^2/l^2$ compared with HD patients for 2009.

- The intact parathyroid hormone (iPTH) level continued to be on the rising trend for both HD and PD patients.

- There was consistently wide centre variation among HD and PD populations in all the renal bone disease parameters more among HD centres.

- Nosocomial transmission in HD has been implicated for the higher HCV prevalence in HD compared to PD. Though there is a consistent annual decline, the wide center variation in HD still exists for HCV infection.

- **Haemodialysis practices:**
    - In 2009, 91% of patients used native arteriovenous fistula. The proportion of patients with blood flow rate above 300mls increased from21% in 2000 to 64% in 2009.
    - The mean and median prescribed Kt/V was 1.6. The percentage of patients with prescribed Kt/V $\geq$ 1.3 in 2009 was 81%. The median delivered Kt/V was only 1.4. 64% of patients had delivered Kt/V $\geq$ 1.3. The median URR remained the same at 71.7%. .The percentage of patients with URR $\geq$ 65% has remained static from 2005-2009 at 79%.
    - There was wide variation among HD centres in the proportion of patients with blood flow rates of >250 ml/min, prescribed Kt/V of $\geq$1.3, delivered Kt/V of $\geq$1.2 and proportion of patients with URR $\geq$ 65%.
    - 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 2009, the total number of PD patients increased to 2209 with APD accounted for 11% of the total.
  - ◊ CAPD prescription has not changed much over the years.
  - ◊ The median delivered weekly Kt/V was 2.0, 81% achieved target Kt/V of $\geq$1.7 with a 1.5 fold variation between the highest and the lowest performing centres.
  - ◊ Increasing age, diabetes, peritonitis episodes, cardiovascular disease, low serum albumin, low BMI, abnormal lipid profile, serum Hb less than 10g/dL and assisted PD are associated with an increased risk for change of modality.
  - ◊ The commonest reason for PD drop-out was peritonitis, followed by membrane failure and patient preference.
  - ◊ Majority of the incident (71%) and prevalent patient (73%) have a low- and high-average peritoneal transport status.
  - ◊ The median peritonitis rate among the PD centres has dropped to 28.2 pt-months per episode compared to 30 in the previous year. There was a wide inter-centre variation with the highest and lowest peritonitis rates of 11.8 and 247.4 pt-months per episode. Gram-positive organisms accounted for 29% of the peritonitis episodes while 32% were due to gram negative organisms.

- **Renal transplantation:**
  - ◊ The number of new transplant recipients is decreasing over the last few years with only 124 new renal transplant recipients in 2008 and 109 in 200. There total number of patients with functioning transplants has remained about 1770 for the last 3 years. The incidence rate and prevalence rate of kidney transplant for 2009 was 4 and 63 pmp respectively. The number of kidney transplantation done locally has remained from 54 – 64 cases per year since 2000.
  - ◊ Age at transplant has been stable at 37 to 42 years and between 58% and 70% of recipients are males over the last 10 years. The number of diabetics transplanted has decreased over the last few years.
  - ◊ Commonest known primary renal disease was chronic glomerulonephritis followed by hypertension and diabetes mellitus.
  - ◊ For the first time in 2009, there were more local cadaveric transplantation than living related transplantation.
  - ◊ About two thirds of transplant recipients were cyclosporine, 60% on mycophenolate mofetil.
  - ◊ The rates of transplant death and graft loss have remained static for the past 10 years. Infection, cardiovascular causes and cancer were the commonest known causes of death. Renal allograft rejection accounted for the majority of graft losses for the last 10 years.
  - ◊ Overall patient survival rates from 2000 to 2009 have been 95%, 90%, 87% and 79% at year 1, 3, 5 and 10 respectively. Overall graft survival rate has been 92%, 86%, 80% and 68% 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 RRT**
  - ◊ The overall RRT incidence rate for paediatric patients less than 20 years old was 8 pmarp and mostly were on dialysis. The new transplant incidence rate was only 1 pmarp.
  - ◊ At the end of 2009; there were a total of 605 children on dialysis giving a dialysis prevalence rate of 52 pmarp.
  - ◊ The number of children with a functioning transplant in 2009 was 191; giving a prevalence rate of 16 pmarp.
  - ◊ The dialysis treatment rate has remained consistently higher among the older age groups; the number of 0-4 year olds provided RRT remained very low.
  - ◊ Chronic PD was the initial dialysis modality in 69% of patients.
  - ◊ Majority (92%) of children received their dialysis in government centres.
  - ◊ The commonest cause of known ESRD was glomerulonephritis (22.5%). FSGS accounted for another 8% of patients.
  - ◊ Renal transplantation had the best patient survival; 92% at 5 years and 90% at 9 years. HD patients had better survival compared to PD patients.
  - ◊ The commonest type of renal transplant done in children is cadaveric transplant (48%) compared to living related transplant (35%).
  - ◊ Graft survival for paediatric transplant was 90% at 1 year and 78% at 5 years.

ACRONYMS and 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 Dialysis
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 haemodialysis 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
SMR	Standardised Mortality Ratio
UQ	Upper quartile
URR	Urea reduction rate

CHAPTER 1

All Renal Replacement Therapy in Malaysia

Lim Yam Ngo
Lim Teck Onn
Lee Day Guat

SECTION 1.1: STOCK AND FLOW

The intake of new dialysis patients continued to show a linear increase - from 1855 in 2000 to 4468 in 2008. The number of prevalent dialysis patients has similarly increased from 6689 in 2000 to at least 21 thousand in 2009. (Data for 2009 however are preliminary since at the time of writing this report there was still many new patients yet to be notified to registry.)

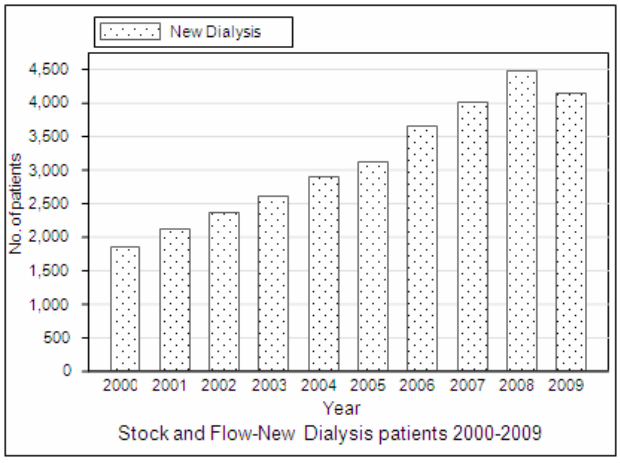
The number of new kidney transplant recipients seems to be showing a decreasing trend from 2005 due most probably to the increasing proscription against commercial transplantation. Patients with functioning renal transplants have also begun to plateau since 2006. (Table and Figure 1.01)

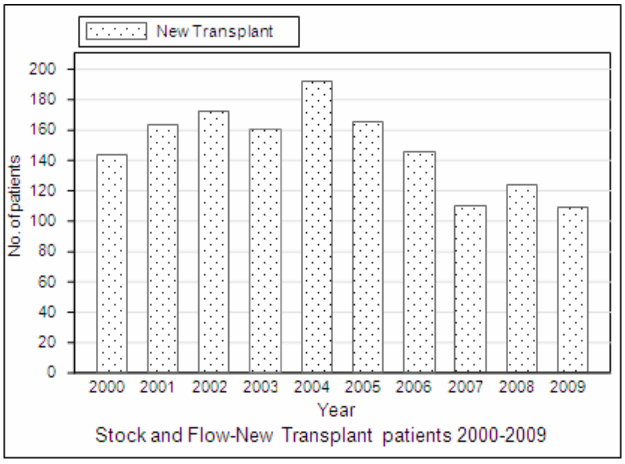
Table 1.1: Stock and Flow of RRT, Malaysia 2000-2009

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
New Dialysis patients	1855	2112	2362	2609	2892	3132	3656	4015	4468	4146
New Transplants	143	163	172	160	192	165	145	110	124	109
Dialysis deaths	602	821	933	1169	1287	1467	1752	1890	2054	2172
Transplant deaths	30	37	35	39	42	44	55	41	52	39
Dialyzing at 31st December	6689	7837	9108	10423	11873	13393	15125	17133	19381	21159
Functioning transplant at 31st December	1255	1339	1433	1507	1602	1692	1739	1753	1768	1779

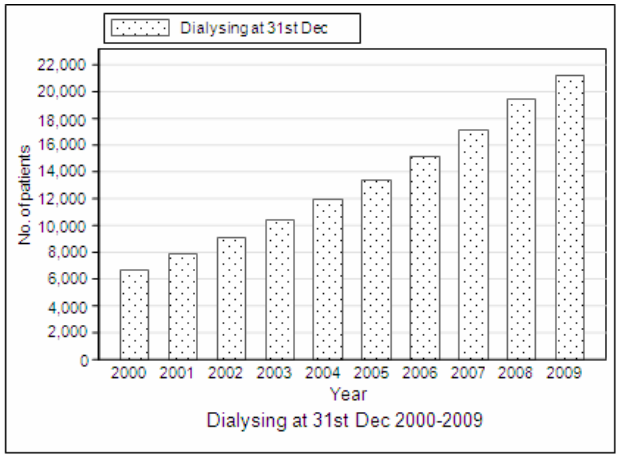
Figure 1.1: Stock and Flow of RRT, Malaysia 2000-2009

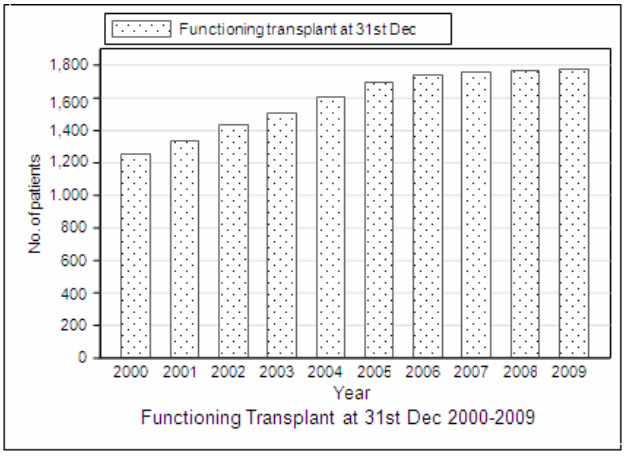
(a) New Dialysis and Transplant patients





(b) Patients Dialysing and with Functioning Transplant at 31st December 2000-2009





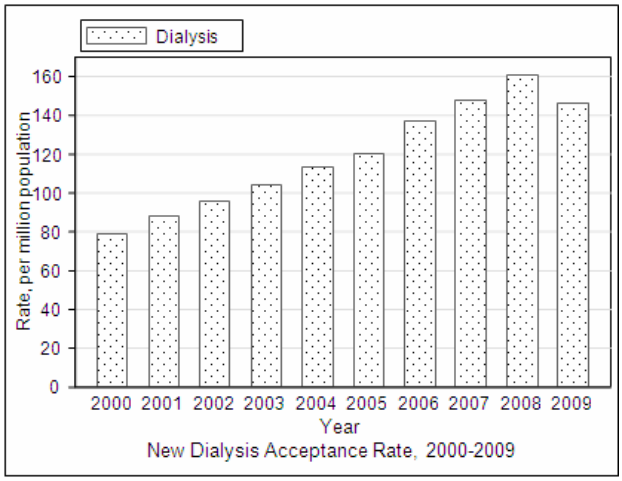
SECTION 1.2: TREATMENT PROVISION RATE

Dialysis acceptance rates doubled over 10 years from 79 per million population in 2000 to 161 per million in 2008. We expect this figure to increase further in 2009 as at the time of writing this report there was still many new patients yet to be notified to registry. The incident kidney transplant rate of 4 per million populations was not enough to increase the transplant prevalence rates over the last few years. Dialysis prevalence rate more than doubled over the last 10 years, from 285 per million population in 1999 to more than 700 per million in 2009.

Table 1. 2: New Dialysis Acceptance rate and New Transplant Rate per million population 2000-2009

Acceptance rate	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
New Dialysis	79	88	96	104	113	120	137	148	161	146
New Transplant	6	7	7	6	8	6	5	4	4	4

Figure 1.2: New Dialysis Acceptance and New Transplant Rate 2000-2009



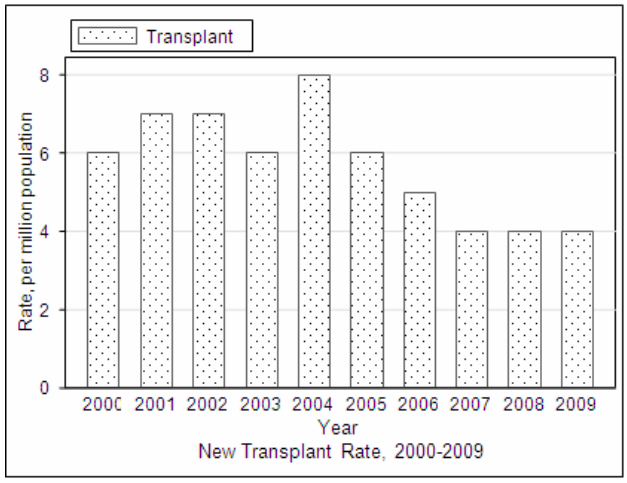
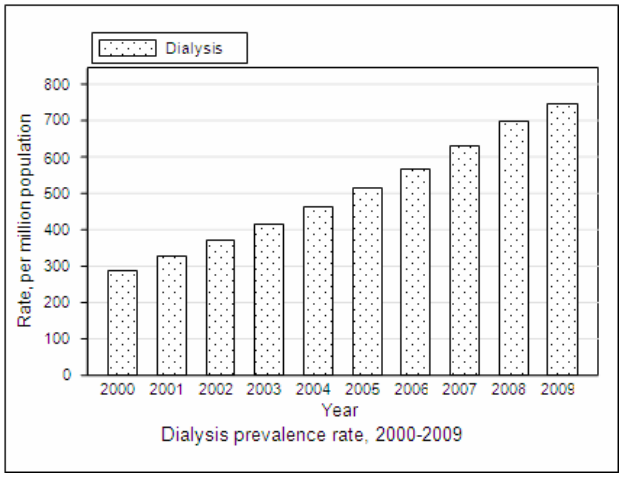
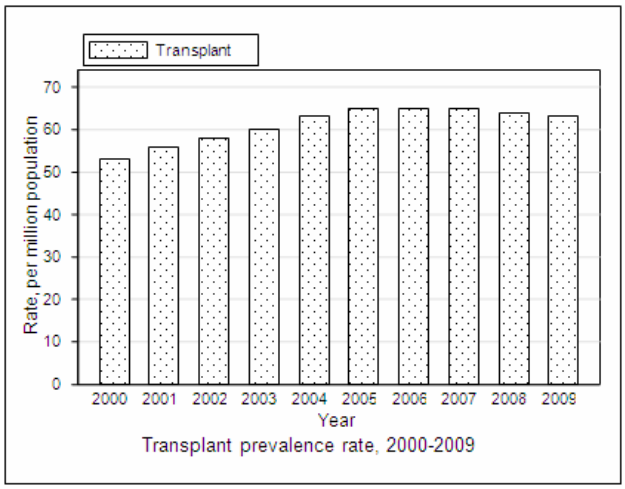


Table 1.3: RRT Prevalence Rate per million population 2000-2009

Prevalence rate	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Dialysis	285	326	371	416	464	513	568	631	699	747
Transplant	53	56	58	60	63	65	65	65	64	63

Figure 1.3: Dialysis and Transplant Prevalence Rate per million population 2000-2009





CHAPTER 2

Dialysis in Malaysia

Lim Yam Ngo
Lim Teck Onn
Lee Day Guat

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

Information on provision of dialysis was obtained from data on individual patients reported to the registry shown in Sections 2.1, 2.3 and 2.4 as well as from the centre survey carried out at the end of each calendar year shown in Section 2.2.

2.1.1 Dialysis treatment provision

The number of patients commencing dialysis was 4468 in 2008 giving an incidence rate of 161 per million population. The number of dialysis patients in Malaysia has tripled in 10 years from 6689 in 2000 to more than 20,000 in 2009 to give a prevalence rate at least 747 in 2009. The number transplanted remained around a hundred in the last 5 years.

Table 2.1.1: Stock and flow-Dialysis Patients 2000-2009

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
New Dialysis patients	1855	2112	2362	2609	2892	3132	3656	4015	4468	4146
Died	602	821	933	1169	1287	1467	1752	1890	2054	2172
Transplanted	106	130	145	121	156	123	121	91	112	103
Lost to Follow-up	8	9	18	22	24	29	64	39	47	93
Dialysing at 31st Dec.	6689	7837	9108	10423	11873	13393	15125	17133	19381	21159

Table 2.1.2: Dialysis Treatment Rate per million population 2000-2009

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Acceptance rate	79	88	96	104	113	120	137	148	161	146
Prevalence rate	285	326	371	416	464	513	568	631	699	747

2.1.2. Geographic distribution

From table 2.1.3, it appears that dialysis treatment rates in almost if not all states in Malaysia have now exceeded 100 per million state population. However, the economically advanced states like Pulau Pinang, Melaka, Johor, Kuala Lumpur and Negeri Sembilan –have double the incident rates of the least developed states.

Table 2.1.3: Dialysis Treatment Rate by state, per million population 2000-2009

State	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pulau Pinang	110	125	158	145	215	201	215	219	198	213
Melaka	150	156	175	186	210	170	199	208	226	179
Johor	132	138	147	147	156	169	213	192	240	200
Perak	105	103	116	129	147	172	190	184	205	194
Selangor & Putrajaya	84	94	111	120	124	135	152	166	174	171
WP Kuala Lumpur	158	188	172	194	209	200	218	251	256	234
Negeri Sembilan	116	110	133	147	157	157	149	218	243	235
Kedah	66	63	88	103	98	108	117	127	152	119
Perlis	72	104	103	128	95	107	127	129	140	54
Terengganu	37	76	90	66	80	100	104	170	138	132
Pahang	49	53	52	68	76	91	125	117	143	113
Kelantan	31	61	61	74	66	80	80	95	85	106
Sarawak	50	67	59	63	73	73	86	106	116	113
Sabah & WP Labuan	26	35	37	44	49	46	64	71	97	81

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

Prior to 2006, data submission of individual dialysis and transplant patients to the National Renal Registry was entirely voluntary. Since then, with the implementation of the Private Health Care Facilities and Services Act 1996 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 2009. Dialysis provision is expressed in terms of number of centres, HD machines, treatment capacity (one HD machine to 5 patients) and patients.

The number of haemodialysis (HD) centres increased from 484 in 2008 to 538 in 2009, peritoneal dialysis (PD) centres increased from 31 to 36 in the same period. 19607 patients were reported to be on HD, and 1936 on PD giving a total of 21543 dialysis patients at year end 2009. The Ministry of Health (MOH) provided dialysis to 31.3% of patients, non-governmental organizations (NGO) 28.29% and the private sector 38.8%. 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 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 but the lowest HD treatment capacity to patient ratio at 1.29 in 2009.

Table 2.2.1 : Number of dialysis centres, HD machines and treatment capacity by sector, December 2009

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.)
MOH	136	1401	7005	4994	1.4	23	1742	6736
NGO	130	1830	9150	6084	1.5			6084
Private(PRV)	257	2137	10685	8303	1.29	9	53	8356
University (UNI)	7	59	295	126	2.34	3	134	260
Armed Force (AF)	8	47	235	100	2.35	1	7	107
TOTAL	538	5474	27370	19607	8.88	36	1936	21543

Figure 2.2.1(a): Distribution of dialysis centres by Sector, December 2009

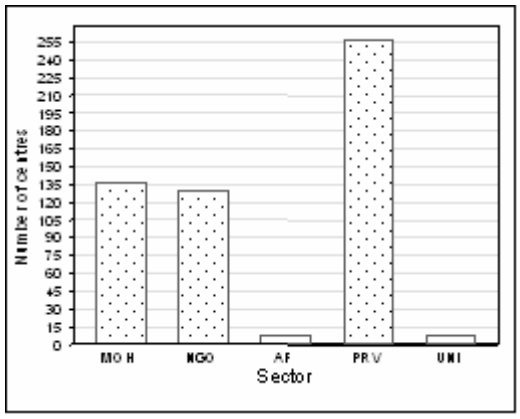


Figure 2.2.1(b): Distribution of HD capacity by Sector, December 2009

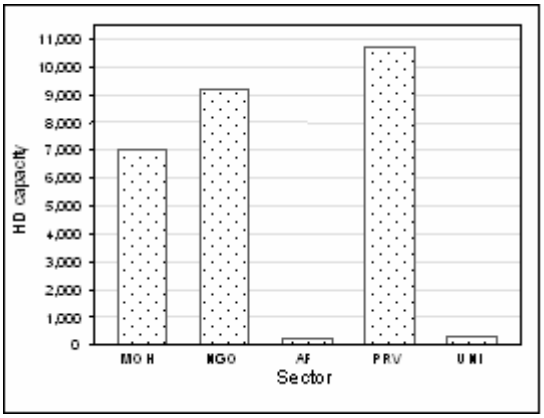


Figure 2.2.1(c): Distribution of dialysis patients by Sector, December 2009

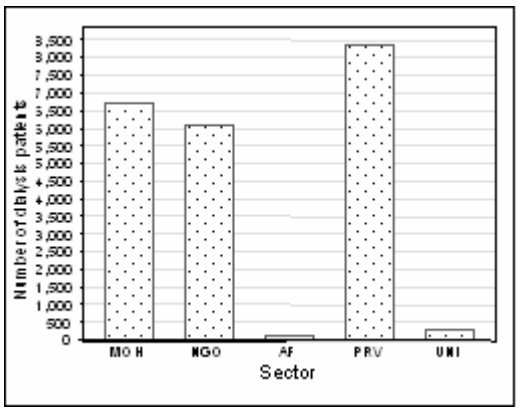
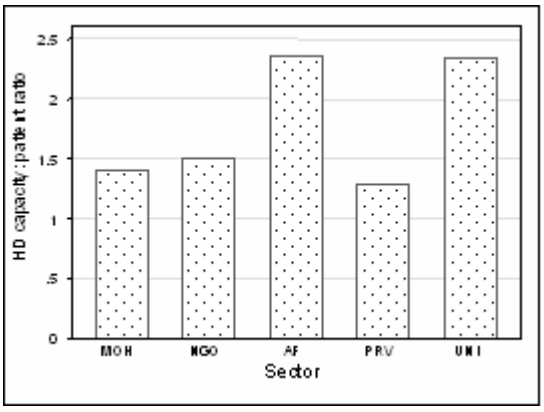


Figure 2.2.1(d): HD capacity: patient ratio by Sector, December 2009



2.2.2 Geographic distribution (centre survey)

The economically advantaged states of Pulau Pinang, Melaka, Johor, Perak, WP Kuala Lumpur and Negeri Sembilan had centre HD capacity rates and dialysis treatment rates above the national rate of 777 per million population. There was a 4-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. Although there was also a wide variation between PD prevalence rate by state, there was no obvious correlation with the economic status of the state.

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 2009

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	52	565	341	2825	1707	1934	1169	1.46	4	402	243	2336	1411
Pulau Pinang	46	505	320	2525	1601	1630	1033	1.55	2	174	110	1804	1144
Johor	72	840	248	4200	1241	3334	985	1.26	5	259	77	3593	1061
Melaka	22	218	283	1090	1417	750	975	1.45	2	43	56	793	1031
Negeri Sembilan	25	253	250	1265	1248	909	897	1.39	2	69	68	978	965
Perak	58	585	244	2925	1222	2140	894	1.37	3	70	29	2210	923
Selangor & Putrajaya	104	1071	207	5355	1034	3584	692	1.49	5	440	85	4024	777
Perlis	2	35	145	175	727	141	586	1.24				141	586
Kedah	34	308	154	1540	770	1116	558	1.38	1	43	22	1159	580
Sarawak	32	313	125	1565	625	1312	524	1.19	3	91	36	1403	560
Pahang	28	254	165	1270	823	752	487	1.69	2	89	58	841	545
Terengganu	10	112	100	560	500	450	401	1.24	1	126	112	576	514
Kelantan	21	144	88	720	441	609	373	1.18	2	68	42	677	414
Sabah & WP Labuan	32	271	82	1355	412	946	288	1.43	4	62	19	1008	306
Malaysia	538	5474	197	27370	987	19607	707	1.4	36	1936	70	21543	777

Figure 2.2.2(a): Distribution of hemodialysis centres by State, 2009

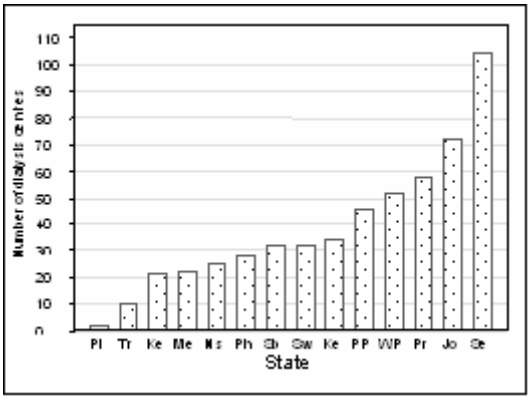


Figure 2.2.2(b): Distribution of dialysis patients by State, 2009

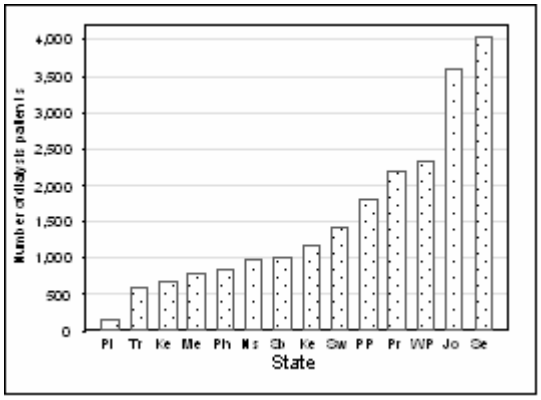


Figure 2.2.2(c): Distribution of patients/million population by State, 2009

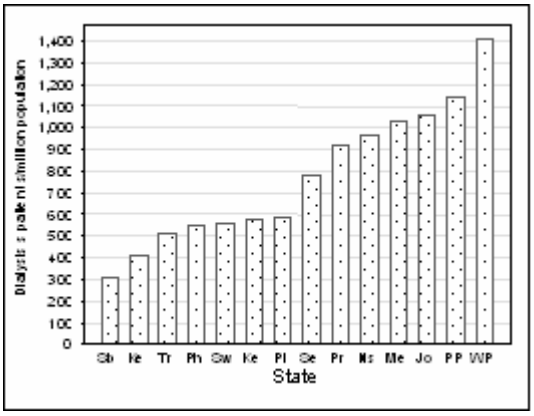
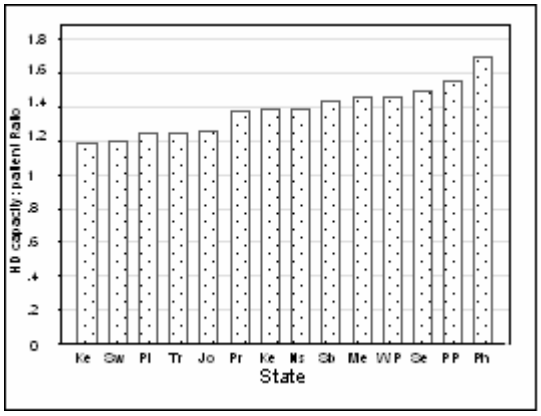


Figure 2.2.2(d): HD capacity to patient ratio by State, 2009



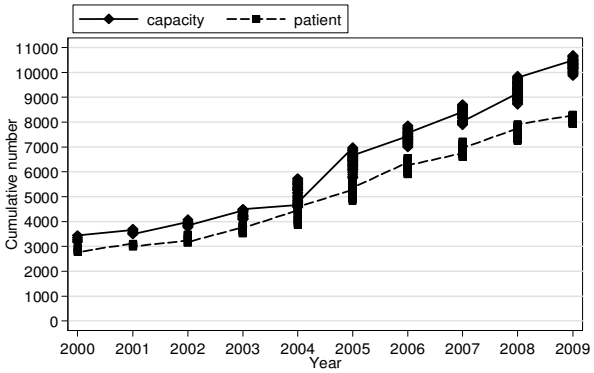
2.2.3 Growth in dialysis provision by sector

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)

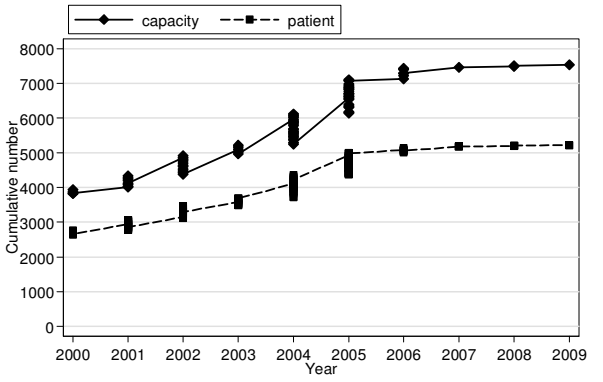
Table 2.2.3: Growth in HD and HD patients in Private, NGO and MOH sectors, 2000-2009

Sector	Private		NGO		MOH	
	Cumulative HD capacity	Cumulative HD patients	Cumulative HD capacity	Cumulative HD patients	Cumulative HD capacity	Cumulative HD patients
2000	3440	2950	4620	3430	3940	2761
2001	3690	3108	4965	3693	4340	3059
2002	4070	3474	5830	4222	4910	3468
2003	4490	3859	6260	4523	5220	3689
2004	5730	4786	6760	4841	6115	4353
2005	6970	5856	7470	5168	7110	4999
2006	7855	6554	8080	5514	7430	5134
2007	8700	7223	8635	5841	7460	5184
2008	9840	7914	8960	6028	7500	5204
2009	10685	8303	9150	6024	7535	5220

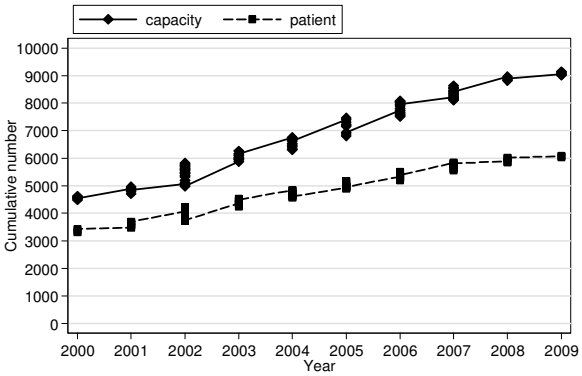
Figure 2.2.3: Growth in HD and HD patients in Private, NGO and MOH sectors, 2000-2009



Growth in HD capacity and patient, private sector 2000-2009



Growth in HD capacity and patient, MOH sector 2000-2009



Growth in HD capacity and patient, NGO sector 2000-2009

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 gender. Since 2001, the male to female dialysis patients remained the same at 55 to 45% respectively. However the ratio between males and females was slightly higher in the incident patients compared to prevalent patients suggesting a small survival advantage in female patients on dialysis.

Table 2.3.1(a) : Dialysis Treatment Rate by Gender, per million male or female population 2000-2009

Gender	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Male	92	97	111	123	130	141	156	169	187	171
Female	73	89	95	96	111	112	133	142	153	140

Figure 2.3.1(a) : Dialysis Treatment Rate by Gender 2000-2009

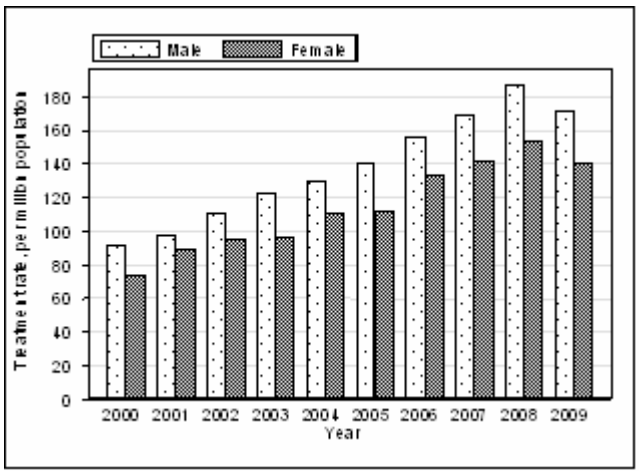
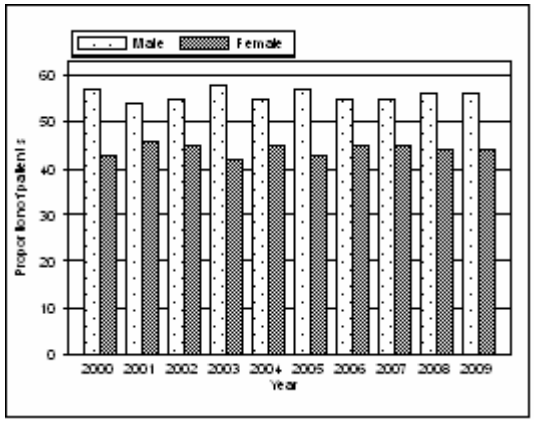


Table 2.3.1(b): Gender Distribution of Dialysis Patients 2000-2009

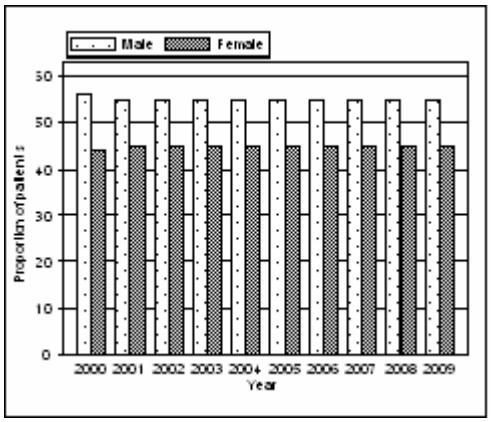
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
New Dialysis patients	1855	2112	2362	2609	2892	3132	3656	4015	4468	4146
% Male	57	54	55	58	55	57	55	55	56	56
% Female	43	46	45	42	45	43	45	45	44	44
Dialysing at 31st December	6689	7837	9108	10423	11873	13393	15125	17133	19381	21159
% Male	56	55	55	55	55	55	55	55	55	55
% Female	44	45	45	45	45	45	45	45	45	45

Figure 2.3.1(b): Gender Distribution of Dialysis Patients 2000-2009

(i)New Dialysis patients



(ii) Dialysing patients at 31st December



2.3.2 Age distribution

New dialysis treatment rates in the younger 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 65 years and older have continued to show rapid increase to almost 1000 per million age related population in 2008. (Table 2.3.2 a) More than half of new dialysis patients were at least 55 years old.

Table 2.3.2 (a): Dialysis Treatment Rate by Age Group, per million age group population 2000-2009

Age groups (years)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
≤14	4	4	5	4	5	5	5	5	6	6
15-24	18	22	29	26	28	30	31	32	30	31
25-34	47	47	55	52	51	56	61	64	74	65
35-44	98	104	100	103	117	113	126	128	154	125
45-54	249	252	275	279	312	305	366	368	403	350
55-64	433	508	535	589	594	658	682	777	759	713
≥ 65	347	439	502	585	658	665	814	848	959	876

Figure 2.3.2 (a): Dialysis Treatment Rate by Age Group 2000-2009

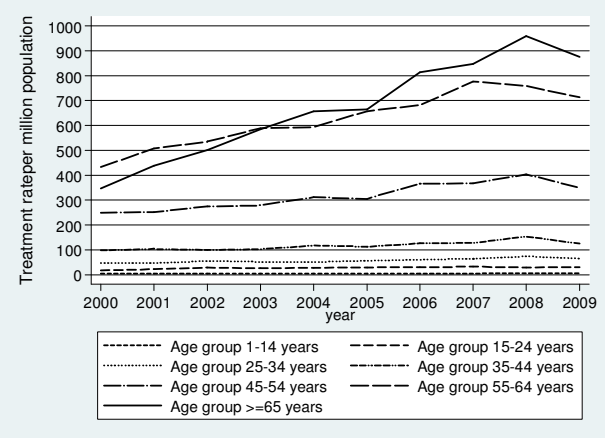
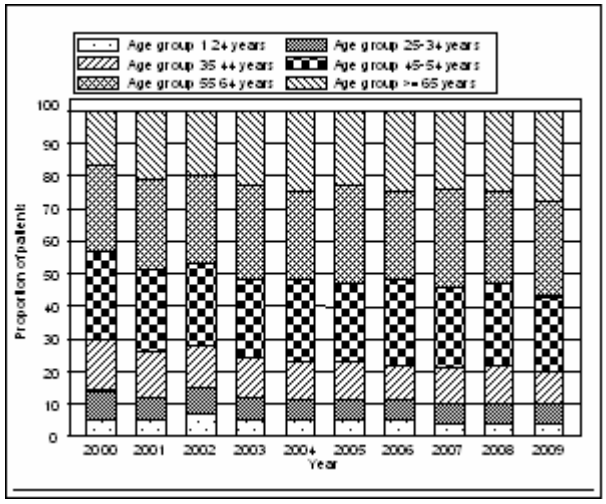


Table 2.3.2 (b) : Percentage Age Distribution of Dialysis Patients 2000-2009

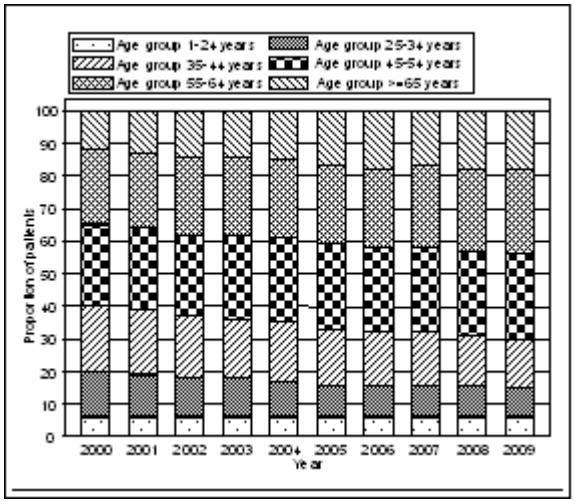
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
New Dialysis patients	1855	2112	2362	2609	2892	3132	3656	4015	4468	4146
% 1-14 years	1	1	2	1	1	1	1	1	1	1
% 15-24 years	4	4	5	4	4	4	4	3	3	3
% 25-34 years	9	7	8	7	6	6	6	6	6	6
% 35-44 years	16	14	13	12	12	12	11	11	12	10
% 45-54 years	27	25	25	24	25	24	26	25	25	23
% 55-64 years	26	28	27	29	27	30	27	30	28	29
% >=65 years	17	21	20	23	25	23	25	24	25	28
Dialysing at 31st December	6689	7837	9108	10423	11873	13393	15125	17133	19381	21159
% 1-14 years	1	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	13	12	12	11	10	10	10	10	9
% 35-44 years	20	20	19	18	18	17	16	16	15	15
% 45-54 years	25	25	25	26	26	26	26	26	26	26
% 55-64 years	23	23	24	24	24	24	24	25	25	26
% >=65 years	12	13	14	14	15	17	18	17	18	18

Figure 2.3.2 (b): Age Distribution of New Dialysis Patients 2000-2009

(i) New Dialysis Patients



(ii) Dialysing patients at 31st December



2.3.3 Method and Location of dialysis

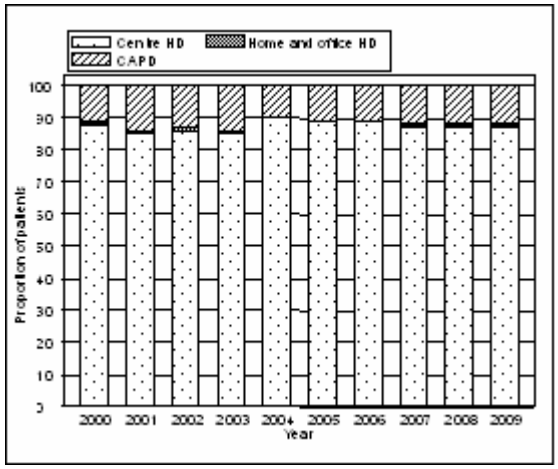
87% of new patients were accepted into centre haemodialysis in 2008 and 2009. Despite the conscious effort by the MOH to place PD first, the proportion of new patients accepted onto chronic PD program has remained about 12% and only accounted for 8% of prevalent dialysis patients. This is because the private sector was the largest provider of dialysis accepting more than 40% since 2008. There were still a handful of new patients accepted into the home and office HD programme. (Table and Figure 2.3.5)

Table 2.3.3: Method and Location of Dialysis Patients 2000-2009

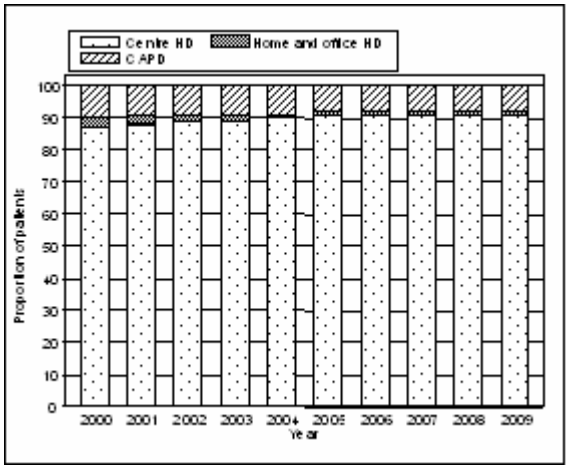
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
New Dialysis patients	1855	2112	2362	2609	2892	3132	3656	4015	4468	4146
% Centre HD	88	85	86	85	90	89	89	87	87	87
% Home and office HD	1	1	1	1	0	0	0	1	1	1
% PD	11	14	13	14	10	11	11	12	12	12
Dialysing at 31st December	6413	7492	8687	9950	11302	12743	14393	16310	18433	20118
% Centre HD	87	88	89	89	90	91	91	91	91	91
% Home and office HD	3	3	2	2	1	1	1	1	1	1
% PD	10	9	9	9	9	8	8	8	8	8

Figure 2.3.3: Method and Location of Dialysis Patients 2000-2009

(i) New Dialysis Patients



(ii) Dialysing patients at 31st December



2.3.4 Funding for Dialysis Treatment

In Malaysia, funding for dialysis may be from multiple sources. 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.

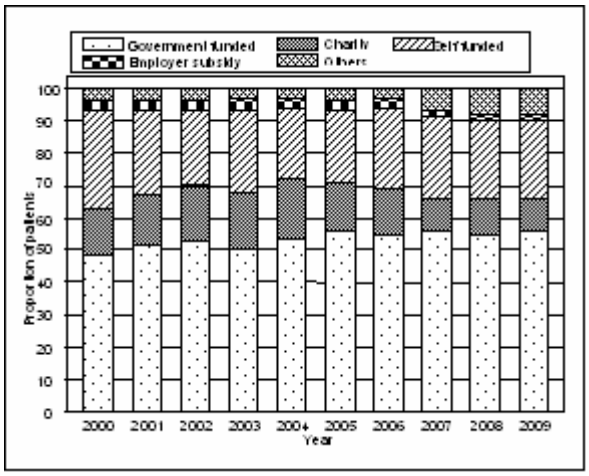
The government continues to be the main payer for dialysis therapy. These funds are channeled not only to the government dialysis centres but also as subsidies to NGO centres and payment of dialysis treatment for civil servants and their dependents in private centres. About a quarter of patients paid for their dialysis. Funding from NGO bodies has declined over the years. (Table and Figure 2.3.4)

Table 2.3.4: Funding for Dialysis Treatment 2000-2009

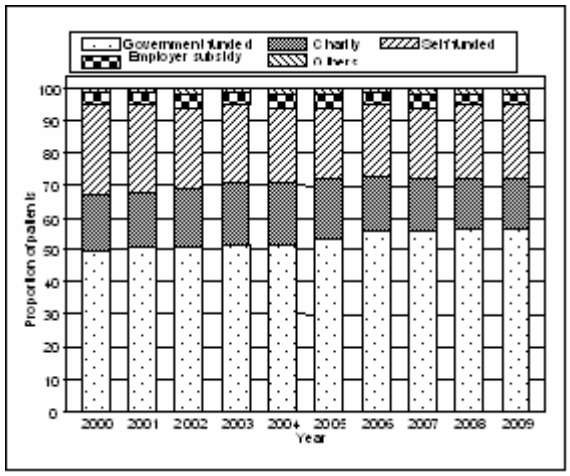
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
New Dialysis patients	1855	2112	2362	2609	2892	3132	3656	4015	4468	4146
% by Government	48	52	53	51	54	56	55	56	55	56
% by Charity	15	15	17	17	18	15	14	10	11	10
% self funded	30	26	23	25	22	22	25	25	24	24
% subsidized by Employer	3	3	3	4	3	3	3	2	2	2
% Others	4	4	4	3	3	4	3	7	8	8
Dialysing at 31st December	6413	7492	8687	9950	11302	12743	14393	16310	18433	20118
% by Government	50	51	51	52	52	54	56	56	57	57
% by Charity	17	17	18	19	19	18	17	16	15	15
% self funded	28	27	25	24	23	22	22	22	23	23
% subsidized by Employer	4	4	4	4	4	4	4	4	3	3
% Others	1	1	2	1	2	2	1	2	2	2

Figure 2.3.4: Funding for Dialysis Treatment 2000-2009

(i) New Dialysis Patients



(ii) Dialysing patients at 31st December



2.3.5 Distribution of dialysis patients by sector

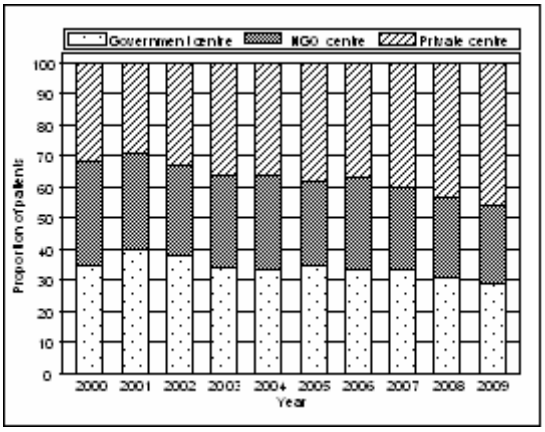
The proportion of incident dialysis patients in private centres continue to increase while that in MOH and NGO centres seem to show a decrease. In 2009 the private sector overtook the government sector as the largest provider of dialysis.

Table 2.3.5: Distribution of Dialysis Patients by Sector 2000-2009

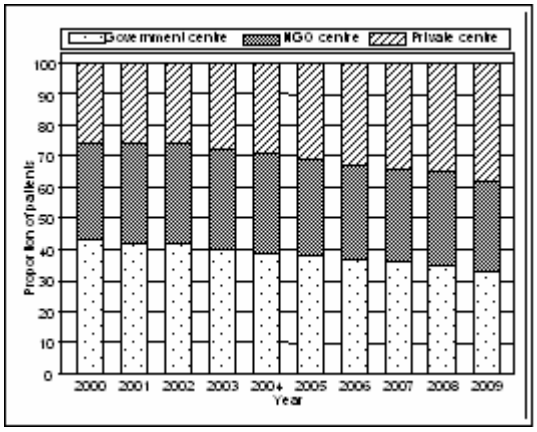
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
New Dialysis patients	1855	2112	2362	2609	2892	3132	3656	4015	4468	4146
% Government centre	35	40	38	34	33	35	33	33	31	29
% NGO centre	33	31	29	30	31	27	30	27	26	25
% Private centre	32	29	33	36	36	38	37	40	43	46
Dialysing at 31st December	6689	7837	9108	10423	11873	13393	15125	17133	19381	21159
% Government centre	43	42	42	40	39	38	37	36	35	33
% NGO centre	31	32	32	32	32	31	30	30	30	29
% Private centre	26	26	26	28	29	31	33	34	35	38

Figure 2.3.5: Distribution of Dialysis Patients by Sector 2000-2009

(i) New Dialysis Patients



(ii) Dialysing patients at 31st December



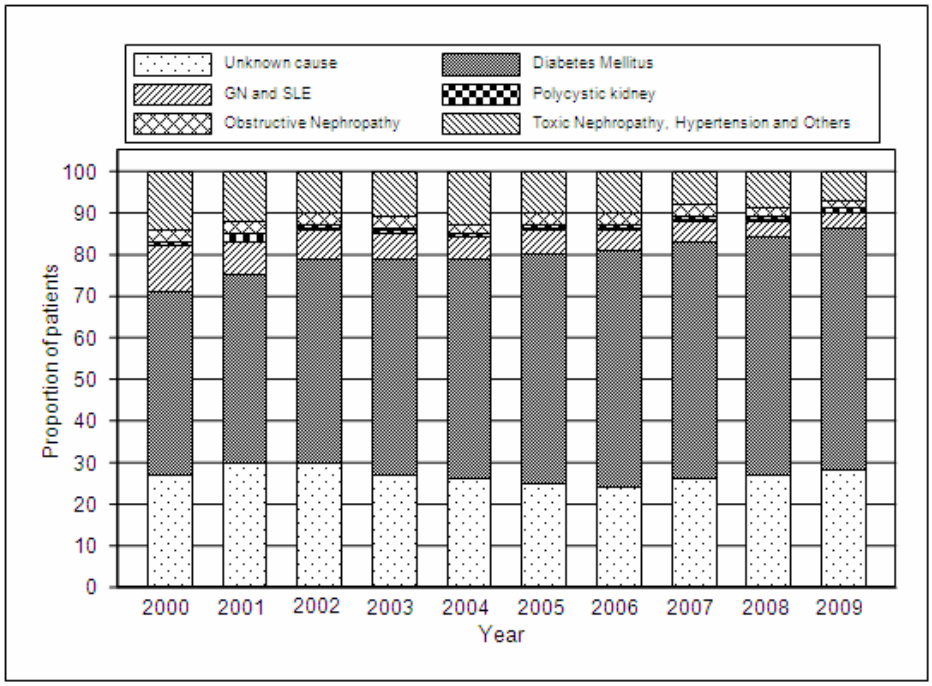
SECTION 2.4: PRIMARY RENAL DISEASE

More and more new dialysis patients were reported to have diabetes mellitus accounting for more than half of all 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. The percentage of patients with unknown primary renal disease has not reduced in the last 10 years despite the increase in the number of nephrologists.

Table 2.4.1: Primary Renal Diseases 2000-2009

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
New Dialysis patients	1855	2112	2362	2609	2892	3132	3656	4015	4468	4146
% Unknown cause	27	30	30	27	26	25	24	26	27	27
% Diabetes Mellitus	44	45	49	52	53	55	57	57	57	58
% GN	9	7	6	5	4	5	4	4	3	3
% SLE	2	1	1	1	1	1	1	1	1	1
% Polycystic kidney	1	2	1	1	1	1	1	1	1	1
% Obstructive Nephropathy	3	3	3	3	3	3	3	3	2	2
% Toxic Nephropathy	0	1	0	0	0	0	0	0	0	0
% Hypertension	13	10	7	9	9	8	8	8	8	8
% Others	1	1	3	2	3	2	2	0	1	0

Figure 2.4.1: Primary Renal Diseases for New Dialysis Patients 2000-2009



CHAPTER 3

Death and Survival on Dialysis

Wong Hin Seng
Ong Loke Meng
Wan Sha'ariah Md Yusuf

SECTION 3.1: DEATH ON DIALYSIS

The number of deaths in dialysis patients for 2009 was 2172 (annual death rate of 10.7%). One thousand eight hundred and ninety nine haemodialysis patients died in 2009 while 273 died while on peritoneal dialysis (continuous ambulatory peritoneal dialysis and automated peritoneal dialysis).

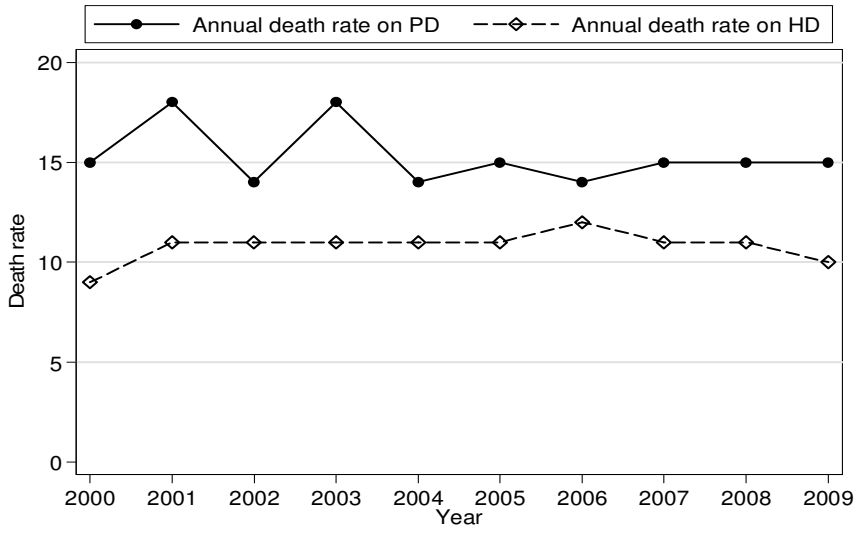
Table 3.1.1: Deaths on Dialysis 2000-2009

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
No. of dialysis patients at risk	6115	7263	8473	9766	11148	12633	14259	16129	18257	20270
Dialysis deaths	602	821	933	1169	1287	1467	1752	1890	2054	2172
Dialysis death rate %	10	11	11	12	12	12	12	12	11	11
No. of HD patients at risk	5487	6550	7629	8776	10058	11490	13022	14702	16612	18453
HD deaths	510	691	818	991	1135	1295	1584	1679	1800	1899
HD death rate %	9	11	11	11	11	11	12	11	11	10
No. of PD patients at risk	628	714	844	990	1091	1143	1238	1428	1645	1818
PD deaths	92	130	115	178	152	172	168	211	254	273
PD death rate %	15	18	14	18	14	15	14	15	15	15

Figure 3.1.1 shows the annual death rate on dialysis from 2000 till 2009. Despite a higher percentage of diabetics and elderly patients 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 peritoneal dialysis (PD) remained unchanged in the last 6 years (between 14-15%) while the annual death rate for those on haemodialysis showed a slight downward trend over the last 4 years. The annual death rate for those on PD in 2009 was 15.0% while the annual death rate for haemodialysis patients in 2009 was 10.3%; a difference of 4.7% between the two modalities.

Figure 3.1.1: Death Rates on Dialysis 2000-2009



The causes of death on dialysis are shown in Table 3.1.2. Cardiovascular disease remained the main cause of death in 2009; accounting for 34%. Death due to cardiovascular disease appeared to be an increasing in the last 5 years and this is probably due to the increasing number of elderly and diabetic patients undergoing dialysis. Death at home accounted for another 22% and a majority of these deaths were probably secondary to cardiovascular events. Dialysis patients dying from infection remained the third most common cause of death in 2009 and appeared to be increasing trend in recent years.

Table 3.1.2: Causes of Death on Dialysis 2000-2009

Year	2000		2001		2002		2003		2004	
Causes of Death	No.	%	No.	%	No.	%	No.	%	No.	%
Cardiovascular	184	31	211	26	307	33	328	28	336	26
Died at home	135	22	228	28	212	23	290	25	307	24
Sepsis	85	14	129	16	142	15	185	16	157	12
PD peritonitis	21	3	29	4	16	15	14	1	13	1
GIT bleed	18	3	18	2	24	15	29	2	24	2
Cancer	8	1	18	2	18	15	27	2	20	2
Liver disease	14	2	11	1	16	15	24	2	29	2
Withdrawal	17	3	20	2	18	15	26	2	9	1
Others	74	12	89	11	104	15	160	14	320	25
Unknown	46	8	68	8	76	15	86	7	72	6
TOTAL	602	100	821	100	933	15	1169	100	1287	100

Year	2005		2006		2007		2008		2009	
Causes of Death	No.	%	No.	%	No.	%	No.	%	No.	%
Cardiovascular	368	25	494	28	484	26	633	31	747	34
Died at home	320	22	354	20	342	18	422	21	473	22
Sepsis	166	11	218	12	197	10	305	15	467	22
PD peritonitis	22	1	22	1	16	1	23	1	26	1
GIT bleed	29	2	26	1	27	1	42	2	40	2
Cancer	28	2	40	2	33	2	52	3	49	2
Liver disease	25	2	35	2	37	2	41	2	25	1
Withdrawal	11	1	23	1	27	1	23	1	31	1
Others	406	28	392	22	552	29	360	18	178	8
Unknown	92	6	148	8	175	9	153	7	136	6
TOTAL	1467	100	1752	100	1890	100	2054	100	2172	100

SECTION 3.2: PATIENT SURVIVAL ON DIALYSIS

3.2.1 Patient survival by dialysis modality

Patient survival by the first dialysis modality (censored for transplant and change of modality) is shown in Table 3.2.1(a) and Figure 3.2.1(a). The overall unadjusted 5 years and 10 years patient survival on dialysis were 57% and 34% respectively. The unadjusted patient survival was better for those on haemodialysis compared to those on PD and this survival difference began to widen after the first year. At 10 years the unadjusted patient survival on haemodialysis was 35% compared 20% in those on PD; a 15% difference.

When the patient survival by the first dialysis modality was analysed as per ITT (disregarding change of dialysis modality) [Table and Figure 3.2.1(b)], the difference in survival became less evident. The overall unadjusted 5 years and 10 years patient survival on haemodialysis versus PD were 59% vs 50% and 37% vs 30% respectively.

Table 3.2.1(a): Patient survival by dialysis modality analysis (censored for change of modality)

	PD			HD			All		
	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	5165	100	-	34669	100	-	39834	100	-
6	4416	94	0	30513	94	0	34929	94	0
12	3660	87	0	26537	89	0	30197	89	0
24	2445	75	1	20388	80	0	22833	79	0
36	1568	63	1	15610	72	0	17178	71	0
48	1026	53	1	11872	65	0	12898	63	0
60	716	47	1	9076	58	0	9792	57	0
72	479	40	1	6925	52	0	7402	51	0
84	283	34	1	5245	47	0	5527	46	0
96	174	29	1	3956	42	0	4127	41	0
108	103	24	1	2984	38	0	3086	37	0
120	60	20	2	2248	35	0	2308	34	0

Figure 3.2.1(a): Patient survival by dialysis modality analysis (censored for change of modality)

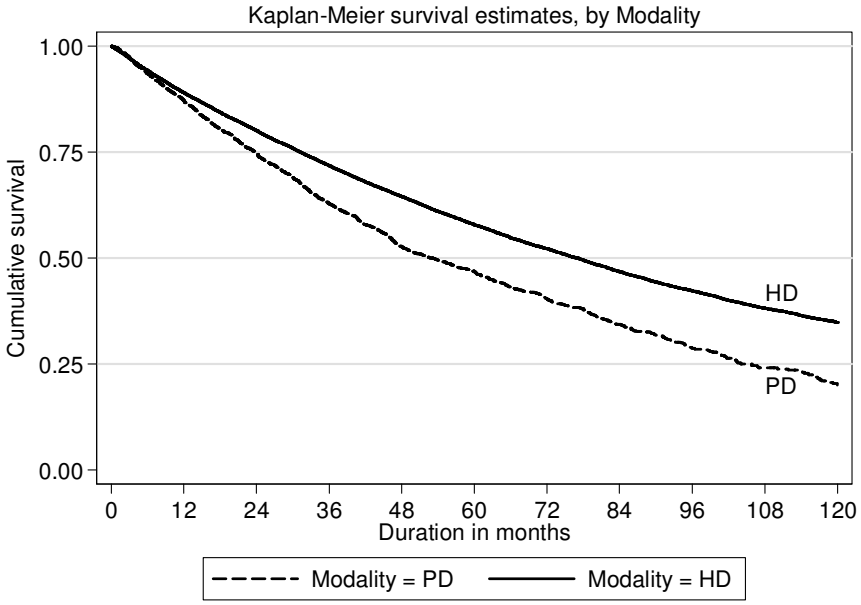
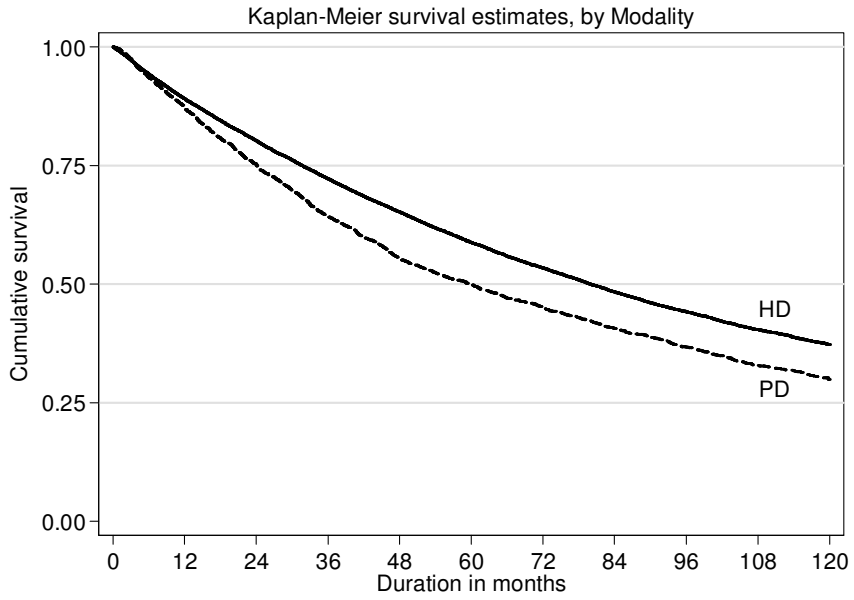


Table 3.2.1(b): Patient survival by dialysis modality analysis (not censored for change of modality)

Dialysis modality Interval (month)	PD			HD			All		
	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	5165	100	-	34669	100	-	39834	100	-
6	4576	94	0	31011	94	0	35587	94	0
12	3988	87	0	27399	89	0	31387	89	0
24	2988	75	1	21571	80	0	24559	80	0
36	2195	64	1	16847	72	0	19042	71	0
48	1679	55	1	13108	65	0	14787	64	0
60	1351	50	1	10249	59	0	11599	58	0
72	1079	45	1	8013	53	0	9089	52	0
84	833	41	1	6242	48	0	7074	47	0
96	633	37	1	4844	44	0	5475	43	0
108	470	33	1	3784	40	0	4252	39	0
120	369	30	1	2954	37	0	3323	36	0

Figure 3.2.1(b): Patient survival by dialysis modality analysis (not censored for change of modality)



3.2.2 Patient survival by year of starting dialysis

Table 3.2.2 and Figure 3.2.2 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 55-56% respectively.

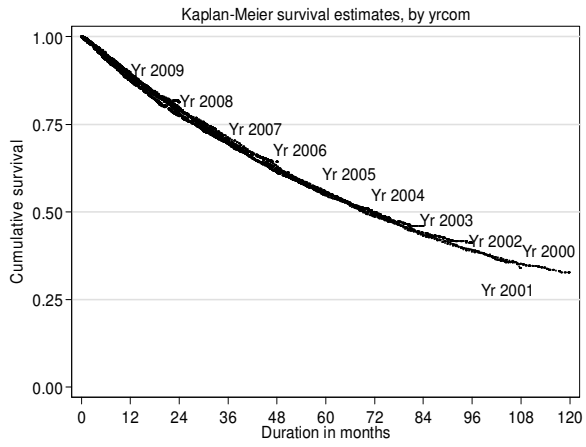
Table 3.2.2: Unadjusted patient survival by year of entry, 2000-2009

Year Interval (month)	2000			2001			2002			2003		
	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	1947	100	-	2238	100	-	2521	100	-	2756	100	-
6	1810	95	1	2072	94	1	2356	95	0	2537	94	0
12	1669	89	1	1889	89	1	2179	90	1	2341	89	1
24	1415	80	1	1605	78	1	1845	79	1	2020	79	1
36	1225	71	1	1387	69	1	1600	70	1	1738	70	1
48	1056	63	1	1201	62	1	1397	62	1	1522	62	1
60	914	55	1	1033	55	1	1215	56	1	1335	56	1
72	794	49	1	910	49	1	1063	49	1	1183	50	1
84	688	43	1	800	43	1	922	44	1	-	-	-
96	603	39	1	705	39	1	-	-	-	-	-	-
108	538	35	1	-	-	-	-	-	-	-	-	-

Year Interval (month)	2004			2005			2006			2007		
	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	3085	100	-	3313	100	-	3861	100	-	4226	100	-
6	2872	95	0	3041	94	0	3543	93	0	3922	94	0
12	2637	89	1	2795	88	1	3266	87	1	3622	88	1
24	2288	79	1	2397	77	1	2823	78	1	3164	79	1
36	1966	70	1	2104	70	1	2484	70	1	-	-	-
48	1715	62	1	1824	61	1	-	-	-	-	-	-
60	1508	55	1	-	-	-	-	-	-	-	-	-

Year Interval (month)	2008			2009		
	No.	% survival	SE	No.	% survival	SE
0	4723	100	-	4420	100	-
6	4381	94	0	2318	95	0
12	4069	89	0	-	-	-

Figure 3.2.2: Unadjusted patient survival by year of entry, 2000-2009



3.2.3 Patient survival by Age at starting dialysis

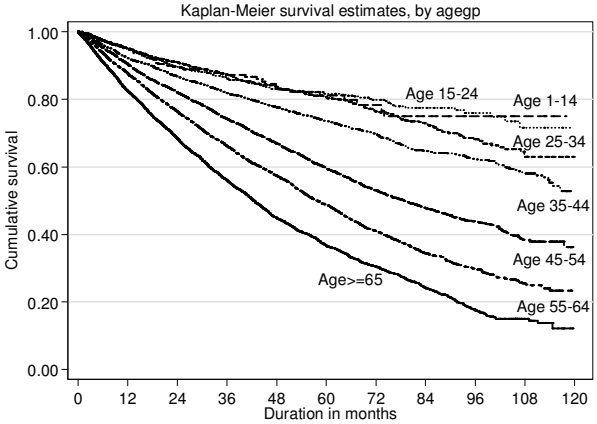
The unadjusted survival for patients starting dialysis at aged less than 25 years was more than 80% at 5 years. Beyond the age of 24 years old, the unadjusted survival progressively worsens with increasing age. The 9-year unadjusted survival for those who started dialysis at the age of less than 15 years was 75 % compared with 15% in those aged more than 64 years at the time of initiation of dialysis.

Table 3.2.3: Unadjusted patient survival by age, 2000-2009

Age group (years)	<=14			15-24			25-34			35-44		
Interval (month)	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	416	100	-	1341	100	-	2318	100	-	4043	100	-
6	369	97	1	1196	97	0	2085	97	0	3583	96	0
12	318	95	1	1040	95	1	1796	95	0	3125	92	0
24	233	90	2	782	90	1	1358	91	1	2372	87	1
36	156	87	2	588	86	1	1050	87	1	1853	82	1
48	112	84	2	440	83	1	801	83	1	1398	78	1
60	75	81	3	333	82	1	614	81	1	1056	74	1
72	51	78	3	229	80	2	445	76	1	759	70	1
84	31	75	4	152	77	2	296	73	2	516	65	1
96	14	75	4	87	76	2	163	68	2	324	62	1
108	5	75	4	34	72	3	83	63	2	146	58	2

Age group (years)	45-54			55-64			>=65		
Interval (month)	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	8160	100	-	9261	100	-	7551	100	-
6	7242	95	0	8051	94	0	6321	91	0
12	6223	90	0	6805	88	0	5165	82	0
24	4610	82	0	4858	76	0	3451	68	1
36	3371	74	1	3323	66	1	2204	56	1
48	2367	67	1	2258	57	1	1341	45	1
60	1652	60	1	1452	49	1	830	37	1
72	1085	53	1	900	41	1	489	30	1
84	682	48	1	487	34	1	254	24	1
96	376	44	1	242	30	1	107	17	1
108	152	38	1	91	26	1	34	15	1

Figure 3.2.3: Unadjusted patient survival by age, 2000-2009



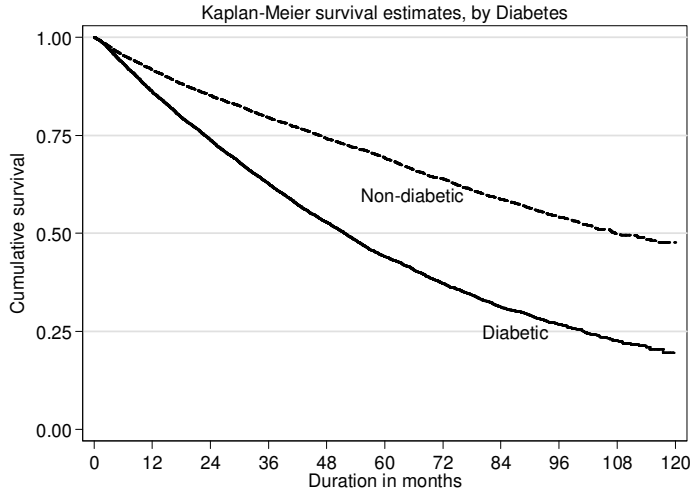
3.2.4 Patient survival by Diabetic status

The unadjusted patient survival among diabetic and non-diabetic patients is shown in Table 3.2.4 and Figure 3.2.4. The presence of diabetes mellitus has major impact on patient survival. The difference in the unadjusted patient survival diverged as early as 6 months after initiation of dialysis. The 9 years unadjusted patient survival among diabetics and non-diabetics were 50% and 23% respectively, a two fold difference in patient survival.

Table 3.2.4: Unadjusted patient survival by Diabetes status, 2000-2009

Diabetes status	Non-diabetic			Diabetic		
Interval (month)	No.	% survival	SE	No.	% survival	SE
0	14878	100	-	18212	100	-
6	13122	95	0	15722	93	0
12	11395	92	0	13071	86	0
24	8650	85	0	9013	74	0
36	6536	79	0	6009	63	0
48	4863	74	0	3848	53	0
60	3616	69	1	2388	44	1
72	2520	64	1	1430	37	1
84	1629	59	1	786	31	1
96	934	54	1	374	27	1
108	397	50	1	142	23	1

Figure 3.2.4: Unadjusted patient survival by Diabetes status, 2000-2009

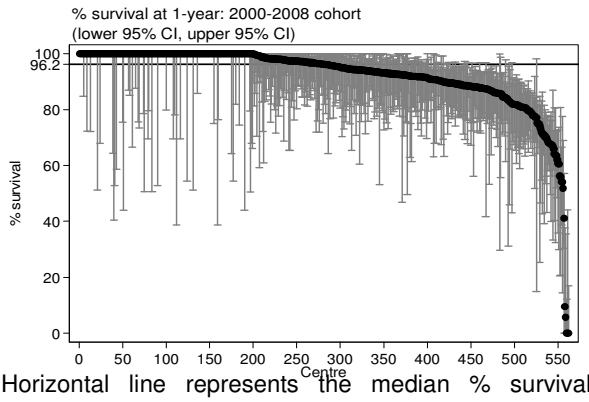


SECTION 3.3: SURVIVAL OF INCIDENCE PATIENTS BY CENTRE

3.3.1. Survival of incident haemodialysis patients 2000-2008 by centre

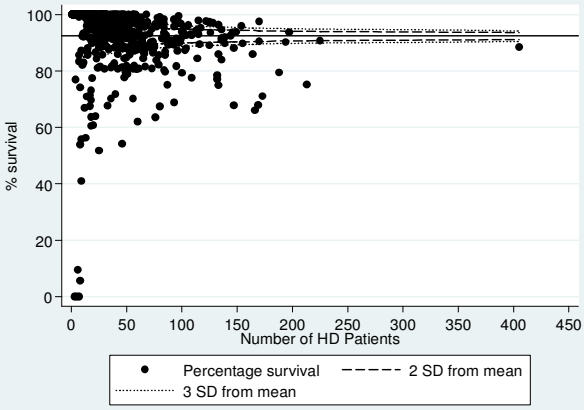
The median patient survival at 1 year (adjusted for age and diabetes) among haemodialysis centres for the 2000-2009 cohort was 96.2% [Figure 3.3.1(a)]. There was wide centre variation and when the 1 year patient survival of the individual heamodialysis centres were illustrated in the funnel plots [Figure 3.3.1(b)], only 46.6% of the haemodialysis centres lies within the 2SD of the median 1 year patient survival.

Figure 3.3.1 (a): Variation in % Survival at 1-years adjusted to age and diabetes, 2000-2008



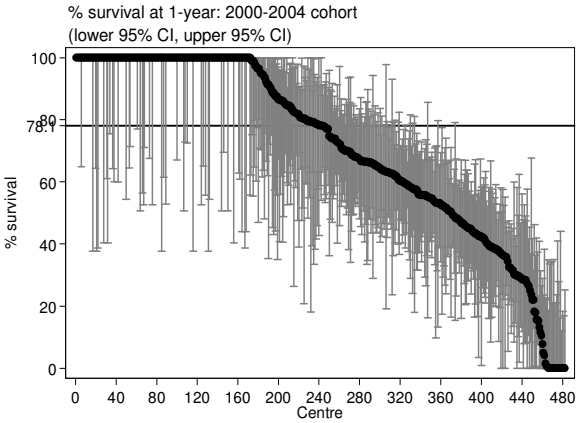
*Horizontal line represents the median % survival among HD centres

Figure 3.3.1 (b): Funnel plot for adjusted age at 60 and diabetes at 1 year, 2000-2008 cohort (HD centres)



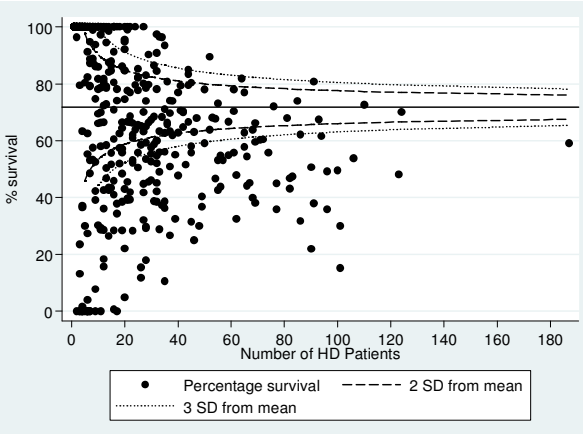
The 5 years median patient survival (adjusted for age and diabetes) among haemodialysis centres for the 2000-2004 cohort was 78.1% [Figure 3.3.1(c)].) with very marked centre variation. As were illustrated in the funnel plots [Figure 3.3.1(d)], only 48.3% of haemodialysis centres lie within 2 SD.

Figure 3.3.1 (c): Variation in % Survival at 5-years adjusted to age and diabetes, 2000-2004



*Horizontal line represents the median % survival among HD centres

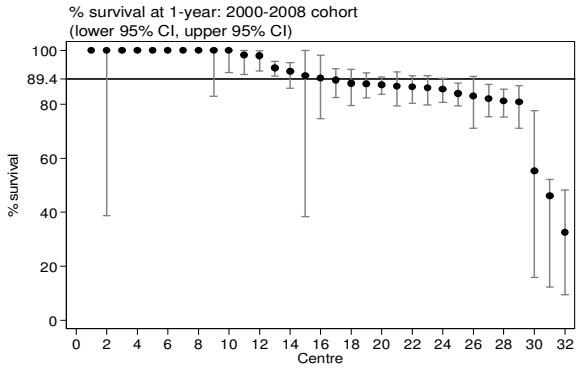
Figure 3.3.1 (d): Funnel plot for adjusted age at 60 and diabetes at 5 year, 2000-2004 cohort (HD centres)



3.3.2. Survival of incidence PD patients by centre

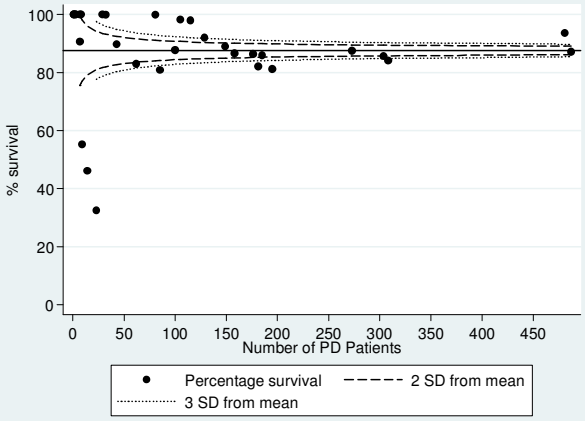
The median patient survival at 1 year (adjusted for age and diabetes) among peritoneal dialysis patients for the 2000-2008 cohort was 89.4% [Figure 3.3.2(a)]. There was centre variation and when the patient survival at 1 year in the individual peritoneal dialysis centres were illustrated in the funnel plots [Figure 3.3.1(b)], only 14 out of 32 (43.8%) peritoneal dialysis centres lie within the 2SD of the 1 year median survival.

Figure 3.3.2 (a): Variation in % Survival at 1-years adjusted to age and diabetes, 2000-2008



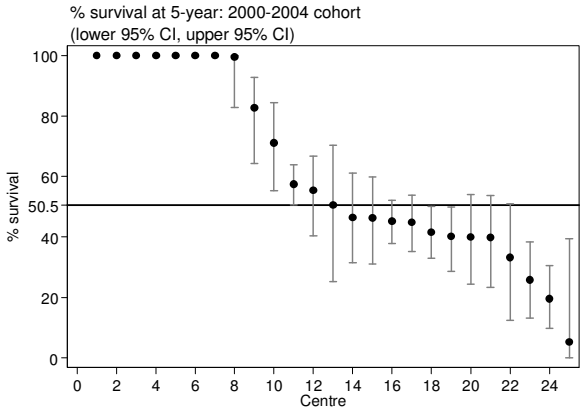
*Horizontal line represents the median % survival among PD centres

Figure 3.3.2 (b): Funnel plot for adjusted age at 60 and diabetes at 1 year after 90 days survival, 2000-2008 cohort (PD centres)



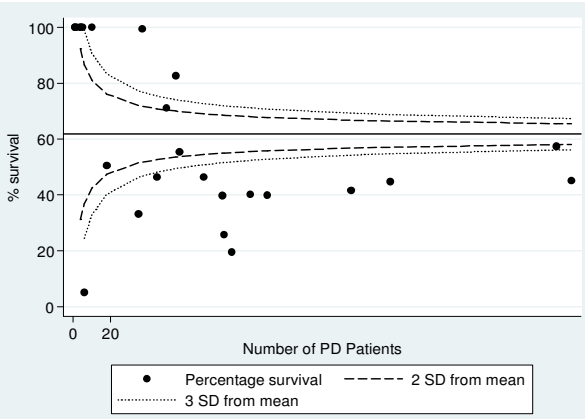
The 5 years median patient survival (adjusted for age and diabetes) among peritoneal centres for the 2000-2004 cohort was 50.5% [Figure 3.3.2(c)]. There was wide centre variation and when the 5 years patient survival in the individual peritoneal centres were illustrated in the funnel plot [Figure 3.3.2(d)], only 5 out of 25 (20%) peritoneal dialysis centres lies within the 2SD of the 5 year median survival.

Figure 3.3.2 (c): Variation in % Survival at 5-years adjusted to age and diabetes, 2000-2004



*Horizontal line represents the median % survival among HD centres

Figure 3.3.2 (d): Funnel plot for adjusted age at 60 and diabetes at 5 year after 90 days survival, 2000-2004 cohort (PD centres



SECTION 3.4: ADJUSTED MORTALITY OF DIALYSIS PATIENT

3.4.1. Adjusted hazard ratio for mortality of dialysis patients

Table 3.4.1 shows the adjusted hazard ratio for mortality of dialysis patients (2000-2009). 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, primary renal disease, 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 and phosphate.

There were positive correlation between age of patient, diastolic blood pressure [Figure 3.4.1(a)], serum calcium, and serum phosphate [Figure 3.4.1(b)] with mortality while negative correlation was noted between BMI, serum albumin, haemoglobin concentration [Figure 3.4.1(c)], and calcium phosphate product with mortality. Patients commencing dialysis in 2007-2009 had a 11% lower adjusted hazard ratio for mortality when compared to those started dialysis from 2000-2001. Patients with diabetic nephropathy as the primary aetiology of renal failure has the highest mortality when compared to other causes of end stage renal failure.

Table 3.4.1: Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality (2000-2009)

Factors	N	Hazard Ratio	95% CI	P-value
Age (years):				
Age 1-14 (ref*)	354	1.00		
Age 15-24	1,135	1.34	(0.99; 1.83)	0.059
Age 25-34	2,066	1.59	(1.18; 2.13)	0.002
Age 35-44	3,731	2.04	(1.53; 2.71)	<0.001
Age 45-54	7,725	2.92	(2.20; 3.87)	<0.001
Age 55-64	8,869	3.76	(2.84; 4.98)	<0.001
Age >=65	7,320	5.17	(3.90; 6.86)	<0.001
Gender:				
Male (ref*)	17,391	1.00		
Female	13,809	0.81	(0.78; 0.85)	<0.001
Primary diagnosis:				
Unknown primary	8,351	1.21	(1.08; 1.36)	0.001
Diabetes mellitus	16,874	1.84	(1.64; 2.06)	<0.001
GN/SLE (ref*)	1,710	1.00		
Polycystic kidney	358	1.13	(0.89; 1.43)	0.309
Obstructive nephropathy	817	1.32	(1.12; 1.56)	0.001
Others	3,090	1.24	(1.09; 1.40)	0.001
Year start dialysis:				
2000-2001 (ref*)	3,932	1.00		
2002-2003	4,959	1.02	(0.97; 1.08)	0.408
2004-2005	6,024	1.05	(0.99; 1.12)	0.090
2006-2007	7,671	1.05	(0.99; 1.12)	0.110
2008-2009	8,614	0.89	(0.82; 0.97)	0.007
Modality:				
HD (ref*)	27,437	1.00		
PD	3,763	1.11	(1.03; 1.19)	0.004
BMI:				
BMI<18.5	2,535	1.26	(1.16; 1.37)	<0.001
BMI 18.5-25	19,858	1.17	(1.12; 1.23)	<0.001
>=25 (ref*)	8,807	1.00		

Table 3.4.1: Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality (2000-2009) *(cont.)*

Factors	N	Hazard Ratio	95% CI	P-value
Serum albumin (g/L):				
<30	1,902	4.20	(3.84; 4.58)	<0.001
30-<35	4,127	2.41	(2.25; 2.58)	<0.001
35-<40	14,748	1.90	(1.80; 2.00)	<0.001
>=40 (ref*)	10,423	1.00		
Serum cholesterol (mmol/L):				
<3.2	1,320	1.18	(1.07; 1.31)	0.001
3.2-<5.2	22,684	1.16	(1.11; 1.22)	<0.001
>=5.2 (ref*)	7,196	1.00		
Diastolic BP (mmHg):				
<70	4,452	0.93	(0.87; 0.99)	0.028
70-<80	12,452	1.12	(1.07; 1.17)	<0.001
80-<90 (ref*)	10,664	1.00		
90-<100	2,952	1.13	(1.04; 1.22)	0.003
>=100	680	1.75	(1.52; 2.02)	<0.001
Hemoglobin:				
<8	2,567	3.42	(3.13; 3.73)	<0.001
8-<9	4,304	2.40	(2.22; 2.61)	<0.001
9-<10	10,045	2.26	(2.10; 2.43)	<0.001
10-<11	8,411	1.51	(1.40; 1.62)	<0.001
11-<12 (ref*)	4,071	1.00		
>=12	1,802	1.07	(0.96; 1.20)	0.223
Serum calcium (mmol/L):				
<2.2	11,472	0.91	(0.87; 0.95)	<0.001
2.2-<2.6 (ref*)	19,161	1.00		
>=2.6	567	1.74	(1.54; 1.97)	<0.001
Calcium Phosphate product ($mmol^2/L^2$):				
<3.5	11,064	0.97	(0.90; 1.04)	0.379
3.5-<4.5 (ref*)	13,650	1.00		
4.5-<5.5	4,578	0.71	(0.65; 0.77)	<0.001
>=5.5	1,908	0.70	(0.59; 0.82)	<0.001
Serum Phosphate (mmol/L):				
<1.6	11,660	0.90	(0.84; 0.97)	0.005
1.6-<2.0 (ref*)	12,956	1.00		
2.0-<2.2	2,838	0.95	(0.86; 1.04)	0.251
2.2-<2.4	1,696	1.07	(0.94; 1.21)	0.291
2.4-<2.6	971	1.28	(1.08; 1.50)	0.003
>=2.6	1,079	1.50	(1.24; 1.81)	<0.001
HBsAg:				
Negative (ref*)	30,051	1.00		
Positive	1,149	1.09	(0.99; 1.20)	0.085
Anti-HCV:				
Negative (ref*)	30,345	1.00		
Positive	855	0.98	(0.88; 1.09)	0.685
Cardiovascular disease (CVD):				
No CVD (ref*)	25,699	1.00		
CVD	5,501	1.31	(1.25; 1.36)	<0.001

Figure 3.4.1 (a): Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by diastolic blood pressure (2000-2009 cohort)

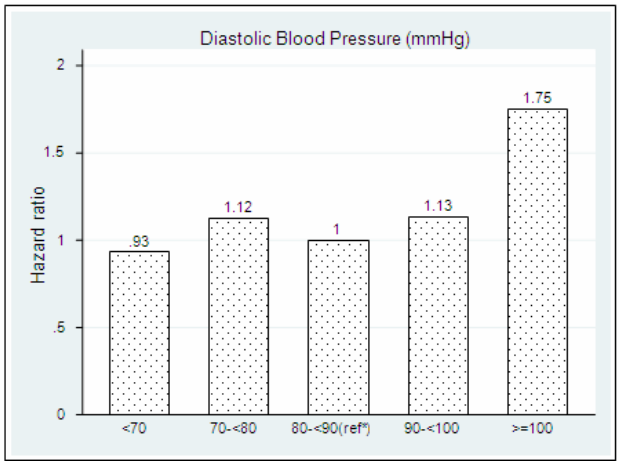


Figure 3.4.1 (b): Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by serum phosphate (2000-2009cohort)

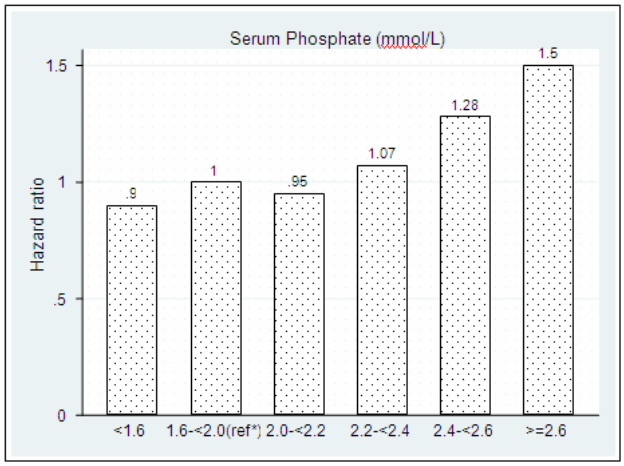
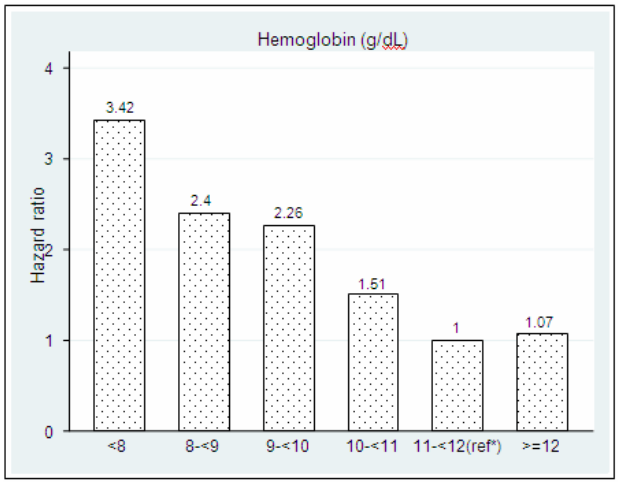


Figure 3.4.1 (c): Adjusted hazard ratio for mortality of dialysis patients uncensored for change of modality by hemoglobin (2000-2009cohort)



3.4.2. Adjusted hazard ratio for mortality of haemodialysis patients

The adjusted hazard ratio for mortality for hemodialysis patients [Table 3.4.2] demonstrated identical pattern with the whole cohort of 2000-2009 dialysis patients. The amount of dialysis treatment (Kt/V) [Figure 3.4.2] has a negative correlation with mortality with hemodialysis patients with Kt/V of > 1.6 having the lowest adjusted hazard ratio for mortality.

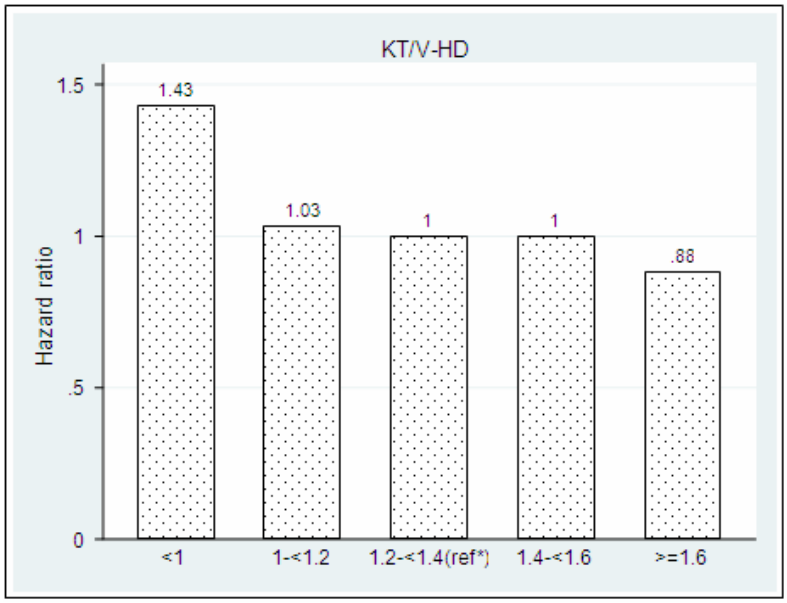
Table 3.4.2: Adjusted hazard ratio for mortality of HD patients uncensored for change of modality (2000-2009 cohort)

Factors	N	Hazard Ratio	95% CI	P-value
Age (years):				
Age 1-14 (ref*)	64	1.00		
Age 15-24	790	0.95	(0.46; 1.95)	0.881
Age 25-34	1,760	1.01	(0.50; 2.05)	0.975
Age 35-44	3,271	1.29	(0.64; 2.61)	0.473
Age 45-54	6,897	1.83	(0.91; 3.69)	0.089
Age 55-64	7,981	2.36	(1.17; 4.75)	0.016
Age >=65	6,674	3.24	(1.61; 6.53)	0.001
Gender:				
Male (ref*)	15,492	1.00		
Female	11,945	0.83	(0.80; 0.87)	<0.001
Primary diagnosis:				
Unknown primary (ref*)	7,506	1.00		
Diabetes mellitus	15,079	1.46	(1.39; 1.54)	<0.001
GN/SLE	1,238	0.78	(0.68; 0.89)	<0.001
Polycystic kidney	321	0.96	(0.77; 1.20)	0.752
Obstructive nephropathy	661	1.05	(0.91; 1.21)	0.483
Others	2,632	1.03	(0.94; 1.12)	0.547
Year start dialysis:				
2000-2001 (ref*)	3,440	1.00		
2002-2003	4,280	1.02	(0.96; 1.08)	0.544
2004-2005	5,418	1.08	(1.01; 1.15)	0.023
2006-2007	6,756	1.06	(0.99; 1.13)	0.111
2008-2009	7,543	0.86	(0.78; 0.94)	0.001
BMI:				
BMI<18.5	1,980	1.39	(1.26; 1.53)	<0.001
BMI 18.5-25	17,932	1.25	(1.18; 1.32)	<0.001
>=25 (ref*)	7,525	1.00		
Serum albumin (g/L):				
<30	884	4.65	(4.19; 5.16)	<0.001
30-<35	2,685	2.41	(2.24; 2.60)	<0.001
35-<40	13,769	1.92	(1.82; 2.02)	<0.001
>=40 (ref*)	10,099	1.00		
Serum cholesterol (mmol/L):				
<3.2	1,254	1.21	(1.09; 1.34)	0.001
3.2-<5.2	20,886	1.21	(1.14; 1.28)	<0.001
>=5.2 (ref*)	5,297	1.00		
Kt/V:				
<1	709	1.43	(1.25; 1.63)	<0.001
1-<1.2	2,446	1.03	(0.95; 1.12)	0.419
1.2-<1.4 (ref*)	5,906	1.00		
1.4-<1.6	7,212	1.00	(0.94; 1.06)	0.913
>=1.6	11,164	0.88	(0.83; 0.94)	<0.001
Diastolic BP (mmHg):				
<70	3,987	0.89	(0.83; 0.96)	0.001
70-<80	11,162	1.12	(1.07; 1.18)	<0.001
80-<90 (ref*)	9,166	1.00		
90-<100	2,507	1.12	(1.03; 1.22)	0.009
>=100	615	1.80	(1.55; 2.09)	<0.001

Table 3.4.2: Adjusted hazard ratio for mortality of HD patients uncensored for change of modality (2000-2009 cohort) *(cont.)*

Factors	N	Hazard Ratio	95% CI	P-value
Hemoglobin:				
<8	2,370	3.76	(3.41; 4.14)	<0.001
8-<9	3,868	2.62	(2.39; 2.87)	<0.001
9-<10	9,175	2.50	(2.30; 2.71)	<0.001
10-<11	7,217	1.59	(1.46; 1.73)	<0.001
11-<12 (ref*)	3,364	1.00		
>=12	1,443	1.08	(0.94; 1.24)	0.258
Serum calcium (mmol/L):				
<2.2	10,030	0.92	(0.87; 0.96)	<0.001
2.2-<2.6 (ref*)	16,941	1.00		
>=2.6	466	1.80	(1.56; 2.06)	<0.001
Calcium Phosphate product ($mmol^2/L^2$):				
<3.5	8,935	0.93	(0.86; 1.00)	0.053
3.5-<4.5 (ref*)	12,552	1.00		
4.5-<5.5	4,183	0.70	(0.64; 0.77)	<0.001
>=5.5	1,767	0.68	(0.57; 0.81)	<0.001
Serum Phosphate (mmol/L):				
<1.6	9,414	0.89	(0.83; 0.97)	0.004
1.6-<2.0 (ref*)	11,950	1.00		
2.0-<2.2	2,611	0.89	(0.81; 0.98)	0.016
2.2-<2.4	1,573	1.05	(0.92; 1.19)	0.479
2.4-<2.6	876	1.21	(1.01; 1.44)	0.033
>=2.6	1,013	1.43	(1.17; 1.74)	<0.001
HBsAg:				
Negative (ref*)	26,427	1.00		
Positive	1,010	1.11	(1.00; 1.23)	0.054
Anti-HCV:				
Negative (ref*)	26,651	1.00		
Positive	786	0.98	(0.88; 1.09)	0.694
Cardiovascular disease (CVD):				
No CVD (ref*)	22,779	1.00		
CVD	4,658	1.27	(1.21; 1.33)	<0.001

Figure 3.4.2: Adjusted hazard ratio for mortality of HD patients uncensored for change of modality by Kt/V (2000-2009 cohort)



3.4.3. Adjusted hazard ratio for mortality of peritoneal dialysis patients

The adjusted hazard ratio for peritoneal dialysis patients [Table 3.4.3] showed similar picture with the whole cohort of 2000-2008 dialysis patients. However significant correlation between mortality and year commencing peritoneal dialysis and serum cholesterol were not demonstrated in peritoneal dialysis patients. This difference could be partly contributed by the smaller number of peritoneal dialysis patients in this cohort. The unadjusted hazard ratio for mortality in peritoneal dialysis patients for Kt/V less than or equal to 1.7 was 2.79 when compared to Kt/V of more than 1.7 [Figure 3.4.3(a)]. However the impact of low Kt/V on mortality disappeared when adjusted for the various confounding variables [Table 3.4.3 & Figure 3.4.3 (b)].

Table 3.4.3: Adjusted hazard ratio for mortality of PD patients uncensored for change of modality (2000-2009 cohort)

Factors	N	Hazard Ratio	95% CI	P-value
Age (years):				
Age 1-14 (ref*)	290	1.00		
Age 15-24	345	1.48	(1.01; 2.18)	0.046
Age 25-34	306	1.87	(1.23; 2.83)	0.003
Age 35-44	460	2.26	(1.51; 3.39)	<0.001
Age 45-54	828	3.75	(2.55; 5.51)	<0.001
Age 55-64	888	4.43	(3.02; 6.52)	<0.001
Age >=65	646	6.73	(4.53; 10.00)	<0.001
Gender:				
Male (ref*)	1,899	1.00		
Female	1,864	0.91	(0.80; 1.03)	0.144
Primary diagnosis:				
Unknown primary (ref*)	845	1.00		
Diabetes mellitus	1,795	2.05	(1.66; 2.53)	<0.001
GN/SLE	472	1.05	(0.82; 1.34)	0.722
Polycystic kidney	37	0.69	(0.34; 1.40)	0.301
Obstructive nephropathy	156	1.49	(1.08; 2.06)	0.016
Others	458	1.11	(0.89; 1.39)	0.369
Year start dialysis:				
2000-2001 (ref*)	492	1.00		
2002-2003	679	1.08	(0.93; 1.27)	0.311
2004-2005	606	0.89	(0.74; 1.06)	0.200
2006-2007	915	0.94	(0.79; 1.13)	0.520
2008-2009	1,071	1.00	(0.80; 1.25)	0.993
BMI:				
BMI<18.5	555	1.54	(1.24; 1.91)	<0.001
BMI 18.5-25	1,926	1.19	(1.06; 1.35)	0.004
>=25 (ref*)	1,282	1.00		
Serum albumin (g/L):				
<30	1,018	1.84	(1.38; 2.45)	<0.001
30-<35	1,442	1.24	(0.94; 1.64)	0.129
35-<40	979	0.93	(0.70; 1.25)	0.643
>=40 (ref*)	324	1.00		
Serum cholesterol (mmol/L):				
<3.2	66	1.41	(0.97; 2.03)	0.069
3.2-<5.2	1,798	0.98	0.87; 1.09)	0.671
>=5.2 (ref*)	1,899	1.00		
Kt/V:				
<=1.7	2,513	0.91	(0.72; 1.16)	0.450
>1.7 (ref*)	1,250	1.00		
Diastolic BP (mmHg):				
<70	465	1.29	(1.08; 1.54)	0.005
70-<80	1,290	1.06	(0.93; 1.21)	0.399
80-<90 (ref*)	1,498	1.00		
90-<100	445	1.23	(1.01; 1.50)	0.037
>=100	65	1.23	(0.78; 1.94)	0.369

Table 3.4.3: Adjusted hazard ratio for mortality of PD patients uncensored for change of modality (2000-2009 cohort) *(cont.)*

Factors	N	Hazard Ratio	95% CI	P-value
Hemoglobin:				
<8	197	2.02	(1.54; 2.65)	<0.001
8-<9	436	1.72	(1.40; 2.12)	<0.001
9-<10	870	1.46	(1.23; 1.73)	<0.001
10-<11	1,194	1.18	(1.01; 1.39)	0.039
11-<12 (ref*)	707	1.00		
>=12	359	1.00	(0.80; 1.26)	0.981
Serum calcium (mmol/L):				
<2.2	1,442	0.90	(0.79; 1.02)	0.113
2.2-<2.6 (ref*)	2,220	1.00		
>=2.6	101	1.56	(1.16; 2.10)	0.003
Calcium Phosphate product ($mmol^2/L^2$):				
<3.5	2,129	1.20	(0.98; 1.46)	0.081
3.5-<4.5 (ref*)	1,098	1.00		
4.5-<5.5	395	0.84	(0.64; 1.11)	0.229
>=5.5	141	0.82	(0.49; 1.39)	0.471
Serum Phosphate (mmol/L):				
<1.6	2,246	1.17	(0.95; 1.44)	0.147
1.6-<2.0 (ref*)	1,006	1.00		
2.0-<2.2	227	1.73	(1.29; 2.32)	<0.001
2.2-<2.4	123	1.15	(0.75; 1.78)	0.524
2.4-<2.6	95	1.99	(1.21; 3.27)	0.007
>=2.6	66	1.95	(1.02; 3.73)	0.043
HBsAg:				
Negative (ref*)	3,624	1.00		
Positive	139	0.96	(0.73; 1.27)	0.780
Anti-HCV:				
Negative (ref*)	3,694	1.00		
Positive	69	1.06	(0.72; 1.55)	0.781
Cardiovascular disease (CVD):				
No CVD (ref*)	2,920	1.00		
CVD	843	1.44	(1.27; 1.63)	<0.001

Figure 3.4.3(a): Unadjusted hazard ratio for mortality of PD patients uncensored for change of modality Kt/V (2000-2009)

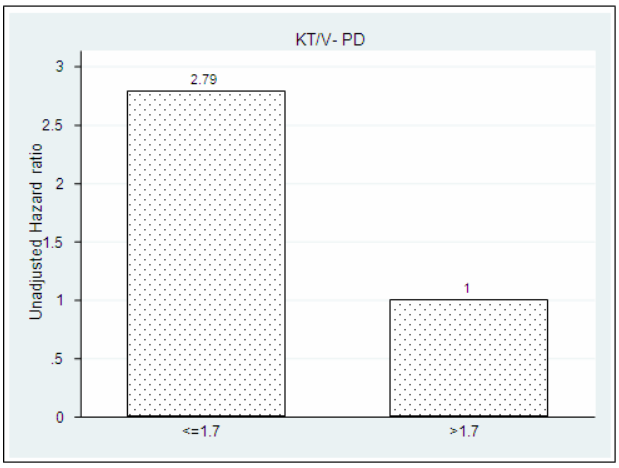
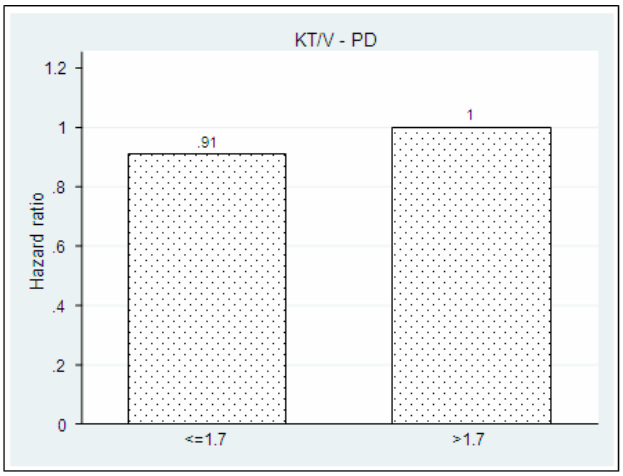


Figure 3.4.3(b): Adjusted hazard ratio for mortality of PD patients uncensored for change of modality by Kt/V (2000-2009 cohort)



SECTION 3.5: RISK ADJUSTED MORTALITY RATE

3.5.1 Risk adjusted mortality rate for haemodialysis patients

The risk adjusted mortality rate (RAMR) for haemodialysis patients was 19.08 with a marked centre variations in RAMR (ranged from 1.13 to 60.69) [Figure 3.5.1(a)]. Despite taking into account the size of the haemodialysis centres, the variation of the RAMR rate among the various haemodialysis centres in this country persisted as demonstrated in the funnel plot [Figure 3.5.1(b)].

Figure 3.5.1(a): Variations in RAMR by HD centre, 2008

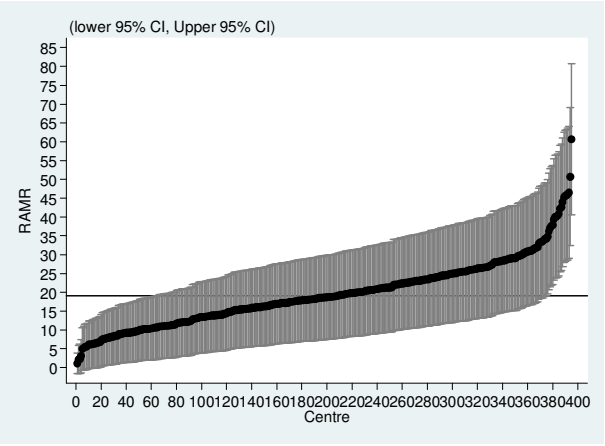
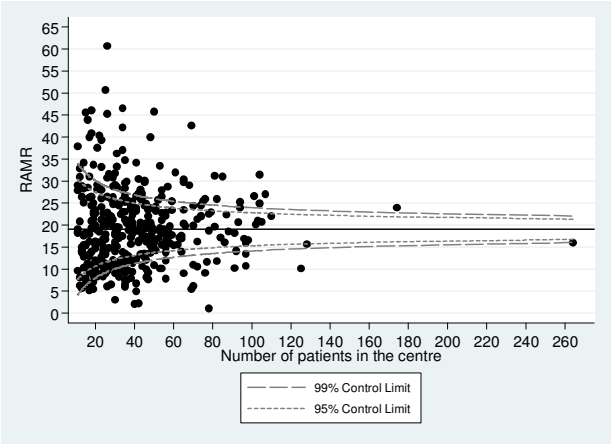


Figure 3.5.1(b): Funnel plot for expected number of death by number of patients in HD centre, 2008



3.5.2 Risk adjusted mortality rate for peritoneal dialysis patients

The risk adjusted mortality rate (RAMR) for peritoneal dialysis patients was similar to those seen in the haemodialysis population. The RAMR was 22.1 (ranged from 8.08 to 41.38) with a similar wide centre

Figure 3.5.2(a): Variations in RAMR by PD centre, 2008

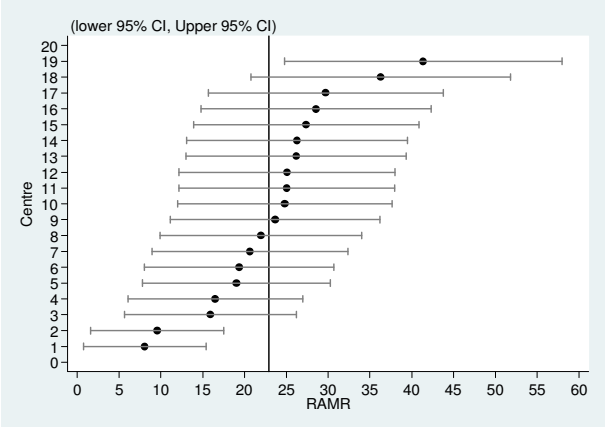
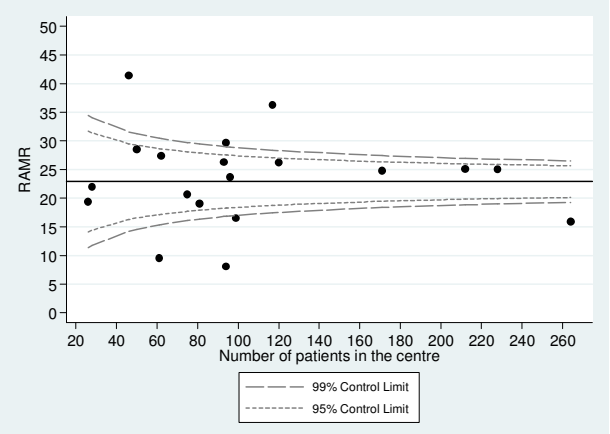


Figure 3.5.2(b): Funnel plot for expected number of death by number of patients in PD centre, 2008



CHAPTER 4

Quality of Life and Rehabilitation Outcomes of Patients on Dialysis

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

SECTION A : QUALITY OF LIFE (QoL) INDEX SCORE

24499 patients who entered dialysis between 2000-2009 were analysed. 20680 HD patients and 3819 PD patients both reported median QoL index score of 9 (Table 4.1, Figure 4.1) Diabetics have a lower median QoL index score (8 versus 10) than non-diabetics (Table 4.2, Figure 4.2) whilst there was no difference seen between gender (Table 4.3, Figure 4.3). There is a trend of lower median QoL index score being associated with older dialysis patients (Table 4.4, Figure 4.4). There are no obvious trends in QoL index seen either in the HD or PD cohort over the last 10 years. (Table 4.5, Table 4.6, Figure 4.5 and Figure 4.6)

Table 4.1: Cumulative distribution of QoL-Index score in relation to dialysis modality, All dialysis patients 2000-2009

Dialysis modality	PD	HD
Number of patients	3819	20680
Centile		
0	0	0
0.05	5	4
0.1	6	5
0.25 (LQ)	8	7
0.5 (median)	9	9
0.75 (UQ)	10	10
0.9	10	10
0.95	10	10
1	10	10

Figure 4.1: Cumulative distribution of QoL-Index score in relation to Dialysis Modality, All Dialysis patients 2000-2009

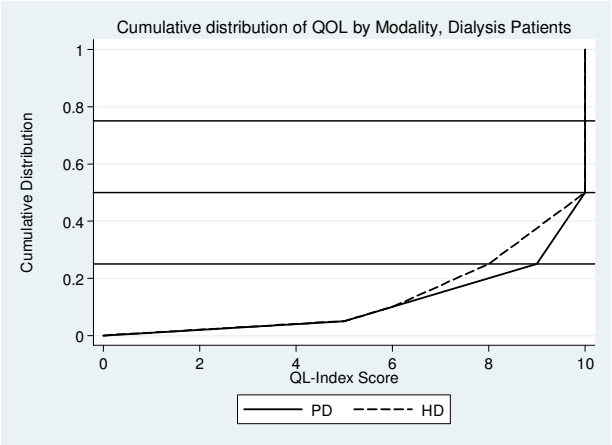


Table 4.2: Cumulative distribution of QoL-Index score in relation to DM, All dialysis patients 2000-2009

Diabetes mellitus	No	Yes
Number of patients	11512	12987
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 4.2: Cumulative distribution of QoL-Index score in relation to DM, All Dialysis patients, 2000-2009

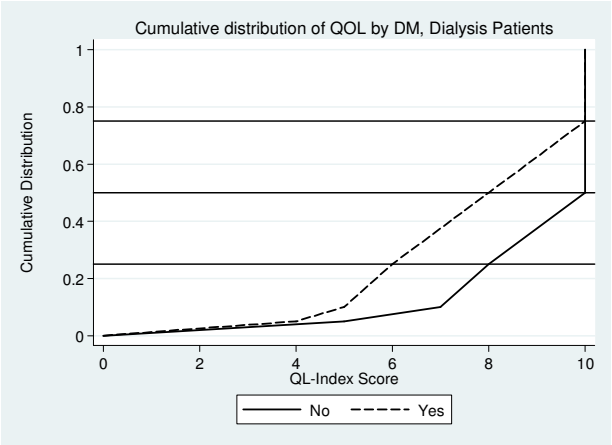


Table 4.3: Cumulative distribution of QoL-index score in relation to Gender, All Dialysis patients 2000-2009

Gender	Male	Female
Number of patients	13512	10987
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 4.3: Cumulative distribution of QoL-Index score in relation to Gender, All Dialysis patients, 2000-2009

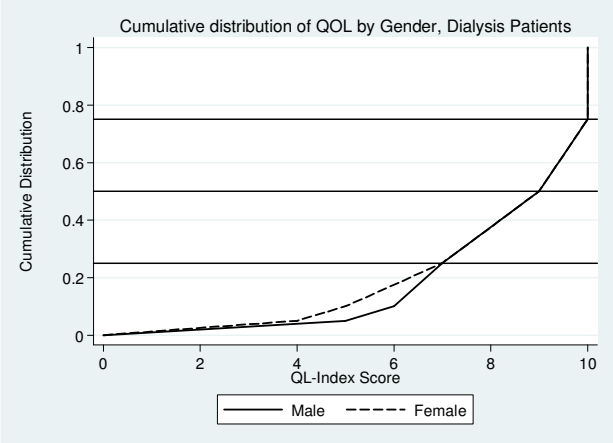


Table 4.4: Cumulative distribution of QoL-index score in relation to Age, All Dialysis patients 2000-2009

Age group (years)	<20	20-39	40-59	>=60
Number of patients	854	3824	11675	8146
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 4.4: Cumulative distribution of QoL-Index score in relation to Age, All Dialysis patients, 2000-2009

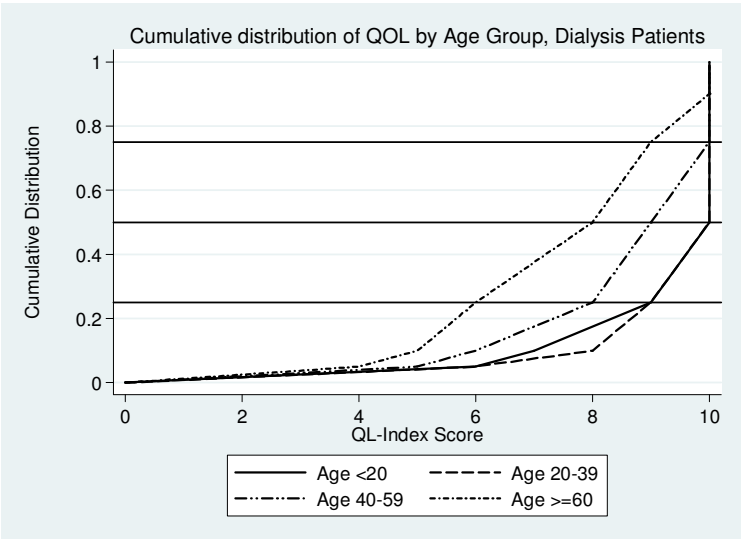


Table 4.5: Cumulative distribution of QoL-Index score in relation to year of entry, HD patients 2000-2009

Year of Entry	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number of patients	1278	1442	1657	1715	2063	2171	2541	2648	2895	2270
Centile										
0	0	0	0	0	0	0	0	0	0	0
0.05	5	5	4	5	4	4	4	4	5	4
0.1	6	5	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 4.5: Cumulative distribution of QoL-Index score in relation to year of entry, HD patients 2000-2009

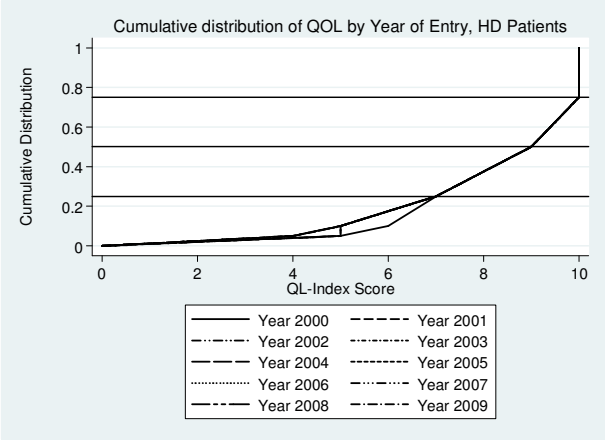


Figure 4.6: Cumulative distribution of QoL-Index score

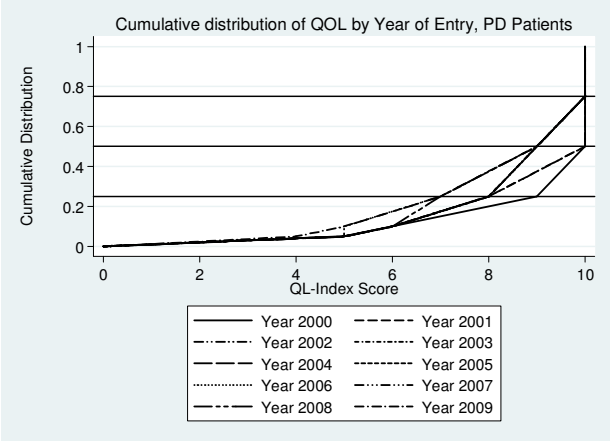


Table 4.6: Cumulative distribution of QoL-Index score in relation to year of entry, PD patients 2000-2009

Year of Entry	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number of patients	188	269	320	369	307	319	425	526	571	525
Centile										
0	0	0	0	0	0	0	0	0	0	0
0.05	5	5	5	5	5	5	5	5	5	4
0.1	6	6	6	6	6	6	6	5	6	5
0.25 (LQ)	9	8	8	8	8	8	8	7	7	7
0.5 (median)	10	10	10	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

SECTION B: WORK RELATED REHABILITATION

Analysis was done on HD patients (n=7993) and PD patients (n=1250) who entered dialysis between 2000-2009 (Table 4.7). Only patients who were working for pay and those who were unable to work for pay due to health reasons are included. The proportion of patients on employment are similar in both modalities (HD = 70% vs PD 70%)

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

Table 4.7: Work related rehabilitation in relation to modality, dialysis patients, 2000 to 2009

Modality	PD		HD	
	No.	%	No.	%
Number of patients	1250		7993	
Able to return for Full or Part time for pay*	879	70	5561	70
Unable to work for pay	371	30	2432	30

Table 4.8: Work related rehabilitation in relation to year of entry, HD patients 2000 to 2009

Year		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number of patients		598	616	703	717	833	827	966	958	1049	726
Able to return for Full or Part time for pay*	No.	462	448	523	529	587	584	678	654	673	423
	%	77	73	74	74	70	71	70	68	64	58
Unable to work for pay	No.	136	168	180	188	246	243	288	304	376	303
	%	23	27	26	26	30	29	30	32	36	42

Table 4.9: Work related rehabilitation in relation to year of entry, PD patients 2000 to 2009

Year		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number of patients		64	85	120	142	103	112	147	165	176	136
Able to return for Full or Part time for pay*	No.	43	69	90	110	73	83	105	109	113	84
	%	67	81	75	77	71	74	71	66	64	62
Unable to work for pay	No.	21	16	30	32	30	29	42	56	63	52
	%	33	19	25	23	29	26	29	34	36	38

Summary :

Median QoL index scores were satisfactory in both HD and PD patients (score of 9). Diabetes mellitus and older age group were factors associated with lower median QoL index scores. Higher employment rate amongst HD and PD patients who started dialysis earlier may be confounded by these healthier individuals who survived longer.

CHAPTER 5

Paediatric Renal Replacement Therapy

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

SECTION A: RRT PROVISION FOR PAEDIATRIC PATIENTS

This chapter presents data on paediatric patients less than 20 years of age receiving renal replacement therapy (RRT) from 2000 to 2009. The dialysis acceptance rate for the paediatric population in 2009 was 7 per million age-related population (pmarp). The number of new transplants had shown some encouraging increase over the last 5 years with about 20 new transplants yearly. The overall incidence rate for all RRT was 8 pmarp in 2009 and it had remained fairly stable over the last 8 years.

As expected, with increasing number of children on dialysis and improve survival; the number of prevalent patients continue to rise. At the end of 2009, 796 paediatric patients were receiving RRT in Malaysia. Of these, 605 children were on dialysis. The equivalent dialysis prevalence rate more than doubled over the last 10 years from 23 pmarp in 2000 to 52 pmarp in 2008. The prevalent HD population continued to expand at a higher rate than the PD population although the dialysis acceptance rate for new PD patients was higher, consistent with higher technique failure among PD patients.

Table 5.1: Stock and Flow of Paediatric Renal Replacement Therapy 2000-2009

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
New HD patients	12	24	29	32	39	34	51	35	43	30
New PD patients	37	40	54	38	41	47	44	50	50	66
New Transplants	17	11	12	11	11	18	23	20	21	17
HD deaths	4	1	11	6	10	9	7	11	11	10
PD deaths	3	8	8	9	5	9	16	8	9	11
Transplant deaths	1	0	1	2	0	1	1	3	4	0
On HD at 31st December	119	143	160	183	216	241	286	313	350	369
On PD at 31st December	109	123	152	163	176	192	189	202	208	236
Functioning transplant at 31st December	92	100	110	115	124	138	156	167	174	191

Figure 5.1 (a): Incidence cases of RRT by modality in children under 20 years old, 2000-2009

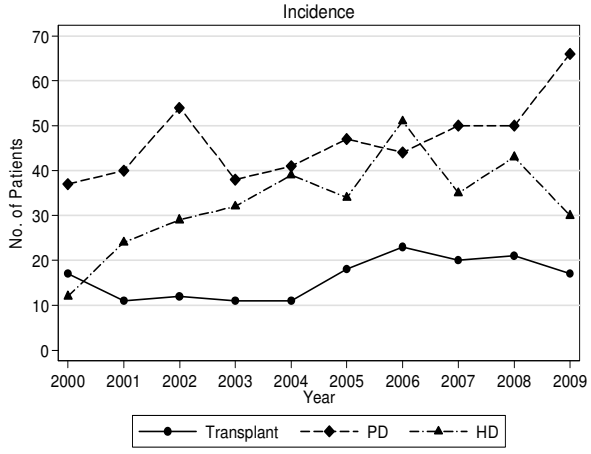


Figure 5.1 (b): Prevalence cases of RRT by modality in children under 20 years old, 2000-2009

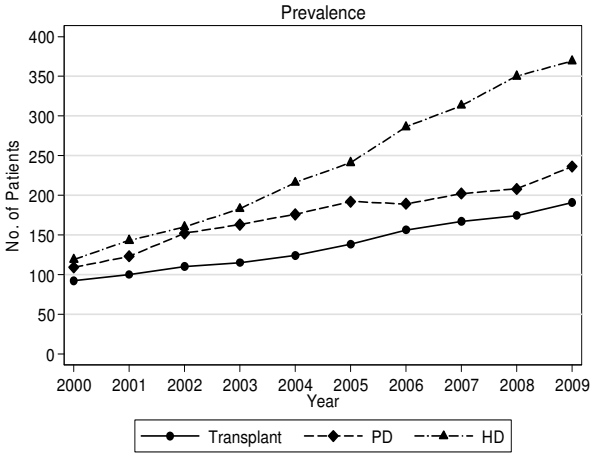
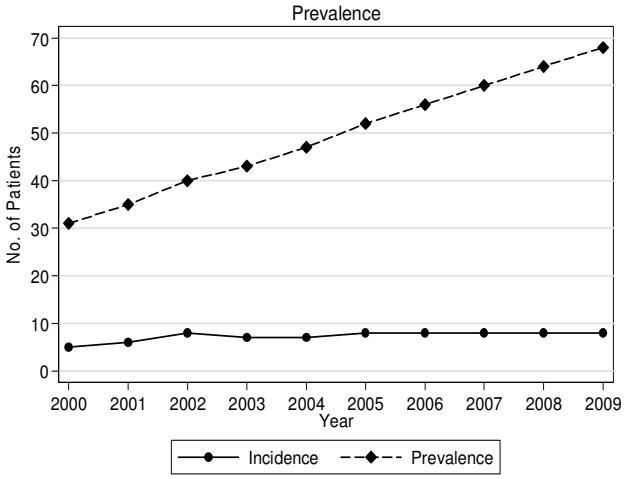


Table 5.2: Paediatric Dialysis and Transplant Rates per million age-group population 2000-2009

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Incidence Rate										
New HD	1	2	3	3	4	3	5	3	4	3
New PD	4	4	5	4	4	4	4	4	4	6
New Transplant	2	1	1	1	1	2	2	2	2	1
All RRT	5	6	8	7	7	8	8	8	8	8
Prevalence Rate at 31st December										
On HD	12	14	15	17	20	22	26	28	30	32
On PD	11	12	14	15	16	17	17	18	18	20
Functioning Graft	9	10	10	11	11	12	14	15	15	16
All RRT	31	34	39	42	47	51	55	59	63	67

Figure 5.2: Incidence and prevalence rate per million age related population years old on RRT, 2000-2009



SECTION B: DISTRIBUTION OF PAEDIATRIC DIALYSIS PATIENTS

The treatment gap between the more economically developed states of West Malaysia and East Malaysia remained. However this gap is becoming less obvious over the years with the set up of new paediatric nephrology centres in these regions particularly in East Malaysia where the number of new dialysis patients had doubled over the last 5 years.

Table 5.3 (a): Dialysis Treatment Rate by State, per million state age group populations; 2000-2009

State	2000-2004	2005-2009
Pulau Pinang	10	17
Melaka	12	12
Johor	11	11
Perak	7	10
Selangor & Putrajaya	7	9
Kuala Lumpur	13	13
Negeri Sembilan	9	13
Kedah	9	6
Perlis	16	10
Terengganu	9	11
Pahang	7	11
Kelantan	8	7
Sarawak	5	8
Sabah & WP Labuan	4	7

Table 5.3 (b): New Dialysis Patients by State, 2000-2009

State	2000-2004	2005-2009
Pulau Pinang	26	45
Melaka	18	18
Johor	67	70
Perak	31	46
Selangor & Putrajaya	62	90
Kuala Lumpur	35	39
Negeri Sembilan	18	25
Kedah	34	27
Perlis	8	5
Terengganu	22	28
Pahang	21	33
Kelantan	29	29
Sarawak	23	43
Sabah & WP Labuan	24	49

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

Table 5.4: Number of New Dialysis and Transplant Patients by Gender 2000-2009

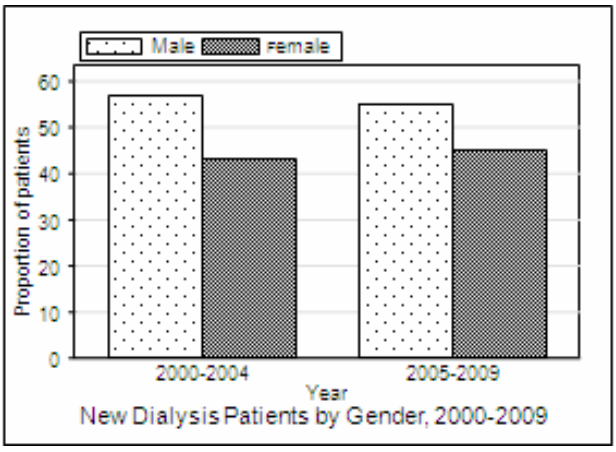
a) New Dialysis

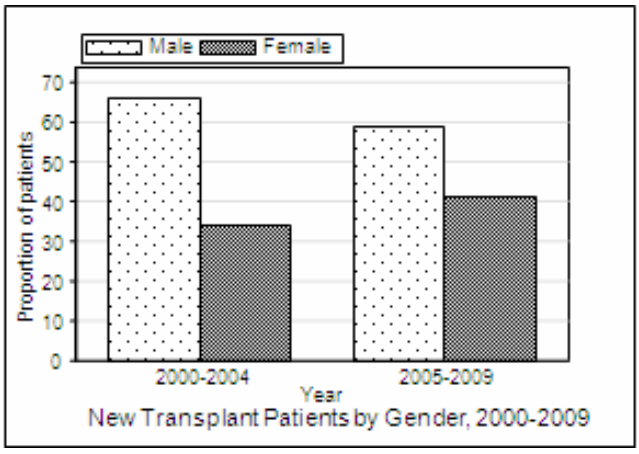
Year	Male		Female	
	No.	%	No.	%
2000-2004	197	57	149	43
2005-2009	248	55	202	45

b) New Transplant

Year	Male		Female	
	No.	%	No.	%
2000-2004	41	66	21	34
2005-2009	58	59	41	41

Figure 5.4: Number of New Dialysis and Transplant Patients by gender 2000-2009



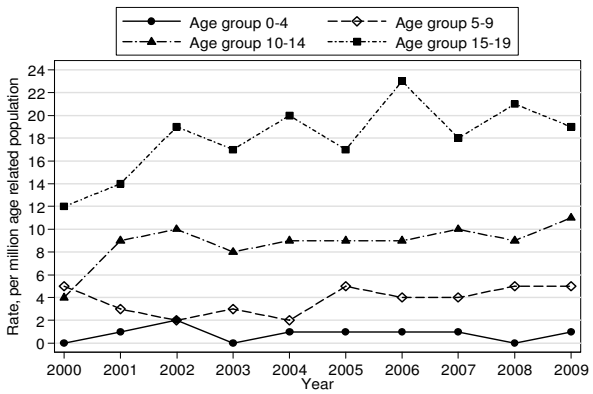


The dialysis treatment rate had leveled off over the last 7 years across the paediatric age spectrum. The treatment rate had remained consistently higher among the older age groups. The number of 0-4 year olds provided chronic dialysis treatment remained very low.

Table 5.5: New RRT Rate, Per Million Age Related Population by Age Group 2000-2009

Year	New RRT rate, pmp Age group (years)			
	0-4	5-9	10-14	15-19
2000	0	5	4	12
2001	1	3	9	14
2002	2	2	10	19
2003	0	3	8	17
2004	1	2	9	20
2005	1	5	9	17
2006	1	4	9	23
2007	1	4	10	18
2008	0	5	9	21
2009	1	5	11	19

Figure 5.5: New RRT Rate by Age group 2000-2009

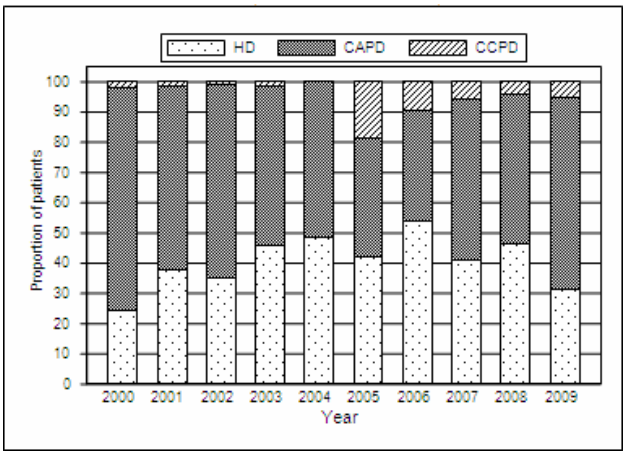


PD was the first modality of dialysis in more than two thirds (69%) of patients. A significant proportion of children were started on automated PD (CCPD) as the first mode of dialysis in 2005 when CCPD was first made widely available to the paediatric population.
However since 2009 the policy had changed back to CAPD first and the numbers on CCPD are expected to show a decreasing trend.

Table 5.6: New Dialysis by treatment modality 2000-2009

Year	HD		CAPD		CCPD	
	No.	%	No.	%	No.	%
2000	12	24	36	73	1	2
2001	24	38	39	61	1	2
2002	29	35	53	64	1	1
2003	32	46	37	53	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	41	45	53	5	6
2008	43	46	46	49	4	4
2009	30	31	61	64	5	5

Figure 5.6: New Dialysis by treatment modality 2000-2009

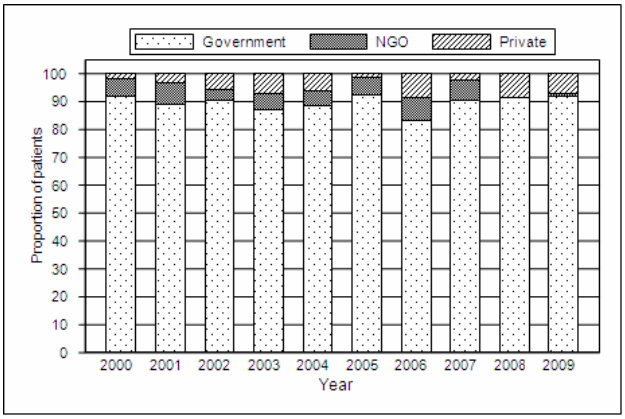


Most of the children (up to 90%) received their dialysis treatment from government centres and hence were government funded. This figure had not changed over the last 10 years.

Table 5.7: New Dialysis by sector 2000-2009

Year	Government		NGO		Private	
	No.	%	No.	%	No.	%
2000	45	92	3	6	1	2
2001	57	89	5	8	2	3
2002	75	90	3	4	5	6
2003	61	87	4	6	5	7
2004	71	89	4	5	5	6
2005	75	93	5	6	1	1
2006	79	83	8	8	8	8
2007	77	91	6	7	2	2
2008	85	91	0	0	8	9
2009	88	92	1	1	7	7

Figure 5.7: New Dialysis by sector 2000-2009



SECTION C: PRIMARY RENAL DISEASE

The most common primary renal disease identified was glomerulonephritis, which accounted for about 22% of the patients. FSGS on its own accounted for almost 8% of the ESRD population. The number of children presenting with ESRD of unknown aetiology was still high at 35%.

Table 5.8: Primary renal disease by sex, 2000-2009

Primary Renal Disease	Male		Female		All	
	No.	%	No.	%	No.	%
Glomerulonephritis	107	24	75	21	182	22
FSGS	31	7	32	9	63	8
Refux nephropathy	25	6	8	2	33	4
SLE	9	2	44	12	53	7
Obstructive uropathy	42	9	19	5	61	8
Renal dysplasia	14	3	10	3	24	3
Hereditary nephritis	11	2	3	1	14	2
Cystic kidney disease	3	1	5	1	8	1
Metabolic	5	1	3	1	8	1
Others	36	8	42	12	78	10
Unknown	170	38	115	32	285	35

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 particularly over the last 5 years in that cadaveric renal transplant is now the most common transplantation done accounting for about 48% compared to 35% for living related renal transplant. About 17% of renal transplant were done overseas mainly from commercial cadaveric programme.

Table 5.9: Types of Renal Transplantation, 2000-2009

Year	2000-2004		2005-2009	
	No.	%	No.	%
Commercial cadaver	16	26	15	15
Commercial living donor	3	5	2	2
Living related donor	19	31	34	35
Cadaver	23	38	47	48
Living emotionally related	0	0	0	0
TOTAL	61	100	98	100

SECTION E: SURVIVAL ANALYSIS

Renal transplantation had the best patient survival with 93% survival at 5 years and 91% at 9 years. HD patients showed a slightly better survival over PD patients with 85% and 80% survival respectively at 5 years. When censored for change of dialysis modality; the survival rate was still better among HD patients (Figure 5.10b)

Table 5.10 (a): Patient survival by dialysis modality analysis (not censored with change of modality)

Modality	Transplant			PD			HD		
Interval (months)	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	232	100	-	609	100	-	460	100	-
6	221	99	1	554	97	1	427	96	1
12	210	98	1	507	94	1	403	95	1
24	188	96	1	426	88	1	348	91	1
36	166	95	2	366	85	2	303	88	2
48	145	95	2	319	82	2	255	86	2
60	126	93	2	276	80	2	225	85	2
72	117	92	2	234	77	2	189	84	2
84	109	92	2	201	74	2	162	82	2
96	100	92	2	156	72	2	139	81	2
108	93	91	2	123	69	3	119	79	2
120	78	88	3	93	66	3	110	79	2

Figure 5.10 (a): Patient survival by dialysis modality analysis (not censored with change of modality)

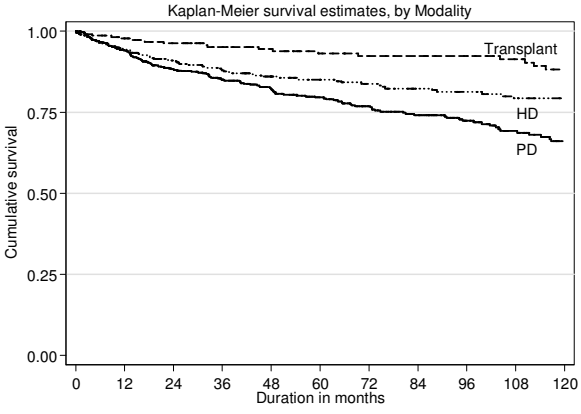


Figure 5.10 (b): Patient survival by dialysis modality analysis (censored with change of modality)

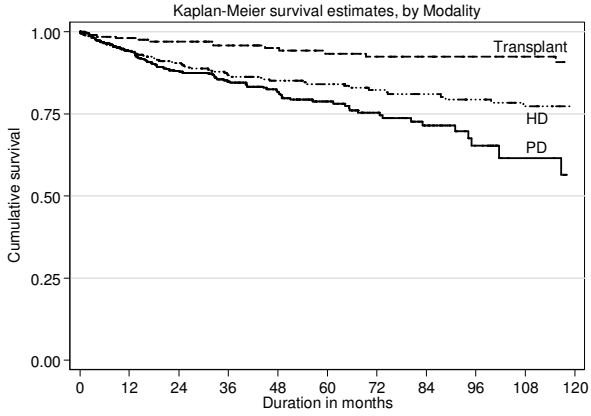


Table 5.10 (b): Patient survival by dialysis modality analysis (censored with change of modality)

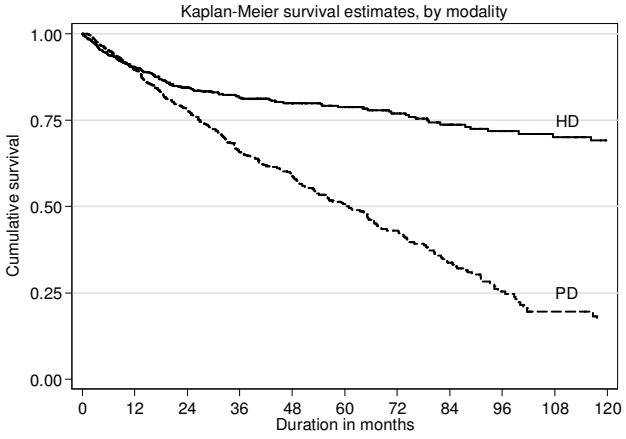
Modality	Transplant			PD			HD		
Interval (months)	No.	% survival	SE	No.	% survival	SE	No.	% survival	SE
0	232	100	-	609	100	-	460	100	-
6	205	99	1	541	97	1	408	96	1
12	195	98	1	465	94	1	361	94	1
24	171	97	1	335	88	1	289	91	1
36	149	96	1	239	85	2	238	87	2
48	123	95	2	184	82	2	191	85	2
60	106	93	2	132	79	2	160	84	2
72	95	92	2	97	75	3	129	82	2
84	82	92	2	58	72	3	106	81	2
96	71	92	2	30	65	4	89	79	3
108	65	92	2	14	62	6	74	77	3
120	55	91	3	9	56	7	63	77	3

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 79% for HD.

Table 5.11: Dialysis Technique Survival by Modality, 2000-2009

Modality	PD			HD		
Interval (months)	No.	% survival	SE	No.	% survival	SE
0	652	100	-	609	100	-
6	580	95	1	537	94	1
12	500	90	1	474	90	1
24	359	78	2	368	85	2
36	256	66	2	300	81	2
48	197	59	2	237	80	2
60	141	51	3	198	79	2
72	105	43	3	156	77	2
84	65	34	3	128	74	2
96	35	25	3	102	72	3
108	16	20	3	81	70	3
120	11	17	3	65	69	3

Figure 5.11: Dialysis Technique Survival by Modality, 2000-2009

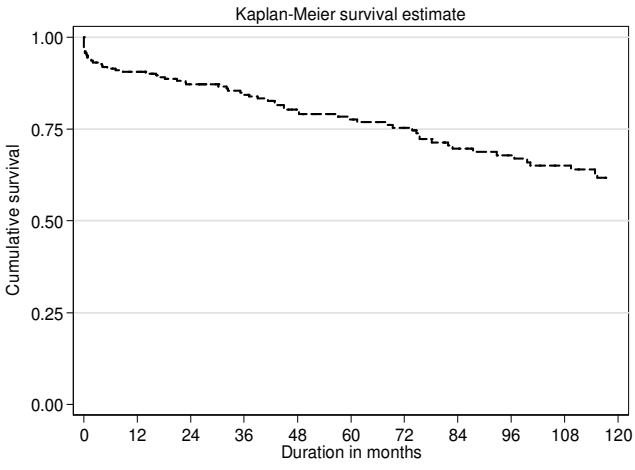


The graft survival for paediatric transplants was 91% at 1 year, 78% at 5 years and 61% at 10 years.

Table 5.12: Transplant Graft Survival, 2000-2009

Interval (month)	No.	% survival	SE
0	237	100	-
6	209	91	2
12	199	91	2
24	175	87	2
36	153	84	2
48	127	80	3
60	110	78	3
72	98	75	3
84	84	70	4
96	72	68	4
108	65	65	4
120	55	61	4

Figure 5.12: Transplant Graft Survival, 2000-2009



CHAPTER 6

Management of Anaemia in Patients on Dialysis

Philip N. Jeremiah
Bee Boon Cheak

SECTION 6.1: TREATMENT FOR ANAEMIA IN DIALYSIS

From 2000 – 2009, there was an increasing percentage of patients receiving erythropoietin (EPO); more haemodialysis patients were on EPO; 89% compared 76% in PD. The percentage of patients requiring blood transfusion has remained at about 15% 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 6.1.1 and Table 6.1.2)

Table 6.1.1: Treatment for Anaemia, HD patients 2000 to 2009

Year	No. of subjects	% on Erythropoietin	% received blood transfusion	% on oral iron	% received parenteral iron
2000	4392	56	15	88	5
2001	5194	62	13	88	5
2002	6108	67	10	85	7
2003	7017	72	12	83	8
2004	8064	74	11	80	10
2005	9344	81	14	74	11
2006	11679	83	18	76	16
2007	12907	85	15	74	17
2008	15348	88	16	63	23
2009	17540	89	15	60	26

Table 6.1.2: Treatment for Anaemia, PD patients 2000 to 2009

Year	No. of subjects	% on Erythropoietin	% received blood transfusion	% on oral iron	% received parenteral iron
2000	662	46	11	92	4
2001	781	45	11	91	2
2002	891	49	11	93	2
2003	1230	53	14	87	4
2004	1312	63	15	85	7
2005	1390	72	12	87	8
2006	1552	74	16	83	13
2007	1806	74	16	80	12
2008	2084	77	16	77	12
2009	2209	76	16	74	14

In 2008, the percentage of patients on EPO among the HD centres varied significantly from 5% to 100%. The median usage of EPO was 92% compared to 56% a decade ago. (Table 6.1.3)

Table 6.1.3: Variation in Erythropoietin utilization (% patients) among HD centres, 2009

Year	No. of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2000	106	0	20	43	56	69	83	100
2001	126	0	19	50	61	75	88	100
2002	154	14	26	56	70	79	91	100
2003	182	17	38	60	73	83	94	100
2004	213	9	39	66	77	86	97	100
2005	241	8	55	73	83	90	100	100
2006	290	3	55	80	87	93	100	100
2007	316	4	64	83	89	94	100	100
2008	366	0	63	85	91	96	100	100
2009	397	5	71	87	92	96	100	100

Figure 6.1.3: Variation in Erythropoietin utilization (% patients) among HD centres, 2009

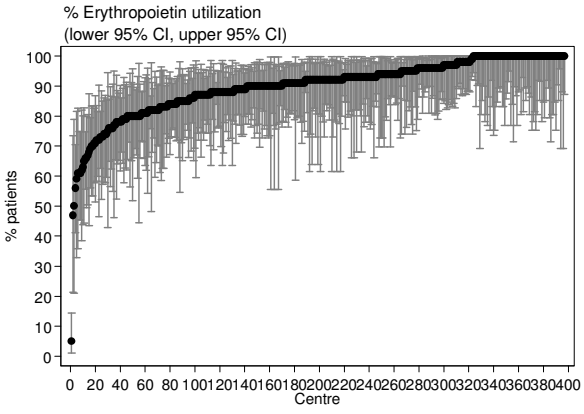
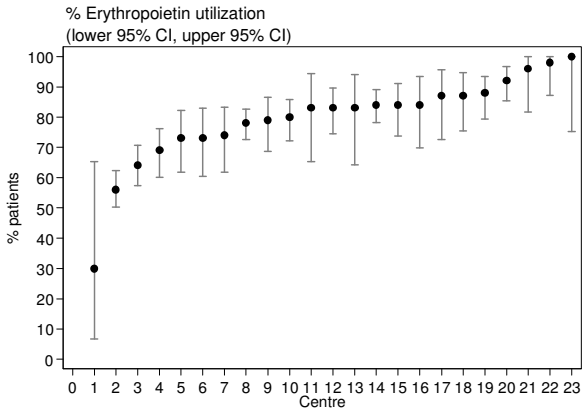


Figure 6.1.4: Variation in Erythropoietin utilization (% patients) among PD centres, 2009



In PD centres, there was a lesser variation in the EPO utilization ; 30 to 100 %. The median usage of EPO was 83% in 2009. (Table 6.1.4)

Table 6.1.4: Variation in Erythropoietin utilization (% patients) among PD centres, 2009

Year	No. of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2000	11	26	26	33	47	56	70	70
2001	12	25	25	33	47	57	87	87
2002	15	26	26	43	53	62	71	71
2003	18	25	25	38	51	69	92	92
2004	18	5	5	54	62.5	78	97	97
2005	19	41	41	61	69	81	97	97
2006	22	36	52	66	74	86	96	97
2007	24	0	42	66	77	90	97	100
2008	24	20	58	70.5	81	88.5	97	100
2009	23	30	56	73	83	87	98	100

The median weekly EPO dose has remained at 4000 units over the last 4 years in both HD and PD centres. It is interesting to note that the maximum dose of EPO used in PD patients is 4000 units per week compared to 8000 units per week in HD patients. (Table 6.1.5 and 6.1.6)

Table 6.1.5: Variation in median weekly Erythropoietin dose (u/week) among HD centres, 2009

Year	No. of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2000	79	2000	2000	2000	2000	2000	4000	6000
2001	94	2000	2000	2000	2000	2000	4000	6000
2002	118	2000	2000	2000	2000	2000	4000	6000
2003	147	2000	2000	2000	2000	2000	4000	5000
2004	178	2000	2000	2000	2000	2000	4000	5000
2005	217	2000	2000	2000	2000	4000	6000	16000
2006	278	2000	2000	4000	4000	6000	8000	24000
2007	305	2000	3000	4000	4000	6000	8000	16000
2008	353	2000	2000	4000	4000	4000	6000	8000
2009	387	2000	3000	4000	4000	6000	6000	8000

Figure 6.1.5: Variation in median weekly Erythropoietin dose (u/week) among HD centres, 2009

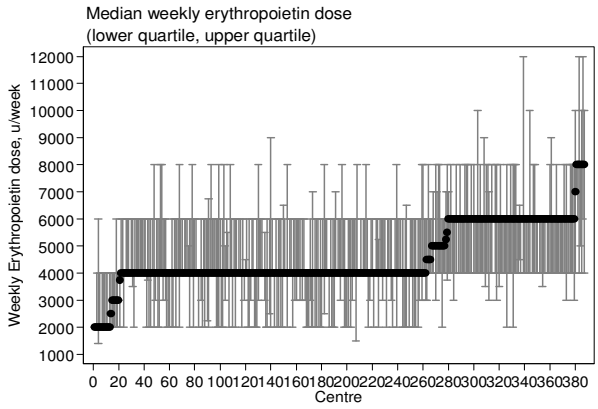


Figure 6.1.6: Variation in median weekly Erythropoietin dose (u/week) among PD centres, 2009

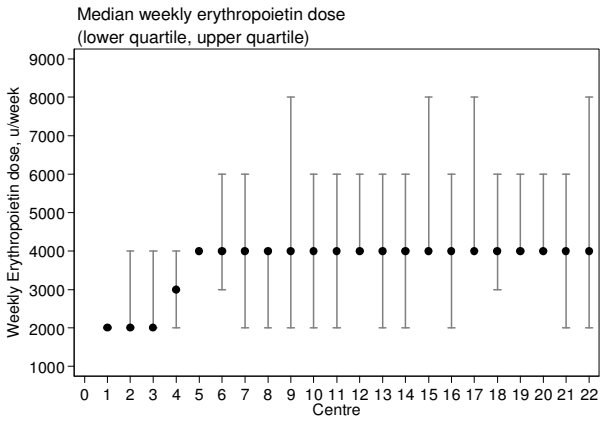


Table 6.1.6: Variation in median weekly Erythropoietin dose (u/week) among PD centres, 2009

Year	No. of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
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	21	2000	2000	3000	4000	4000	4500	5000
2007	22	2000	2000	4000	4000	4000	6000	8000
2008	22	2000	2000	4000	4000	4000	6000	6000
2009	22	2000	2000	4000	4000	4000	4000	4000

In HD and PD centres, the median requirement of blood transfusion has remained at around 15% over the last 3 years. (Table 6.1.7 and Table 6.1.8)

Table 6.1.7: Variation in use of blood transfusion (% patients) among HD centres, 2009

Year	No. of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2000	106	0	0	4	10.5	21	47	76
2001	126	0	0	5	12	20	36	50
2002	154	0	0	2	8	14	28	67
2003	182	0	0	3	9	19	36	63
2004	213	0	0	2	7	16	38	48
2005	241	0	0	5	11	20	40	75
2006	290	0	4	10	18	29	48	89
2007	315	0	0	8	15	24	44	100
2008	365	0	0	8	16	27	44	100
2009	396	0	0	7	14	23	46	100

Figure 6.1.7: Variation in use of blood transfusion (% patients) among HD centres, 2009

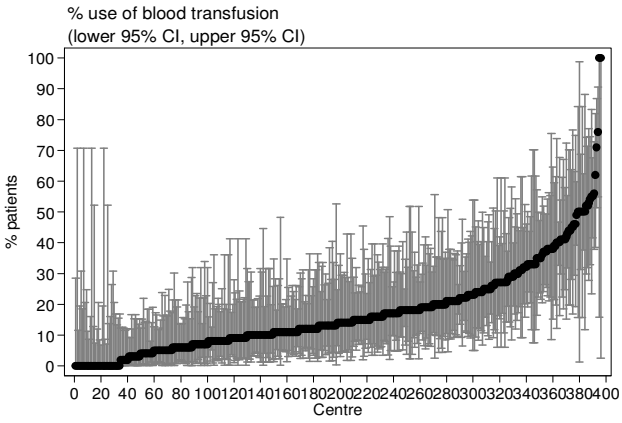


Figure 6.1.8: Variation in use of blood transfusion (% patients) among PD centres, 2009

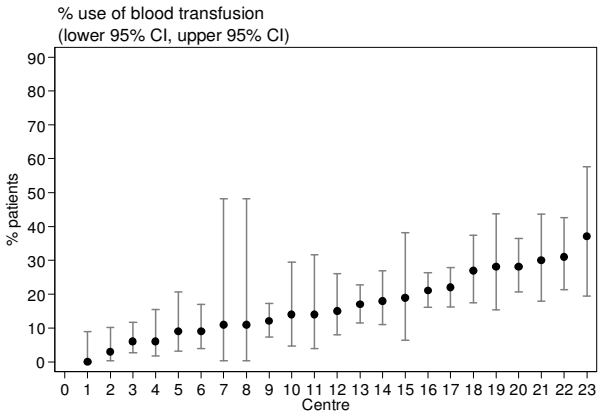


Table 6.1.8: Variation in use of blood transfusion (% patients) among PD centres, 2009

Year	No. of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
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	18	0	0	3	10.5	21	59	59
2004	18	0	0	6	15	20	37	37
2005	19	0	0	4	11	17	45	45
2006	22	0	4	9	16.5	27	36	48
2007	24	6	6	11	18	24	35	38
2008	24	2	4	7.5	16.5	27.5	35	40
2009	23	0	3	9	15	27	31	37

SECTION 6.2: 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 98% of patients have serum ferritin of greater 100 ng/ml. (Table 6.2.1 and Table 6.2.4)

Table 6.2.1: Distribution of Serum Ferritin without Erythropoietin, HD patients 2000-2009

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% Patients ≥100 ng/ml
2000	571	487.5	416.8	363.2	152.5	741	83
2001	758	537.6	453.9	383.5	172	828	87
2002	803	519.5	447.3	373	168.5	781	85
2003	916	551.5	434.2	456.7	190	827.7	87
2004	1042	590.7	463.6	473.5	218	910.5	89
2005	1010	618.5	498.7	485.5	225	902	90
2006	1169	562.4	485.6	408	193.8	817.5	87
2007	1182	586	501	431	196	860.9	86
2008	1186	578	489.9	431.9	197	838.1	87
2009	1249	547.7	461.3	424.5	175	799.9	87

Figure 6.2.1: Cumulative Distribution of Serum Ferritin without Erythropoietin, HD patients 2000-2009

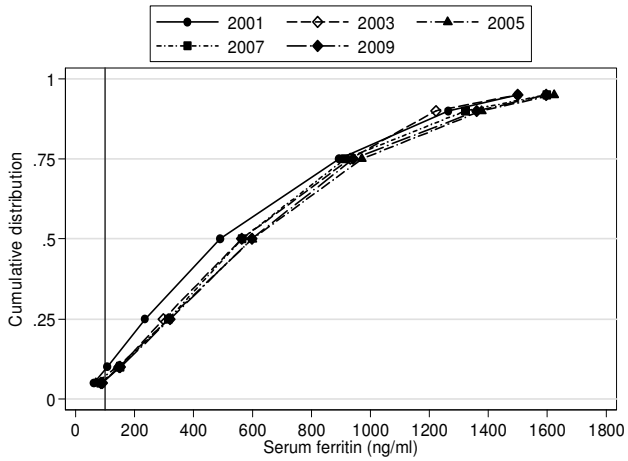


Figure 6.2.2: Distribution of Serum Ferritin without Erythropoietin, PD patients 2000-2009

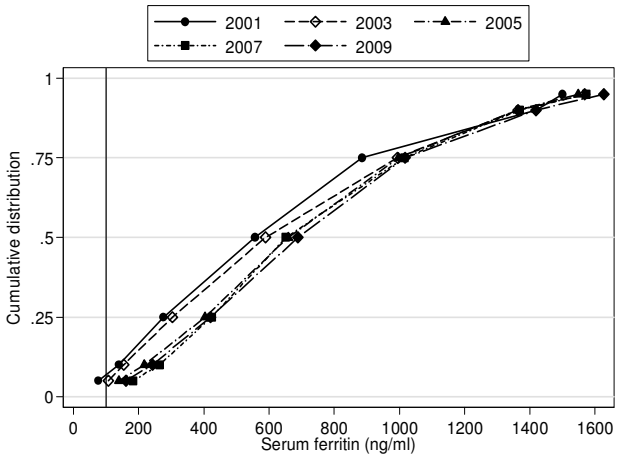


Table 6.2.2: Distribution of Serum Ferritin without Erythropoietin, PD patients 2000-2009

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% Patients ≥100 ng/ml
2000	144	505.9	433.8	420	152.3	675.5	88
2001	223	543.8	417.5	440	216.9	754	91
2002	236	634.8	491.2	514.9	226	924.6	93
2003	329	602.5	429.2	503.7	269	834	93
2004	303	608.4	385.7	522.7	330	882	94
2005	225	651.4	397.8	609	324	913.3	96
2006	263	589.9	411.3	484	280	815.8	95
2007	305	636.9	396.6	582.3	342.8	841.9	96
2008	338	634	410.1	592	327.4	841	93
2009	364	621.6	401.1	553	322.5	861.8	95

Table 6.2.3: Distribution of Serum Ferritin on Erythropoietin, HD patients 2000-2009

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% Patients ≥100 ng/ml
2000	1174	588.3	456.6	475.5	219	860	91
2001	1637	597.5	444.2	491	236	894.2	91
2002	2224	593.1	459.3	464.8	231.3	878.2	91
2003	3134	640.8	428.1	563.3	298	931	94
2004	3904	669.7	460.4	571	306	976.5	94
2005	5116	682.7	471	599.5	315.3	971.5	93
2006	6765	640.3	459	543	291.2	881	93
2007	8032	658.8	452.2	564.4	315.5	914	94
2008	9910	703.5	469.2	611.1	337.5	979.2	95
2009	11961	679.8	458.5	597.7	320.5	942	94

Figure 6.2.3: Cumulative distribution of Serum Ferritin on Erythropoietin, HD patients 2000-2009

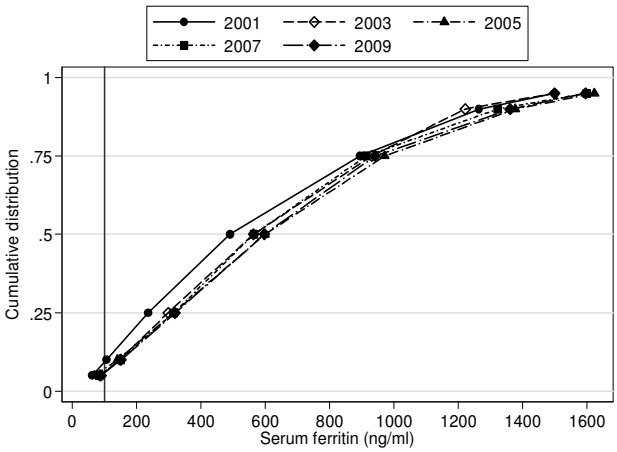


Figure 6.2.4: Cumulative distribution of Serum Ferritin on Erythropoietin, PD patients 2000-2009

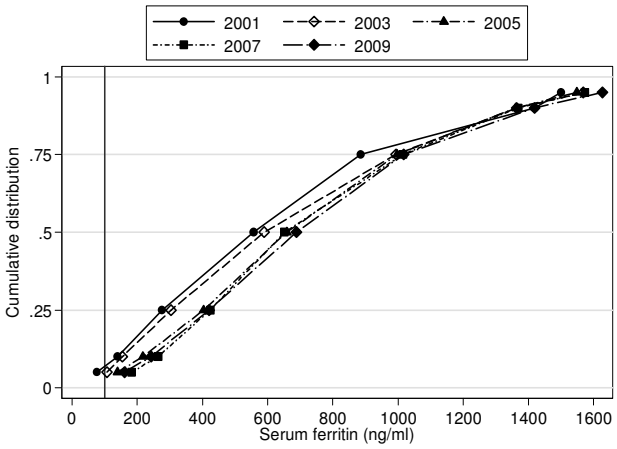


Table 6.2.4: Distribution of Serum Ferritin on Erythropoietin, PD patients 2000-2009

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% Patients ≥100 ng/ml
2000	180	608.2	416.7	560	295.2	846.3	92
2001	261	645.9	449.2	557.5	275.7	885.4	93
2002	345	666.8	462.4	538.5	284	999.5	94
2003	517	689.9	459.9	589	304	993.2	96
2004	540	728.8	427.2	655.6	406.3	986.7	98
2005	767	732.9	433.6	659	403.6	997.5	97
2006	888	729.9	435.6	638.4	399.5	986.2	98
2007	1091	741.3	426.1	652	423.8	1015	98
2008	1310	758.4	445.4	668.6	422.4	1030.3	98
2009	1387	759.2	438.9	688.7	421	1017.5	98

The median transferrin saturation has remained the same over the last decade, with the mean and median always greater than 30%. In 2009, up to 92% of all patients have transferrin saturation greater than 20%. (Table 6.2.5 and Table 6.2.8)

Table 6.2.5: Distribution of transferrin saturation without Erythropoietin, HD patients, 2000-2009

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% Patients ≥20 %
2000	800	32.7	16.9	28.6	20.9	41.4	78
2001	836	36.9	18.5	32.5	23.9	45.8	84
2002	811	36.5	18.9	32	22.9	45.7	83
2003	922	40.3	18.6	36.1	27.2	51.2	91
2004	1031	41.2	18.1	37.5	28.5	50.1	92
2005	1106	37.7	17.8	34.4	25.6	46.2	87
2006	1149	36.2	16.9	32.9	24.7	44.2	87
2007	1206	36.1	16.5	32.5	25	43.7	87
2008	1211	34.3	15.5	31.8	23.7	41.4	85
2009	1251	34.4	15.9	31.4	24.1	41	85

Figure 6.2.5: Cumulative distribution of transferrin saturation without Erythropoietin, HD patients 2000-2009

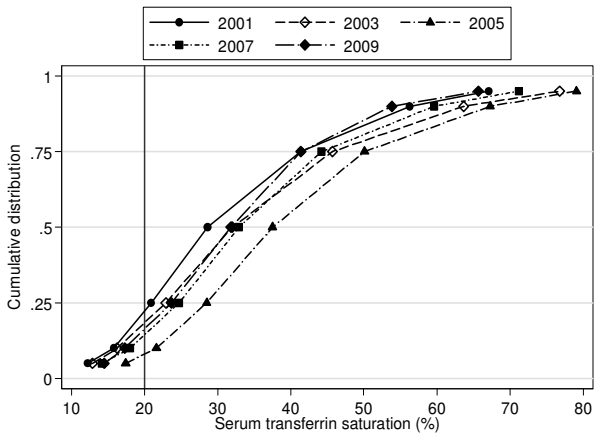


Figure 6.2.6: Cumulative distribution of transferrin saturation without Erythropoietin, PD patients 2000-2009

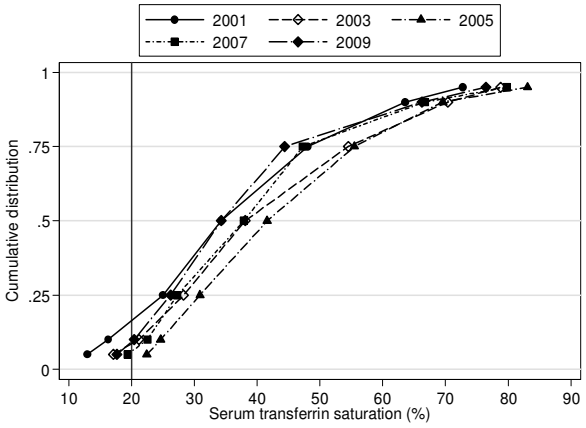


Table 6.2.6: Distribution of transferrin saturation without Erythropoietin, PD patients, 2000-2009

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% Patients ≥20 %
2000	236	38	18.5	34.3	25	48.1	86
2001	279	43.2	20.8	40	27.8	56.7	89
2002	332	42.7	19.1	38.1	28.3	54.5	92
2003	397	45.2	19.7	41.2	31.4	58.1	93
2004	379	44.5	18.2	41.6	30.9	55.5	98
2005	287	40.6	16.2	37.8	29.4	48.2	95
2006	299	40.5	17.4	37.9	27.3	47.3	95
2007	348	40.3	17.9	36.6	27.5	48.2	92
2008	349	38.2	17.8	34.3	26.2	44.4	91
2009	439	38.4	18.2	36.1	26.4	45.7	87

Table 6.2.7: Distribution of Transferrin saturation on Erythropoietin, HD patients, 2000-2009

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% Patients ≥20 %
2000	1247	34.9	16.7	30.4	23	44	84
2001	1634	36.2	17.9	32.3	23.6	45	84
2002	1995	34.6	17.6	30.6	22.2	43.6	81
2003	2641	39.6	18.4	35.9	26.6	48.8	90
2004	3269	39.6	17	36.1	27.8	48.1	93
2005	4808	36.6	17.2	32.8	24.6	45	87
2006	6384	35.1	16.4	31.6	24.1	42.1	87
2007	7604	34.7	15.4	31.6	24.4	41.6	88
2008	9528	34.7	15.4	31.5	24	41.6	87
2009	11647	34	15.4	30.9	23.8	40.5	86

Figure 6.2.7: Cumulative distribution of transferrin saturation on Erythropoietin, HD patients 2000-2009

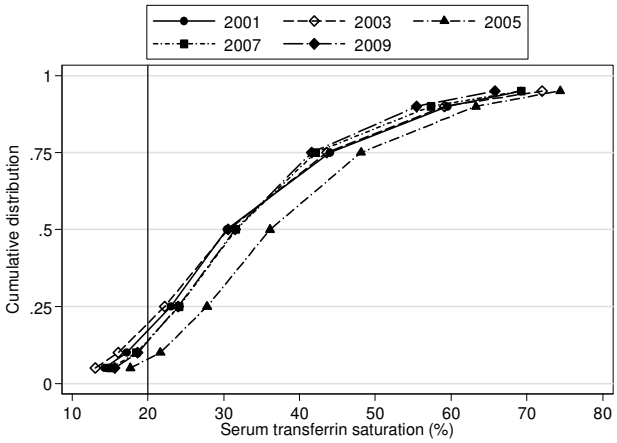


Figure 6.2.8: Cumulative distribution of transferrin saturation on Erythropoietin, PD patients 2000-2009

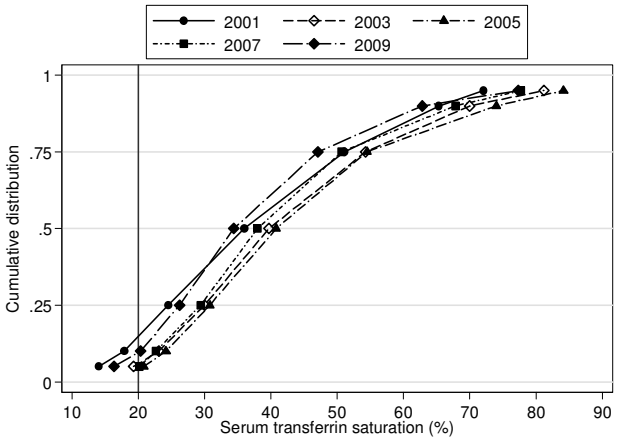


Table 6.2.8: Distribution of Transferrin saturation on Erythropoietin, PD patients, 2000-2009

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% Patients ≥20 %
2000	239	38.9	18.7	36	24.5	51.1	86
2001	292	44.1	19.6	40.7	29.2	55.8	94
2002	363	43.6	18.6	39.7	30	54.3	94
2003	460	44.6	17.8	40.4	31.7	55.7	96
2004	697	44.7	18.7	40.8	30.8	54.5	96
2005	820	43.5	19.3	39.1	29.4	53.7	95
2006	916	41.6	17.5	38	29.4	50.7	95
2007	1080	39.3	17.6	35.3	26.9	47.3	92
2008	1265	38.6	17.9	34.4	26.2	47.1	91
2009	1547	39.1	17.3	35.4	26.9	47.6	92

From 2000 to 2009, the median ferritin for all HD centres has remained at 500 to 600 ng/ml. There was a wide variation in ferritin levels ranging from 100 to 1500 ng/ml between HD centres in 2009. At the median, 95% of patients on EPO have a serum ferritin greater 100 ng/ml. The median transferrin saturation has been > 30% over the last 10 years. 88% of patients on HD have transferrin saturation greater than 20%. (Table 6.2.9)

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

Table 6.2.9: Variation in iron status outcomes among HD centres, 2009

a) Medium serum ferritin among patients on erythropoietin

Year	No. of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2000	42	154	235.5	373	559	652	813.5	1087.5
2001	51	199	222	374	493.5	696.5	886.5	1209.5
2002	68	106.6	193.9	372	478.7	610	828	1070.8
2003	100	152.5	288.6	463.9	555.3	691.1	973.6	1742.8
2004	123	99.5	337.5	451	562	715.5	1000	2000
2005	161	1.6	318	461	623.5	730	947	2000
2006	209	1.5	237	416	554.8	688.8	907	2000
2007	241	92.7	256	437	565.5	695.5	880.5	1411
2008	276	89.2	286.5	478.6	600	719.2	970.5	2000
2009	329	113.1	285	448.3	595.2	721	904.1	1501.8

Figure 6.2.9(a): Variation in medium serum ferritin among patients on erythropoietin, HD centres 2009

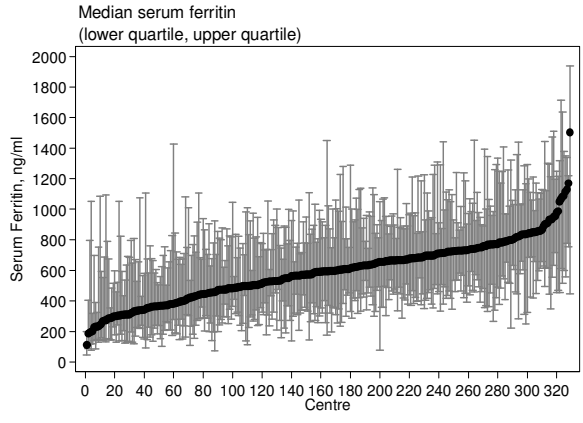
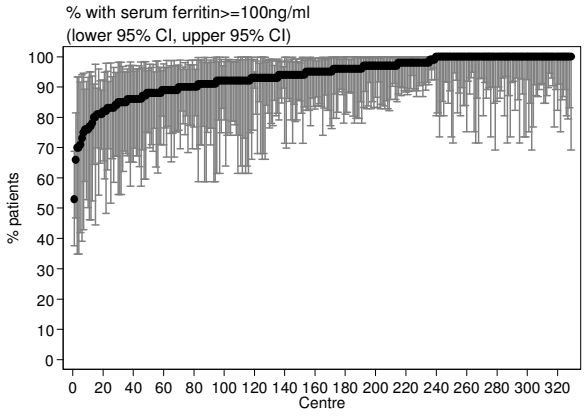


Figure 6.2.9(b): Variation in proportion of patients on erythropoietin with serum ferritin ≥100 ng/ml, HD centres 2009



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
2000	42	68	71	85	92.5	97	100	100
2001	51	67	71	88	93	97	100	100
2002	68	55	73	89	93	96.5	100	100
2003	100	57	76	90.5	96	100	100	100
2004	123	50	86	92	96	100	100	100
2005	161	5	80	90	95	100	100	100
2006	209	0	74	91	95	100	100	100
2007	241	44	78	92	96	100	100	100
2008	276	45	81	92	96	100	100	100
2009	329	53	81	91	95	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
2000	43	16	23.2	27.9	31.4	36.8	44.1	57.5
2001	54	21	22.6	27.1	30.9	37	48.4	76.1
2002	60	14.1	20.9	26	30.8	36.5	51.7	60.2
2003	90	18.2	24.2	30.9	34.2	41	55.6	70.7
2004	113	22	26.8	32.9	36	41.4	52	67.6
2005	147	15.2	25.1	29.1	32.5	37.9	48.9	69.7
2006	187	13.7	22.4	27.7	31.3	35.9	46.4	78.7
2007	215	17.6	22	27.6	31.4	35.3	43.1	77.8
2008	263	15.9	23.7	28.2	31.9	34.7	46.2	76
2009	301	16.6	22	27.4	30.4	34.2	42	81.8

Figure 6.2.9(c): Variation in median transferring saturation among patients on erythropoietin HD centres, 2009

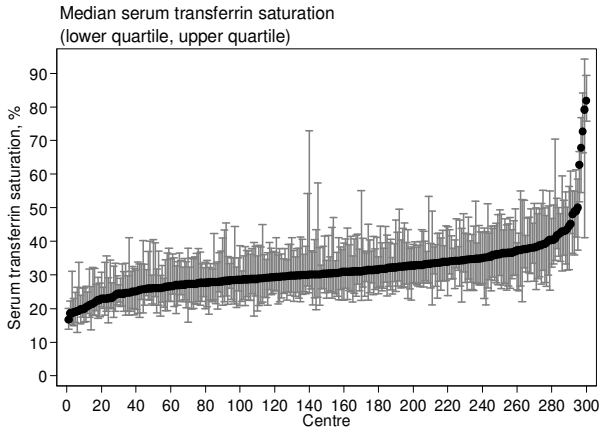
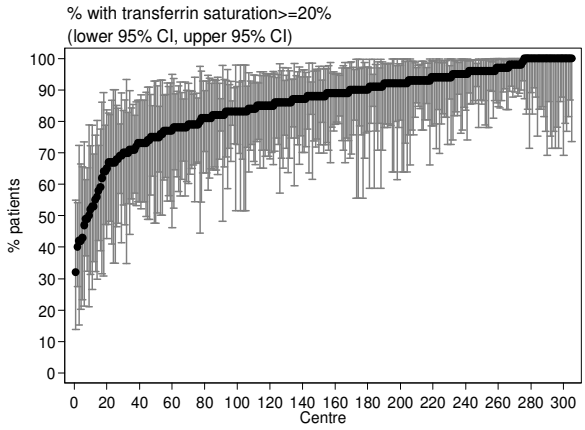


Figure 6.2.9(d): Variation in proportion of patients on erythropoietin with transferring saturation ≥20%, HD centres, 2009



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
2000	43	20	60	78	86	94	100	100
2001	54	57	60	77	88.5	96	100	100
2002	60	32	54.5	70	83	92	100	100
2003	90	45	69	86	92.5	100	100	100
2004	113	53	73	90	94	100	100	100
2005	149	30	70	84	91	95	100	100
2006	187	20	61	80	90	95	100	100
2007	216	27	61	83	90	96	100	100
2008	264	12	65	81	89	95	100	100
2009	305	32	59	80	88	94	100	100

Table 6.2.10: Variation in iron status outcomes among PD centres, 2009

a) Medium serum ferritin among patients on erythropoietin

Year	No. of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
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	701.3	860.3	860.3
2005	17	338.5	338.5	557.2	709.9	800.9	843	843
2006	19	348.9	348.9	531.8	633.5	787.4	925.8	925.8
2007	21	277.3	290.3	594.4	652	687	943.2	1048.6
2008	21	289.2	381.3	499	656.3	811.3	970.1	979
2009	21	280	332.1	545	676.6	797.6	951	1158

Figure 6.2.10(a): Variation in medium serum ferritin among patients on erythropoietin, PD centres 2009

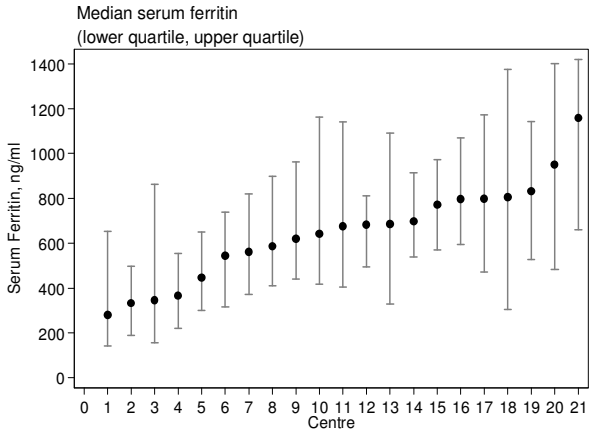
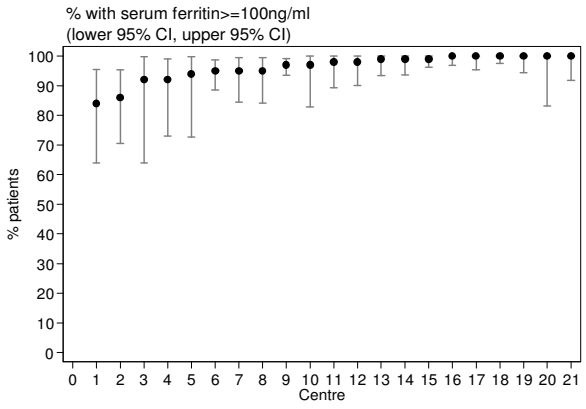


Figure 6.2.10(b): Variation in proportion of patients on erythropoietin with serum ferritin ≥100 ng/ml, PD centres 2009



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
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	21	86	90	96	98	100	100	100
2008	21	86	87	93	98	100	100	100
2009	21	84	86	95	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
2000	6	23.1	23.1	26.7	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	43.4	74.9	74.9
2006	19	31.9	31.9	34.5	37.7	40.2	75.8	75.8
2007	19	25.8	25.8	29.6	37.5	43	83.2	83.2
2008	19	25.2	25.2	31.7	34.5	42.1	81.2	81.2
2009	21	24.9	28.4	32.9	37.3	39.6	56	84.7

Figure 6.2.10 (c): Variation in median transferrin saturation among patients on erythropoietin, PD centres 2009

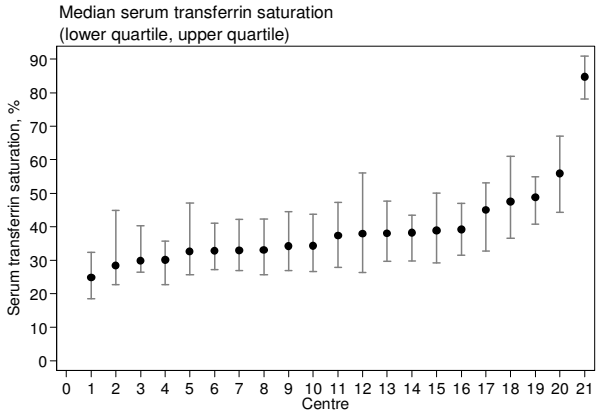
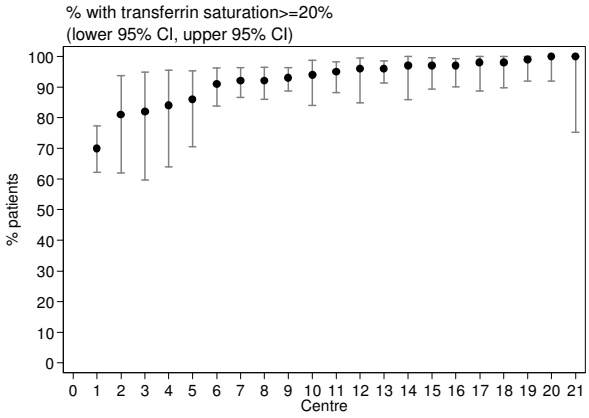


Figure 6.2.10 (d): Variation in proportion of patients on erythropoietin with transferrin saturation ≥20 %, PD centres 2009



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
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	94	95	98	100	100
2007	19	76	76	88	94	98	100	100
2008	19	65	65	92	95	96	100	100
2009	21	70	81	91	95	97	100	100

SECTION 6.3: HAEMOGLOBIN OUTCOMES ON DIALYSIS

The mean and median haemoglobin concentrations in all dialysis patients with or without EPO is static, except for HD patients not on EPO, where a steady increased in haemoglobin is noted. Perhaps, the improved Hb in HD patients without EPO may be due to increasing use of IV Iron.

In 2009 the mean and median haemoglobin ranged from 10.3 to 11.4g/dL for all dialysis patients. The percentage of patients with haemoglobin >10 or >11g/dL steadily increased for HD patients not on EPO; the Hb is otherwise static for all other patients (Table 6.3.1 and Table 6.3.4)

Table 6.3.1: Distribution of Haemoglobin Concentration without Erythropoietin, HD patients 2000-2009

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% Patients ≤10g/dL	% Patients >10g/dL	% Patients ≤11g/dL	% Patients >11g/dL
2000	1754	9.4	2.1	9.1	7.9	10.6	67	33	80	20
2001	1809	9.4	1.9	9.3	8	10.6	64	36	81	19
2002	1795	9.6	2.1	9.4	8.1	10.9	62	38	76	24
2003	1801	9.7	2.1	9.5	8.3	11	60	40	75	25
2004	1925	10.1	2.2	9.9	8.6	11.5	53	47	68	32
2005	1667	10.5	2.3	10.3	8.9	12.1	46	54	62	38
2006	1760	10.6	2.2	10.5	9	12.1	42	58	59	41
2007	1756	10.8	2.2	10.7	9.1	12.4	40	60	54	46
2008	1749	10.8	2.3	10.8	9.1	12.5	39	61	54	46
2009	1802	11.2	2.3	11.4	9.4	12.9	32	68	45	55

Figure 6.3.1: Cumulative distribution of haemoglobin concentration without Erythropoietin, HD patients 2000-2009

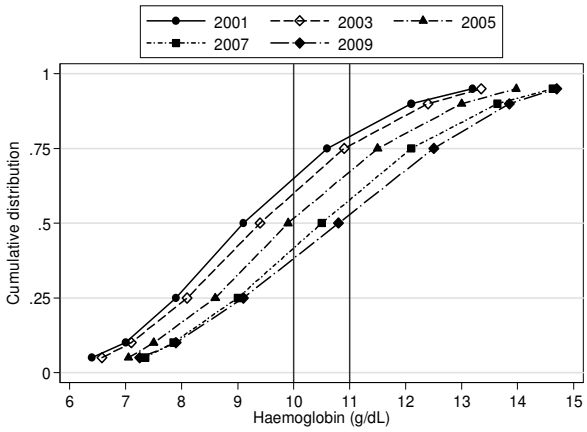


Figure 6.3.2: Cumulative distribution of haemoglobin concentration without Erythropoietin, PD patients 2000-2009

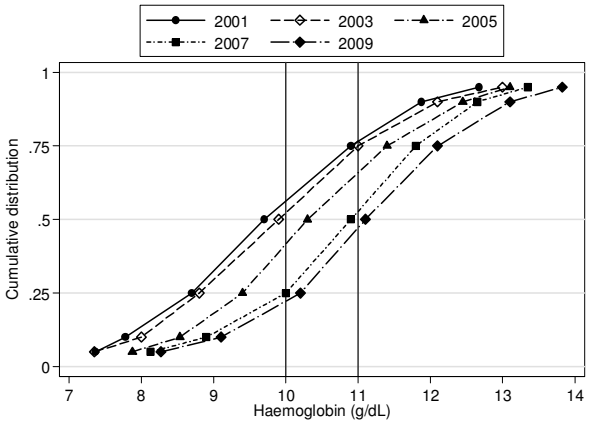


Table 6.3.2: Distribution of Haemoglobin Concentration without Erythropoietin, PD patients 2000-2009

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% Patients ≤10g/dL	% Patients >10g/dL	% Patients ≤11g/dL	% Patients >11g/dL
2000	341	9.8	1.7	9.7	8.7	10.9	58	42	79	21
2001	405	9.8	1.8	9.7	8.6	10.7	59	41	78	22
2002	434	10	1.8	9.9	8.8	11	54	46	76	24
2003	542	10	1.7	9.9	8.9	11	52	48	76	24
2004	481	10.4	1.6	10.3	9.4	11.4	42	58	67	33
2005	375	10.8	1.6	10.8	9.9	11.8	28	72	60	40
2006	387	10.9	1.6	10.9	10	11.8	25	75	54	46
2007	436	11.1	1.6	11	10.2	12.1	22	78	50	50
2008	450	11.1	1.7	11.1	10.2	12.1	21	79	46	54
2009	488	11.1	1.8	11.1	10.1	12.2	25	75	48	52

Table 6.3.3: Distribution of Haemoglobin Concentration on Erythropoietin, HD patients 2000-2009

Year	No. of subject	Mean	SD	Median	LQ	UQ	% Patients ≤10g/dL	% Patients >10g/dL	% Patients ≤11g/dL	% Patients >11g/dL
2000	2332	9.4	1.7	9.4	8.3	10.5	65	35	85	15
2001	3049	9.4	1.6	9.4	8.3	10.5	65	35	85	15
2002	3859	9.5	1.7	9.5	8.4	10.7	62	38	81	19
2003	4783	9.6	1.6	9.6	8.5	10.7	61	39	81	19
2004	5806	9.8	1.6	9.9	8.8	10.9	54	46	77	23
2005	7218	10	1.6	10	8.9	11.1	50	50	73	27
2006	9415	10.1	1.6	10	9	11.1	50	50	72	28
2007	10696	10.2	1.5	10.3	9.1	11.3	44	56	69	31
2008	12985	10.2	1.5	10.3	9.1	11.3	44	56	69	31
2009	15169	10.3	1.5	10.4	9.2	11.4	42	58	67	33

Figure 6.3.3: Cumulative distribution of Haemoglobin Concentration on Erythropoietin, HD patients 2000-2009

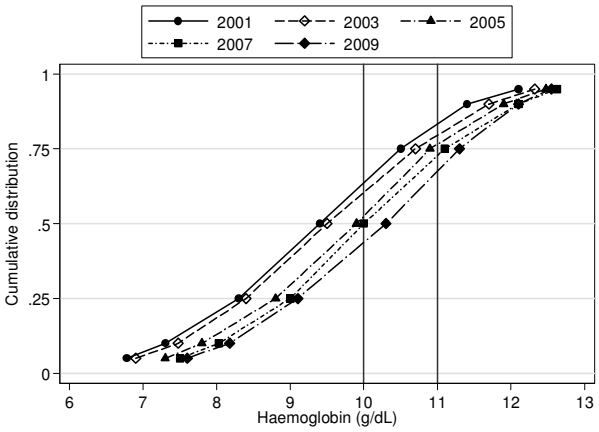


Figure 6.3.4: Cumulative distribution of Haemoglobin Concentration on Erythropoietin, PD patients 2000-2009

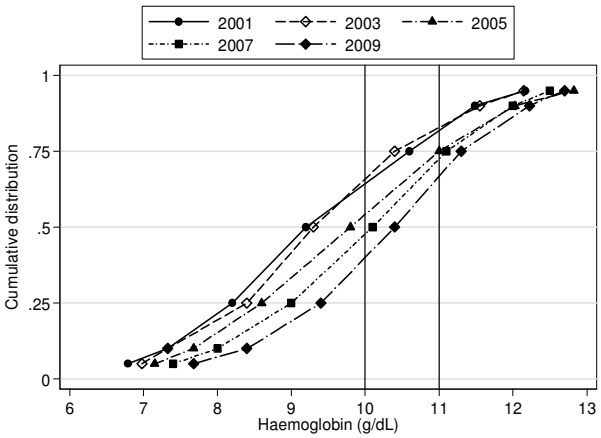


Table 6.3.4: Distribution of Haemoglobin Concentration on Erythropoietin, PD patients 2000-2009

Year	No. of subject	Mean	SD	Median	LQ	UQ	% Patients ≤10g/dL	% Patients >10g/dL	% Patients ≤11g/dL	% Patients >11g/dL
2000	300	9.4	1.7	9.2	8.2	10.6	65	35	82	18
2001	345	9.3	1.6	9.4	8.2	10.5	65	35	86	14
2002	432	9.4	1.6	9.3	8.4	10.4	69	31	83	17
2003	639	9.7	1.7	9.6	8.6	10.8	59	41	78	22
2004	798	9.8	1.7	9.8	8.6	11	54	46	76	24
2005	970	9.9	1.7	9.9	8.8	11.1	53	47	73	27
2006	1118	10	1.6	10.1	9	11.1	50	50	74	26
2007	1319	10.3	1.6	10.4	9.3	11.4	42	58	66	34
2008	1577	10.3	1.5	10.4	9.4	11.3	39	61	66	34
2009	1661	10.3	1.5	10.4	9.3	11.4	40	60	65	35

In 2009, for HD patients on EPO, the median haemoglobin in HD centres ranged 8.2 to 12.3g/dL with the median at 10.3g/dL . Similar trend is noted in the PD centres with a significantly lesser variation.

In 2009 for HD patients on EPO, the proportion of patients with Hb >11g/dL varied between 0 to 77%, with median at 30.5%. As expected, a lesser variation was seen in the PD patients.

Table 6.3.5: Variation in Haemoglobin outcomes among HD centres 2009

a) Median haemoglobin level among patients on Erythropoietin

Year	No. of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
2000	76	8.1	8.2	8.8	9.3	9.7	10.5	14.6
2001	92	8.2	8.4	8.9	9.4	9.9	10.4	11
2002	111	8.3	8.5	9	9.4	10	10.8	11.3
2003	143	7.8	8.6	9.1	9.6	10	10.7	11.5
2004	176	7.8	8.6	9.2	9.7	10.2	10.9	11.3
2005	212	8.3	8.8	9.5	10	10.5	11.1	11.7
2006	270	7.7	8.9	9.6	10	10.5	11.3	12.8
2007	304	8.6	9.1	9.8	10.3	10.6	11.3	12.8
2008	349	8	9	9.8	10.2	10.7	11.4	12.7
2009	384	8.2	9.1	9.8	10.3	10.9	11.4	12.3

Figure 6.3.5(a): Variation in median haemoglobin level among patients on Erythropoietin, HD centres 2009

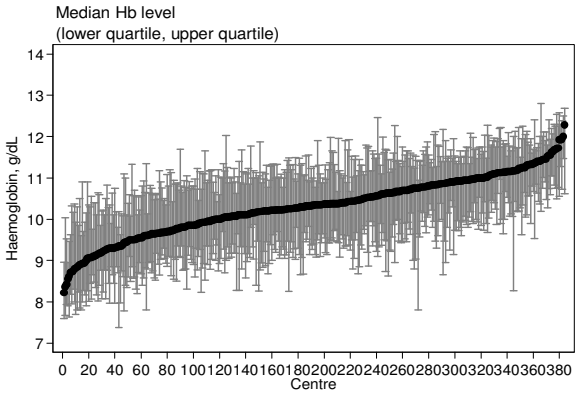
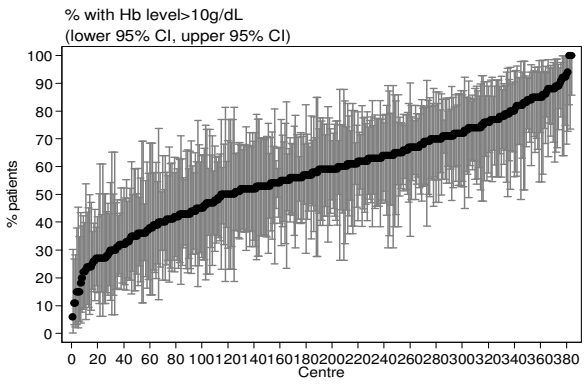


Figure 6.3.5(b): Variation in proportion of patients on erythropoietin with haemoglobin level > 10g/dL, HD centres 2009



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
2000	76	0	5	20	32	42.5	61	97
2001	92	4	10	23.5	33	47	68	71
2002	111	8	15	27	35	50	67	86
2003	143	6	14	27	36	50	69	89
2004	176	9	18	30	41	57	73	85
2005	212	0	21	33	49.5	62	78	100
2006	270	0	19	36	47	63	80	92
2007	304	13	25	42	55	67.5	83	100
2008	349	0	27	43	56	68	84	100
2009	384	6	27	45	59	71	87	100

Table 6.3.5(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
2000	76	0	0	6.5	13	20	32	92
2001	92	0	0	8	13	24	36	50
2002	111	0	6	12	17	27	45	71
2003	143	0	0	7	15	27	41	55
2004	176	0	0	11	19	29	47	58
2005	212	0	4	13.5	25	35	53	75
2006	270	0	7	17	25	37	58	75
2007	304	0	9	19	28	40	62	92
2008	349	0	7	20	30	41	61	100
2009	384	0	9	21	30.5	44	62	77

Figure 6.3.5(c): Variation in proportion of patients on erythropoietin with haemoglobin level > 11g/dL, HD centres 2009

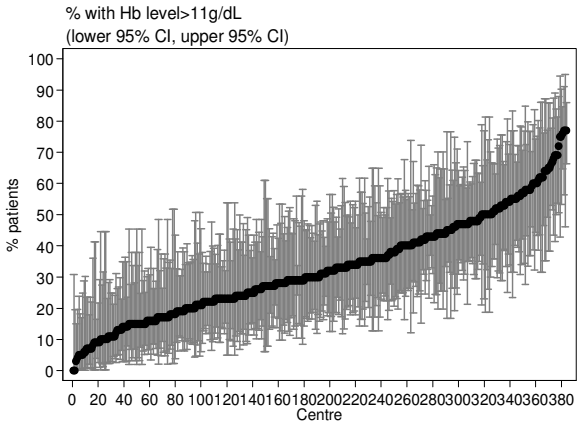


Figure 6.3.6(a): Variation in median haemoglobin level among patients on Erythropoietin, PD centres 2009

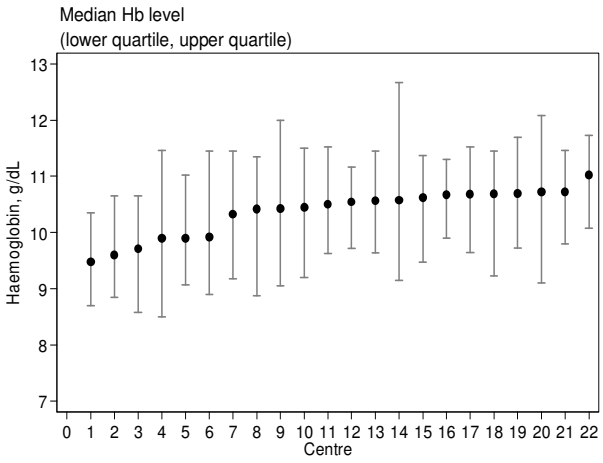


Table 6.3.6: Variation in Haemoglobin outcomes among PD centres 2009

a) Median haemoglobin level among patients on Erythropoietin

Year	No. of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
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	10.3	11.2	11.2
2005	18	8.9	8.9	9.5	9.9	10.3	11	11
2006	22	8.8	8.8	9.5	9.9	10.4	10.6	10.9
2007	22	9.4	9.5	10.1	10.3	10.6	11.1	11.4
2008	22	9.2	9.6	10.1	10.4	10.8	11.1	11.2
2009	22	9.5	9.6	9.9	10.5	10.7	10.7	11

Table 6.3.6(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
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	57	72	72
2005	18	21	21	35	47.5	56	76	76
2006	22	17	19	44	47	58	70	79
2007	22	33	36	52	59	63	72	72
2008	22	31	37	53	61	65	78	89
2009	22	35	38	48	60.5	66	74	77

Figure 6.3.6(b): Variation in proportion of patients on erythropoietin with haemoglobin level > 10g/dL, PD centres, 2009

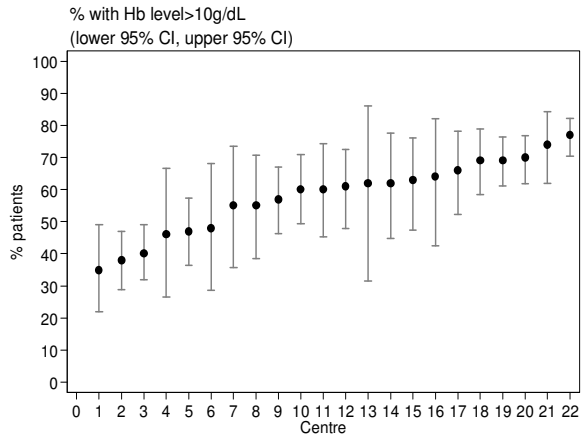


Figure 6.3.6(c): Variation in proportion of patients on erythropoietin with haemoglobin level > 11g/dL, PD centres 2009

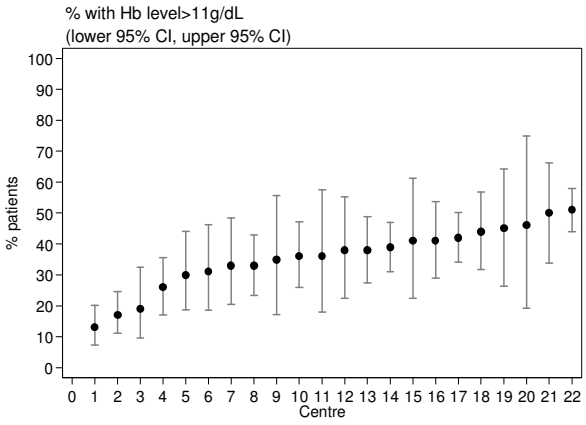


Table 6.3.6(c) Proportion of patients on erythropoietin with haemoglobin level >11g/dL, PD centres

Year	No. of centres	Min	5th centile	LQ	Median	UQ	95th centile	Max
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	29	34	51	51
2006	22	0	5	16	24.5	32	41	48
2007	22	13	14	22	34.5	44	53	56
2008	22	11	15	23	34	44	54	60
2009	22	13	17	31	37	42	50	51

CHAPTER 7

Nutritional Status on Dialysis

Tilakavati Karupaiah
Winnie Chee Siew Swee
Ahmad Fauzi Abdul Rahman

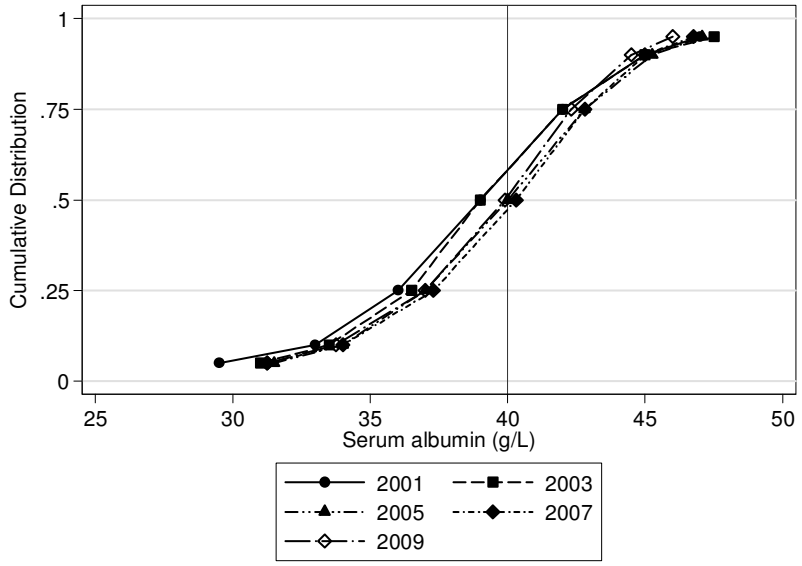
SECTION 7.1: SERUM ALBUMIN LEVELS ON DIALYSIS

Patient numbers on HD increased by 2062 from 2008 which represents a 14% increase. Mean serum albumin levels in 2009 stood at 39.4 g/L, which is just below the desired level of >40 g/L. However, the overall trend for percentage distribution of patients for serum albumin remains unchanged since 2001, i.e. >39 g/L. In 2009, the percent well-nourished patients (>40g/L) is at 51% whilst 35% of patients are in the 35-40g/L range. Improving trends are also indicated from the cumulative distribution graph of albumin in HD patients (Figure 7.1.1).

Table 7.1.1: Distribution of serum albumin, HD patients, 2000-2009

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% patients <30g/L	% patients 30-<35g/L	% patients 35-<40g/L	% patients ≥40g/L
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	14497	39.4	5.1	39.9	37	42.3	3	10	36	50
2009	16559	39.4	5.1	40	37	42.3	3	11	35	51

Figure 7.1.1: Cumulative distribution of Albumin, HD patients 2000-2009

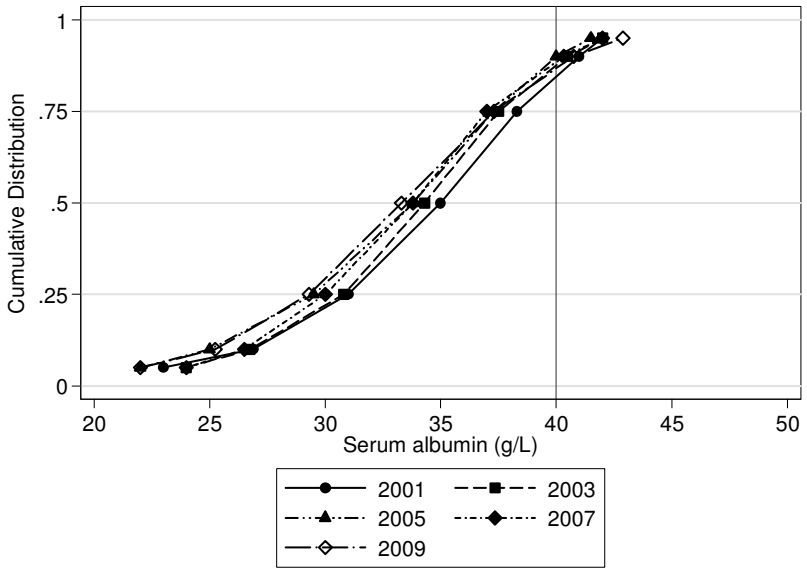


The number of PD patients increased to 2135 with an increment of 5.6% compared to the previous year. The downward trend in mean serum albumin levels for patients on PD continued; from 34.3 g/L in 2000 to 32.7g/L in 2009 (Table 7.1.2). Percentage of patients with unsatisfactory serum albumin (<35 g/L) increased from 48% in 2000 to 64% by 2009. This was despite a 2% improvement in the number of patients with serum albumin >40g/L in 2009 compared to 2008. The cumulative distribution graph in 2009, reflects the continuing trend that percent of PD patients with serum albumin <35 g/L is increasing (Figure 7.1.2).

Table 7.1.2: Distribution of serum albumin, PD patients, 2000-2009

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% patients <30g/L	% patients 30-<35g/L	% patients 35-<40g/L	% patients ≥40g/L
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
2009	2135	32.7	6.4	33	29	36.8	30	34	25	11

Figure 7.1.2: Cumulative distribution of serum albumin, PD patients 2000-2009



A wide variation between HD centers was observed for those achieving serum albumin ≥40g/L (target albumin) for 2009. The median was 52% for the year 2009. The trend in the percent of HD centres achieving a median >50% since 2003 is continuing but decreasing. 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 16.6-fold variation in meeting albumin target was observed (Table 7.1.3) Indicating the wide variation amongst 385 HD centers reporting the proportion of patients able to achieve the target serum albumin ≥40g/L for the year 2009 (Figure 7.1.3).

Table 7.1.3: Variation in Proportion of patients with serum albumin ≥40g/L among HD centres 2009

Year	No. of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
2000	92	0	7	24	43	62.5	83	91
2001	117	0	3	17	40	57	85	100
2002	142	0	9	26	44	62	84	100
2003	172	0	17	40	55	70	92	100
2004	201	0	12	34	57	73	88	100
2005	229	4	13	43	56	70	86	100
2006	279	0	10	38	54	70	87	100
2007	311	0	14	38	54	67	86	100
2008	350	0	7	34	51	66	84	100
2009	385	0	6	36	52	65	84	100

Figure 7.1.3: Variation in Proportion of patients with serum albumin ≥40g/L, HD centres 2009

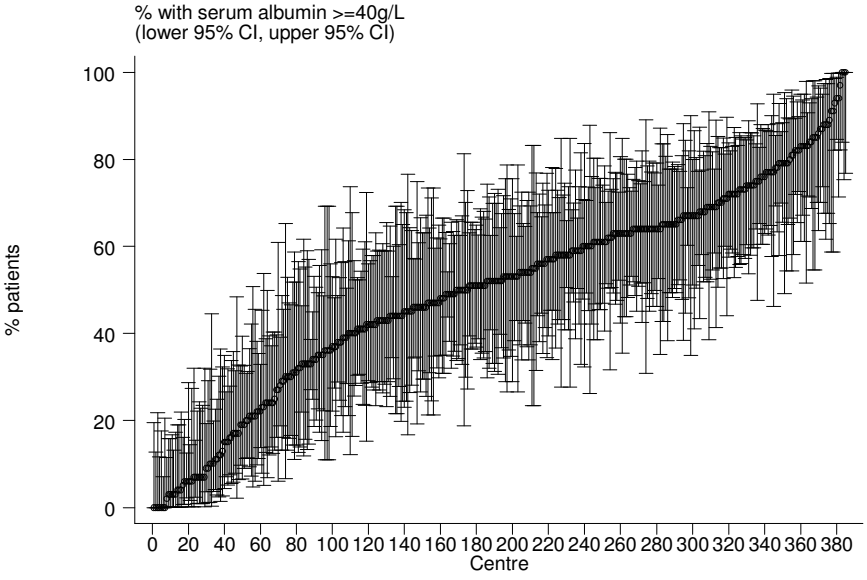
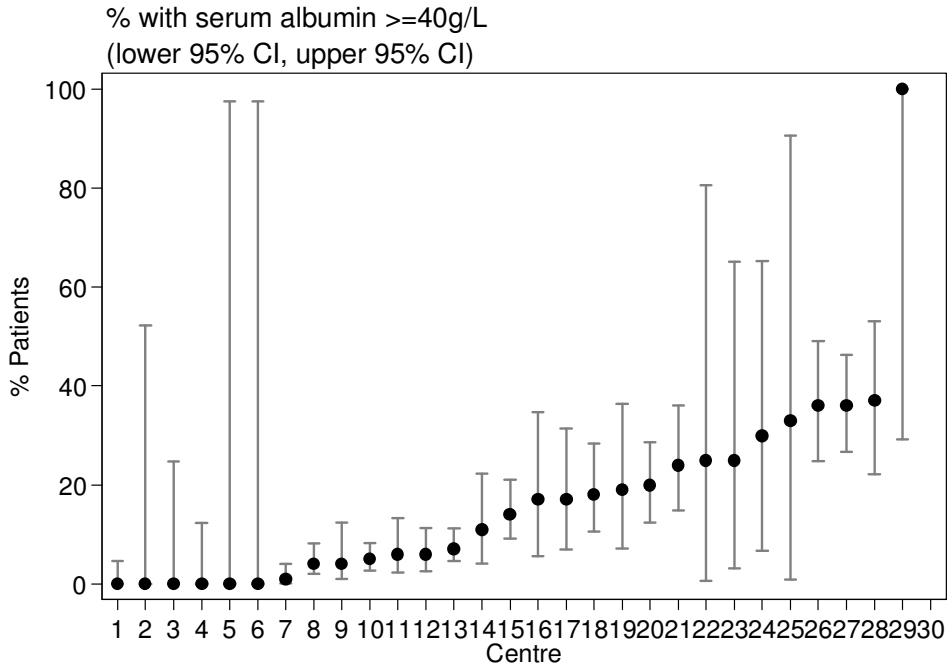


Table 7.1.4 indicates that for 29 PD centers in 2009, one center reported the maximum proportion of patients achieving the target serum albumin ≥40g/L was 100% whilst majority of centers reported achieving less than this target. Overall 19 centres reported <20% of their patients achieving the target serum albumin ≥40g/L. (Figure 7.1.4)

Table 7.1.4: Variation in Proportion of patients with serum albumin ≥40g/L among PD centres 2009

Year	No. of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
2000	19	0	0	0	11	25	42	42
2001	21	0	0	0	8	28	43	67
2002	22	0	0	5	9.5	25	36	100
2003	25	0	0	4	12	19	50	58
2004	27	0	0	0	11	21	35	50
2005	27	0	0	3	11	22	29	50
2006	28	0	0	1.5	11	20.5	44	69
2007	27	0	0	3	14	22	36	59
2008	28	0	0	2	15	25.5	50	54
2009	29	0	0	4	14	25	37	100

Figure 7.1.4: Variation in Proportion of patients with serum albumin ≥40g/L, PD centres 2009



SECTION 7.2: BODY MASS INDEX (BMI) ON DIALYSIS

Table 7.2.1 indicates the mean BMI for HD patients from 2000 to 2009. For the year 2009 the mean BMI was 23.8 ± 8.2 for a HD population of 13416. This indicates that overall mean BMI trend is stabilizing at >23 [22.9 in 2000 to 23.5 in 2008] despite a 3-fold increase in patient numbers from 2000 onwards. An increasing trend of improved BMI is observed for HD patients, with the percentage of HD patients with BMI ≥25 increasing from 22% in 2000 to 33% in 2009. The percent number of patients with BMI <18.5 is at 13%.

Figure 7.2.1 reflects the increasing BMI trends as curve for 2009 continues in moving right. About 75% of the HD population is at BMI 26.

Table 7.2.1: Distribution of BMI, HD patients, 2000-2009

Year	No.	Mean	SD	Median	LQ	UQ	% patients <18.5	% patients 18.5-25	% patients >=25
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	22.2	19.5	25.1	16	58	26
2004	6775	23.3	9	22.4	19.8	25.4	14	58	28
2005	7838	23.4	9	22.5	19.8	25.6	14	57	29
2006	9791	23.3	7.9	22.6	19.9	25.7	14	56	29
2007	10507	23.4	7.9	22.7	19.9	25.8	14	56	30
2008	12199	23.5	7.5	22.8	20.1	26	14	55	31
2009	13416	23.8	8.2	23	20.1	26.1	13	54	33

Figure 7.2.1: Cumulative distribution of BMI, HD patients 2000-2009

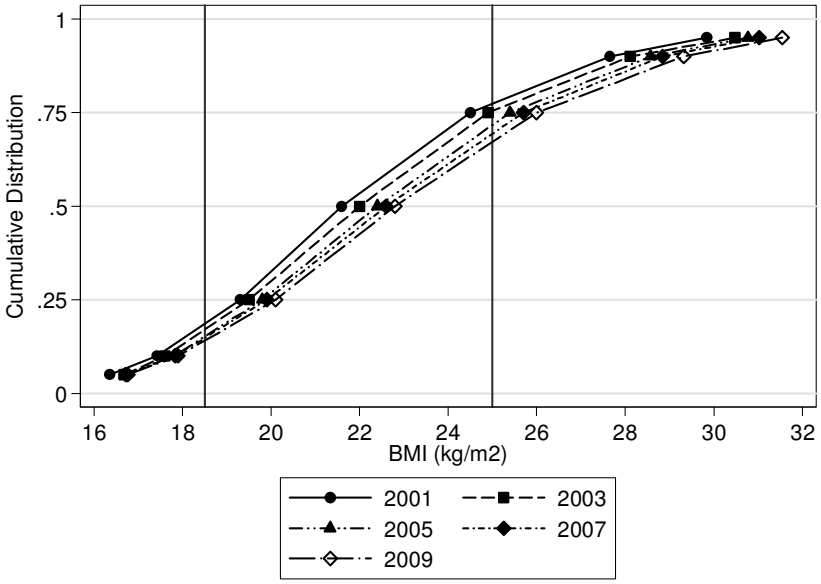
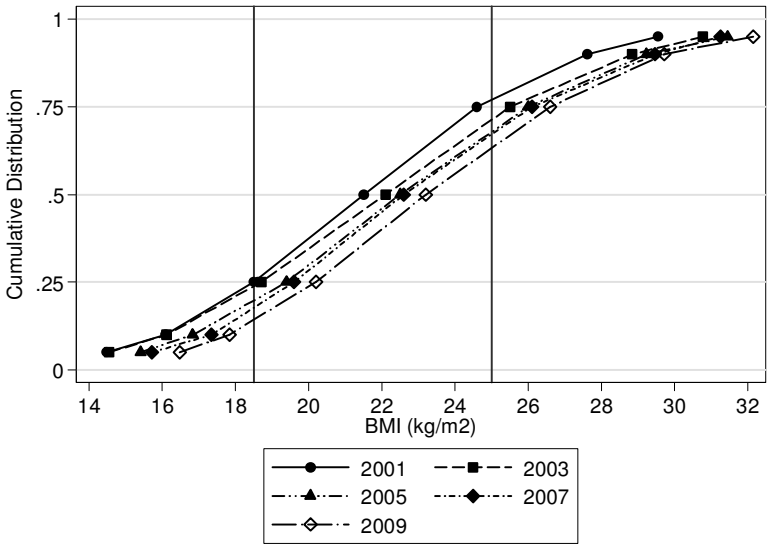


Table 7.2.2. indicates that mean BMI for PD patients from 2000 to 2009 is increasing from 21.6 to 24.1 despite a 3-fold increase in patient numbers. The percentage of PD patients with BMI ≥25 increased from 22% in 2000 to 38% in 2009. The shifting of the cumulative distribution curve for 2009 to the right reflects the small increases in BMI compared to the previous years. (Figure 7.2.2)

Table 7.2.2: Distribution of BMI, PD patients 2000-2009

Year	No.	Mean	SD	Median	LQ	UQ	% patients <18.5	% patients 18.5-25	% patients >=25
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	5.1	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	7.3	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	50	33
2007	1620	23.4	5.9	22.9	19.9	26.3	15	51	34
2008	1876	23.8	7.7	23.2	20.2	26.6	14	50	36
2009	1945	24.1	8.5	23.4	20.4	26.8	13	50	38

Figure 7.2.2: Cumulative distribution of BMI, PD patients 2000-2009



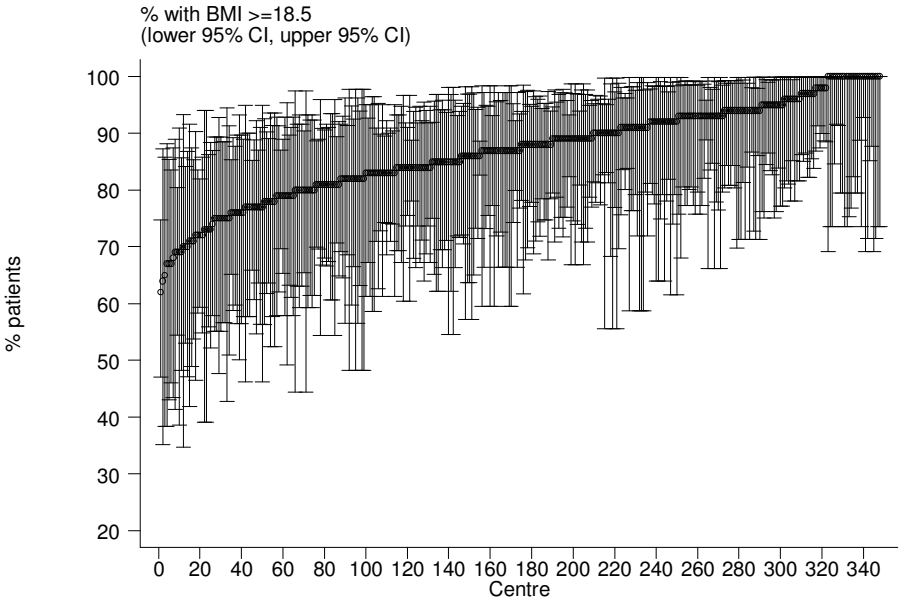
The variation in HD centres with proportion of patients with BMI ≥18.5 for 2009 is given in Table 7.2.3. The median for HD centers achieving the BMI target was 87.5% for the year 2009 and this trend is continuing from the previous years. One centre had all (100%) patients achieving BMI ≥18.5, whilst the worst center had 62% of patients achieving this target. For all HD centres, a 1.6-fold variation in meeting the BMI target was observed.

A smaller variation is present amongst 348 HD centers reporting the proportion of patients able to achieve the target BMI ≥18.5 for the year 2009. About 300 HD centres reported 75% of their patients achieving this target.

Table 7.2.3: Variation in Proportion of patients with BMI ≥ 18.5 among HD centres 2009

Year	No. of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
2000	91	53	65	77	83	89	96	100
2001	111	60	65	77	84	88	92	100
2002	133	55	67	79	85	89	100	100
2003	156	60	70	79	84	91	100	100
2004	189	62	68	82	86	91	100	100
2005	208	50	70	80.5	88	93	100	100
2006	262	53	70	80	86	92	100	100
2007	285	54	71	81	87	92	100	100
2008	330	58	70	82	88	93	100	100
2009	348	62	72	82	87.5	93	100	100

Figure 7.2.3: Variation in Proportion of patients with BMI ≥ 18.5 among HD centres 2009



For 21 PD centers in 2009, the maximum proportion of patients achieving the target BMI ≥18.5 was 97% whilst the worst centres reported 29% of the patients achieving this target. This represented a 3.3-fold difference in variation.

Figure 7.2.4 indicates that only 2 centers reported <50% of their patients achieving the target BMI ≥18.5 whilst 17 centers reported higher proportions (>75%) meeting the target.

Table 7.2.4: Variation in Proportion of patients with BMI ≥18.5 among PD centres 2009

Year	No. of centers	Min	5th centile	LQ	Median	UQ	95th centile	Max
2000	11	11	11	63	76	87	90	90
2001	11	15	15	72	77	88	92	92
2002	15	16	16	63	81	85	87	87
2003	18	17	17	74	81.5	88	96	96
2004	18	27	27	75	82.5	89	94	94
2005	18	17	17	69	83.5	87	91	91
2006	22	13	23	78	84	91	92	93
2007	22	14	21	76	87	92	97	100
2008	22	21	26	78	88	91	95	100
2009	21	29	42	80	89	93	95	97

Figure 7.2.4: Variation in Proportion of patients with BMI ≥18.5 among PD centres 2009

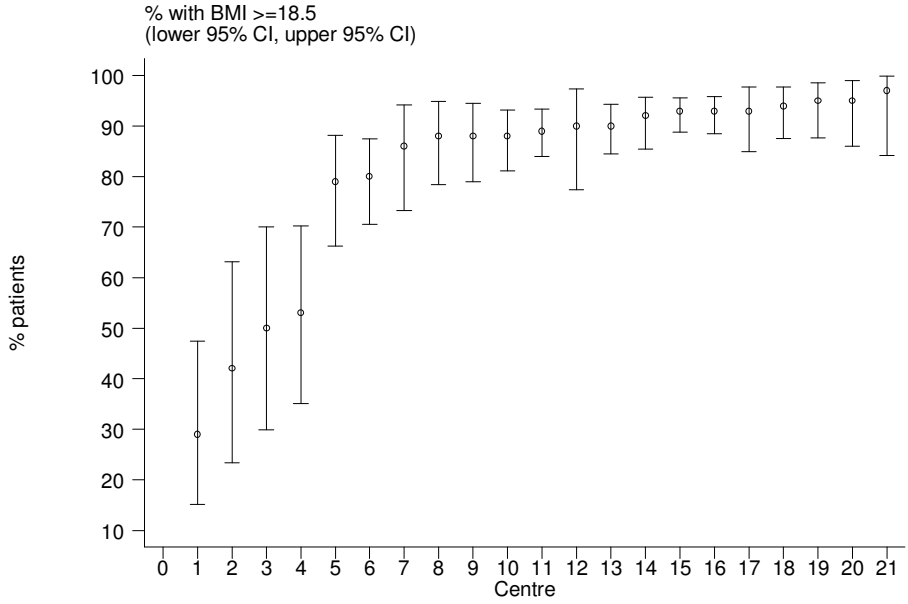


Table 7.2.5 and Figure 7.2.5 indicate a wide variation (23.3%) in the nutritional status of patients at 311 HD centers. Only 4% of patients in one centre met the criteria of BMI ≥18.5 and serum albumin ≥40 g/dL in contrast to 93% of patients in the best center meeting the criteria. A decreasing trend in centres with severely malnourished patients is observed.

Table 7.2.5: Variation in Proportion of patients with BMI ≥18.5 and serum albumin ≥40 g/dL among HD centres 2009

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
2009	311	0	4	30	45	60	76	93

Figure 7.2.5: Variation in Proportion of patients with BMI ≥18.5 and serum albumin ≥40 g/dL among HD centres 2009

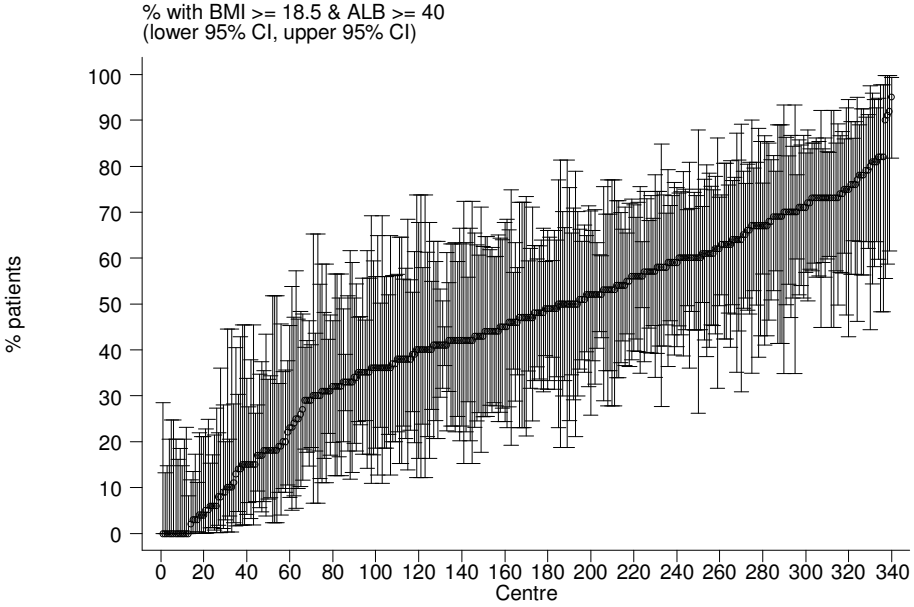
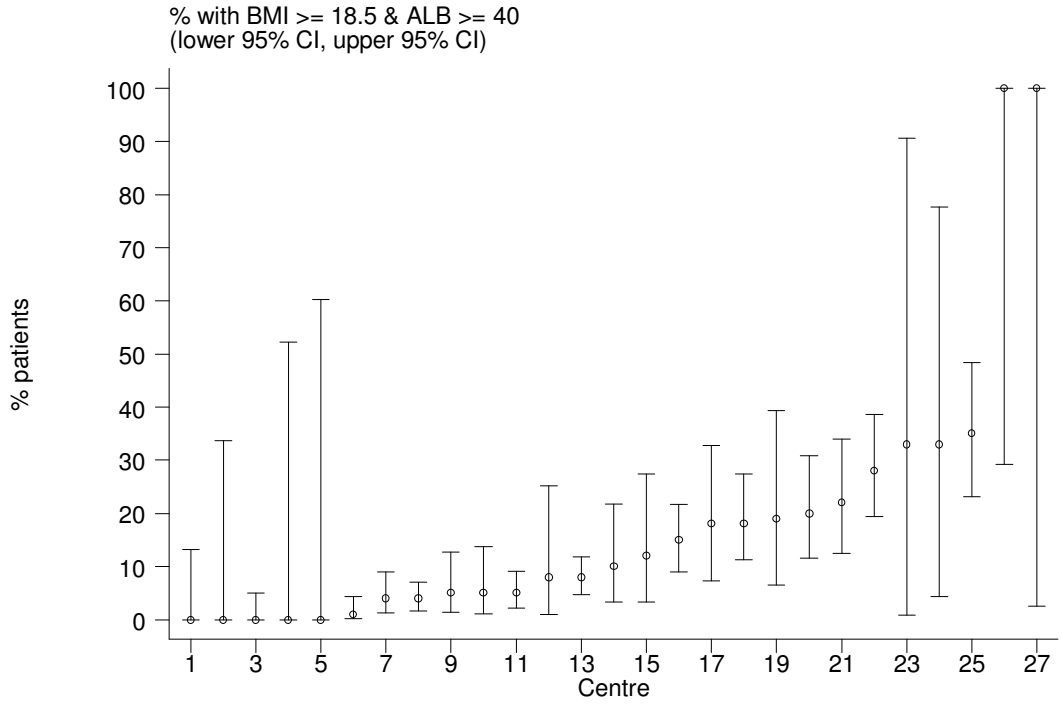


Table 7.2.6 and Figure 7.2.6 indicate a wide variation (15.2%) in the nutritional status of patients at 22 PD centers. Only 5% of patients in one centre met the criteria of BMI ≥18.5 and serum albumin ≥40 g/dL in contrast to 76% of patients in the best center meeting the criteria. An increasing trend in improvement of nutritional status is observed with these centres.

Table 7.2.6: Variation in Proportion of patients with BMI ≥18.5 and serum albumin ≥40 g/dL among PD centres 2009

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
2009	22	5	8	17	34	54	71	76

Figure 7.2.6: Variation in Proportion of patients with BMI ≥18.5 and serum albumin ≥40 g/dL among PD centres 2009



CHAPTER 8

Blood Pressure Control and Dyslipidaemia in Patients on Dialysis

S. Prasad Menon
Lee Wan Tin

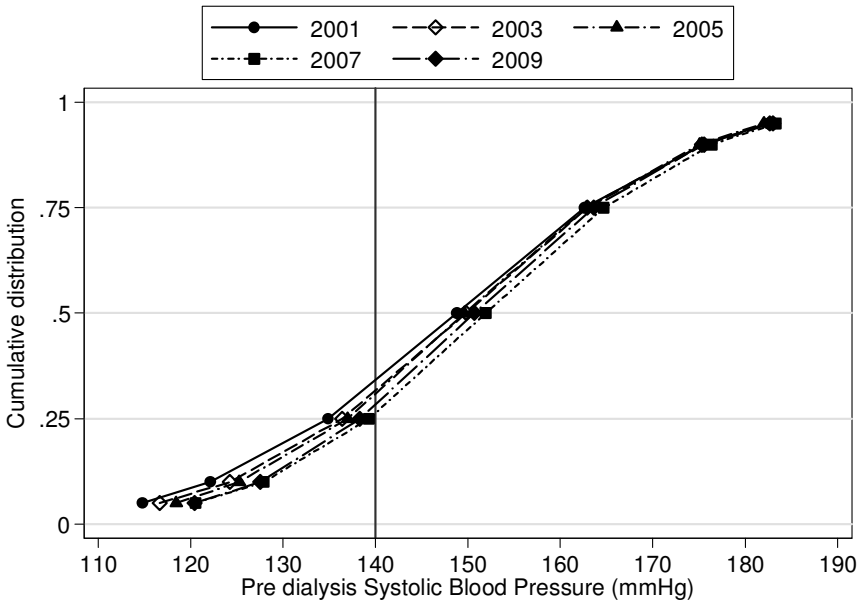
SECTION 8.1: BLOOD PRESSURE CONTROL ON DIALYSIS

As we enter into the final year of the first decade of the 21st century, pre-dialysis systolic blood pressure in haemodialysis patients in Malaysia remains sub-optimally controlled with only 28% of haemodialysis patients achieving systolic BP < 140 mmHg in 2009 (Table 8.1.1). The mean and median pre-dialysis systolic blood pressure in haemodialysis patients were still unacceptably high at 151.1 mmHg and 150.7 mmHg respectively in 2009.

Table 8.1.1: Distribution of Pre dialysis Systolic Blood Pressure, HD patients 2000-2009

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
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	15263	152	19	151.9	139.4	164.6	4	21	40	27	7
2009	17450	151.1	19	150.7	138.3	163.6	5	23	41	25	6

Figure 8.1.1: Cumulative distribution of Pre dialysis Systolic Blood Pressure, HD patients 2000-2009

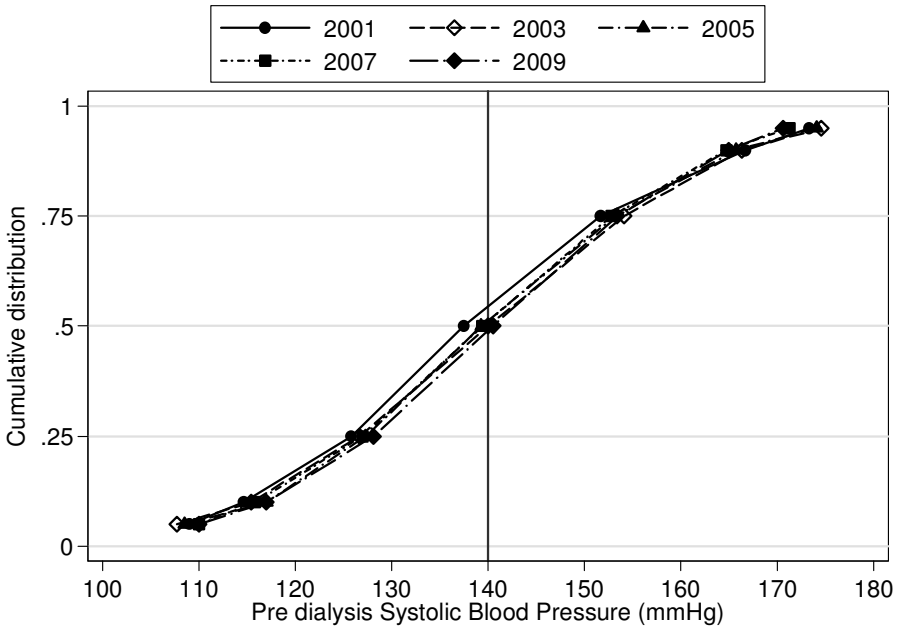


As in previous years pre-dialysis systolic blood pressure was better controlled in PD patients compared to haemodialysis patients in 2009, with 48% of PD patients having a pre-dialysis systolic BP < 140 mmHg (Table 8.1.2). The mean and median pre-dialysis systolic BP in PD patients were also lower than haemodialysis patients at 140.7 mmHg and 140.5 mmHg respectively in 2009.

Table 8.1.2: Distribution of Pre dialysis Systolic Blood Pressure, PD patients 2000-2009

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
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
2009	2174	140.7	18.7	140.5	128.1	153.4	13	35	35	14	2

Figure 8.1.2: Distribution of Pre dialysis Systolic Blood Pressure, PD patients 2000-2009

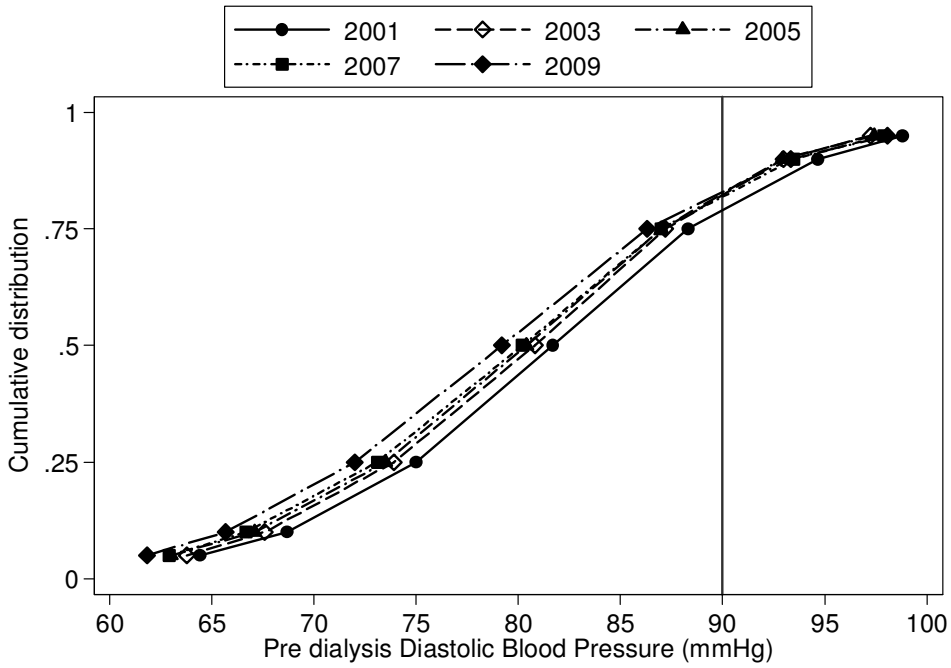


In contrast to systolic blood pressure, pre-dialysis diastolic blood pressure in haemodialysis patients in 2009 was better controlled, with 83% of such patients achieving diastolic BP < 90 mmHg (Table 8.1.3). The mean and median pre-dialysis diastolic blood pressure in haemodialysis patients were satisfactory at 79.6 mmHg and 79.2 mmHg respectively in 2009.

Table 8.1.3: Distribution of Pre dialysis Diastolic Blood Pressure, HD patients 2000-2009

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
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	15261	79.8	11.2	79.6	72.4	86.7	18	33	33	13	3
2009	17449	79.6	12	79.2	72	86.3	19	33	31	12	4

Figure 8.1.3: Cumulative Distribution of Pre dialysis Diastolic Blood Pressure, HD patients 2000-2009

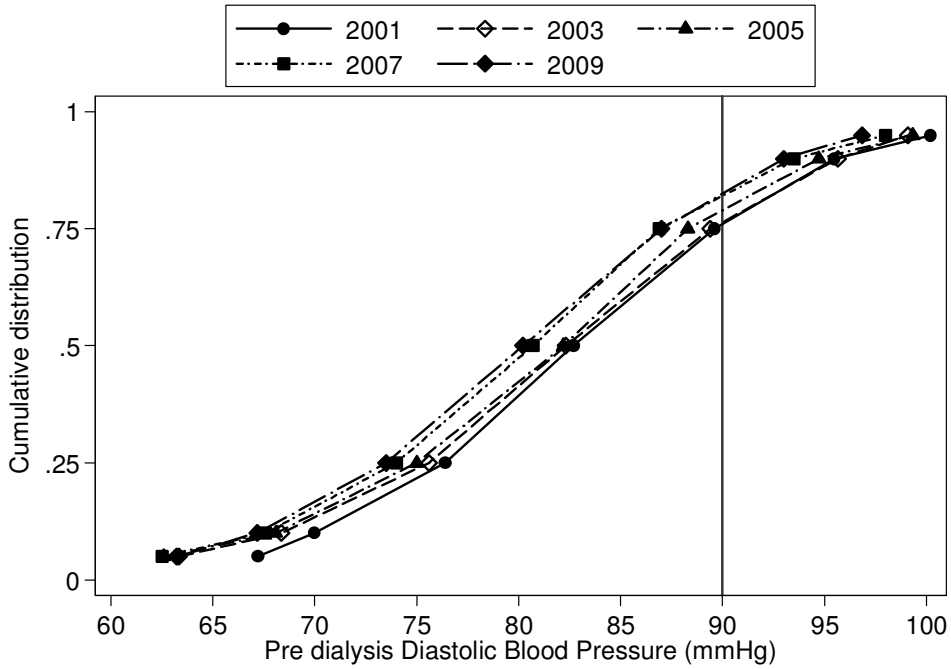


The percentage of PD patients achieving pre-dialysis diastolic blood pressure < 90 mmHg was exactly identical to haemodialysis patients at 83% in 2009 (Table 8.1.4). The mean and median pre-dialysis diastolic blood pressure in PD patients were also satisfactory at 80.2 mmHg and 80.2 mmHg respectively in 2009.

Table 8.1.4: Distribution of Pre dialysis Diastolic Blood Pressure, PD patients 2000-2009

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
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
2009	2174	80.2	10.3	80.2	73.5	87	15	33	35	14	3

Figure 8.1.4: Cumulative Distribution of Pre dialysis Diastolic Blood Pressure, PD patients 2000-2009



There was a mild variation in pre-dialysis median systolic blood pressure and predialysis median diastolic blood pressure among haemodialysis centres in 2009 (Table 8.1.5a and Table 8.1.5b).

Table 8.1.5: Variation in BP control among HD centres 2009

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

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	105	130.6	137.1	143.3	148	153.1	162.8	167.7
2001	125	126.9	136.2	143.3	149.2	154.8	161.8	180.5
2002	148	126.7	136.7	144.8	149.2	154.4	162	169.7
2003	176	126.7	136.6	144.9	150.2	155.5	161.3	173.7
2004	212	120	138.1	145	149.9	155.5	162.4	168.3
2005	239	130	136.7	143.6	150.1	154.6	160.9	172.9
2006	288	127.9	138.4	146.4	151.3	156.1	163.1	180.1
2007	316	133.1	140.1	147.4	151.6	156.9	164.4	175
2008	364	130	140	147.5	152.2	157.2	164.4	171
2009	395	121.7	139.7	146.5	151.3	156	162.5	170.3

Figure 8.1.5 (a): Variation in median systolic blood pressure among HD patients, HD centres 2009

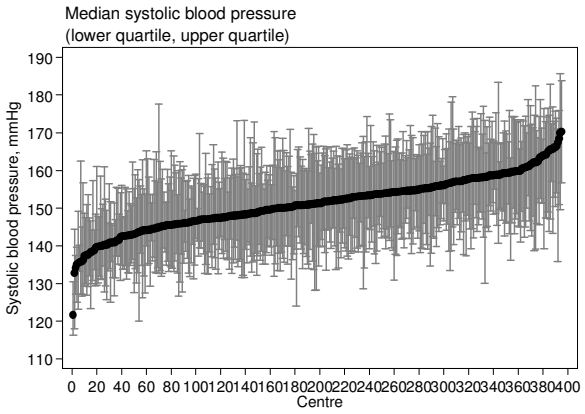


Figure 8.1.5 (b): Variation in median diastolic blood pressure among HD patients, HD centres 2009

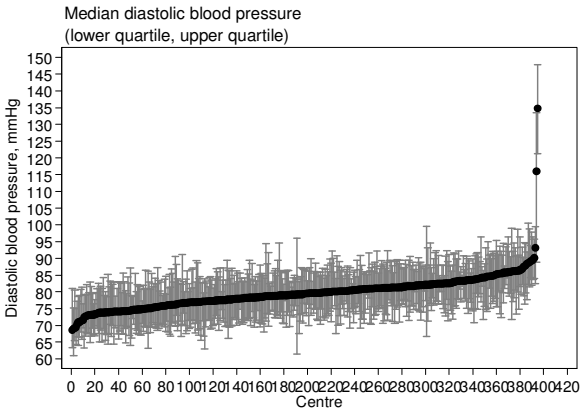


Table 8.1.5 (b): Median Diastolic blood pressure among HD patients, HD centres

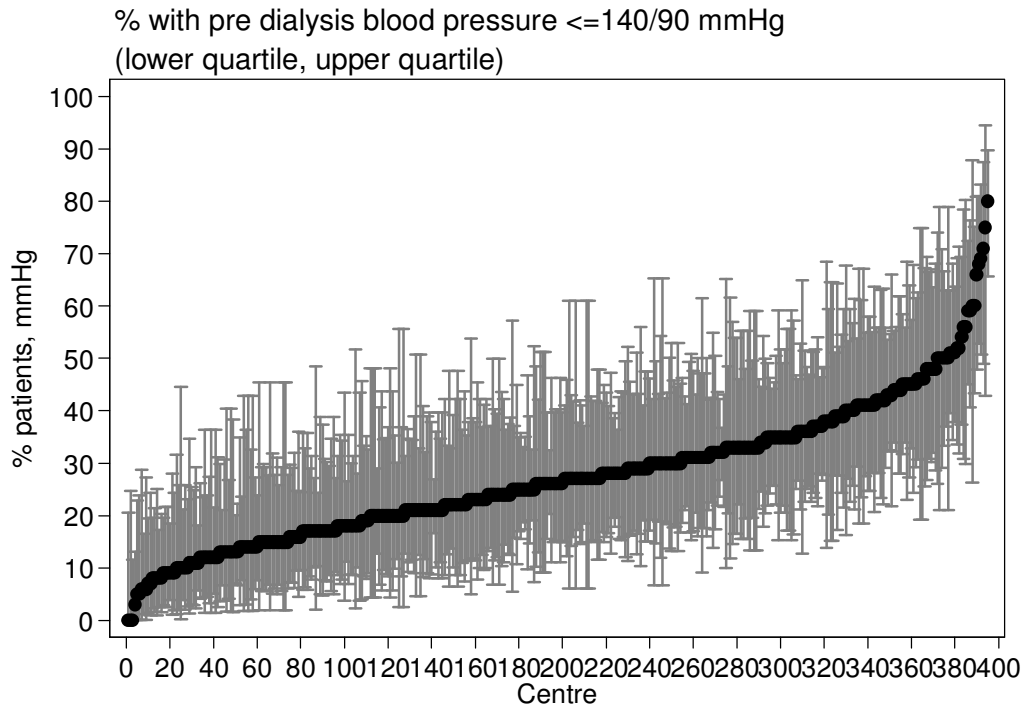
Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	105	75.1	76.8	80	82.2	84.7	89.3	92.4
2001	125	73.9	76	79.8	81.9	83.7	87.5	91.3
2002	148	72.2	76	79.4	81.3	83.7	87.4	92
2003	176	70.1	75.4	78.5	80.8	83.6	86.7	93.3
2004	212	70.3	74	78	80.8	82.5	86.8	89.1
2005	239	67.4	73.1	78	80.4	82.8	86.7	90.1
2006	288	67.3	74.3	78	80.5	83	87.1	104.9
2007	316	70.1	73.6	77.8	80.2	82.8	87.3	124.5
2008	364	66.8	73.6	77	79.9	82.4	86.5	92.3
2009	395	68.5	73.3	76.8	79.4	82	86.2	134.8

There appears to be a wide variation among haemodialysis centres in the proportion of patients achieving BP < 140/90 mmHg (Table 8.1.5c and Figure 8.1.5c). This pattern is similar to previous years.

Table 8.1.5 (c): Proportion of HD patients with pre dialysis blood pressure < 140/90 mmHg, HD centres

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	105	4	12	21	32	43	60	73
2001	125	0	10	20	30	42	58	73
2002	148	0	11	21	29	39	59	71
2003	176	5	9	21	27.5	38	58	80
2004	212	0	9	20	29	39	57	90
2005	239	4	11	20	27	40	56	90
2006	288	0	9	17	25	34.5	52	73
2007	316	0	8	17	25.5	33	48	73
2008	364	0	8	17	24	33	50	75
2009	395	0	9	18	26	35	50	80

Figure 8.1.5 (c): Variation in proportion of HD patients with pre dialysis blood pressure < 140/90 mmHg, HD centers 2009



There is some variation in predialysis median systolic blood pressure and predialysis median diastolic blood pressure among PD centres in 2009 (Table 8.1.6a and Table 8.1.6b). It is noted that the number of PD centres in 2009 is still much lower than the number of haemodialysis centres.

Table 8.1.6: Variation in BP control among PD centres 2009

(a) Median systolic blood pressure among PD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	123.6	123.6	134.5	140	144.5	148.2	148.2
2003	18	123.8	123.8	132.4	142.6	144.3	151.8	151.8
2004	18	122.9	122.9	134.5	139.8	144.3	149.7	149.7
2005	19	120.8	120.8	134.8	136.8	142	158	158
2006	22	113	118.3	130.7	136.3	140.4	146	154.9
2007	23	113	114.2	130.2	137.8	141.8	147.4	153.5
2008	22	111.8	118.1	136	138.3	141.9	147.7	147.9
2009	23	113.8	117	133.3	138.4	144.9	150.5	161.5

Figure 8.1.6 (a): Variation in median systolic blood pressure among PD patients, PD centres 2009

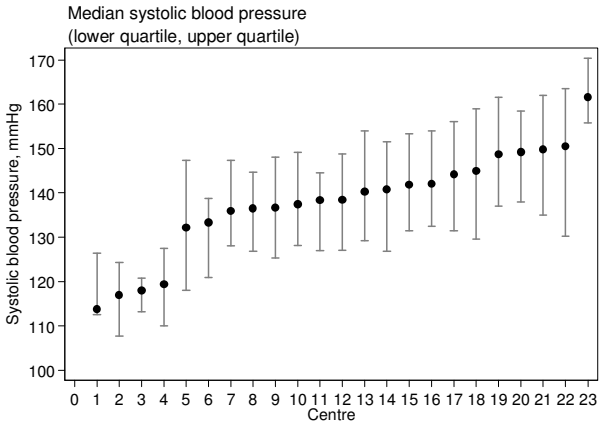


Figure 8.1.6 (b): Variation in median diastolic blood pressure among PD patients, PD centres 2009

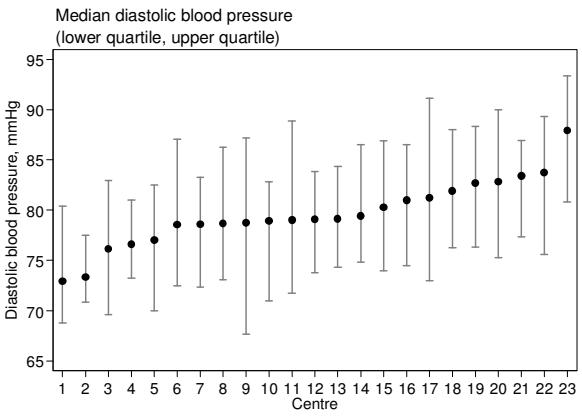


Table 8.1.6 (b): Median Diastolic blood pressure among PD patients, PD centres

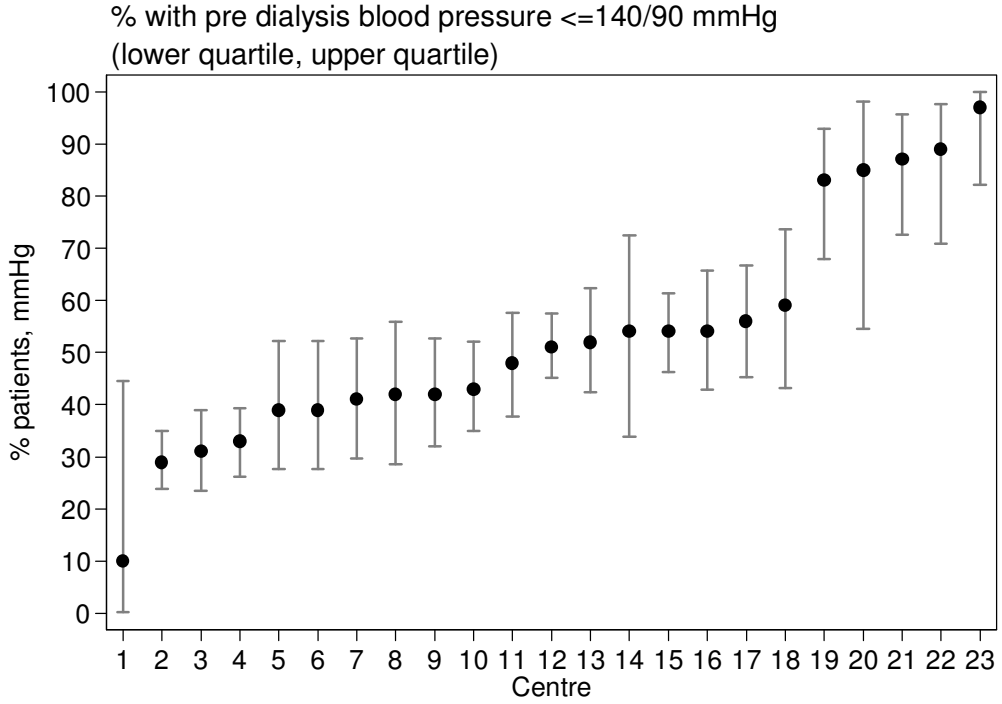
Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	11	73.1	73.1	80	83	84.4	88	88
2001	11	78	78	80.9	83.4	84.8	88	88
2002	15	75.7	75.7	81.8	83.3	85.7	89.5	89.5
2003	18	77.2	77.2	81.2	82.9	84	88	88
2004	18	77.5	77.5	80.8	83.4	84.3	87	87
2005	19	74.4	74.4	80.5	82.8	84.2	86	86
2006	22	71.6	73.5	77.6	81.3	82.4	86.5	88.4
2007	23	67	72.5	78.8	80.6	82.3	83.2	87
2008	22	75.3	76.7	77.9	79.8	82	84.5	86.8
2009	23	72.9	73.3	78.5	79.1	81.9	83.8	87.9

Similar to haemodialysis centres, there is a wide variation among PD centres in the proportion of patients achieving BP < 140/90 mmHg in 2009 (Table 8.1.6c and Figure 8.1.6c).

Table 8.1.6 (c): Proportion of PD patients with pre dialysis blood pressure < 140/90 mmHg, PD centres

Year	No. of centre	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	90	90
2003	18	28	28	38	46	65	77	77
2004	18	30	30	38	47.5	56	74	74
2005	19	23	23	43	55	62	92	92
2006	22	18	37	44	58.5	69	100	100
2007	23	27	29	44	54	68	91	92
2008	22	28	29	43	52	59	85	96
2009	23	10	29	39	51	59	89	97

Figure 8.1.6 (c): Variation in proportion of PD patients with pre dialysis blood pressure ≤140/90 mmHg, PD centres 2009



In summary pre-dialysis systolic blood pressure in haemodialysis patients in Malaysia in 2009 remains sub-optimally controlled while diastolic blood pressure in haemodialysis patients was better controlled. On the other hand both systolic and diastolic blood pressure were well controlled in the majority of PD patients. Further attention to fluid control, suitable low salt diet, regular exercise and antihypertensive medications in haemodialysis patients is warranted.

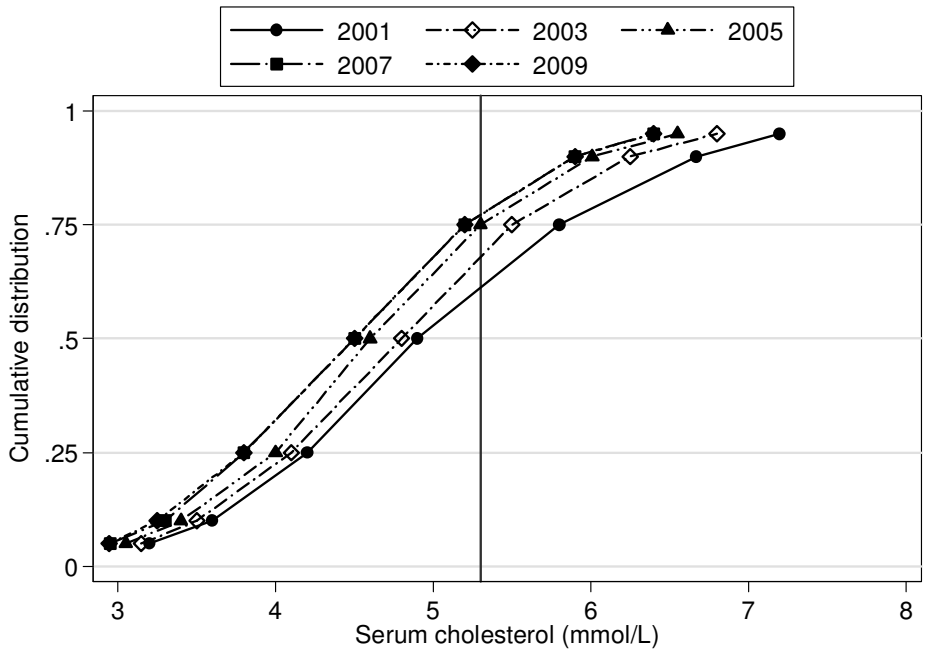
SECTION 8.2: DYSLIPIDAEMIA IN DIALYSIS PATIENTS

The total cholesterol levels in haemodialysis patients was better in 2009 compared to that at the beginning of the decade in 2000, with 77% of haemodialysis patients achieving total cholesterol <5.3 mmol/l (Table 8.2.1 and Figure 8.2.1) compared with a percentage of only 61% in the year 2000. The mean and median serum cholesterol levels in haemodialysis patients were 4.6 mmol/l and 4.5 mmol/l respectively in 2009. Perhaps collecting further data in the future such as HDL cholesterol and LDL cholesterol levels will give a better insight into the true lipid profile of patients with end stage renal failure.

Table 8.2.1: Distribution of serum Cholesterol, HD patients 2000-2009

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
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	13771	4.5	1.1	4.4	3.8	5.2	15	63	16	6
2009	15613	4.6	1.1	4.5	3.8	5.2	14	63	16	6

Figure 8.2.1: Cumulative distribution of Cholesterol, HD patients 2000-2009

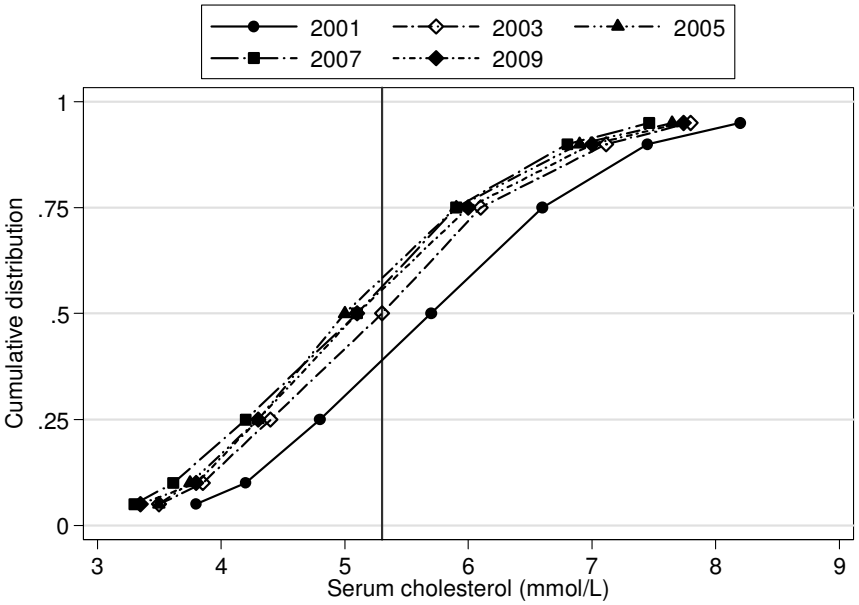


In contrast, total cholesterol levels in PD patients was less optimally controlled in comparison with HD patients, with 56% of PD patients achieving total cholesterol < 5.3 mmol/l in 2009 (Table 8.2.2 and Figure 8.2.2). However this figure of 56% is still better than the figure at the beginning of this decade in the year 2000 when only 34% of PD patients achieved total cholesterol < 5.3 mmol/l. The mean and median serum cholesterol levels in PD patients were 5.3 mmol/l and 5.1 mmol/l respectively in 2009.

Table 8.2.2: Distribution of serum Cholesterol, PD patients 2000-2009

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
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
2009	2013	5.3	1.5	5.1	4.3	6	6	50	24	20

Figure 8.2.2: Cumulative distribution of Cholesterol (mmol/L), PD patients 2000-2009



As in previous years, serum triglyceride control was better in haemodialysis patients than PD patients, with 75% of haemodialysis patients achieving serum triglyceride levels < 2.3 mmol/l (Table 8.2.3 and Figure 8.2.3) compared to 67% of PD patients achieving serum triglyceride level < 2.3 mmol/l in 2009 (Table 8.2.4 and Figure 8.2.4). It is noted that control of triglyceride levels in both haemodialysis and PD patients have progressively improved over the past 10 years.

Table 8.2.3: Distribution of serum Triglyceride, HD patients 2000-2009

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
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	12877	1.9	1.2	1.6	1.1	2.3	56	20	15	8
2009	14886	1.9	1.3	1.6	1.1	2.3	54	21	16	9

Figure 8.2.3: Cumulative distribution of serum triglyceride, HD patients 2000-2009

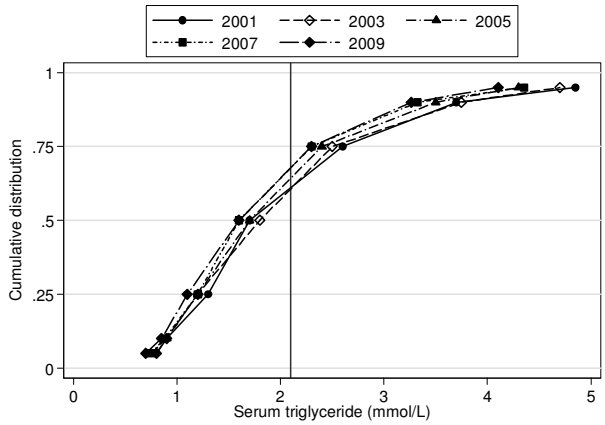


Figure 8.2.4: Cumulative distribution of serum triglyceride, PD patients 2000-2009

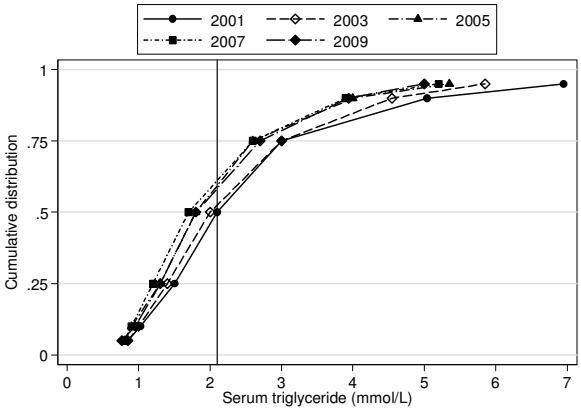


Table 8.2.4: Distribution of serum Triglyceride, PD patients 2000-2009

Year	No. of subjects	Mean	SD	Me-dian	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
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
2009	2014	2.2	1.6	1.8	1.3	2.7	46	21	20	14

The mild variation in median serum cholesterol levels and proportion of patients with serum cholesterol < 5.3 mmol/l in haemodialysis centres in 2009 were similar to previous years (Table 8.2.5a and Table 8.2.5b). It is noted that the median of the proportion of patients with serum cholesterol level < 5.3 mmol/l in HD centres has significantly increased from 61% in 2000 to 78% in 2009 (Table 8.2.5b) reflecting improved cholesterol control over the past decade.

Table 8.2.5: Variation in dyslipidaemia among HD centres 2009

(a) Median serum cholesterol level among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	76	4	4.3	4.7	4.9	5.2	5.5	5.7
2001	94	4.1	4.4	4.7	5	5.2	5.6	6.3
2002	122	4.3	4.5	4.7	4.9	5.1	5.5	6.4
2003	151	4.2	4.3	4.6	4.8	5	5.3	5.6
2004	178	3.9	4.2	4.5	4.7	4.9	5.3	6.2
2005	213	3.8	4.1	4.4	4.6	4.8	5.3	5.7
2006	267	3.4	3.9	4.3	4.6	4.8	5.1	5.7
2007	288	3.7	4	4.3	4.5	4.8	5	5.5
2008	338	3.4	3.9	4.2	4.5	4.8	5.1	5.7
2009	365	3.5	4	4.3	4.6	4.8	5.1	5.7

Figure 8.2.5 (a): Variation in median serum cholesterol level among HD patients, HD centres 2009

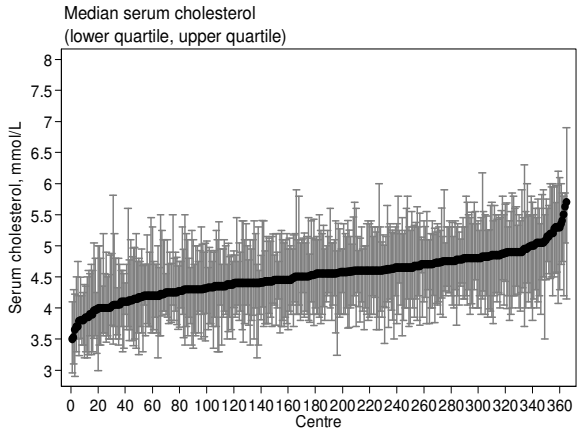


Figure 8.2.5 (b): Variation in proportion of patients with serum cholesterol < 5.3 mmol/l, HD centres 2009

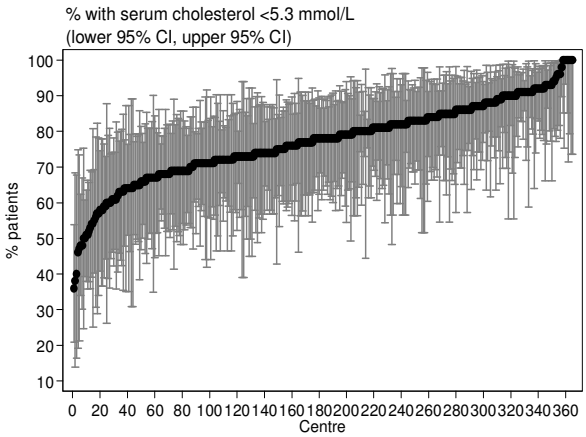


Table 8.2.5 (b): Proportion of HD patients with serum cholesterol < 5.3 mmol/L

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	76	36	40	52.5	61	70	86	93
2001	94	14	36	54	60	68	80	89
2002	122	28	46	58	64	71	79	93
2003	151	40	47	60	68	76	83	92
2004	178	38	47	62	69.5	79	90	94
2005	213	38	53	67	73	81	91	95
2006	267	29	55	69	76	83	92	100
2007	288	35	58	69	77	84	94	100
2008	338	36	58	71	79	86	93	100
2009	365	36	57	71	78	85	93	100

There was only a mild variation in median serum triglyceride levels in haemodialysis patients in 2009 while the variation in the proportion of patients with serum triglyceride < 2.1 mmol/l in haemodialysis centres appears greater in the same year (Table 8.2.5c and Table 8.2.5d). In comparison with serum cholesterol levels, the median of the proportion of haemodialysis patients with serum triglyceride <2.1 mmol/l has also increased slightly from 66% in 2000 to 70% in 2009.

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

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	59	1	1.4	1.5	1.8	2	2.6	2.8
2001	81	1.1	1.4	1.5	1.7	2	2.3	2.5
2002	98	1.1	1.4	1.6	1.8	2	2.3	3.2
2003	127	1.2	1.3	1.5	1.7	1.9	2.2	2.5
2004	154	1	1.3	1.5	1.7	1.8	2.2	3
2005	195	0.9	1.3	1.5	1.7	1.9	2.2	2.8
2006	255	0.9	1.3	1.5	1.6	1.8	2.2	4.1
2007	276	0.8	1.2	1.4	1.6	1.8	2.1	3.5
2008	314	1	1.2	1.4	1.6	1.7	2	2.4
2009	343	1	1.2	1.4	1.6	1.8	2.1	2.5

Figure 8.2.5 (c): Variation in median serum triglyceride level among HD patients, HD centers 2009

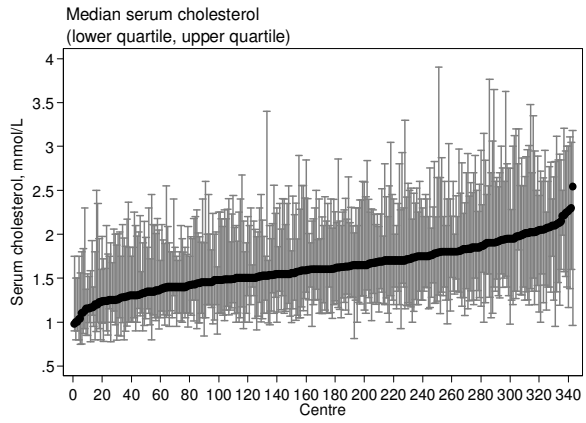


Figure 8.2.5 (d): Variation in proportion of patients with serum triglyceride < 2.1mmol/L, HD centers 2009

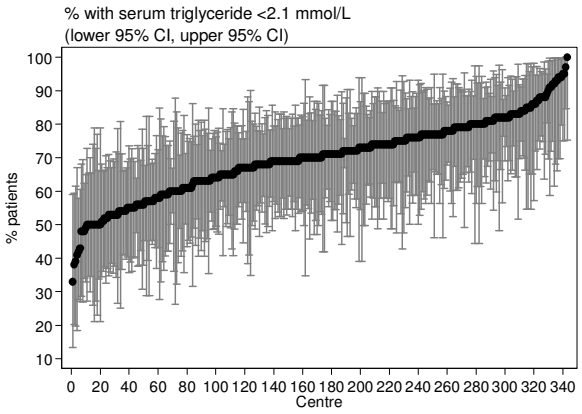


Table 8.2.5 (d): Proportion of HD patients with serum triglyceride < 2.1mmol/L

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	59	23	30	57	66	73	83	87
2001	81	38	45	57	65	76	86	90
2002	98	27	44	55	65.5	73	81	93
2003	127	27	45	58	68	75	90	100
2004	154	14	47	60	68	78	87	93
2005	195	29	42	59	67	75	84	100
2006	255	0	47	63	70	76	88	100
2007	276	36	49	63	70	78	88	100
2008	314	36	54	64	71	79	88	100
2009	343	33	50	63	70	78	88	100

In 2009 there was only a mild variation in median serum cholesterol levels in PD patients while the variation in the proportion of patients with serum cholesterol <5.3 mmol/l in PD centres appears greater in the same year (Table 8.2.6a and Table 8.2.6b). Similar to haemodialysis patients, the median of the proportion of patients with total cholesterol level < 5.3 mmol/l in PD centres has increased significantly this decade from 31% in 2000 to 53% in 2009 (Table 8.2.6b), again reflecting gradual improvement in cholesterol control in PD patients over the past 10 years.

Table 8.2.6: Variation in dyslipidaemia among PD centres 2009

(a) Median serum cholesterol level among PD patients, PD centres

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	6.1	6.1
2004	18	4.6	4.6	4.9	5.2	5.5	6.1	6.1
2005	19	4.4	4.4	4.7	5	5.4	5.8	5.8
2006	21	4.4	4.6	4.9	5	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	5.1	5.4	5.6	6.2
2009	21	4.6	4.7	4.8	5.1	5.3	5.9	6.7

Figure 8.2.6 (a): Variation in median serum cholesterol level among PD patients, PD centres 2009

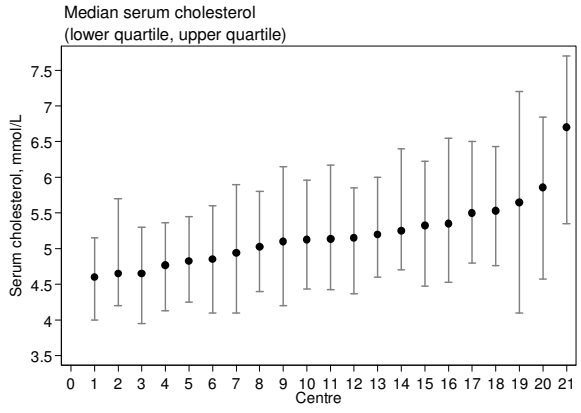


Figure 8.2.6 (b): Variation in proportion of patients with serum cholesterol < 5.3 mmol/L, PD centres 2009

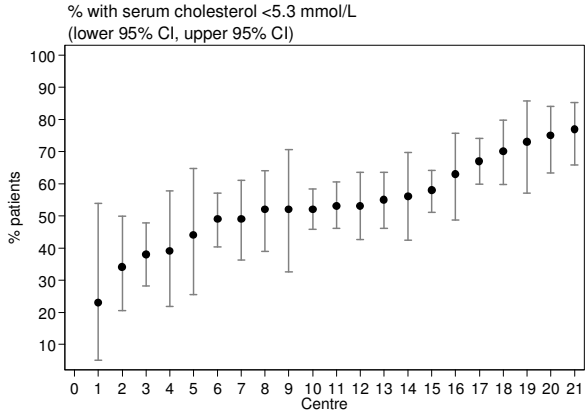


Table 8.2.6 (b): Proportion of PD patients with serum cholesterol < 5.3 mmol/L

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	10	11	11	18	31	46	54	54
2001	10	22	22	30	34.5	45	63	63
2002	15	13	13	33	42	45	80	80
2003	18	18	18	39	48.5	59	83	83
2004	18	21	21	42	51.5	60	71	71
2005	19	28	28	49	60	70	77	77
2006	21	20	24	48	59	66	75	79
2007	23	29	30	46	53	68	77	86
2008	22	38	41	47	58	67	75	76
2009	21	23	34	49	53	63	75	77

As in previous years, there was only mild variation among PD centres with the median triglyceride levels in PD patients as well as proportion of patients with serum triglyceride levels < 2.1 mmol/l (Table 8.2.6.c and Table 8.2.6.d). The median of the proportion of PD patients with serum triglyceride < 2.1 mmol/l has gradually increased from 49% in 2000 to 61% in 2009.

Table 8.2.6 (c): Median serum triglyceride level among PD patients, PD centres

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	1.9	2.3	2.3
2004	18	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	1.9	2.1	2.6
2007	23	1.2	1.5	1.7	1.8	1.9	2.2	2.7
2008	24	1.3	1.5	1.7	1.8	2	2.2	2.2
2009	22	1.4	1.5	1.7	1.8	1.9	2.2	2.5

Figure 8.2.6 (c): Variation in median serum triglyceride level among PD patients, PD centres 2009

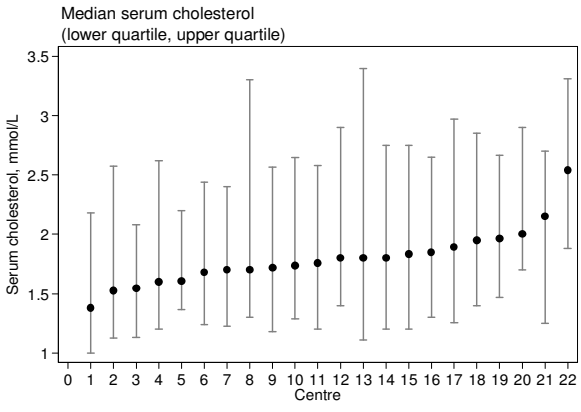


Figure 8.2.6 (d): Variation in proportion of patients with serum triglyceride < 2.1mmol/L, PD centres 2009

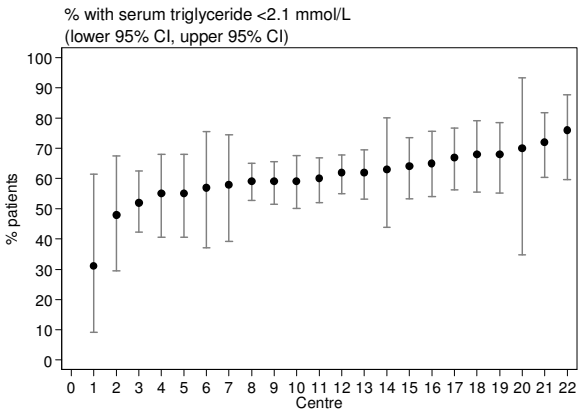


Table 8.2.6 (d): Proportion of PD patients with serum triglyceride < 2.1mmol/L

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	10	18	18	42	49	54	62	62
2001	10	27	27	50	53	58	68	68
2002	15	38	38	52	56	58	76	76
2003	18	49	49	55	58.5	62	92	92
2004	18	47	47	60	62	67	89	89
2005	19	40	40	55	60	69	92	92
2006	21	33	50	57	61	63	78	82
2007	23	40	48	57	64	69	80	81
2008	24	46	48	55	62	66.5	80	85
2009	22	31	48	57	61	67	72	76

In summary control of total serum cholesterol and serum triglyceride levels were poorer in PD patients compared to haemodialysis in 2009. It is however noted that control of total cholesterol and triglyceride levels has improved over this past decade.

CHAPTER 9

Management of Renal Bone Disease in Patients on Dialysis

Fan Kin Sing
Rozina Ghazalli
Ching Chen Hua
Liew Yew Fong

SECTION 9.1: TREATMENT OF RENAL BONE DISEASE

Calcium carbonate remained the main phosphate binder for both HD patients (92%) and PD patients (85%) over the last decade. The percentage of patients on aluminium based phosphate binders had decreased steadily for both HD and PD patients from 5.4% and 2.26% in 2000 to 0.18% and 0.34 in 2009 respectively. On the other hand, the use of lanthanum as non-calcium based phosphate binder has increased from 0.13% and 0.18% in 2006 to 1.39% and 2.24% in 2009 respectively. In fact its use has doubled in the last one year from 0.56% and 1.00% in 2008 to 1.39% and 2.24% in 2009 for both HD and PD patients. There was a higher percentage of PD patients taking lanthanum compared to HD patients. Calcitriol remained the main Vitamin D used in the treatment of renal bone disease for both HD and PD patients. The percentage of patients on calcitriol therapy had increased steadily over the years for both HD and PD patients. Paricalcitol was first used in Malaysia in 2006 and its use had nearly doubled for HD patients between 2008 and 2009 (0.28% to 0.45%) but it remained static for PD patients during this period (0.15% versus 0.14%). The percentage of patients that underwent parathyroidectomy had decreased for the first time in 2009 from 1.13% in 2008 to 0.95% in 2009 for HD patients and from 0.64% to 0.46% for PD patients. Twice as many HD patients underwent parathyroidectomy in 2009 compared to PD patients (0.95% vs 0.46%). (Table 9.1.1 and 9.1.2)

Table 9.1.1 Treatment for renal bone disease, HD patients, 2000-2009

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 Paricalcitol	No. of subjects had Para-thyroidectomy
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	15348	14090	92	72	86	5890	38	43	174
2009	17545	16076	92	32	244	7189	41	79	167

Table 9.1.2 Treatment for renal bone disease, PD patients, 2000-2009

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 Paracalcitol	No. of subjects had Para-thyroidectomy
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
2009	3476	2939	85	12	78	1125	32	5	16

SECTION 9.2: SERUM CALCIUM AND PHOSPHATE CONTROL

The median corrected serum calcium level has remained stable for the last decade for both HD and PD patients. There were more HD patients with normal range calcium level (2.1 to 2.37 mmol/l) compared to PD patients (52% vs 39%). (Table and Figure 9.2.1 and 9.2.2)

Table 9.2.1: Distribution of corrected serum calcium, HD patients, 2000-2009

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% patients ≥2.1& ≤2.37 mmol/L
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	14427	2.3	0.2	2.3	2.1	2.4	53
2009	16471	2.3	0.2	2.3	2.2	2.4	52

Figure 9.2.1 Cumulative distribution of corrected serum calcium, HD patients, 2000-2009

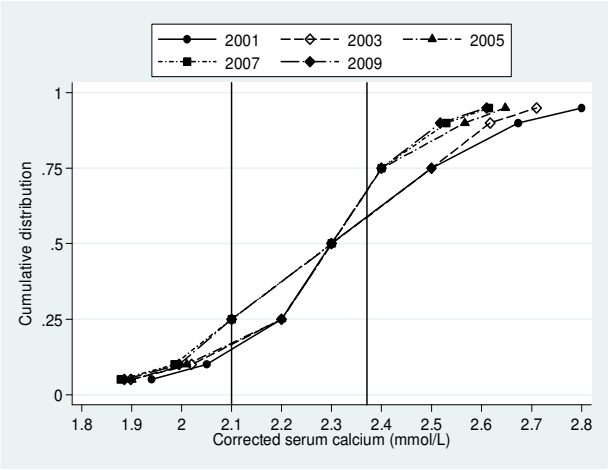


Figure 9.2.2: Cumulative distribution of corrected serum calcium, PD patients, 2000-2009

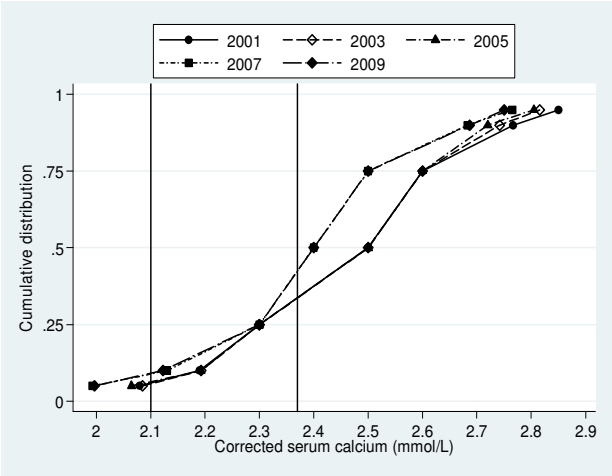


Table 9.2.2: Distribution of corrected serum calcium, PD patients, 2000-2009

Year	No. of subjects	Mean	SD	Median	LQ	UQ	%patients ≥2.1& ≤2.37 mmol/L
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
2009	2132	2.4	0.2	2.4	2.2	2.5	39

Phosphate control among HD and PD patients had also been quite constant for the past decade. However, PD patients had better phosphate control compared to HD patients (median level 1.5 vs 1.7mmol/l) and a larger percentage of PD patients had normal range phosphate level (1.13-1.78mmol/l) as opposed to HD patients (53 vs 47%). (Table and Figure 9.2.3 and 9.2.4)

Table 9.2.3: Distribution of serum phosphate, HD patients, 2000-2009

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
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	14823	1.7	0.5	1.7	1.4	2	9	48	37	5
2009	16842	1.8	0.5	1.7	1.4	2.1	8	47	40	6

Figure 9.2.3: Cumulative distribution of serum phosphate, HD patients, 2000-2009

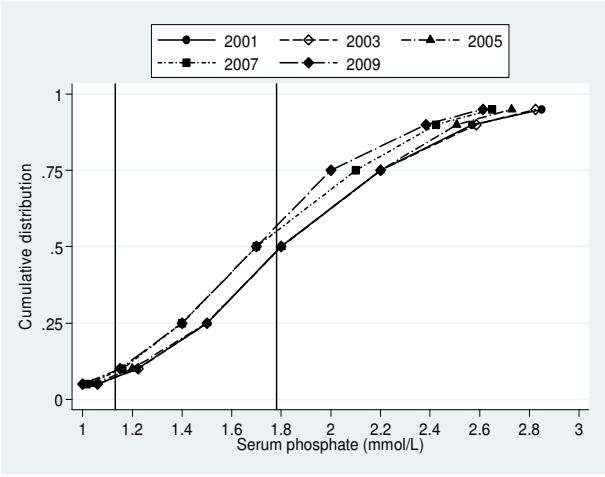


Figure 9.2.4: Cumulative distribution of serum phosphate, PD patients, 2000-2009

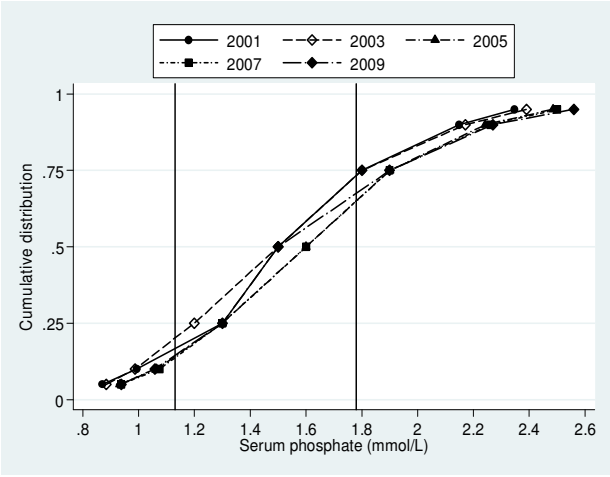


Table 9.2.4: Distribution of serum phosphate, PD patients, 2000-2009

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
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
2009	2144	1.6	0.5	1.5	1.2	1.9	16	53	27	4

The corrected calcium phosphate product had remained stable for the last 5 years for both HD and PD patients (median 3.9 and 3.6 $mmol^2/L^2$ respectively). However, PD patients had better calcium phosphate product compared to HD patients. About 46% of PD patients had corrected calcium phosphate product <3.5 $mmol^2/L^2$ compared to 36% in HD patients. (Table and Figure 9.2.5 and 9.2.6)

Table 9.2.5: Distribution of corrected calcium x phosphate product, HD patients 2000-2009

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 $mmol^2/L^2$
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	14309	3.9	1.2	3.8	3.1	4.6	39	33	19	9
2009	16334	4	1.2	3.9	3.2	4.7	36	34	20	11

Figure 9.2.5: Cumulative distribution of corrected calcium x phosphate product, HD patients 2000-2009

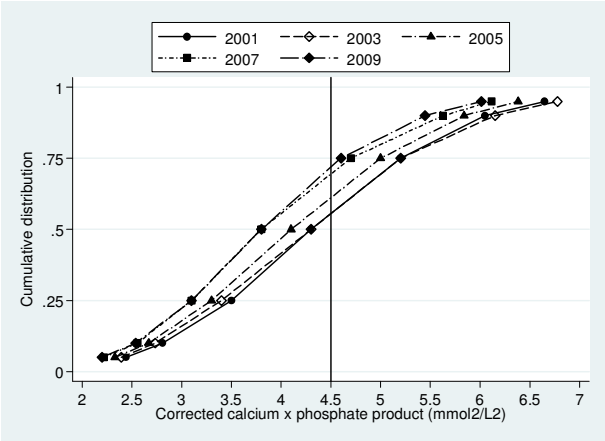


Figure 9.2.6: Cumulative distribution of corrected calcium x phosphate product, PD patients 2000-2009

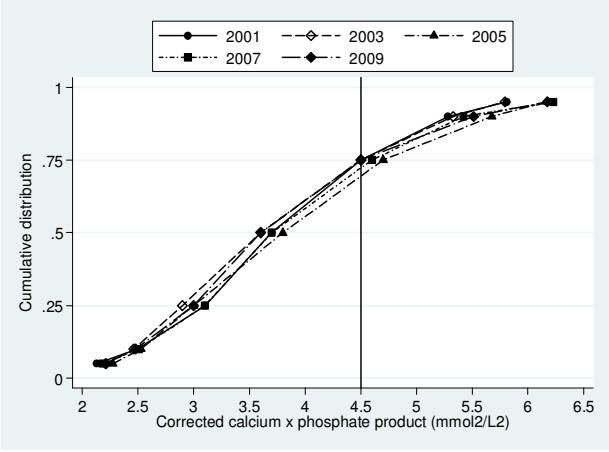


Table 9.2.6: Distribution of corrected calcium x phosphate product, PD patients 2000-2009

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 $mmol^2/L^2$
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
2009	2127	3.8	1.2	3.6	2.9	4.5	46	29	15	11

There was wide variation in corrected serum calcium level among both HD and PD centres even though the median corrected serum calcium had remained relatively constant over the last 10 years. The variation was wider for HD centres in 2009, ranging from 1.5 to 2.6 mmol/l (Table 9.2.7 and Figure 9.2.7a) compared to PD centers, which ranged from 2.2 to 2.6 mmol/l. (Table 9.2.8 and Figure 9.2.8a)

Table 9.2.7: Variation in corrected serum calcium level among HD centres, 2009
a) median serum calcium level among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	91	2	2.1	2.3	2.3	2.4	2.6	3.2
2001	117	2	2.1	2.3	2.3	2.4	2.5	2.6
2002	139	1.9	2.1	2.3	2.3	2.4	2.5	2.6
2003	171	2	2.1	2.2	2.3	2.4	2.5	2.5
2004	201	1.9	2.1	2.2	2.3	2.4	2.4	2.5
2005	229	1.8	2	2.2	2.3	2.3	2.4	2.5
2006	279	1.9	2.1	2.2	2.3	2.3	2.4	2.5
2007	311	1.8	2	2.2	2.2	2.3	2.4	2.5
2008	349	1.8	2.1	2.2	2.2	2.3	2.4	2.6
2009	384	1.5	2.1	2.2	2.3	2.3	2.4	2.6

Figure 9.2.7(a): Variation in median serum calcium among HD patients, HD centres, 2009

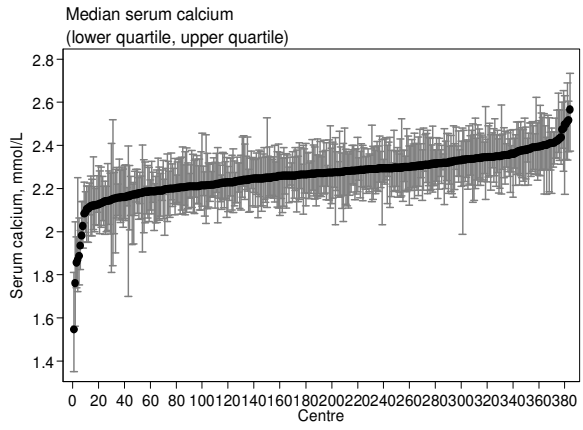


Figure 9.2.8(a): Variation in median serum calcium level among PD patients, PD centres, 2009

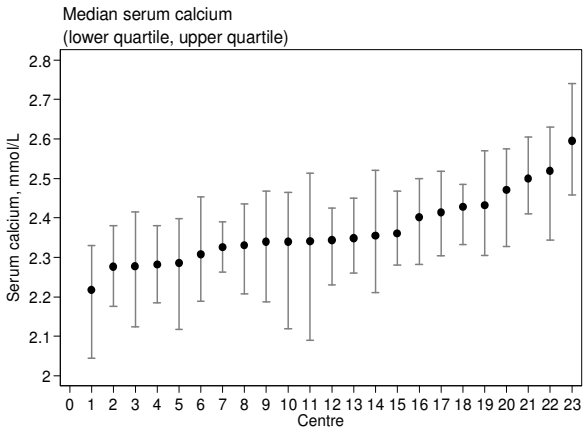


Table 9.2.8: Variation in corrected serum calcium level among PD centres, 2009
a) median serum calcium level among PD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	18	2.2	2.2	2.4	2.4	2.5	2.6	2.6
2004	18	2.3	2.3	2.4	2.4	2.5	2.5	2.5
2005	19	2.2	2.2	2.4	2.4	2.4	2.6	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
2009	23	2.2	2.3	2.3	2.3	2.4	2.5	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 0 to 90% for HD centres and 10-65% for PD centers. The median was 53% for HD centres (Table and Figure 9.2.7b) and 41% for PD centres (Table and Figure 9.2.8b).

Table 9.2.7(b): Proportion of patients with serum calcium 2.1 to 2.37 mmol/L, HD centres, 2009

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	91	0	13	29	42	50	69	96
2001	117	7	11	30	39	50	65	87
2002	139	5	17	33	44	52	66	71
2003	171	13	24	36	46	56	70	91
2004	201	8	20	38	47	58	70	82
2005	229	0	19	39	50	56	70	84
2006	279	13	30	42	50	60	73	90
2007	311	9	28	44	52	60	74	88
2008	349	9	29	46	53	60	75	87
2009	384	0	29	44.5	53	62	72	90

Figure 9.2.7(b): Variation in proportion of patients with serum calcium 2.1 to 2.37 mmol/L, HD centres, 2009

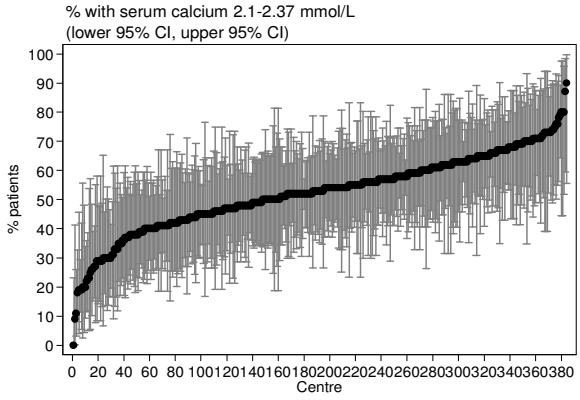


Figure 9.2.8(b): Variation in proportion of patients with serum calcium 2.1 to 2.37 mmol/L, PD centres, 2009

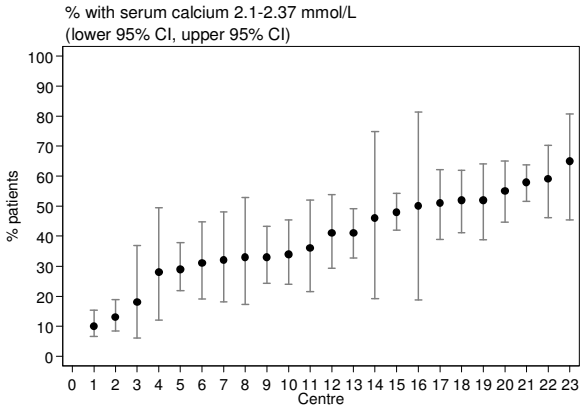


Table 9.2.8(b): Proportion of patients with serum calcium 2.1 to 2.37 mmol/L, PD centres

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	18	9	9	19	32	39	58	58
2004	18	11	11	18	24.5	31	53	53
2005	19	17	17	25	34	40	51	51
2006	22	16	23	35	42	49	60	76
2007	23	20	26	31	44	50	62	63
2008	24	13	14	31.5	43	51.5	58	65
2009	23	10	13	31	41	52	59	65

There was also wide variation in serum phosphate level among HD and PD centers even though the median value was static over the years. The variation was narrower among PD centers, ranging from 1.3mmol/l to 2.2mmol/l compared to HD centers, which ranged from 1mmol/l to 2.4mmol/l (Table 9.2.9 and 9.2.10, Figure 9.2.9a and 9.2.10a). About 54% of PD centres achieved the recommended target of serum phosphate level 1.13 – 1.78 mmol/l compared to 47% of HD centres. There was a wide variation between the HD centres with regards to the proportion of patients with serum phosphate 1.13 – 1.78 mmol/l, ranging from 6 to 83% while the variation was narrower among PD centres ranging from 20 to 69%. (Table and Figure 9.2.9b and 9.2.10b)

Table 9.2.9: Variation in serum phosphate level among HD centres, 2000-2009
a) Median serum phosphate level among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	99	1.4	1.6	1.7	1.9	2	2.2	3.8
2001	118	1.3	1.5	1.7	1.8	2	2.1	2.4
2002	146	1.3	1.5	1.8	1.9	2	2.2	2.4
2003	175	0.9	1.5	1.7	1.8	1.9	2.2	2.4
2004	201	1.4	1.5	1.7	1.8	1.9	2.1	2.3
2005	229	0.8	1.4	1.6	1.8	1.9	2.1	2.2
2006	281	0.9	1.5	1.6	1.7	1.8	2	2.3
2007	312	0.9	1.5	1.6	1.7	1.8	2	2.3
2008	357	1.2	1.5	1.6	1.7	1.8	2	2.5
2009	388	1	1.5	1.6	1.7	1.8	2	2.4

Figure 9.2.9(a): Variation in median serum phosphate level among HD patients, HD centres, 2009

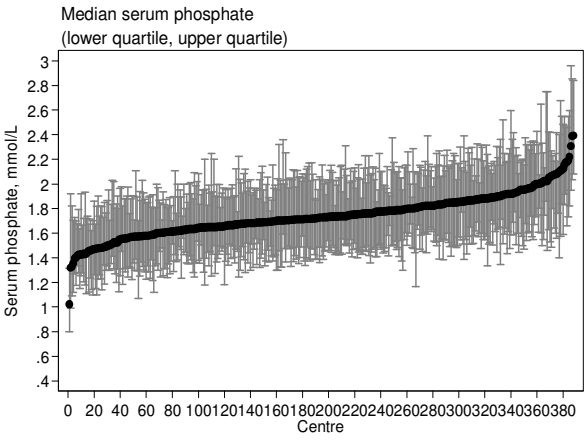


Figure 9.2.9(b): Variation in proportion of patients with serum phosphate 1.13-1.78 mmol/L, HD centres, 2009

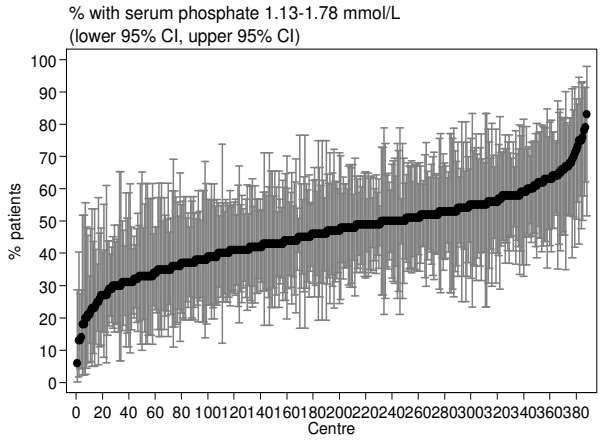


Table 9.2.9(b) Proportion of patients with serum phosphate 1.13-1.78 mmol/L, HD centres, 2000-2009

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	99	9	17	29	36	44	58	73
2001	118	0	17	32	39	47	62	67
2002	146	6	15	30	37.5	46	65	91
2003	175	9	20	31	40	48	67	93
2004	201	0	18	30	41	50	64	92
2005	229	10	25	36	43	52	68	90
2006	281	7	27	39	46	53	70	93
2007	312	13	29	39	46	54.5	67	92
2008	357	12	29	39	48	56	68	92
2009	388	6	27	38	47	54	66	83

Table 9.2.10: Variation in serum phosphate levels among PD centres, to 2000-2009
a) Median serum phosphate level among PD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	18	1.3	1.3	1.5	1.5	1.6	1.7	1.7
2004	18	1.4	1.4	1.5	1.5	1.7	1.8	1.8
2005	19	1.4	1.4	1.5	1.5	1.7	1.9	1.9
2006	22	1.3	1.4	1.5	1.6	1.7	1.8	1.9
2007	23	1.3	1.4	1.5	1.6	1.7	1.9	2.4
2008	24	1.3	1.3	1.5	1.6	1.8	2	2.1
2009	23	1.3	1.4	1.5	1.6	1.7	1.9	2.2

Figure 9.2.10(a): Variation in median serum phosphate level among PD patients, PD centres 2009

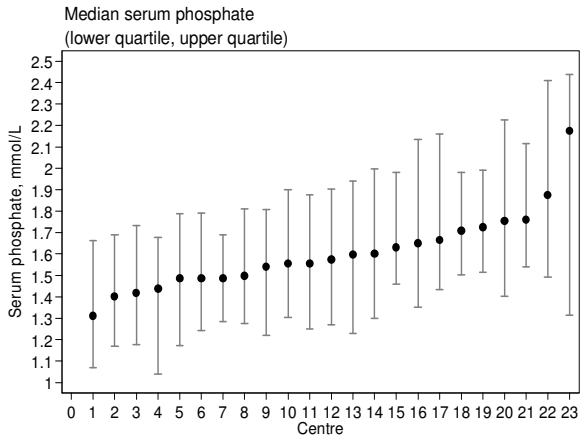


Figure 9.2.10(b): Variation in proportion of patients with serum phosphate 1.13-1.78 mmol/L, PD centres 2009

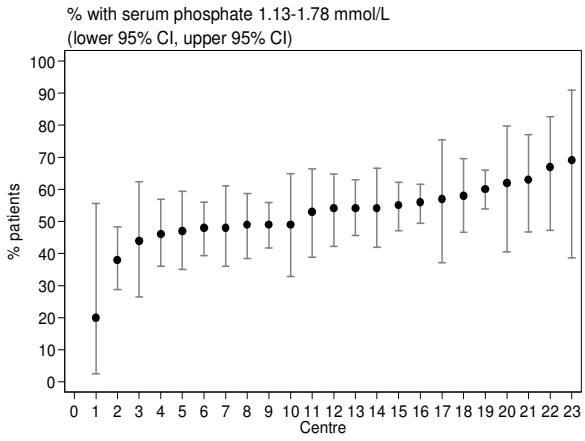


Table 9.2.10(b): Proportion of patients with serum phosphate 1.13-1.78 mmol/L, PD centres 2000-2009

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	18	43	43	52	54	58	77	77
2004	18	37	37	49	52.5	60	76	76
2005	19	38	38	46	53	57	76	76
2006	22	42	42	48	52.5	58	66	68
2007	23	39	40	48	53	58	73	78
2008	24	30	38	47	52	59	66	71
2009	23	20	38	48	54	58	67	69

In 2009, the corrected serum calcium phosphate product among 380 HD centres ranged from 2.3 to 6.1 with median of 3.9 $mmol^2/L^2$ (Table 9.2.11 and Figure 9.2.11a). The median corrected serum calcium phosphate product among 23 CAPD centres ranged from 3.3 to 4.8 $mmol^2/L^2$ with median of 3.7 $mmol^2/L^2$ (Table 9.2.12 and Figure 9.2.12a). There was wider centre variation for HD compare to PD probably because there were more new HD centres registered each year while the PD centres remained static.

Table 9.2.11: Variation in corrected calcium x phosphate product HD centres, 2000-2009
a) median corrected calcium x phosphate product among HD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	90	3.1	3.5	4	4.3	4.6	5.1	6.2
2001	114	2.9	3.6	3.9	4.2	4.6	5	6
2002	139	2.9	3.5	4	4.3	4.6	5.1	5.9
2003	171	2.1	3.3	3.8	4.1	4.5	5	5.5
2004	199	2.9	3.3	3.8	4.1	4.4	4.9	5.6
2005	221	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	4.6	5.2
2007	308	2.2	3.2	3.6	3.9	4.1	4.5	5.1
2008	346	2.7	3.2	3.6	3.8	4.1	4.5	5.9
2009	380	2.3	3.2	3.6	3.9	4.1	4.7	6.1

Figure 9.2.11(a): Variation in median corrected calcium x phosphate product among HD patients, HD centres, 2009

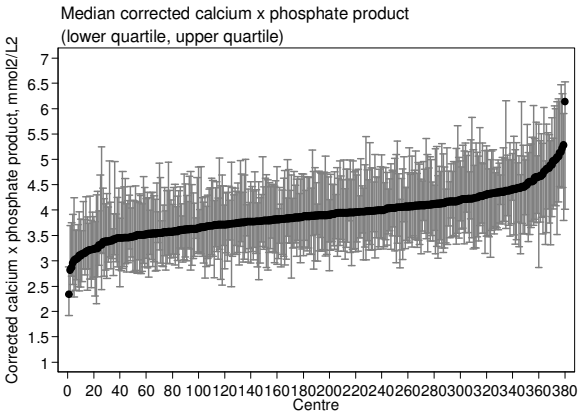


Figure 9.2.12(a): Variation in median corrected calcium x phosphate product among PD centres, to 2009

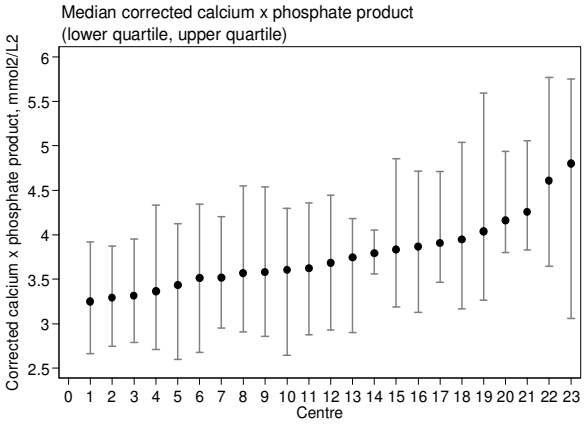


Table 9.2.12: Variation in corrected calcium x phosphate product among PD centres, 2000-2009
(a) median corrected calcium x phosphate product among PD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	18	3.2	3.2	3.4	3.7	3.9	4.1	4.1
2004	18	3.3	3.3	3.5	3.8	4	4.4	4.4
2005	19	3.3	3.3	3.5	3.7	4	4.3	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	4.2	4.4	4.6
2008	24	3.1	3.1	3.5	3.7	4.1	4.6	5.1
2009	23	3.3	3.3	3.5	3.7	3.9	4.6	4.8

With regards to the proportion of patients with calcium phosphate product less than 4.5 $mmol^2/L^2$, the median was 70% for HD centres (Table & Figure 9.2.11b) and 76% for PD centres (Table & Figure 9.2.12 b). This figure was the highest achieved in PD centres for the last 5 years and but it had been quite static among HD centres. 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 27% to 100%. (Table 9.2.11b) Among the PD centres, the proportion of patients with calcium phosphate product less than 4.5 $mmol^2/L^2$ ranged from 40% to 86% (Table 9.2.12b). Similarly, these variations were wider among HD centres as opposed to PD centres as a result of more new HD centers were registered while PD centre numbers in fact reduced by one compared to last year.

Table 9.2.11(b): Proportion of patients with corrected calcium x phosphate < 4.5 $mmol^2/L^2$, HD centres 2000-2009

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	90	13	25	48	56.5	67	80	88
2001	114	18	39	47	56.5	70	81	91
2002	139	13	32	48	57	68	89	100
2003	171	25	33	50	62	71	85	100
2004	199	15	38	53	64	72	90	100
2005	221	24	45	58	68	77	91	100
2006	276	30	46	60.5	69	79	91	100
2007	308	37	50	62.5	72	80	92	100
2008	346	23	50	64	72	81	92	100
2009	380	27	43.5	62	70	79	90	100

Figure 9.2.11(b): Variation in propotion of patients with corrected calcium x phosphate product < 4.5 $mmol^2/L^2$, HD centres 2009

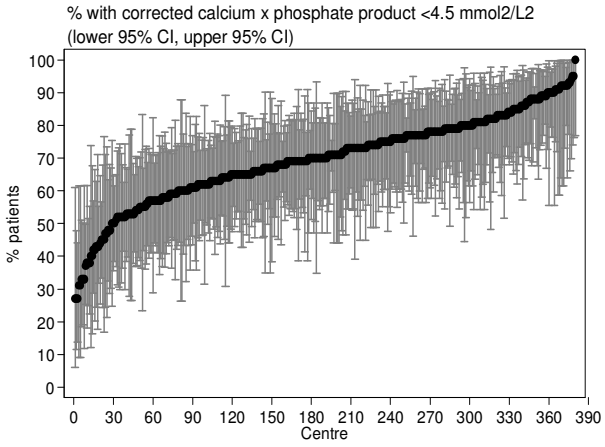


Figure 9.2.12(b): Variation in proportion of patients with corrected calcium x phosphate product < 4.5 $mmol^2/L^2$, PD centres, 2009

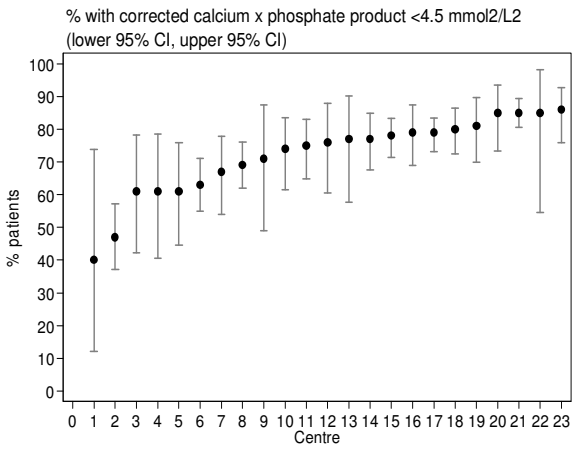


Table 9.2.12(b): Proportion of patients with corrected calcium x phosphate < 4.5 $mmol^2/L^2$, PD centre 2000-20009

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	18	61	61	64	74.5	82	88	88
2004	18	57	57	66	73	78	89	89
2005	19	55	55	65	73	78	85	85
2006	22	55	57	66	72	78	88	96
2007	23	50	50	61	73	78	89	98
2008	24	40	46	63	70	81	90	97
2009	23	40	47	63	76	80	85	86

SECTION 9.3: SERUM PARATHYROID HORMONE CONTROL

Current trend showed that the intact parathyroid hormone (iPTH) level was on a rising trend in both HD and PD patients for the past 10 years. PD patients had relatively higher level of iPTH compared to HD patients. The mean iPTH level for HD patients was 270ng/ml with a median of 141.1ng/ml (Table and Figure 9.3.1a). For PD patients, the mean iPTH level was 270.2ng/ml with a median of 174.2ng/ml. (Table and Figure 9.3.2a). There was higher percentage of HD patients with iPTH level less than 150 ng/ml (52%) compared to PD patients (45%). Diabetic patients had lower iPTH levels than non diabetic patients in both HD and PD populations, with the mean of 218.3ng/ml vs 313.9ng/ml for HD patients and 188.6ng/ml vs. 335.2ng/ml for PD patients. (Table and Figure 9.3.1b, 9.3.1c, 9.3.2b and 9.3.2c)

Table 9.3.1(a): Distribution of iPTH, HD patients, 2000-2009

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
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	10720	260.1	330.1	126.2	36	360	54	17	13	17
2009	12391	270	337.3	141.1	40.4	367.4	52	18	13	17

Figure 9.3.1(a): Cumulative distribution of iPTH, HD, 2000-2009

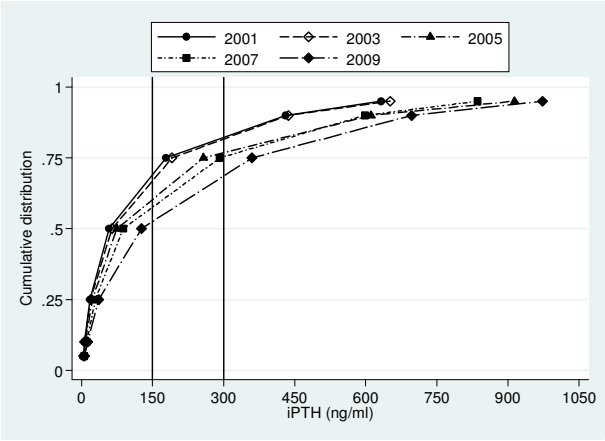


Figure 9.3.1(b): Cumulative distribution of iPTH, diabetic HD patients, 2000-2009

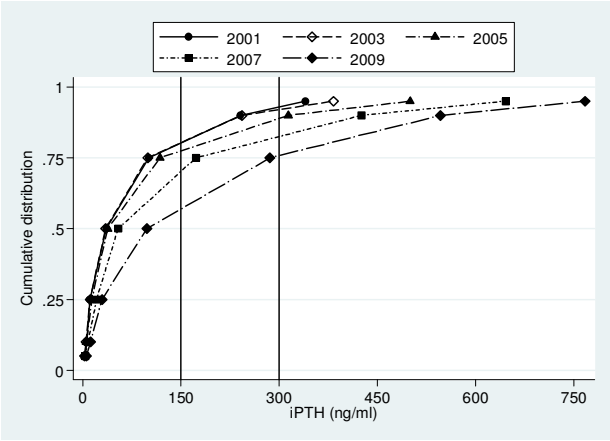


Table 9.3.1(b): Distribution of iPTH, diabetic HD patients, 2000-2009

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
2000	532	87.3	136.9	35.8	10.8	100.8	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	1250	122.1	210.7	40.6	13.5	124.5	78	10	6	6
2004	1582	113.4	196.2	38	14	118	80	10	5	5
2005	2166	150.6	248	47.5	16.4	171	72	12	8	8
2006	3149	154.5	252	54	20.9	173	72	12	8	7
2007	3811	184.5	269.3	71.2	23	238.5	65	14	10	10
2008	4748	208.1	274.4	98	29.2	286	59	17	12	12
2009	5683	218.3	284.2	111.5	33.7	292	57	18	12	12

Table 9.3.1(c): Distribution of iPTH, non diabetic HD patients, 2000-2009

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
2000	1712	168.6	248.9	65.8	21.8	204.3	69	14	9	9
2001	2040	162	238.1	71	23.5	198	69	16	7	8
2002	2424	189.2	270.2	85	26	236.8	65	15	10	10
2003	2818	262.1	361.1	108.8	33.6	331	57	16	10	17
2004	3166	261.4	363.9	102.9	31	341	58	14	12	17
2005	3660	263.6	338.2	115	36	365	55	15	13	17
2006	4595	263.4	332.8	125.3	39.6	366	54	16	13	17
2007	5340	289.5	365.1	135.5	39	406	52	15	13	20
2008	5972	301.5	363.1	157.7	43.3	425	49	17	14	21
2009	6708	313.9	370.8	173.5	49	441.4	47	17	15	21

Figure 9.3.1(c): Cumulative distribution of iPTH, non diabetic HD patients, 2000-2009

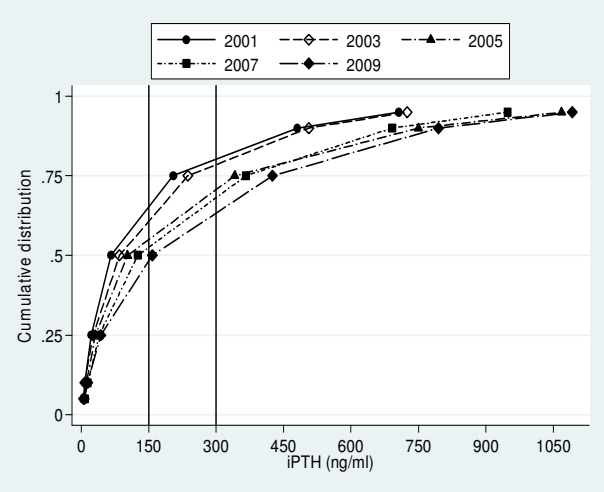


Figure 9.3.2(a): Cumulative distribution of iPTH, PD patients, 2000-2009

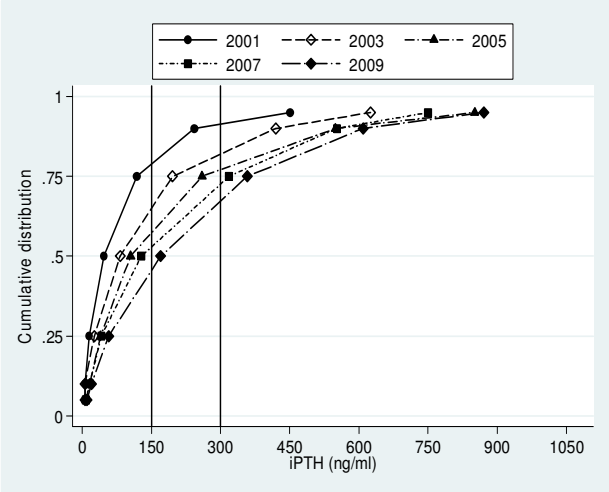


Table 9.3.2(a): Distribution of iPTH, PD patients, 2000-2009

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
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
2009	1822	270.2	291.9	174.2	67.5	381	45	22	16	16

Table 9.3.2(b): Distribution of iPTH, diabetic PD patients, 2000-2009

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
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	727	209	225.8	140.6	56	292.5	51	24	16	8
2009	808	188.6	189.4	131	56.8	257.9	54	26	13	7

Figure 9.3.2(b): Cumulative distribution of iPTH, diabetic PD patients, 2000-2009

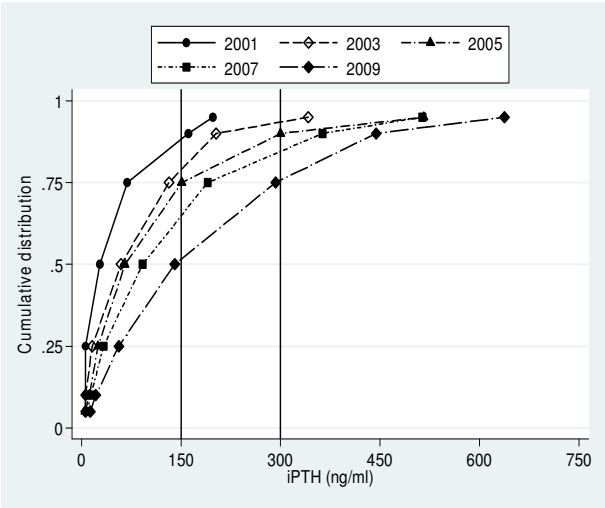


Figure 9.3.2(c): Cumulative distribution of iPTH, non diabetic PD patients, 2000-2009

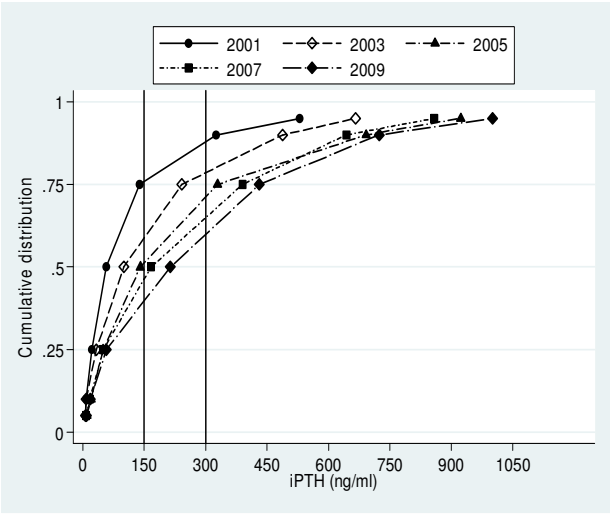


Table 9.3.2(c): Distribution of iPTH, non diabetic PD patients, 2000-2009

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
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	881	309.7	335.6	214	58	431	41	20	19	21
2009	1014	335.2	339.3	231.8	82	467.5	38	20	19	23

There was also wide variation seen in iPTH among HD centres and PD centres and the degree of variation seemed to become wider since 1999. The variation was also noted to be greater among HD centres compared to PD centres. With regards to the proportion of patients with serum iPTH level in the range 150-300 ng/ml, the median was only 18% for HD centres (Table and Figure 9.3.3b) and 21.5% for PD centres (Table and Figure 9.3.4b).

Table 9.3.3(a): Variation in iPTH among HD centres 2000-2009

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	59	5.6	15.5	31.5	51.5	94.1	355	487.5
2001	69	7.2	10.4	27.9	56	81	224	566.5
2002	93	1.4	10.8	28.4	48.5	136.5	309	660.3
2003	113	4	10.8	35.5	88	193.5	344.3	624.5
2004	134	3.6	12.4	30	76	203.5	412	702
2005	165	5.8	14.6	37	96.3	228.3	409.5	626.4
2006	219	7.7	16	41	88.8	208.3	377.5	658
2007	246	11.4	20.4	46.5	117	230.8	430.5	615
2008	288	8.5	22.5	55	137.4	253.7	410.7	695.2
2009	322	1.9	25.5	63.6	158.4	260.5	410	956.1

Figure 9.3.3(a): Variation in median iPTH among HD patients, HD centres 2009

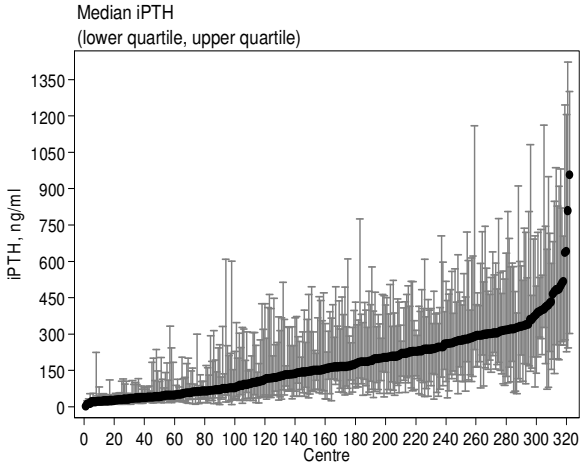


Figure 9.3.3(b): Variation in proportion of patients with iPTH 150-300ng/ml, HD centres, 2009

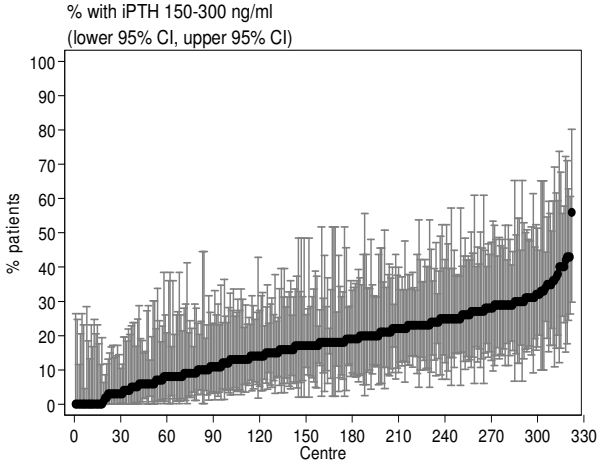


Table 9.3.3(b): Variation in proportion of patients with iPTH 150-300ng/ml, HD centres, 2000-2009

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	59	0	0	5	10	16	33	40
2001	69	0	0	5	10	20	32	40
2002	93	0	0	2	10	22	31	45
2003	113	0	0	7	14	21	38	42
2004	134	0	0	5	11	19	37	50
2005	165	0	0	7	13	20	33	47
2006	219	0	0	7	14	20	29	45
2007	246	0	0	9	15	21	31	52
2008	288	0	0	9	16	24	31	44
2009	322	0	0	10	18	25	35	56

Table 9.3.4: Variation in iPTH among PD centres, 2000-2009
a) Median iPTH among PD patients

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	22.4	22.4	70	136	175	309.5	309.5
2004	18	41	41	74.5	138.8	169.3	330	330
2005	18	25.5	25.5	87.5	140.6	259.5	494.5	494.5
2006	21	34.5	36.9	102.5	172	243	386	429
2007	22	26.3	32	107.5	201.3	290.5	440	523.8
2008	22	34.5	62	144	206.1	310.9	352.3	454.5
2009	22	36	56.5	144.3	201.8	285.8	462.5	1047

Figure 9.3.4(a): Variation in median iPTH among PD patients, PD centres, 2009

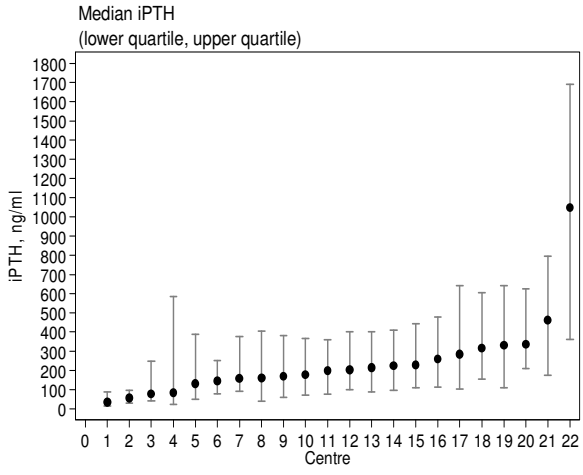


Figure 9.3.4(b): Variation in proportion of patients with iPTH 150-300ng/ml, PD centres 2009

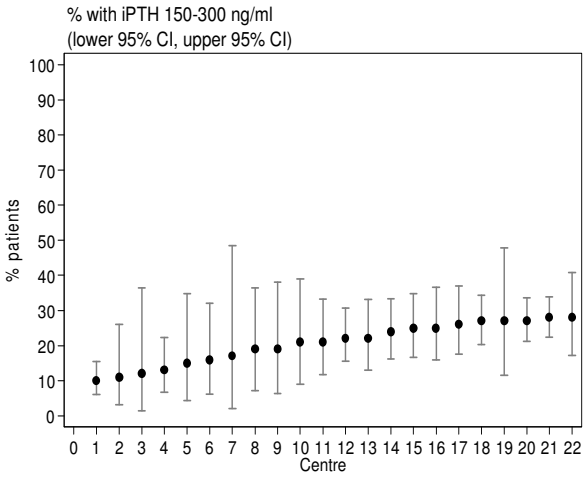


Table 9.3.4(b): Proportion of patients with iPTH 150-300ng/ml, PD centres, 2000-2009

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	18	0	0	10	15	23	31	31
2006	21	5	6	13	20	25	33	41
2007	22	0	3	17	20.5	27	31	39
2008	22	0	7	15	19.5	26	31	34
2009	22	10	11	16	21.5	26	28	28

Conclusion

Calcium carbonate remained as the main phosphate binder for both HD (92%) and PD (85%) patients in 2009 and this has been relatively constant for the past 5 years. As for the non-calcium based phosphate binder, the use of aluminium based phosphate binder continued to decrease, on the other hand, we noticed a slow but steady rise in the use of Lanthanum since its introduction into Malaysia in 2006. In fact Lanthanum usage had doubled for the past one year from 0.56% and 1.00% in 2008 to 1.39% and 2.24% in 2009 for both HD and PD patients respectively.

Calcitriol remained the main vitamin D used in both HD and PD patients and its use continued to rise. Paricalcitol usage had nearly doubled for HD patients between 2008 and 2009 (0.28% to 0.45%) but it remained static for PD patients during this period (0.15% versus 0.14%). There were twice as many HD patients who underwent parathyroidectomy in 2009 compared to PD patients (0.95% vs. 0.46%). For the first time in the past 10 years, the percentage of patients that underwent parathyroidectomy had decreased from 1.13% and 0.64% in 2008 to 0.95% and 0.46% in 2009 for HD and PD patients respectively. This could not be explained since the intact parathyroid hormone (iPTH) level seemed to be still on the rising trend for both HD and PD patients and more so for HD patients.

The mean corrected serum calcium level remained slightly lower in the HD patients (2.3 mmol/l) compared to PD patients (2.4 mmol/l). But PD patients had better phosphate control compared to HD patients. The proportion of PD patients achieving target serum phosphate level of 1.13-1.78 mmol/l was higher compared to HD patients (53% vs. 47%). More PD patients achieved the target serum calcium phosphate product of less than 4.5 $mmol^2/l^2$ (75%) compared with HD patients (70.0%) for 2009. This explained why there were more HD patients on both calcium-based and non-calcium based phosphate binder.

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

There was consistently wide centre variation among HD and PD populations in all the renal bone disease parameters reflecting the large differences in the management of renal bone disease among dialysis centres. This variation was observed more among HD centres which most likely is due to the increase in new HD centres being established each year while the number of PD centres has remained relatively static.

CHAPTER 10

Hepatitis on Dialysis

Teo Sue Mei
Clare Tan Hui Hong
Foo Sui Mei

SECTION A : HEPATITIS ON DIALYSIS

Prevalence of Hepatitis B was quite similar between HD and PD patients, and remains low annually. The prevalence of Hepatitis C in HD patients continues to decline annually. This implies that dialysis facilities around the country have been consistent with maintaining stringent infection control measures to prevent new HCV seroconversions.

Table 10.1: Prevalence of positive HBsAg and positive Anti-HCV at annual survey, HD patients 2000-2009

Year	No. of subjects	Prevalence of HBsAg+ (%)	Prevalence of Anti-HCV+ (%)
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	14900	4	9
2009	16947	4	8

Table 10.2: Prevalence of positive HBsAg and positive Anti-HCV at annual survey, PD patients 2000-2009

Year	No. of subjects	Prevalence of HBsAg+ (%)	Prevalence of Anti-HCV+ (%)
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
2009	2141	4	3

SECTION B : HEPATITIS B

There was larger center to center variation among HD compared to PD centers in terms of the proportion of Hepatitis B patients. This is probably due to the fact that Hepatitis B patients tend to be segregated to the larger HD centers as some smaller centers may practice the policy of not accepting Hepatitis B patients.

Table 10.3: Variation in Proportion of patients with positive HBsAg at annual survey among HD centres, 2009

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2000	106	0	0	0	4	9	14	80
2001	126	0	0	0	5	9	15	90
2002	154	0	0	0	3	8	14	26
2003	181	0	0	0	3	8	15	67
2004	206	0	0	0	3	7	15	92
2005	235	0	0	0	2	7	15	100
2006	289	0	0	0	0	6	16	94
2007	314	0	0	0	0	6	15	100
2008	359	0	0	0	0	6	13	95
2009	389	0	0	0	0	5	13	92

Figure 10.3: Variation in Proportion of patients with positive HBsAg among HD centres, 2009

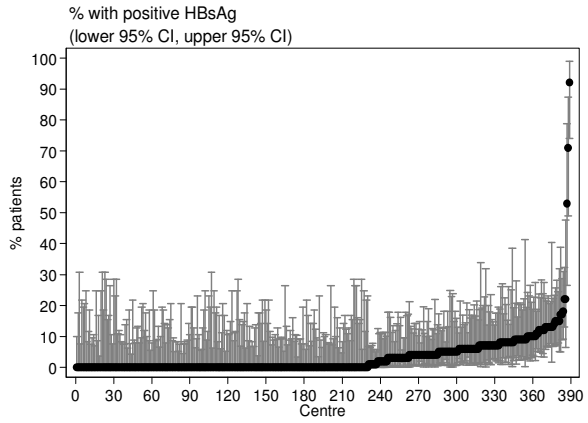


Figure 10.4: Variation in Proportion of patients with positive HBsAg among PD centres, 2009

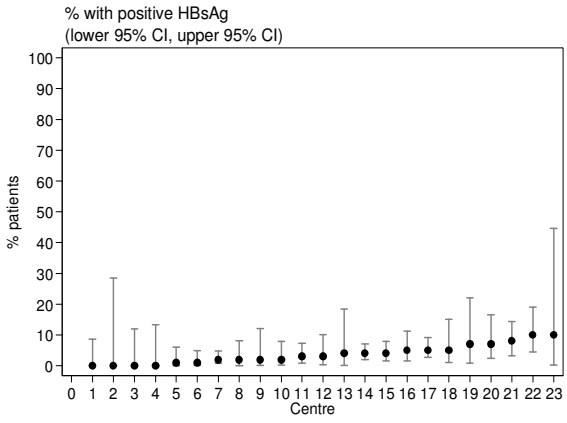


Table 10.4: Variation in Proportion of patients with positive HBsAg at annual survey among PD centres, 2009

Year	No. of centres	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	18	0	0	2	4	6	8	8
2004	18	0	0	1	3	5	11	11
2005	19	0	0	1	3	5	10	10
2006	22	0	0	2	4	6	9	13
2007	23	0	0	0	4	6	7	11
2008	23	0	0	1	3	6	10	13
2009	23	0	0	1	3	5	10	10

SECTION C : HEPATITIS C

Despite the annual decline in the median proportion of HCV infected HD patients, there still remains a wide center to center variation in its prevalence. This reflects the diversities in infection control protocols among centers. There should be regular audits to ensure standardization and consistent implementation of stringent infection control protocols to further reduce the incidence of new HCV seroconversion.

Table 10.5: Variation in Proportion of patients with positive anti-HCV at annual survey among HD centres, 2000-2009

Year	No. of centre	Min	5th centile	LQ	Median	UQ	95th centile	Max
2000	106	0	0	9	18.5	31	67	90
2001	126	0	0	7	17	30	65	89
2002	154	0	0	5	14	26	58	96
2003	181	0	0	5	14	25	50	92
2004	208	0	0	4	11	25	50	100
2005	237	0	0	2	10	21	40	96
2006	288	0	0	0	8	17	42	98
2007	313	0	0	0	7	14	35	100
2008	358	0	0	0	5	12	32	100
2009	388	0	0	0	3	10	27	98

Figure 10.5: Variation in Proportion of patients with positive anti-HCV among HD centres, 2009

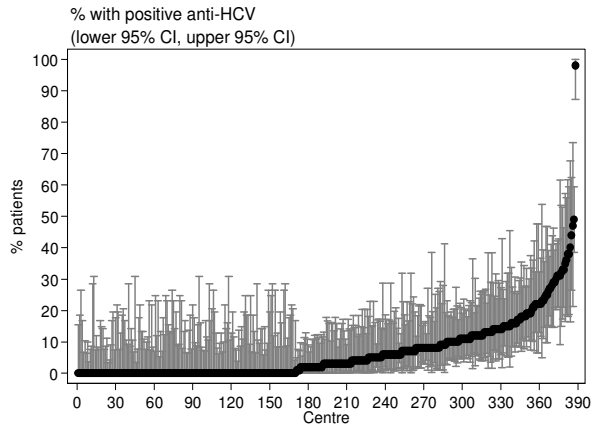


Figure 10.6: Variation in Proportion of patients with positive anti-HCV among PD centres, 2009

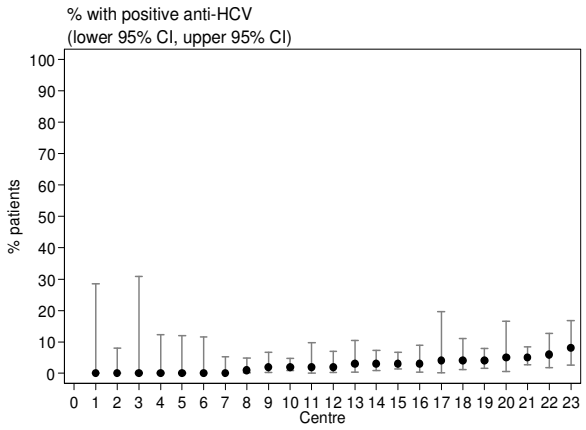


Table 10.6: Variation in Proportion of patients with positive anti-HCV at annual survey among PD centres, 2000-2009

Year	No. of centre	Min	5th centile	LQ	Median	UQ	95th centile	Max
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	18	0	0	1	4.5	7	9	9
2004	18	0	0	1	4.5	7	10	10
2005	19	0	0	2	4	8	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
2009	23	0	0	0	2	4	6	8

Risk factors for HCV sero-conversion 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, and interestingly, diabetics and older patients had lower sero-conversion risks. Completely assisted patients are fully assisted by trained staff who tend to be more stringent with infection control measures. These patients also tend be older and may have more co-morbidities such as diabetes, and as such may explain why there is a lower tendency to acquire HCV infection among the older and diabetic patients.

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

Risk factor	Number of patients	Risk Ratio	95% CI	p-value
Assistance to Perform HD:				
Self care (ref*)	163	1.00		
Partial self care	129	0.74	(0.59; 0.94)	0.013
Completely assisted	361	0.45	(0.39; 0.57)	0.000
Dialyzer Reuse:				
less than 10 (ref*)	299	1.00		
more than 10	391	0.93	(0.80; 1.08)	0.340
Dialyzer Reprosessing System:				
Fully Auto (ref*)	383	1.00		
Semi Auto	45	0.83	(0.61; 1.14)	0. 248
Manual	35	0.87	(0.61; 1.23)	0.434
Age:				
<=20 (ref*)	35	1.00		
21-40	247	0.90	(0.63; 1.30)	0.588
(41-60	320	0.44	(0.31; 0.63)	0.000
>60	102	0.20	(0.13; 0.29)	0.000
Gender:				
Female (ref*)	280	1.00		
Male	410	1.13	(0.97; 1.32)	0.109
Diabetes:				
No (ref*)	495	1.00		
Yes	195	0.37	(0.32; 0.44)	0.000
Previous Renal Transplant::				
No (ref*)	586	1.00		
Yes	104	4.67	(3.76; 5.81)	0.000
History of Blood Transfusion:				
No (ref*)	384	1.00		
Yes	306	1.38	(1.19; 1.61)	0.000

Risk factors for HCV sero-conversion among PD patients are previous renal transplant, blood transfusion and modality switch from HD to PD. Similar to HD, there was also a trend for increased risk of sero-conversion in younger patients. This finding may imply other factors which may contribute to the increased risk, such as sexual promiscuity and use of recreational drugs.

Table 10.7 (b): 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:				
<=20 (ref*)	4	1.00		
21-40	14	2.24	(0.74; 6.84)	0.157
41-60	31	2.37	(0.83; 6.74)	0.106
>60	3	0.34	(0.08; 1.52)	0.157
Gender:				
Female (ref*)	28	1.00		
Male	24	0.86	(0.49; 1.48)	0.577
Diabetes:				
No (ref*)	45	1.00		
Yes	7	0.18	(0.08; 0.39)	0.000
Switch from HD to PD:				
No (ref*)	30	1.00		
Yes	22	7.73	(4.42; 13.52)	0.000
Previous Renal Transplant::				
No (ref*)	47	1.00		
Yes	5	1.83	(0.72; 4.66)	0.020
History of Blood Transfusion:				
No (ref*)	23	1.00		
Yes	29	1.93	(1.11; 3.31)	0.019

Conclusion

Nosocomial transmission in HD has been implicated for the higher HCV prevalence in HD compared to PD. Though there is a consistent annual decline, the wide center variation in HD still exists for HCV infection. There is still room for improvement and for this, a nationwide audit looking specifically into aspects of our current HD practices will be useful to identify areas which will require change in order to further reduce the risk of HCV sero-conversion among HD patients.

CHAPTER 11

Haemodialysis Practices

Tan Chwee Choon
Shahnaz Shah Firdaus Khan
Rafidah Abdullah
Norleen bt Zulkarnain Sim

SECTION 11.1: VASCULAR ACCESS AND ITS COMPLICATIONS

The proportion of patients with native vascular access was 91% in 2009. The total number of patients using catheter (permanent / temporary) have increased from 2% in 2000 to 7% in 2009.

Table 11.1.1: Vascular Access on Haemodialysis, 2000-2009

Access types	2000		2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%	No.	%
Wrist AVF	3561	82	4049	79	4680	78	5249	75	5891	73
BCF*	655	15	897	17	1068	18	1359	20	1693	21
Venous graft	11	0	19	0	14	0	23	0	41	1
Artificial graft	31	1	64	1	78	1	113	2	149	2
Permanent CVC	19	0	25	1	43	1	61	1	99	1
Temporary CVC*	77	2	90	2	138	2	179	3	233	3
Temporary FVC*	0	0	0	0	0	0	0	0	0	0
TOTAL	4354	100	5144	100	6021	100	6984	100	8106	100

Access types	2005		2006		2007		2008		2009	
	No.	%	No.	%	No.	%	No.	%	No.	%
Wrist AVF	6405	69	7798	68	8309	65	9448	62	10435	61
BCF*	2169	23	2856	25	3421	27	4396	29	5111	30
Venous graft	30	0	22	0	37	0	19	0	32	0
Artificial graft	221	2	284	3	305	2	350	2	367	2
Permanent CVC	179	2	235	2	261	2	298	2	458	3
Temporary CVC*	266	3	298	3	424	3	579	4	742	4
Temporary FVC*	4	0	19	0	25	0	59	0	45	0
TOTAL	9274	100	11512	100	12782	100	15149	100	17190	100

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

No increase in difficulties were reported with vascular assess since 2008.

Table 11.1.2: Difficulties report with Vascular Access, 2000-2009

Access difficulty	2000		2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%	No.	%
Difficulty with needle placement	146	4	217	5	215	4	217	3	255	3
Difficulty in obtaining desired blood flow rate	136	4	239	5	235	4	243	4	301	4
Other difficulties	32	1	39	1	57	1	60	1	67	1
No difficulties	3402	92	4276	90	5073	91	5970	92	6957	92
TOTAL	3716	100	4771	100	5580	100	6490	100	7580	100

Access difficulty	2005		2006		2007		2008		2009	
	No.	%	No.	%	No.	%	No.	%	No.	%
Difficulty with needle placement	319	4	394	4	478	4	416	3	500	3
Difficulty in obtaining desired blood flow rate	354	4	356	3	368	3	420	3	463	3
Other difficulties	58	1	45	0	57	1	81	1	100	1
No difficulties	8339	92	10592	93	11577	93	14026	94	16103	94
TOTAL	9070	100	11387	100	12480	100	14943	100	17166	100

Complication rates for vascular access have reduced over the years from 17% in 2000 to 10% in 2009.

Table 11.1.3: Complications reported with Vascular Access, 2000-2009

Complication	2000		2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%	No.	%
Thrombosis	148	4	209	4	202	4	220	3	284	4
Bleed	30	1	62	1	66	1	54	1	67	1
Aneurysmal dilatation	208	5	212	4	211	4	199	3	193	2
Swollen limb	44	1	67	1	56	1	55	1	77	1
Access related infection, local/systemic	52	1	49	1	52	1	43	1	70	1
Distal limb ischaemia	26	1	22	0	17	0	13	0	37	1
Venous outflow obstruction	78	2	123	2	101	2	119	2	151	2
Carpal tunnel	42	1	41	1	44	1	63	1	49	1
Others	37	1	74	2	118	2	118	2	133	2
No complications	3237	83	4204	83	4988	85	5963	87	6896	87
TOTAL	3902	100	5063	100	5855	100	6847	100	7957	100

Complication	2005		2006		2007		2008		2009	
	No.	%	No.	%	No.	%	No.	%	No.	%
Thrombosis	289	3	317	3	405	3	436	3	470	3
Bleed	73	1	69	1	58	1	75	1	69	0
Aneurysmal dilatation	179	2	246	2	385	3	386	3	445	3
Swollen limb	84	1	89	1	101	1	98	1	158	1
Access related infection, local/systemic	63	1	78	1	97	1	92	1	130	1
Distal limb ischaemia	35	0	30	0	27	0	31	0	25	0
Venous outflow obstruction	170	2	202	2	196	2	247	2	295	2
Carpal tunnel	55	1	48	0	46	0	46	0	47	0
Others	109	1	116	1	152	1	165	1	117	1
No complications	8113	89	10154	90	11052	88	13477	90	15492	90
TOTAL	9170	100	11349	100	12519	100	15053	100	17248	100

SECTION 11.2: HD PRESCRIPTION

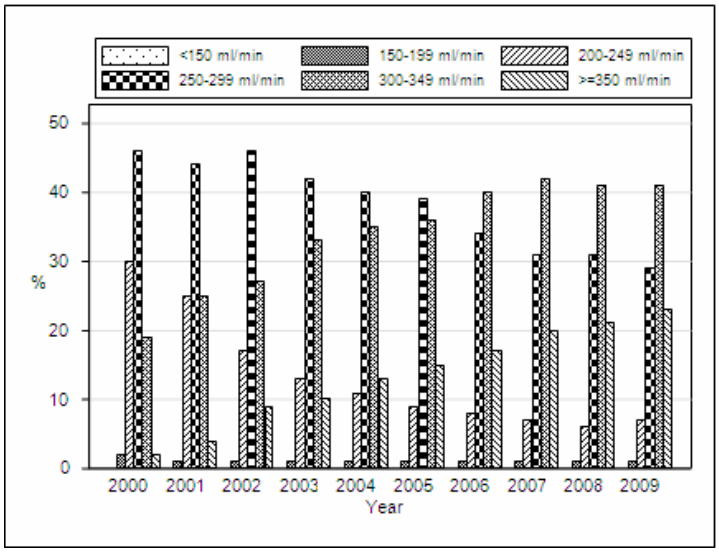
There is an increase in the proportion of patients with blood flow rate above 300mls from year 2000 at 21% to 64% in 2009. A hundred and thirty seven patients were haemodialysed with a blood flow rate of less than 200mls/min

Table 11.2.1: Blood Flow Rates in HD centers, 2000-2009

Blood flow rates	2000		2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%	No.	%
<150 ml/min	9	0	7	0	9	0	4	0	11	0
150-199 ml/min	85	2	69	1	69	1	84	1	86	1
200-249 ml/min	1282	30	1233	25	973	17	882	13	879	11
250-299 ml/min	1938	46	2229	44	2692	46	2865	42	3112	40
300-349 ml/min	814	19	1276	25	1590	27	2241	33	2711	35
>=350 ml/min	94	2	216	4	505	9	690	10	1020	13
TOTAL	4222	100	5030	100	5838	100	6766	100	7819	100

Blood flow rates	2005		2006		2007		2008		2009	
	No.	%	No.	%	No.	%	No.	%	No.	%
<150 ml/min	7	0	5	0	10	0	10	0	13	0
150-199 ml/min	94	1	103	1	87	1	120	1	124	1
200-249 ml/min	814	9	923	8	929	7	928	6	1142	7
250-299 ml/min	3523	39	3818	34	3821	31	4607	31	4902	29
300-349 ml/min	3226	36	4529	40	5214	42	6111	41	6965	41
>=350 ml/min	1328	15	1920	17	2451	20	3090	21	3887	23
TOTAL	8992	100	11298	100	12512	100	14866	100	17033	100

Figure 11.2.1: Blood Flow Rates in HD centers, 2000-2009



The majority of patients (98%) were on 3 dialysis sessions per week. The number of patients that were on more than 3 times per week has increased from 10 patients in 2000 to 87 patients in 2009.

Table 11.2.2: Number of HD Sessions per week, 2000-2009

HD sessions per week	2000		2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%	No.	%
1	8	0	8	0	10	0	15	0	11	0
2	341	8	337	7	369	6	343	5	281	4
3	3982	92	4761	92	5603	93	6585	95	7751	96
4	10	0	50	1	18	0	9	0	30	0
TOTAL	4341	100	5156	100	6000	100	6952	100	8073	100

HD sessions per week	2005		2006		2007		2008		2009	
	No.	%	No.	%	No.	%	No.	%	No.	%
1	7	0	25	0	14	0	5	0	6	0
2	265	3	273	2	256	2	259	2	247	1
3	9011	97	11326	97	12602	98	15003	98	17170	98
4	31	0	34	0	31	0	61	0	87	1
TOTAL	9314	100	11658	100	12903	100	15328	100	17510	100

Majority of patients (99%) were on 4 hours HD session. There is an increasing trend towards longer hours of dialysis.

Table 11.2.3: Duration of HD, 2000-2009

Duration of HD per session	2000		2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%	No.	%
<=3 hours	10	0	8	0	18	0	14	0	25	0
3.5 hours	12	0	12	0	15	0	3	0	11	0
4 hours	4088	94	4988	97	5854	98	6798	98	7885	98
4.5 hours	154	4	93	2	60	1	66	1	106	1
5 hours	75	2	59	1	47	1	63	1	45	1
>5 hours	13	0	0	0	0	0	0	0	3	0
TOTAL	4352	100	5160	100	5994	100	6944	100	8075	100

Duration of HD per session	2005		2006		2007		2008		2009	
	No.	%	No.	%	No.	%	No.	%	No.	%
<=3 hours	31	0	28	0	37	0	54	0	63	0
3.5 hours	9	0	6	0	11	0	10	0	25	0
4 hours	9175	99	11507	99	12792	99	15149	99	17308	99
4.5 hours	46	1	66	1	23	0	74	1	78	0
5 hours	52	1	42	0	31	0	42	0	42	0
>5 hours	0	0	1	0	1	0	0	0	1	0
TOTAL	9313	100	11650	100	12895	100	15329	100	17517	100

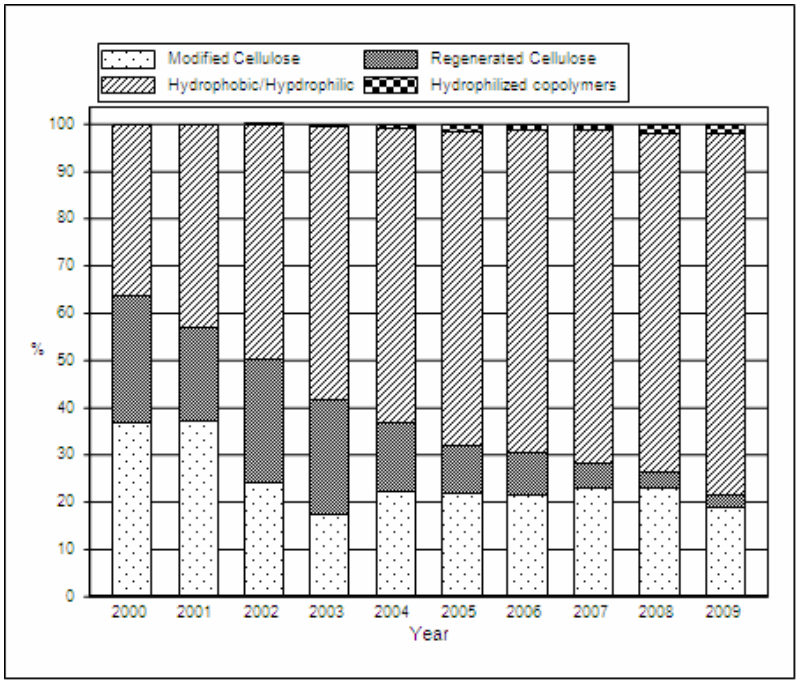
The use of synthetic membrane (hydrophobic/ hydrophilic and hydrophilised copolymer) has increased from 36% in 2000 to 77% in 2009. Regenerated cellulose membrane usage has progressively declined from 27% in 2000 to 2% in 2009. The use of modified cellulose membrane has declined over the years.

Table 11.2.4: Dialyser membrane types in HD centres, 2000-2009

Dialyser membrane	2000		2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%	No.	%
Modified Cellulose	1611	37	1666	37	1377	24	1150	17	1719	22
Regenerated Cellulose	1190	27	890	20	1474	26	1599	24	1150	15
Hydrophobic/Hypdrophilic	1589	36	1944	43	2828	50	3841	58	4846	62
Hydrophilized copolymers	0	0	0	0	1	0	35	1	74	1
TOTAL	4390	100	4500	100	5680	100	6625	100	7789	100

Dialyser membrane	2005		2006		2007		2008		2009	
	No.	%	No.	%	No.	%	No.	%	No.	%
Modified Cellulose	1974	22	2489	22	2890	23	3431	23	3168	19
Regenerated Cellulose	930	10	997	9	699	6	486	3	403	2
Hydrophobic/Hypdrophilic	6020	66	7860	68	8984	71	10836	72	12813	77
Hydrophilized copolymers	150	2	161	1	137	1	286	2	300	2
TOTAL	9074	100	11507	100	12710	100	15039	100	16684	100

Figure 11.2.4: Dialyser membrane types in HD centres, 2000-2009



Reuse of dialyzers is a common practice whereby 92% reuse the dialyzer. The practice of single use dialyzer is increasing over the years from 3% in 2000 to 8% in 2009.

Table 11.2.5: Dialyser Reuse Frequency in HD centres, 2000-2009

Dialyser Reuse Frequency	2000		2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%	No.	%
1	116	3	152	3	197	4	251	4	319	5
2	17	0	15	0	41	1	19	0	42	1
3	205	5	232	5	316	6	349	6	194	3
4	477	12	416	9	337	7	339	6	192	3
5	312	8	357	8	318	6	267	5	192	3
6	1730	43	1413	31	1216	24	915	16	806	13
7	69	2	85	2	124	2	71	1	89	1
8	357	9	793	17	866	17	852	15	809	13
9	101	3	132	3	59	1	87	2	50	1
10	246	6	400	9	538	11	880	15	1160	19
11	4	0	43	1	36	1	25	0	42	1
12	333	8	470	10	879	17	1511	26	1916	31
≥ 13	18	1	84	2	175	3	280	5	458	7
TOTAL	3985	100	4592	100	5102	100	5846	100	6269	100

Dialyser Reuse Frequency	2005		2006		2007		2008		2009	
	No.	%	No.	%	No.	%	No.	%	No.	%
1	196	5	400	6	568	6	810	7	1142	8
2	1	0	5	0	24	0	29	0	28	0
3	81	2	36	1	117	1	87	1	114	1
4	85	2	75	1	151	2	120	1	79	1
5	137	3	190	3	128	1	168	1	182	1
6	555	13	593	9	809	8	699	6	726	5
7	44	1	63	1	141	1	156	1	193	1
8	477	11	422	7	797	8	844	7	765	6
9	46	1	115	2	107	1	247	2	294	2
10	770	18	959	15	1530	15	2009	16	2586	19
11	12	0	100	2	94	1	101	1	58	0
12	1353	31	2243	35	4075	41	5266	43	5625	41
≥ 13	565	13	1185	19	1440	14	1783	15	1939	14
TOTAL	4322	100	6386	100	9981	100	12319	100	13731	100

Majority of patients were using bicarbonate dialysate buffer.

Table 11.2.6: Dialyser Buffer used in HD centres, 2000-2009

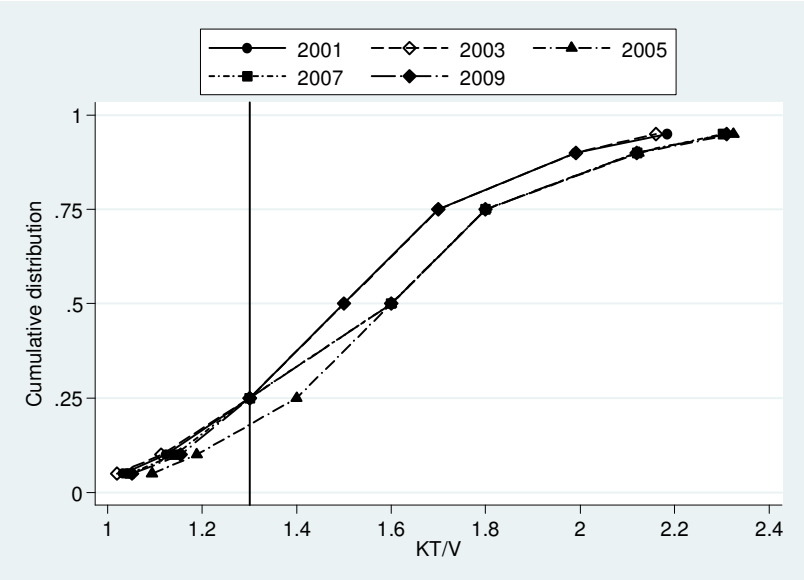
Dialyser Buffer	2000		2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%	No.	%
Acetate	393	9	240	5	138	2	76	1	33	0
Bicarbonate	3969	91	4920	95	5880	98	6815	99	7957	100
TOTAL	4362	100	5160	100	6018	100	6891	100	7990	100
Dialyser Buffer	2005		2006		2007		2008		2009	
	No.	%	No.	%	No.	%	No.	%	No.	%
Acetate	24	0	12	0	40	0	3	0	28	0
Bicarbonate	9268	100	11640	100	12853	100	15284	100	17464	100
TOTAL	9292	100	11652	100	12893	100	15287	100	17492	100

The mean and median prescribed Kt/V was 1.6. The percentage of patients with prescribed Kt/V $\geq$ 1.3 in 2009 was 81%.

Table 11.2.7(a): Distribution of prescribed Kt/V, HD patients 2000-2009

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% patients ≥ 1.3
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	1.9	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	14701	1.6	0.4	1.6	1.3	1.8	79
2009	16854	1.6	0.4	1.6	1.4	1.9	81

Figure 11.2.7(a): Cumulative distribution of prescribed Kt/V, HD patients 2000-2009



The median prescribed Kt/V was 1.6 but the median delivered Kt/V was only 1.4. The percentage of patients with a delivered Kt/V ≥ 1.3 was 64%. The median URR remained the same at 71.7% over the last 2 years. The percentage of patients with URR ≥ 65% has remained static from 2005-2009 at 79%.

Table 11.2.7(b): Distribution of delivered Kt/V, HD patients 2005-2009

Year	No. of subjects	Mean	SD	Median	LQ	UQ	% patients ≥1.2	% patients ≥1.3	Variance*
2005	1760	1.6	2.7	1.4	1.2	1.7	80	63	0.02
2006	5555	1.4	1.3	1.4	1.2	1.6	76	59	0.02
2007	6360	1.5	0.6	1.4	1.2	1.6	78	62	0.02
2008	8500	1.4	0.3	1.4	1.2	1.6	78	61	0.02
2009	10276	1.5	0.7	1.4	1.2	1.6	81	64	0.02

*Variance = (prescribed Kt/V – delivered Kt/V) / Prescribed Kt/V

Figure 11.2.7 (b): Cumulative distribution of delivered Kt/V, HD patients 2005-2009

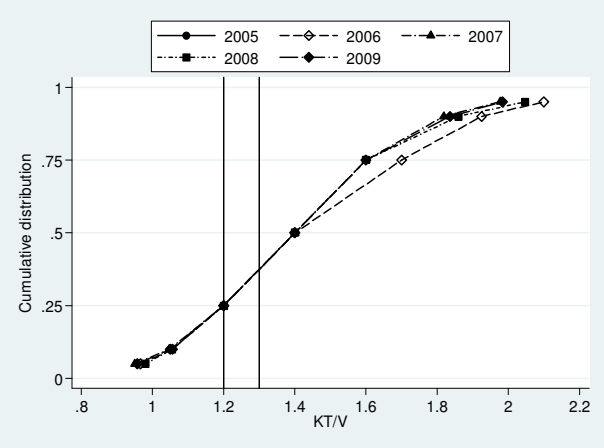


Figure 11.2.7 (c): Cumulative distribution of URR, HD patients 2005-2009

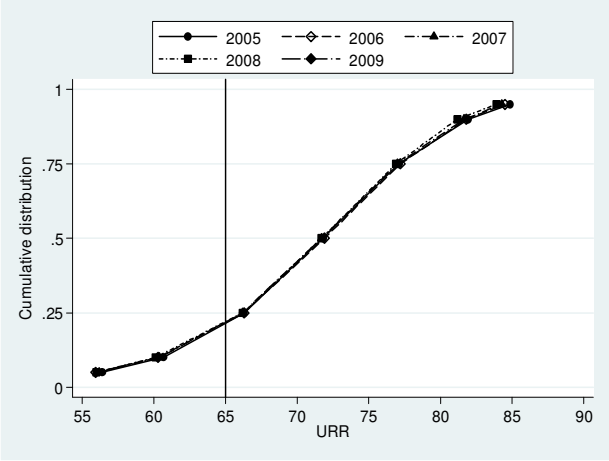


Table 11.2.7(c): Distribution of URR, HD patients 2005-2009

Year	No. of subjects	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	12551	71.2	9	71.7	66.2	77	79
2009	14636	71	8.9	71.7	66.2	76.9	79

The median blood flow rates among centres had increased from 250 ml/min in 2000 to 300ml/min in 2009. There is still a wide variation in practices among centres. The median blood flow rates among centres ranged from 200ml/min to 400ml/min with one centre with median flow blood flow rate of <200ml/min.

Table 11.2.8: Variation HD prescription among HD centres, 2000-2009

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

Year	No. of centers	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	354	200	250	280	300	300	350	400
2009	396	180	250	280	300	320	350	400

Figure 11.2.8 (a): Variation in medical blood flow rates in HD patients among centres 2009

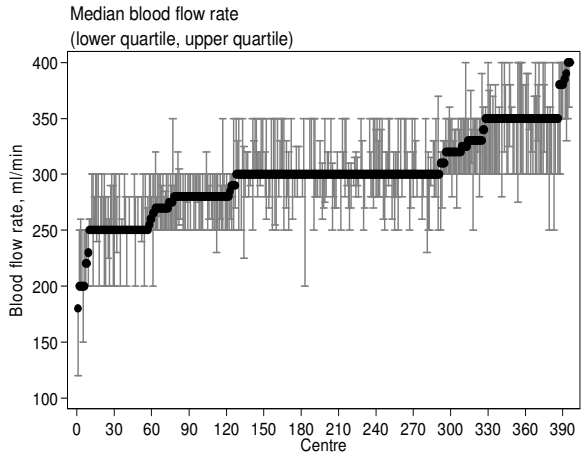
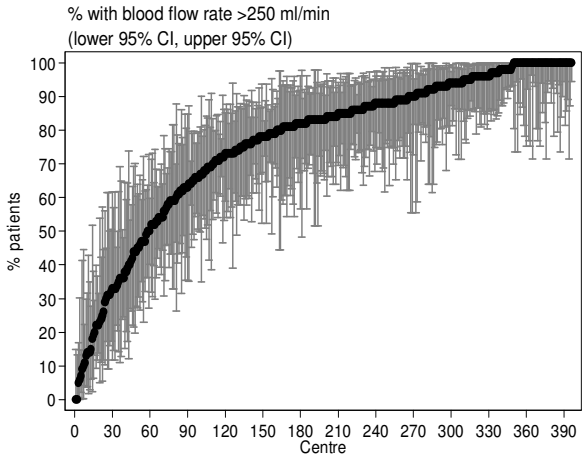


Figure 11.2.8 (b): Variation in Proportion of patients with blood flow rates > 250 ml/min among HD centres 2009



(b) Proportion of patients with blood flow rates > 250 ml/min, HD centres 2000-2009

Year	No. of centers	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	354	0	30	68	85	94	100	100
2009	396	0	23	66.5	83	93.5	100	100

Fifty percent of centres had 83 % of their patients with blood flow rates of >250ml/min in 2009 compared to only 31.5% in 2009. There is still a wide variation in the proportion of patients with blood flow rate >250ml/min among centres. There is one centre that had no patients with blood flow rates of >250ml/min in 2009.

The majority of centres had 100% of their patients with 3 HD sessions/ week. There is 2 centres with 50% of their patients on less than 3 HD session/ week.

Table 11.2.8 (c): Proportion of patients with 3 HD sessions per week, HD centres 2000-2009

Year	No. of centers	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	358	51	89	98	100	100	100	100
2009	396	19	88	100	100	100	100	100

Figure 11.2.8 (c): Variation in proportion of patients with 3 HD sessions per week among HD centres 2009

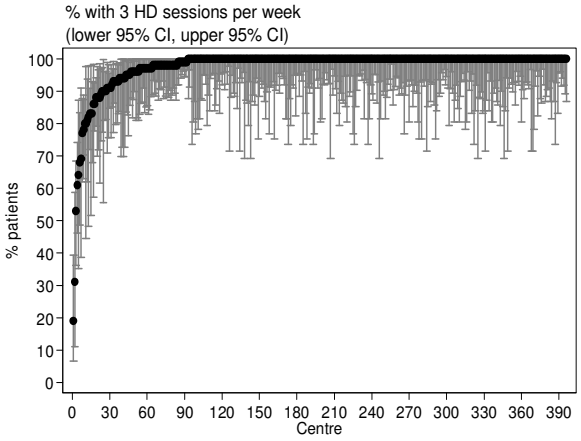


Figure 11.2.8 (d): Variation in median prescribed Kt/V in HD patients among HD centres 2009

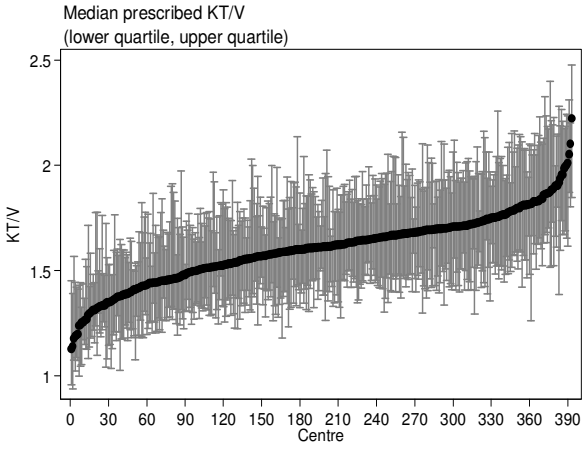


Table 11.2.8 (d): Median prescribed Kt/V in HD patients, HD centres 2000-2009

Year	No. of centers	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	352	1.1	1.3	1.4	1.6	1.7	1.9	2.1
2009	393	1.1	1.3	1.5	1.6	1.7	1.9	2.2

The median prescribed Kt/V in HD patients by centre was 1.6 in 2009. The minimum prescribed Kt/V was 1.1 and maximum Kt/V was 2.2

In 2009, half the centres had 83% of their patients with a prescribed Kt/V ≥1.3. However there is still a wide variation in proportion of patients with Kt/V ≥1.3 among the centres. One centre was noted to have less than 30% of their patients with a prescribed Kt/V ≥1.3.

Table 11.2.8 (e): Proportion of patients with prescribed Kt/V ≥ 1.3, HD centres 2000-2009

Year	No. of centers	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
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	352	14	47	68.5	83	89	97	100
2009	393	26	51	74	83	90	97	100

Figure 11.2.8 (e): Variation in proportion of patients with prescribed Kt/V ≥ 1.3 among HD centres 2009

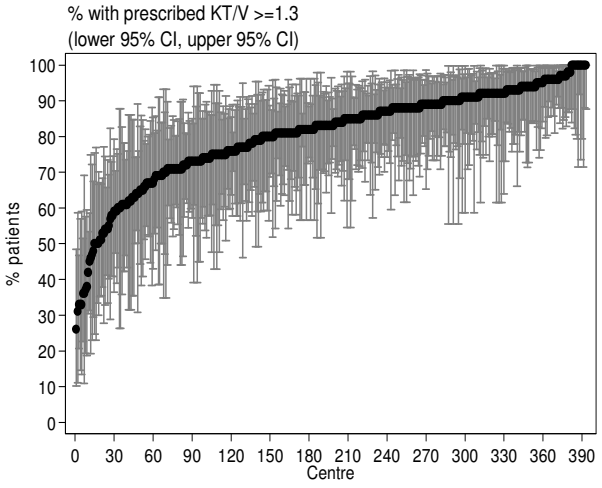


Figure 11.2.8 (f): Variation in median delivered Kt/V in HD patients among HD centres 2009

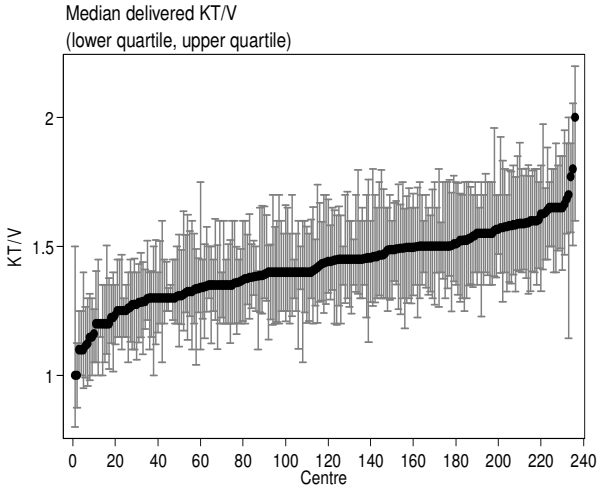


Table 11.2.8 (f): Median delivered Kt/V in HD patients, HD centres 2005-2009

Year	No. of centers	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2005	52	1.1	1.2	1.3	1.4	1.5	1.7	1.7
2006	142	1	1.2	1.3	1.4	1.5	1.6	1.7
2007	157	1.1	1.2	1.3	1.4	1.5	1.7	1.8
2008	198	1	1.2	1.3	1.4	1.5	1.7	1.8
2009	236	1	1.2	1.3	1.4	1.5	1.6	2

The median delivered Kt/V was 1.4. The variation of median delivered Kt/V ranges from 1 to 2 in 2009.

In 2009, 50% of centres had 83% of their patients with a delivered Kt/V $\geq$ 1.2. There is one centre with < 40% of their patients with a delivered Kt/V $\geq$ 1.2 in 2009 compared to 8 in 2008.

Table 11.2.8 (g): Proportion of patients with delivered Kt/V ≥ 1.2, HD centres 2005-2009

Year	No. of centers	Min	5th Centile	LQ	Median	UQ	95th Centile	Max
2005	52	36	40	69	81.5	90	100	100
2006	142	0	43	65	76	86	94	100
2007	157	34	46	70	79	89	97	100
2008	198	21	49	68	81	88	100	100
2009	236	16	57	74.5	83	89	97	100

Figure 11.2.8 (g): Variation in proportion of patients with delivered Kt/V ≥ 1.2, HD centres 2009

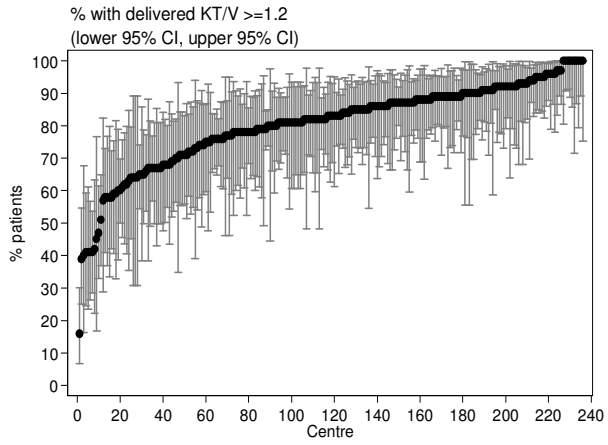


Figure 11.2.8 (h): Variation in median URR among HD patients, HD centres 2009

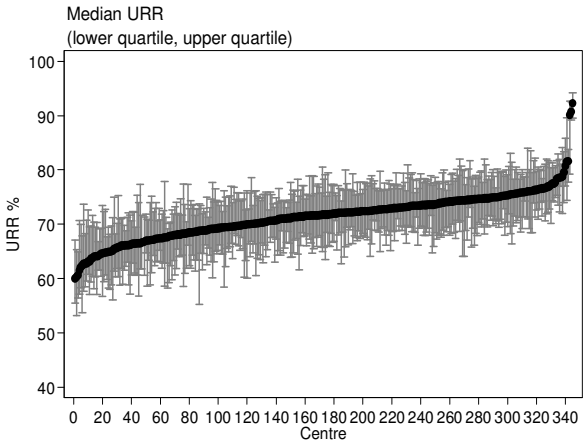


Table 11.2.8 (h): Median URR among HD patients, HD centres 2005-2009

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	309	40.4	63.5	68.5	71.7	74.4	77.9	93.6
2009	345	60	64.4	68.8	71.8	74.1	77	92.2

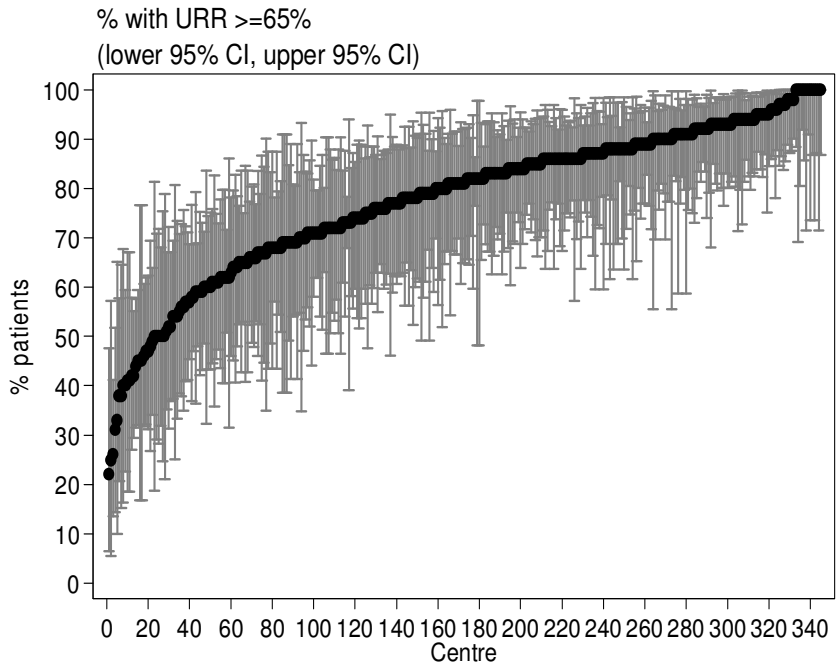
The median URR for 2009 was 71.8%. The number of centres reporting URR has increased from 73 in 2005 to 345 centres in 2009. The variation of URR ranges from 60 to 92.2% in 2009.

In 2009, 50% of centres had 81% of their patients with URR ≥65%. There were 6 centres with less than 40% of their patients with URR ≥65% in 2009 compared to 12 in 2008.

Table 11.2.8 (i): Proportion of HD patients with URR ≥ 65%, HD centres 2005-2009

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	309	0	43	69	82	90	98	100
2009	345	22	46	69	81	89	97	100

Figure 11.2.8 (i): Variation in proportion of patients with URR ≥ 65% among HD centres 2009



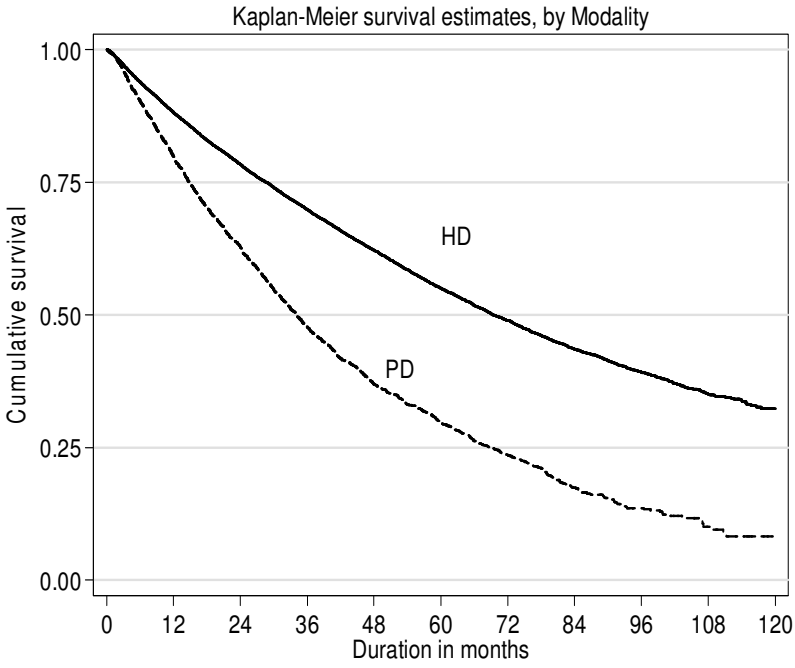
SECTION 11.3: TECHNIQUE SURVIVAL ON DIALYSIS

The unadjusted HD technique survival at 1 year, 5 years and 9 years was 88%, 55% and 35% respectively. The PD unadjusted technique survival was 80% at 1year, 30% at 5 years and 10% at 9 years.

Table 11.3.1: Unadjusted technique survival by Dialysis modality, 2000-2009

Dialysis modality Interval (month)	PD No.	PD % Survival	PD SE	HD No.	HD % Survival	HD SE	All Dialysis No.	All Dialysis % Survival	All Dialysis SE
0	4367	100	.	28723	100	.	33090	100	.
6	3671	90	0	25173	94	0	28844	93	0
12	2948	80	1	21518	88	0	24466	87	0
24	1897	63	1	15766	78	0	17663	76	0
36	1142	48	1	11403	70	0	12545	67	0
48	702	37	1	8009	62	0	8711	59	0
60	452	30	1	5552	55	0	6004	52	0
72	279	24	1	3673	49	0	3950	46	0
84	131	17	1	2285	44	0	2415	40	0
96	62	14	1	1247	39	1	1308	36	0
108	19	10	1	520	35	1	538	32	1

Figure 11.3.1: Unadjusted technique survival by Dialysis modality, 2000-2009



There was no apparent difference in the unadjusted HD technique survival by year of starting dialysis for the years 2000 to 2009.

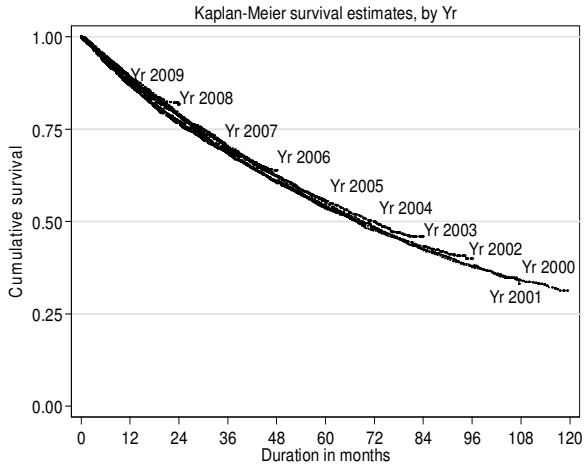
Table 11.3.2: Unadjusted technique survival by year of entry, 2000-2009

Year Interval (month)	2000 No.	2000 % Survival	2000 SE	2001 No.	2001 % Survival	2001 SE	2002 No.	2002 % Survival	2002 SE
0	1720	100	.	1901	100	.	2148	100	.
6	1605	94	1	1770	93	1	2013	94	1
12	1484	89	1	1624	87	1	1885	89	1
24	1278	79	1	1408	77	1	1617	78	1
36	1125	71	1	1236	68	1	1434	70	1
48	979	62	1	1094	61	1	1270	62	1
60	848	54	1	955	54	1	1119	55	1
72	748	48	1	846	48	1	985	49	1
84	653	42	1	754	42	1	873	43	1
96	577	38	1	670	38	1	.	.	.
108	520	34	1	.	.	.	.	.	.

Year Interval (month)	2003 No.	2003 % Survival	2003 SE	2004 No.	2004 % Survival	2004 SE	2005 No.	2005 % Survival	2005 SE	2006 No.	2006 % Survival	2006 SE
0	2336	100	.	2745	100	.	2951	100	.	3398	100	.
6	2167	94	0	2569	94	0	2719	93	0	3116	93	0
12	2008	88	1	2370	88	1	2516	87	1	2896	87	1
24	1767	79	1	2074	79	1	2177	76	1	2544	77	1
36	1556	70	1	1804	69	1	1943	69	1	2268	69	1
48	1380	62	1	1590	61	1	1701	60	1	.	.	.
60	1226	56	1	1406	54	1	.	.	.	.	.	.
72	1094	50	1	.	.	.	.	.	.	.	.	.

Year Interval (month)	2007 No.	2007 % Survival	2007 SE	2008 No.	2008 % Survival	2008 SE	2009 No.	2009 % Survival	2009 SE
0	3635	100	.	4080	100	.	3809	100	.
6	3402	94	0	3808	94	0	2017	95	0
12	3160	88	1	3578	89	0	.	.	.
24	2796	78	1	.	.	.	.	.	.

Figure 11.3.2: Unadjusted technique survival by year of entry, 2000-2009



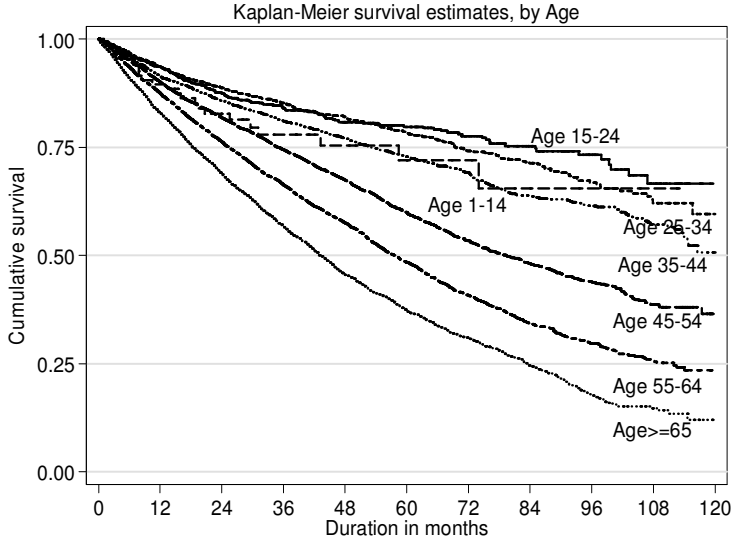
The unadjusted HD technique survival was better in the younger age groups than the older age group. At 9 years unadjusted HD technique survival in the age group of ≤14, 15-24, 25-34, 35-44, 44-54, 55-64 and ≥65 years old was 65%, 67%, 62%, 57 %, 39%, 26% and 15% respectively

Table 11.3.3: Unadjusted technique survival by age, 2000-2009

Age group (year) Interval (month)	≤ 14 No.	% Survival	SE	15-24 No.	% Survival	SE	25-34 No.	% Survival	SE	35-44 No.	% Survival	SE
0	115	100	.	954	100	.	1956	100	.	3501	100	.
6	104	96	2	860	96	1	1769	97	0	3110	95	0
12	88	90	3	757	94	1	1542	94	0	2727	91	0
24	63	83	4	588	87	1	1181	89	1	2089	86	1
36	43	78	5	456	84	1	927	85	1	1663	81	1
48	29	75	5	346	81	2	725	82	1	1275	77	1
60	21	72	6	270	80	2	563	78	1	973	73	1
72	13	72	6	189	78	2	412	74	1	699	69	1
84	9	65	8	132	75	2	285	71	1	480	64	1
96	5	65	8	78	73	2	157	67	1	304	62	1
108	3	65	8	31	67	4	82	62	2	138	57	2

Age group (year) Interval (month)	45-54 No.	% Survival	SE	55-64 No.	% Survival	SE	≥ 65 No.	% Survival	SE
0	7198	100	.	8223	100	.	6776	100	.
6	6414	95	0	7186	94	0	5732	91	0
12	5547	90	0	6116	87	0	4745	83	0
24	4174	82	0	4438	76	1	3234	69	1
36	3097	74	1	3106	66	1	2112	57	1
48	2199	67	1	2140	58	1	1300	46	1
60	1541	60	1	1385	48	1	807	37	1
72	1027	53	1	862	41	1	479	31	1
84	656	48	1	475	34	1	251	25	1
96	364	44	1	238	30	1	106	18	1
108	148	39	1	91	26	1	34	15	1

Figure 11.3.3: Unadjusted technique survival by age, 2000-2009

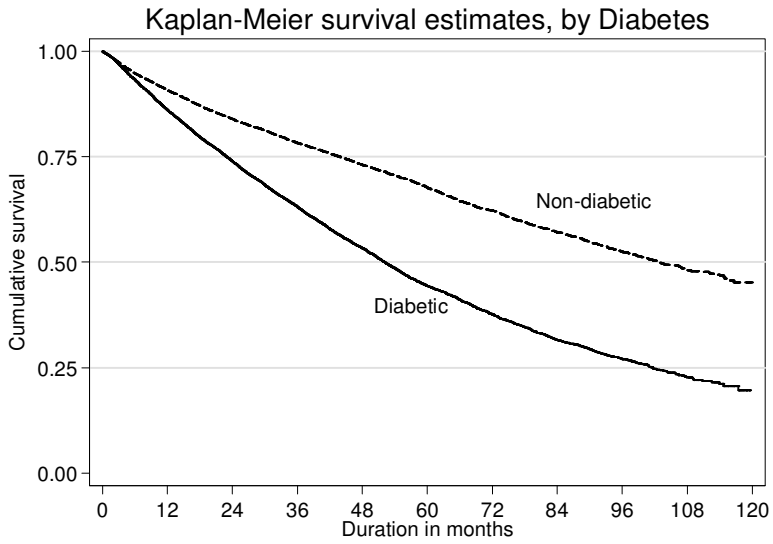


Unadjusted HD technique survival in non diabetics at 1 year, 5 years and 9 years was 91%, 68% and 48% respectively. Unadjusted HD technique survival for diabetics was worse than non diabetics; 86% at 1 year, 44% at 5 years and only 23% at 9 years.

Table 11.3.4: Unadjusted technique survival by Diabetes status, 2000-2009

Diabetes status Interval (month)	No.	Non-Diabetic % Survival	SE	No.	Diabetic % Survival	SE
0	12631	100	.	16092	100	.
6	11174	95	0	13999	93	0
12	9773	91	0	11745	86	0
24	7514	84	0	8252	74	0
36	5750	78	0	5653	63	0
48	4344	73	0	3665	53	1
60	3256	68	1	2296	44	1
72	2286	62	1	1387	38	1
84	1518	57	1	767	32	1
96	883	52	1	364	27	1
108	381	48	1	140	23	1

Figure 11.3.4: Unadjusted technique survival by Diabetes status, 2000-2009



CHAPTER 12

Chronic Peritoneal Dialysis Practices

Sunita Bavanandan
Lily Mushahar

SECTION 12.1: PD PRACTICES

12.1.1: Modalities and prescription of PD (Tables 12.1.1 -12.1.4)

The growth of PD practices in Malaysia has been steadily increasing over the past decade. In 2009, there was a 6% increment of PD penetration over a 1 year period with a total number of 2209 patients. However, the use of APD has plateaued at 11% compared to the previous year (Table 12.1.1). This lack of growth is most likely due to APD being a more costly modality of PD.

Majority of patients are on the Baxter disconnect system (92%) and most perform 4 exchanges per day (94%). Majority of patients (88%) are being prescribed a dwell volume of 2 litres compared to lower or larger dwell volumes (Table 12.1.4).

Table 12.1.1: Chronic Peritoneal Dialysis Regimes, 2000-2009

PD Regime	2000		2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%	No.	%
Standard CAPD	641	97	762	98	861	97	1192	97	1266	96
DAPD	16	2	17	2	24	3	34	3	39	3
Automated PD/ CCPD	5	1	2	0	3	0	5	0	12	1
TOTAL	662	100	781	100	888	100	1231	100	1317	100
PD regime	2005		2006		2007		2008		2009	
	No.	%	No.	%	No.	%	No.	%	No.	%
Standard CAPD	1303	93	1397	90	1547	86	1717	82	1844	84
DAPD	45	3	67	4	115	6	121	6	119	5
Automated PD/ CCPD	50	4	88	6	144	8	245	12	246	11
TOTAL	1398	100	1552	100	1806	100	2083	100	2209	100

Table 12.1.2: CAPD Connectology, 2000-2009

CAPD Connectology	2000		2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%	No.	%
Baxter disconnect	237	100	439	100	726	99	1048	87	1147	89
Fresenius disconnect	0	0	0	0	11	1	154	13	145	11
Others	0	0	1	0	0	0	3	0	0	0
TOTAL	237	100	440	100	737	100	1205	100	1292	100
CAPD Connectology	2005		2006		2007		2008		2009	
	No.	%	No.	%	No.	%	No.	%	No.	%
Baxter disconnect	1286	92	1425	92	1675	94	1955	94	2011	92
Fresenius disconnect	111	8	119	8	116	6	124	6	173	8
Others	0	0	5	0	0	0	4	0	0	0
TOTAL	1397	100	1549	100	1791	100	2083	100	2184	100

Table 12.1.3: PD Number of Exchanges per day, 2000-2009

No. of Exchanges/ day	2000		2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%	No.	%
2	2	0	1	0	0	0	4	0	6	0
3	1	0	5	1	11	1	14	1	12	1
4	624	96	735	95	834	96	1136	96	1225	95
5	23	4	31	4	28	3	32	3	52	4
TOTAL	650	100	772	100	873	100	1186	100	1295	100
No. of Exchanges/ day	2005		2006		2007		2008		2009	
	No.	%	No.	%	No.	%	No.	%	No.	%
2	3	0	4	0	2	0	3	0	3	0
3	25	2	55	4	40	2	54	3	87	4
4	1280	94	1359	91	1566	91	1728	86	1788	85
5	48	4	76	5	123	7	216	11	233	11
TOTAL	1356	100	1494	100	1731	100	2001	100	2111	100

Table 12.1.4: PD Volume per Exchange, 2000-2009

Volume per Exchange (L)	2000		2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%	No.	%
<1.5	25	4	32	4	37	4	41	4	42	3
1.5-1.9	0	0	0	0	0	0	0	0	0	0
2.0	595	95	711	95	793	94	1088	94	1154	92
>2.0	5	1	9	1	14	2	31	3	60	5
TOTAL	625	100	752	100	844	100	1160	100	1256	100

Volume per Exchange (L)	2005		2006		2007		2008		2009	
	No.	%	No.	%	No.	%	No.	%	No.	%
<1.5	55	4	50	3	46	2	56	3	60	3
1.5-1.9	0	0	0	0	0	0	0	0	0	0
2.0	1195	89	1315	88	1508	88	1756	88	1803	88
>2.0	92	7	135	9	167	10	189	9	189	9
TOTAL	1342	100	1500	100	1721	100	2001	100	2052	100

SECTION 12.2: ACHIEVEMENT OF SOLUTE CLEARANCE AND PERITONEAL TRANSPORT

Eighty one percent of PD patients achieved the KDOQI target Kt/V of ≥1.7 per week with a median Kt/V of 2.0 (Table 12.2.1). Comparison between PD centres according to the percentage of patients in each centre achieving this target Kt/V has shown a 1.5-fold variation between the highest- and lowest-performing centres (97% vs 63%). The median percentage of patients achieving target Kt/V was 83%. Approximately half of the total 21 PD centres achieved the target Kt/V of ≥1.7 in 83% or more of their patients (Figure 12.2.1 and Table 12.2.2).

Majority of the incident (71%) and prevalent patient (73%) have a low- and high-average peritoneal transport status (Table 12.2.3). Less than 20% of the prevalent PD patient developed high transport peritoneal membrane characteristic over time (Table 12.2.4). There is no apparent association between co-morbidities (cardiovascular disease and diabetes) with patients' peritoneal membrane characteristics (Table 12.2.5).

Table 12.2.1: Distribution of delivered Kt/V, PD patients 2003-2009

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
2009	1836	2.1	0.5	2	1.8	2.4	81

Figure 12.2.1: Cumulative distribution of delivered Kt/V, PD patients 2003-2009

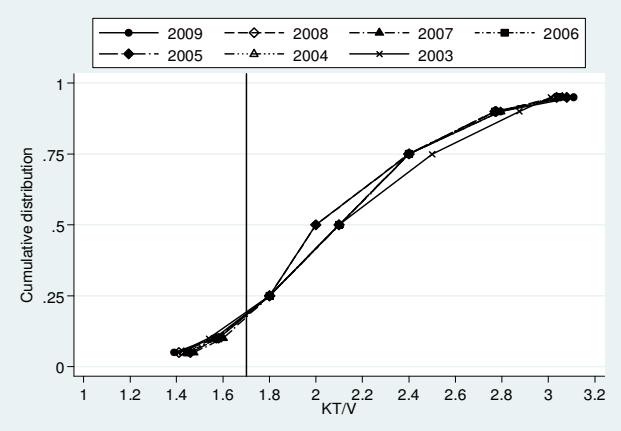


Table 12.2.2: Variation in proportion of patients with Kt/V ≥1.7 per week among PD centres, 2003-2009

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
2009	21	48	63	76	83	89	97	100

Figure 12.2.2: Variation in proportion of patients with Kt/V ≥1.7 per week among PD centres 2009

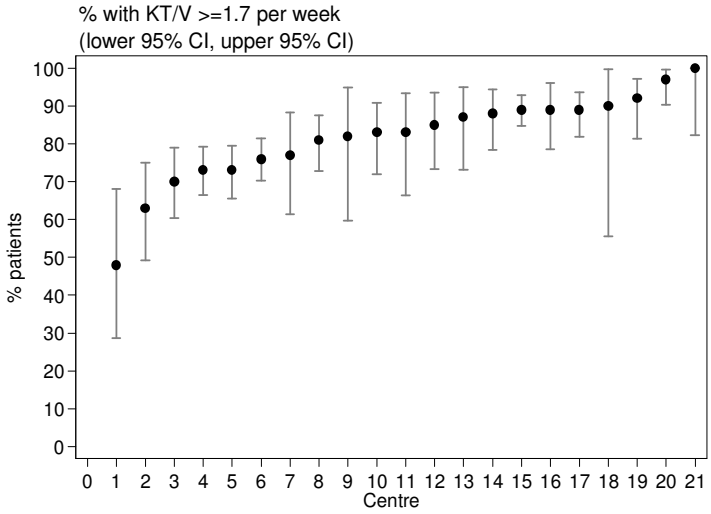


Table 12.2.3: Peritoneal transport status by PET D/P creatinine at 4 hours, new PD patients 2003-2009

Year	2003		2004		2005		2006		2007		2008		2009	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Low	10	6	67	15	69	12	105	12	106	10	151	13	196	14
Low average	85	51	187	41	246	41	359	42	429	42	500	42	557	39
High average	62	37	176	38	223	37	315	37	392	38	415	35	478	34
High	11	7	29	6	62	10	75	9	95	9	114	10	186	13
TOTAL	168	100	459	100	600	100	854	100	1022	100	1180	100	1417	100

Table 12.2.4: Peritoneal transport status by PET D/P creatinine at 4 hours, prevalent PD patients 2003-2009

Year	2003		2004		2005		2006		2007		2008		2009	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Low	10	3	39	9	44	13	23	8	19	10	19	14	10	10
Low average	174	44	180	42	130	39	106	38	65	34	43	31	36	37
High average	171	43	168	39	118	35	106	38	78	41	50	36	33	34
High	39	10	41	10	42	13	41	15	28	15	25	18	18	19
TOTAL	394	100	428	100	334	100	276	100	190	100	137	100	97	100

Table 12.2.5: Association among PET and co-morbidity, 2003-2009

Co morbidity	Low		Low Average		High Average		High	
	No.	%	No.	%	No.	%	No.	%
No CVD	591	13	1902	42	1628	36	430	9
CVD	113	10	461	40	433	38	142	12
No DM	443	14	1355	42	1132	35	288	9
DM	261	11	1008	41	929	37	284	11

SECTION 12.3: TECHNIQUE SURVIVAL ON PD

There was no change in the technique survival in PD compared to HD over the years. PD consistently has poorer technique survival compared to HD beginning as early as 6 months. One-, three-and five-year technique survival for PD was 80%, 48% and 30% respectively as compared to 88%, 70% and 55% for HD (Table and Figure 12.3.1(a)). Median technique survival time was less than 36 months. Overall these trends in technique survival are unchanged by year of entry (Table and Figure 12.3.2).

Analysis of the data according to two different eras (2000-2004 and 2005-2009) shows that there has been no improvement in technique survival in the last part of the decade as compared with the first half. (Table and Figure 12.3.1(b)). However in the diabetic subpopulation, patients with diabetes in the latter era appear to have better technique survival compared to the former era starting from as early as 6 months (Table and Figure 12.3.1(c)). The best technique survival was seen in the age group <14 years while the oldest age group (>65 years) consistently had the worst technique survival (Table and Figure 12.3.3). There was no association of gender with technique survival (Table and Figure 12.3.4).Diabetics consistently have a poorer technique survival than non-diabetics (Table and Figure 12.3.5). After 36 months there was a clear separation in survival curves according to solute clearance. Patients with Kt/V $\geq$1.7 have better technique survival compared to patients with Kt/V $\geq$1.7 (Table and Figure 12.3.6).

Increasing age, diabetes, peritonitis episodes, cardiovascular disease, low serum albumin, low BMI, abnormal lipid profile, serum Hb less than 10g/dL and assisted PD are associated with an increased risk for change of modality (Table 12.3.7). The commonest reason for PD drop-out was peritonitis (42%), followed by patient preference (18%) and membrane failure (17%) (Table 12.3.8).

Table 12.3.1(a): Unadjusted technique survival by Dialysis modality, 2000-2009

Dialysis Modality Interval (month)	PD			HD			All dialysis		
	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
0	4367	100	-	28723	100	-	33090	100	-
6	3671	90	0	25173	94	0	28844	93	0
12	2948	80	1	21518	88	0	24466	87	0
24	1897	63	1	15766	78	0	17663	76	0
36	1142	48	1	11403	70	0	12545	67	0
48	702	37	1	8009	62	0	8711	59	0
60	452	30	1	5552	55	0	6004	52	0
72	279	24	1	3673	49	0	3950	46	0
84	131	17	1	2285	44	0	2415	40	0
96	62	14	1	1247	39	1	1308	36	0
108	19	10	1	520	35	1	538	32	1
120	-	-	-	-	-	-	-	-	-

Figure 12.3.1(a): Unadjusted technique survival by Dialysis modality, 2000-2009

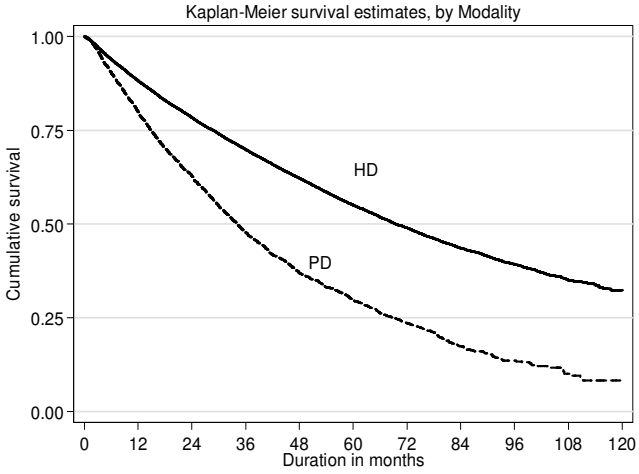


Table 12.3.1(b): Unadjusted technique survival by era 2000–2004 and 2005–2009

Era	2000 – 2004			2005 – 2009		
Interval (month)	No.	% Survival	SE	No.	% Survival	SE
0	1697	100	-	2670	100	-
6	1523	90	1	2150	90	1
12	1344	80	1	1604	79	1
24	1029	63	1	868	62	1
36	762	47	1	380	48	1
48	579	36	1	124	38	2
60	452	29	1	-	-	-
72	279	23	1	-	-	-
84	131	17	1	-	-	-
96	62	13	1	-	-	-
108	19	10	1	-	-	-
120	-	-	-	-	-	-

Figure 12.3.1(b): Unadjusted technique survival by era 2000 – 2004 and 2005 – 2009

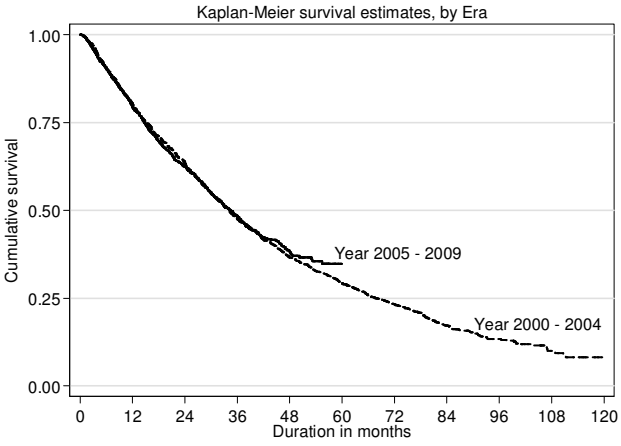


Figure 12.3.1(c): Unadjusted technique survival of by Diabetes Status in era 2000 – 2004 and 2005 – 2009

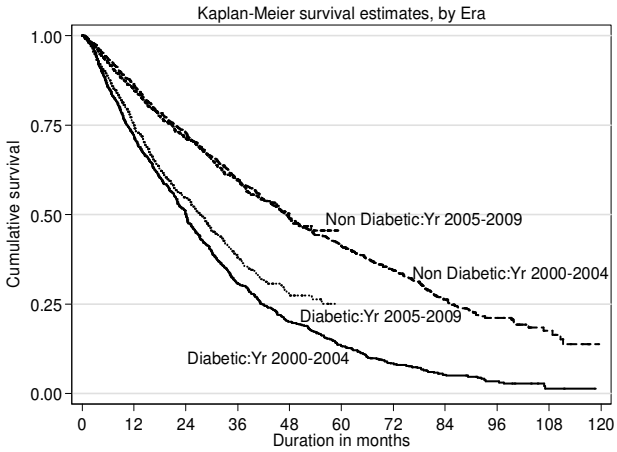


Table 12.3.1(c): Unadjusted technique survival of by Diabetes Status in era 2000 – 2004 and 2005 – 2009

Diabetic Era	Non Diabetic 2000-2004			Diabetic 2000–2004			Non Diabetic 2005–2009			Diabetic 2005–2009		
Interval (month)	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
0	992	100	-	705	100	-	1255	100	-	1415	100	-
6	921	94	1	603	86	1	1029	92	1	1124	88	1
12	836	86	1	508	72	2	792	85	1	818	75	1
24	679	73	1	351	50	2	458	71	2	411	55	2
36	549	60	2	214	31	2	237	60	2	143	38	2
48	440	49	2	140	20	2	80	50	2	45	27	2
60	362	41	2	92	13	1	-	-	-	-	-	-
72	236	34	2	44	8	1	-	-	-	-	-	-
84	112	26	2	20	5	1	-	-	-	-	-	-
96	52	21	2	11	3	1	-	-	-	-	-	-
108	17	17	2	3	1	1	-	-	-	-	-	-
120	-	-	-	-	-	-	-	-	-	-	-	-

Table 12.3.2: Unadjusted technique survival by year of entry, 2000-2009

Year Interval (month)	2000			2001			2002			2003			2004		
	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
0	227	100	-	337	100	-	373	100	-	420	100	0	340	100	-
6	206	91	2	303	90	2	343	92	1	371	89	2	303	90	2
12	185	81	3	266	80	2	294	80	2	334	80	2	268	80	2
24	138	63	3	198	61	3	229	64	3	255	63	2	214	66	3
36	101	46	3	152	47	3	167	48	3	183	45	2	163	51	3
48	78	36	3	108	34	3	128	37	3	143	36	2	126	39	3
60	67	31	3	79	26	2	97	29	2	110	28	2	103	33	3
72	47	22	3	65	21	2	79	24	2	90	23	2	-	-	-
84	36	18	3	47	15	2	50	17	2	-	-	-	-	-	-
96	27	14	2	36	12	2	-	-	-	-	-	-	-	-	-
108	19	10	2	-	-	-	-	-	-	-	-	-	-	-	-
120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Year Interval (month)	2005			2006			2007			2008			2009		
	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
0	362	100	-	463	100	-	591	100	-	643	100	-	611	100	-
6	323	89	2	428	93	1	527	89	1	574	90	1	302	90	1
12	280	79	2	371	81	2	463	80	2	491	77	2	-	-	-
24	220	63	3	280	63	2	369	64	2	-	-	-	-	-	-
36	162	48	3	217	49	2	-	-	-	-	-	-	-	-	-
48	124	37	3	-	-	-	-	-	-	-	-	-	-	-	-
60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Figure 12.3.2: Unadjusted technique survival by year of entry, 2000-2009

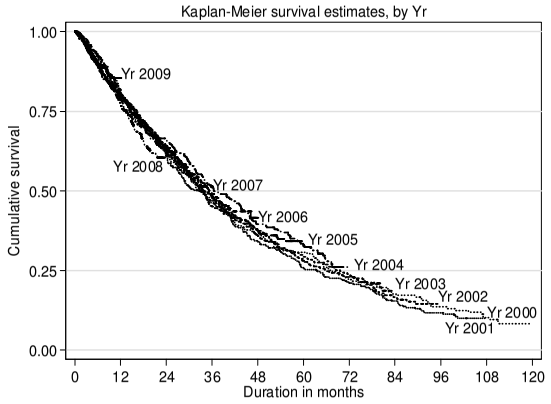


Table 12.3.3: Unadjusted technique survival by age, 2000-2009

Age group (years) 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	301	100	-	387	100	-	362	100	-	542	100	-
6	266	96	1	337	93	1	317	93	1	474	93	1
12	231	92	2	283	86	2	255	85	2	398	85	2
24	171	84	2	196	74	2	179	71	3	284	71	2
36	114	69	3	133	62	3	123	62	3	191	58	2
48	83	61	4	95	54	3	77	50	3	124	47	3
60	55	53	4	64	44	3	52	43	4	83	37	3
72	39	44	4	41	38	4	34	35	4	61	32	3
84	23	36	5	21	31	4	13	25	4	37	26	3
96	10	28	5	10	21	5	7	20	5	21	23	3
108	3	24	6	4	21	5	2	10	6	9	21	3
120	-	-	-	-		-	-	-	-	-	-	-

Age group (years) 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	962	100	-	1038	100	-	775	100	-
6	830	91	1	866	89	1	589	83	1
12	676	81	1	689	78	1	420	67	2
24	436	61	2	421	58	2	217	47	2
36	274	45	2	220	40	2	92	30	2
48	168	34	2	119	28	2	42	18	2
60	112	28	2	68	21	2	24	13	2
72	59	20	2	39	15	2	11	10	2
84	27	15	2	13	9	2	4	4	2
96	13	10	2	5	6	2	2	4	2
108	5	9	2	-	-	-	-	-	-
120	-	-	-	-	-	-	-	-	-

Figure 12.3.3: Unadjusted technique survival by age, 2000-2009

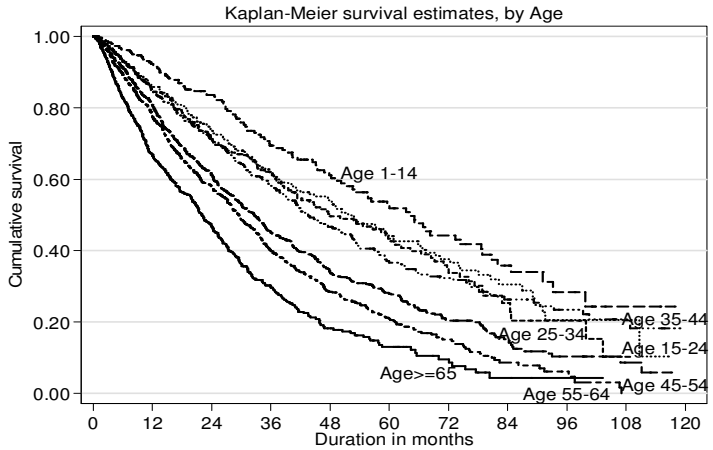


Table 12.3.4: Unadjusted technique survival by Gender, 2000-2009

Gender		Male			Female	
Interval (months)	No.	% survival	SE	No.	% survival	SE
0	2194	100	-	2173	100	-
6	1859	91	1	1815	90	1
12	1484	80	1	1464	80	1
24	936	63	1	961	63	1
36	553	47	1	589	48	1
48	331	34	1	373	39	1
60	195	26	1	259	33	1
72	122	20	1	158	27	1
84	53	14	1	79	21	2
96	22	10	1	41	17	2
108	5	6	2	15	14	2
120	-	-	-	-	-	-

Figure 12.3.4: Unadjusted technique survival by Gender, 2000-2009

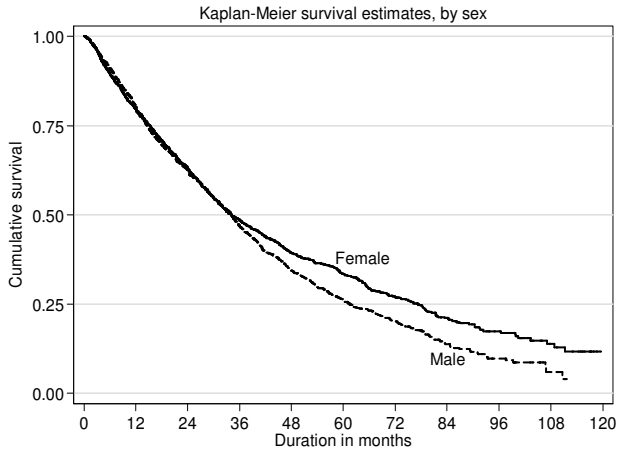


Figure 12.3.5: Unadjusted technique survival by Diabetes status, 2000-2009

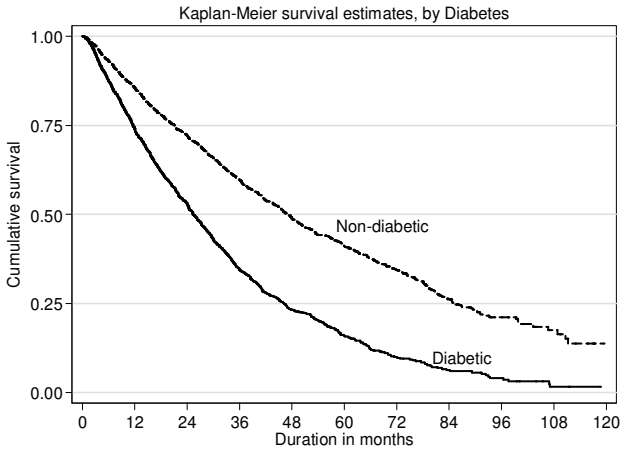


Table 12.3.5: Unadjusted technique survival by Diabetes status, 2000-2009

Diabetes status		Non-Diabetic			Diabetic	
Interval (month)	No.	% survival	SE	No.	% survival	SE
0	2247	100	-	2120	100	-
6	1948	93	1	1726	87	1
12	1622	85	1	1326	74	1
24	1136	72	1	761	53	1
36	786	60	1	356	34	1
48	519	49	1	184	23	1
60	362	41	1	92	16	1
72	236	34	1	44	10	1
84	112	26	2	20	6	1
96	52	21	2	11	4	1
108	17	17	2	3	2	1
120	-	-	-	-	-	-

Table 12.3.6 Unadjusted technique survival by Kt/V, 2000-2009

Kt/V Interval (months)	<1.7			1.7-2.0			>2.0		
	No.	% Survival	SE	No.	% Survival	SE	No.	% Survival	SE
0	1574	100	-	2378	100	-	5078	100	-
6	1519	98	0	2328	99	0	4930	99	0
12	1403	94	1	2197	96	0	4610	96	0
24	1170	86	1	1830	88	1	3825	87	0
36	889	74	1	1452	78	1	2898	76	1
48	689	63	1	1070	68	1	2166	67	1
60	492	51	1	797	59	1	1667	60	1
72	306	40	2	601	51	1	1218	54	1
84	169	30	2	352	41	1	764	45	1
96	102	26	2	209	33	1	497	38	1
108	65	19	2	108	26	2	321	32	1
120	46	17	2	55	19	2	198	26	1

Figure 12.3.6 Unadjusted technique survival by Kt/V, 1999 -2009

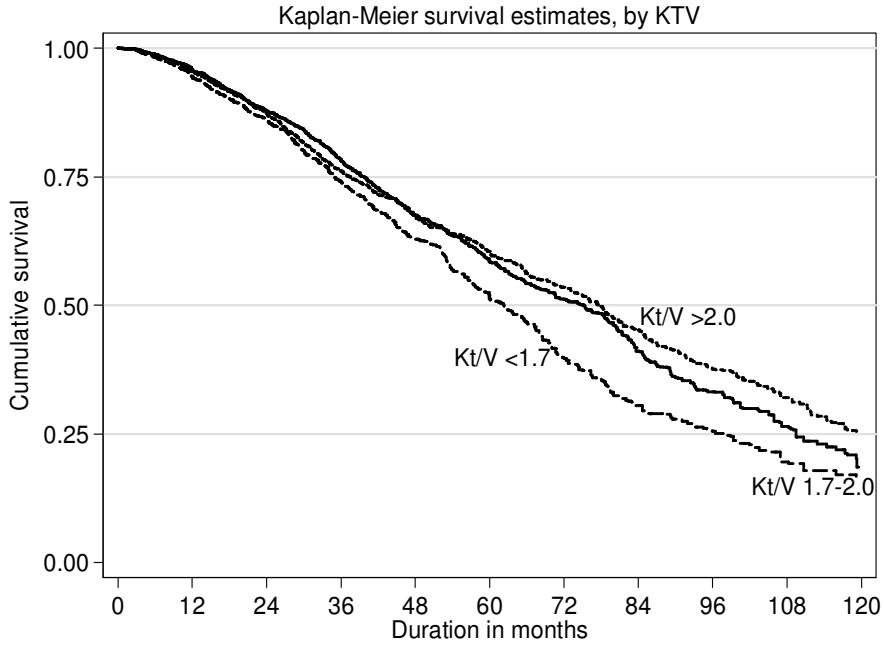


Table 12.3.7: Adjusted hazard ratio for change of modality, 2000-2009

Factors	No.	Hazard Ratio	95% CI	p value
Age (years):				
Age 1-14 (ref*)	301	1.00		
Age 15-24	387	1.60	(1.13; 2.26)	0.009
Age 25-34	362	1.78	(1.23; 2.56)	0.002
Age 35-44	542	2.10	(1.48; 2.98)	0.000
Age 45-54	962	2.58	(1.85; 3.61)	0.000
Age 55-64	1,038	3.10	(2.22; 4.32)	0.000
Age >=65	775	3.91	(2.76; 5.54)	0.000
Peritonitis				
No (ref*)	4,054	1.00		
Yes	313	2.97	(2.52; 3.49)	0.000
Diabetes Mellitus				
Non-diabetic (ref*)	2,247	1.00		
Diabetic	2,120	1.56	(1.36; 1.79)	0.000
Gender				
Maleref	2,194	1.00		
Female	2,173	0.84	(0.75; 0.95)	0.005
Cardiovascular Disease:				
No CVD (ref*)	3,397	1.00		
CVD	970	1.21	(1.06; 1.39)	0.006
BMI:				
<18.5	618	1.44	(1.20; 1.74)	0.000
18.5-<25 (ref*)	2,269	1.00		
>=25	1,480	0.87	(0.77; 0.98)	0.021
Serum Albumin:				
<30	1,172	1.95	(1.68; 2.26)	0.000
30-<35	1,693	1.23	(1.07; 1.41)	0.003
35-<45 (ref*)	1,124			
>=45	378	1.06	(0.39; 2.85)	0.912
Serum Cholesterol:				
<3.2	81	1.78	(1.22; 2.60)	0.003
3.2-<5.2 (ref*)	2,150	1.00		
>=5.2	2,136	1.11	(0.99; 1.24)	0.077
Diastolic BP:				
<70	548	1.07	(0.88; 1.29)	0.509
70-<80	1,484	0.92	(0.81; 1.05)	0.243
80-<90 (ref*)	1,752	1.00		
90-<100	508	1.27	(1.05; 1.53)	0.014
>=100	75	2.19	(1.41; 3.39)	0.000
Hemoglobin:				
<8	214	1.63	(1.21; 2.18)	0.001
8-<9	486	1.85	(1.50; 2.27)	0.000
9-<10	1,012	1.36	(1.15; 1.61)	0.000
10-<11	1,393	1.01	(0.86; 1.19)	0.886
11-<12 (ref*)	821	1.00		
>=12	441	1.01	(0.80; 1.26)	0.964
Serum Calcium:				
<2.2	1,615	0.91	(0.80; 1.04)	0.167
2.2-<2.6 (ref*)	2,614	1.00		
>=2.6	138	2.49	(1.77; 3.51)	0.000
Calcium Phosphate product:				
<3.5	2,417	1.48	(1.21; 1.80)	0.000
3.5-<4.5 (ref*)	1,287	1.00		
4.5-<5.5	480	0.87	(0.68; 1.12)	0.273
>=5.5	183	0.64	(0.39; 1.05)	0.077
Serum Phosphate:				
<1.6 (ref*)	2,563	1.00		
1.6-<2.0	1,189	1.08	(0.88; 1.32)	0.474
2.0-<2.2	272	1.41	(1.00; 1.99)	0.051
2.2-<2.4	145	1.45	(0.95; 2.23)	0.089
2.4-<2.6	110	1.57	(0.90; 2.72)	0.109
>=2.6	88	2.64	(1.38; 5.05)	0.003
Kt/V:				
<=1.7 (ref*)	610	1.00		
>1.7	2,738	0.80	(0.70; 0.92)	0.002
Assisted PD:				
Selfcare (ref*)	2,402	1.00		
Assisted	1,865	1.25	(1.10; 1.42)	0.001

Table 12.3.8 Reasons for change of dialysis modality to HD, 2000-2009

Cause	No.	Percentage
Peritonitis	395	42
Catheter related infection	32	4
Membrane failure	165	17
Technical problem	78	8
Patient preference	175	18
Others	69	7
Unknown	41	4
Total	955	100

SECTION 12.4: PERITONITIS

The median peritonitis rate among the PD centres has dropped to 38.3 pt-months per episode compared to the previous year (Table 12.4.1). There was a wide inter-centre variation with the highest and lowest peritonitis rates of 14 and 247.4 pt-months per episode. Gram-positive organisms accounted for 29% of the peritonitis episodes while 32% were due to gram negative organisms. The commonest organism for gram positive peritonitis was staphylococcus aureus (16%) and Staphyloccal coagulase negative (9%). Meanwhile, pseudomonas aeruginosa (14%) and E.coli was the commonest organism (7%) for gram negative peritonitis. Fungal organisms accounted for 5% of cases. The culture negative rate continues to show a slow but steady reduction over the years, with the present rate at 29% (Table 12.4.2).

Catheter removal rate was highest in fungal infection (61%), followed by pseudomonas aeruginosa (27%) infection (Table 12.4.3). Mortality was highest for mycobacterial infections. There were no statistically significant identifiable risk factors influencing the peritonitis rate apart from an increasing number of years on PD therapy (Table 12.4.4).

Table 12.4.1 Variation in peritonitis rate (pt-month/epi) among PD centres, 2000- 2009

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	42.4	219.2	219.2
2003	13	18	18	21.3	32.9	39.6	312.1	312.1
2004	15	0	0	23.6	32.8	36.6	41.5	41.5
2005	15	18	18	26.1	35.6	43	57.7	57.7
2006	21	14.8	18.5	26.8	37.4	49.7	62.2	97.7
2007	23	12	15.3	30.7	42	56.9	68.4	106.7
2008	25	12	13	29.4	40.1	58.9	110.4	123.8
2009	25	14	16.9	29.4	38.3	60.3	132	247.4

Figure 12.4.1 Variation in peritonitis rate among PD centres, 2009

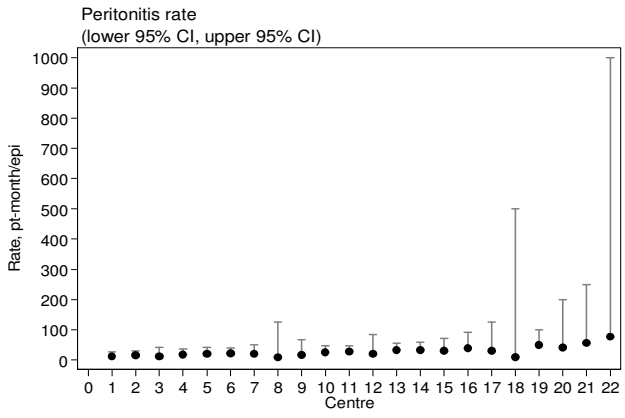


Table 12.4.2: Causative organism in PD peritonitis, 2000-2009

Microorganism	2000		2001		2002		2003		2004		2005		2006		2007		2008		2009	
	No.	%	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	74	12	118	16
Staph Coagulase Neg.	34	11	30	10	39	11	47	13	41	11	43	13	32	9	29	8	69	11	68	9
Strep	17	6	18	6	12	3	16	4	13	3	10	3	17	5	14	4	19	3	20	3
Others	4	1	10	3	8	2	16	4	4	1	8	2	14	4	11	3	9	1	8	1
(**B) Gram Negatives**																				
Pseudomonas	19	6	14	4	23	6	20	5	28	8	27	8	23	6	30	8	93	15	99	14
Acinetobacter	0	0	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	21	3
Enterobacter	11	4	16	5	11	3	13	4	19	5	19	6	20	5	17	5	24	4	32	4
E.Coli	15	5	16	5	23	6	20	5	23	6	30	9	15	4	32	9	42	7	47	7
Others	9	3	17	5	15	4	15	4	16	4	17	5	14	4	14	4	22	4	29	4
(C) Polymicrobial	9	3	11	4	8	2	3	1	2	1	0	0	1	0	0	0	0	0	17	2
(D) Others																				
Fungal	19	6	21	7	12	3	12	3	15	4	7	2	16	4	20	5	29	5	33	5
Mycobacterium	6	2	4	1	1	0	3	1	4	1	2	1	4	1	1	0	4	1	1	0
Others	2	1	9	3	11	3	12	3	8	2	3	1	10	3	12	3	30	5	22	3
(E) No growth	119	39	99	32	118	33	115	32	123	33	96	30	142	39	122	33	179	29	201	28
TOTAL	309	100	312	100	361	100	364	100	373	100	322	100	367	100	370	100	618	100	716	100

Table 12.4.3: Outcome of peritonitis by Causative organism, 2000-2009

Causative Organism	Outcome							
	Resolved		Not resolved, catheter removed		Death		Total	
	No.	%	No.	%	No.	%	No.	%
(A) Gram Positives								
Staph. Aureus	285	54	76	14	170	32	531	100
Staph Coagulase Neg.	232	58	33	8	136	34	401	100
Strep	75	51	11	8	60	41	146	100
Others	37	44	8	10	39	46	84	100
(**B) Gram Negatives**								
Pseudomonas	152	45	91	27	98	29	341	100
Acinetobacter	0		0		0		0	100
Klebsiella	72	43	34	20	62	37	168	100
Enterobacter	71	40	42	24	63	36	176	100
E.Coli	109	44	55	22	86	34	250	100
Others	72	48	37	25	41	27	150	100
(C) Polymicrobial	12	24	12	24	25	51	49	100
(D) Others								
Fungal	20	11	109	61	50	28	179	100
Mycobacterium	1	3	12	41	16	55	29	100
Others	49	45	23	21	36	33	108	100
(E) No growth	638	51	171	14	437	35	1246	100

Table 12.4.4: Risk factor influencing peritonitis rate, 2000 -2009

Factors	No.	Risk Ratio	95% CI		P value
Age (years):					
<=14	217	0.93	(0.76;	1.13)	0.45
15-24	289	0.95	(0.79;	1.14)	0.57
25-34 (ref*)	268	1.00			
35-44	410	1.11	(0.94;	1.30)	0.21
45-54	698	1.11	(0.95;	1.30)	0.18
55-64	731	1.07	(0.91;	1.26)	0.43
>=65	463	1.00	(0.83;	1.22)	0.96
Gender:					
Male (ref*)	1,542	1.00			
Female	1,534	1.00	(0.92;	1.08)	0.98
Diabetes:					
No (ref*)	1,712	1.00			
Yes	1,364	1.01	(0.92;	1.11)	0.78
Income:					
RM 0-999 (ref*)	1,277	1.00			
RM 1000-1999	1,052	0.86	(0.79;	0.94)	0.00
RM 2000-2999	439	0.91	(0.80;	1.02)	0.11
>=3000	308	0.81	(0.70;	0.95)	0.01
Education:					
Nil	279	1.08	(0.92;	1.26)	0.34
Primary	1,088	1.11	(1.01;	1.21)	0.02
Secondary (ref*)	1,440	1.00			
Tertiary	269	0.80	(0.68;	0.94)	0.01
Assistance to perform CAPD:					
Self care (ref*)	1,807	1.00			
Partially assisted	428	0.92	(0.82;	1.05)	0.22
Completely assisted	841	0.94	(0.85;	1.05)	0.28
Year vintage:					
1 to < 2 (ref*)	1,853	1.00			
>2 to < 4	746	0.72	(0.66;	0.79)	0.00
> 4	477	0.52	(0.47;	0.57)	0.00

CHAPTER 13

Renal Transplantation

Goh Bak Leong
Zaki Morad b Mohd Zaher
Fan Kin Sing
Lily Mushahar
Rohan Malek
S. Prasad Menon
Tan Si Yen

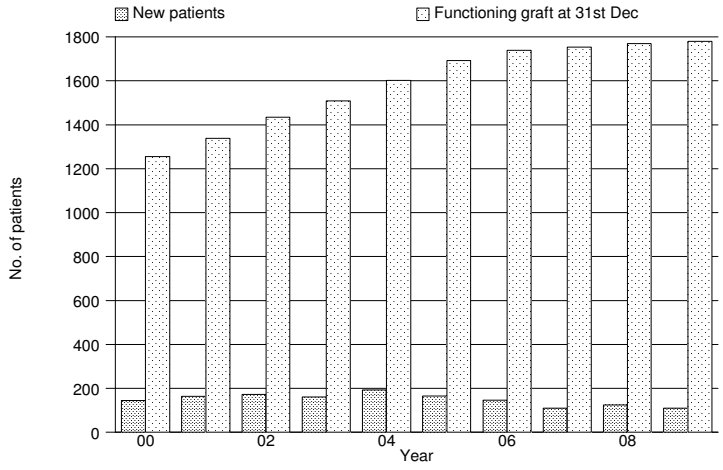
SECTION 13.1: STOCK AND FLOW

The number of new renal transplant patients shows an initial rise from 143 transplants per year in 2000 to a peak of 192 transplants in 2004. This is a rise of nearly 34% but the number declined subsequently to only 109 in 2009 (Table 13.1.1). 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. The number of functioning renal transplants reported to the National Transplant Registry (NTR) had increased from 1255 in 2000 to 1779 in 2009 (Table 13.1.1).

Table 13.1.1: Stock and Flow of Renal Transplantation, 2000-2009

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
New transplant patients	143	163	172	160	192	165	145	110	124	109
Died	30	37	35	39	42	44	55	41	52	39
Graft failure	32	40	39	42	44	21	38	38	40	34
Lost to Follow up	8	2	4	5	11	10	5	17	17	13
Functioning graft at 31st December	1255	1339	1433	1507	1602	1692	1739	1753	1768	1779

Figure 13.1.1: Stock and Flow of Renal Transplantation, 2000-2009



The incidence of renal transplantation shows a modest decline from of 6-7 per million population in the early 2000's to 4 per million population for the last 3 years (Table 13.1.2) while transplant prevalence rate has grown slowly from 53 per million in 2000 to 63 per million population in 2008 (Table 13.1.3), an increase of 19% over the 2000 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 2009 (4 and 63 per million population respectively (Table 13.1.2 and 13.1.3).

Table 13.1.2: New transplant rate per million population (pmp), 2000-2009

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
New transplant patients	143	163	172	160	192	165	145	110	124	109
New transplant rate, pmp	6	7	7	6	8	6	5	4	4	4

Figure 13.1.2: New transplant rate, 2000-2009

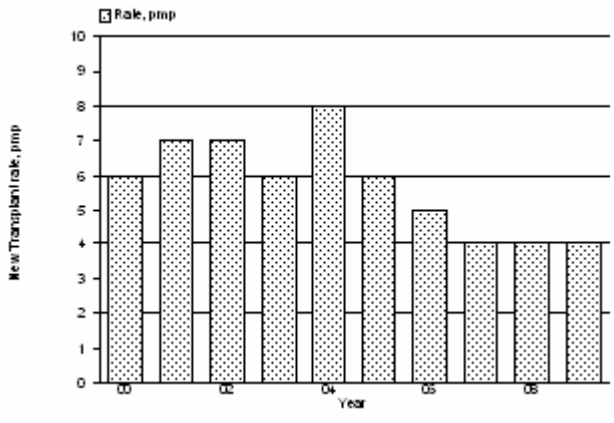


Figure 13.1.3: Transplant prevalence rate, 2000-2009

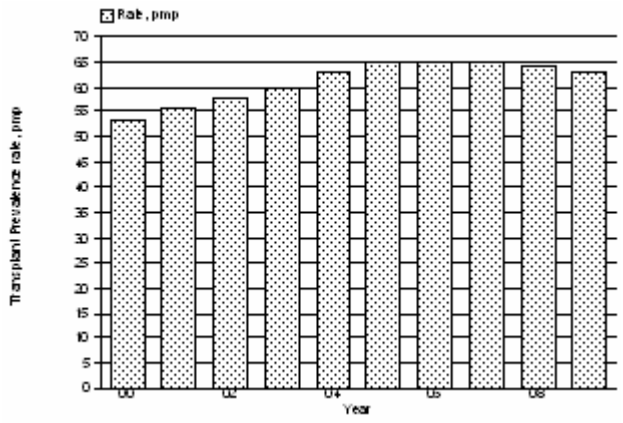


Table 13.1.3: Transplant prevalence rate per million population (pmp), 2000-2009

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Functioning graft at 31st Dec	1255	1339	1433	1507	1602	1692	1739	1753	1768	1779
Transplant prevalence rate, pmp	53	56	58	60	63	65	65	65	64	63

In terms of place of transplantation, transplantation within local centres has remained quite the same from 2000 to 2008, with 54 to 64 cases. 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 49% of all of renal transplant recipients with 61 patients.

Table 13.1.4: Place of transplantation, 2000-2009

Year	2000		2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%	No.	%
HKL	28	20	33	20	30	17	26	16	20	10
UMMC	19	13	23	14	15	9	6	4	7	4
Selayang Hospital	4	3	11	7	11	6	11	7	11	6
Other local	3	2	4	3	1	1	1	1	2	1
China	80	56	83	51	103	60	111	69	139	72
India	9	6	8	5	12	7	4	3	11	6
Other overseas	0	0	1	1	0	0	1	1	2	1
Unknown	0	0	0	0	0	0	0	0	0	0
TOTAL	143	100	163	100	172	100	160	100	192	100

Year	2005		2006		2007		2008		2009		TOTAL	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
HKL	31	19	35	24	36	33	32	26	34	31	305	21
UMMC	7	4	5	3	3	3	10	8	6	6	101	7
Selayang Hospital	5	3	9	6	14	13	10	8	18	17	104	7
Other local	4	2	2	1	4	4	8	7	6	6	35	2
China	109	66	84	58	45	41	61	49	41	38	856	58
India	6	4	7	5	3	3	2	2	2	2	64	4
Other overseas	3	2	3	2	5	5	1	1	0	0	16	1
Unknown	0	0	0	0	0	0	0	0	2	2	2	0
TOTAL	165	100	145	100	110	100	124	100	109	100	1483	100

SECTION 13.2: RECIPIENTS' CHARACTERISTICS

In terms of renal transplant recipients' characteristics, age at transplant has been stable at 37 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 13.2.1). However, there is a drastic drop in number of diabetic patients who underwent transplantation since 2007. 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. In terms of cause of end stage renal failure (Table 13.2.2), 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 13.2.1: Renal Transplant Recipients' Characteristics, 2000-2009

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
New Transplant Patients	143	163	172	160	192	165	145	110	124	109
Age at transplant (years), Mean	39	41	41	42	42	38	37	38	37	37
Age at transplant (years), SD	14	13	12	13	13	14	15	16	14	13
% Male	64	63	58	66	63	70	67	64	58	60
% Diabetic (co-morbid/ primary renal disease)	15	18	15	23	21	21	20	14	18	12
% HBsAg positive	5	5	7	8	5	4	7	6	3	3
% Anti-HCV positive	8	15	9	10	8	2	8	9	3	7

Table 13.2.2: Primary causes of end stage renal failure, 2000-2009

Year	2000		2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%	No.	%
New transplant patients	143	100	163	100	172	100	160	100	192	100
Glomerulonephritis	50	35	44	27	54	31	55	34	64	33
Diabetes Mellitus	16	11	23	14	16	9	27	17	32	17
Hypertension	20	14	17	10	24	14	26	16	52	27
Obstructive uropathy	3	2	3	2	2	1	2	1	4	2
ADPKD	3	2	1	1	3	2	5	3	5	3
Drugs/ toxic nephropathy	0	0	0	0	0	0	2	1	2	1
Hereditary nephritis	0	0	0	0	0	0	0	0	1	1
Unknown	54	38	61	37	70	41	58	36	82	43
Others	12	8	23	14	15	9	12	8	28	15

Year	2005		2006		2007		2008		2009	
	No.	%	No.	%	No.	%	No.	%	No.	%
New transplant patients	165	100	145	100	110	100	124	100	109	100
Glomerulonephritis	45	27	53	37	29	26	30	24	35	32
Diabetes Mellitus	30	18	22	15	10	9	18	15	12	11
Hypertension	41	25	32	22	27	25	22	18	25	23
Obstructive uropathy	3	2	6	4	1	1	2	2	4	4
ADPKD	3	2	1	1	2	2	0	0	5	5
Drugs/ toxic nephropathy	0	0	1	1	0	0	2	2	1	1
Hereditary nephritis	0	0	0	0	0	0	0	0	0	0
Unknown	52	32	44	30	42	38	54	44	42	39
Others	16	10	16	11	14	13	13	10	2	2

SECTION 13.3: TRANSPLANT PRACTICES

In 2009, only 29% of the renal transplant recipients received their grafts from commercial sources, compare to 79% in 2004. Live donor transplantation made up 33% of transplants (30 recipients) in 2009. Since 2006, the number of life donor has remained low - 33 in 2007 and 38 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. 2009 marked the first time in 10 years where there were more local cadaver transplantations (37%) compared to local life transplantations (33%).

Table 13.3.1: Type of Renal Transplantation, 2000-2009

Year	2000		2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial cadaver	80	56	83	51	103	60	112	70	145	76
Commercial live donor	9	6	7	4	11	6	3	2	6	3
Live donor (genetically related)	21	15	32	20	33	19	25	16	21	11
Live donor (emotionally related)	6	4	4	2	3	2	5	3	2	1
Cadaver	27	19	37	23	22	13	15	9	17	9
TOTAL	143	100	163	100	172	100	160	100	191	100

Year	2005		2006		2007		2008		2009	
	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial cadaver	105	64	84	59	45	42	53	46	17	19
Commercial live donor	9	6	5	4	3	3	1	1	9	10
Live donor (genetically related)	37	23	24	17	20	19	32	28	20	22
Live donor (emotionally related)	3	2	4	3	13	12	6	5	10	11
Cadaver	9	6	26	18	27	25	23	20	33	37
TOTAL	163	100	143	100	108	100	115	100	89	100

*Commercial Cadaver (China, India, other oversea) *Commercial live donor (living unrelated) *Cadaver (local)

Table 13.3.2: Biochemical data, 2006-2009

Biochemical parameter	Summary	2006	2007	2008	2009
Creatinine, umol/L	N	1592	1688	1697	1692
	Mean	135.7	131.8	131.9	128.2
	SD	81.3	77.6	80.8	62.8
	Median	120	116	115	115
	Minimum	21.7	36	29	10.7
	Maximum	1152	1186	1181	657
Hb, g/dL	N	1592	1688	1697	1692
	Mean	12.7	12.8	12.8	12.6
	SD	1.9	1.9	1.9	1.8
	Median	12.8	12.8	12.8	12.8
	Minimum	3.3	4.4	6.2	5.3
	Maximum	19.8	18.7	18.6	18.5
Albumin, g/L	N	1592	1688	1697	1692
	Mean	39.6	39.7	39.7	39.6
	SD	0.7	0.8	0.8	1.2
	Median	39.6	39.6	39.6	39.6
	Minimum	29	29	30	21
	Maximum	48	48	50	50
Calcium, mmol/L	N	1592	1688	1697	1692
	Mean	2.3	2.3	2.3	2.3
	SD	0.2	0.2	0.2	0.2
	Median	2.3	2.3	2.3	2.3
	Minimum	1.1	1.4	1	1.1
	Maximum	3.1	3.2	3.5	3.3

Table 13.3.2: Biochemical data, 2006-2009 *(cont.)*

Biochemical parameter	Summary	2006	2007	2008	2009
Phosphate, mmol/L	N	1592	1688	1697	1692
	Mean	1.1	1.1	1.1	1.1
	SD	0.2	0.3	0.3	0.2
	Median	1.1	1.1	1.1	1.1
	Minimum	0.5	0.5	0.5	0.5
	Maximum	3.5	3.9	3.2	2.8
Alkaline Phosphate (ALP), U/L	N	1592	1688	1697	1692
	Mean	79.1	79.4	78.9	79.9
	SD	43.2	39.8	46.5	45.3
	Median	71	72.5	72	73
	Minimum	24	22	20	21
	Maximum	700	508	985	732
ALT, U/L	N	1592	1688	1697	1692
	Mean	29.9	29.9	30.1	29.9
	SD	30.4	25.6	37.8	32.6
	Median	22	23	23	24
	Minimum	4	4	4	4
	Maximum	433	356	881	881
Total cholesterol, mmol/L	N	1592	1688	1697	1692
	Mean	5.3	5.2	5.2	5.2
	SD	1	1	1	1.1
	Median	5.3	5.3	5.3	5.3
	Minimum	1.5	1.7	2	1.9
	Maximum	11.1	11.4	11.2	10.6
LDL cholesterol, mmol/L	N	1592	1688	1697	1692
	Mean	3	2.9	2.9	2.8
	SD	0.8	0.8	0.8	1
	Median	2.9	2.9	2.9	2.9
	Minimum	1	1	0.9	0.9
	Maximum	11.1	8.9	7.7	10.8
HDL cholesterol, mmol/L	N	1592	1688	1697	1692
	Mean	1.6	1.5	1.6	1.5
	SD	0.5	0.4	0.5	0.5
	Median	1.6	1.6	1.6	1.6
	Minimum	0.4	0.4	0.5	0.4
	Maximum	5.8	7.5	7.5	6.9
Systolic Blood Pressure, mmHg	N	1592	1688	1697	1692
	Mean	130.7	131.6	129.5	130.1
	SD	15.9	15.7	15.3	14.7
	Median	130	130	130	130
	Minimum	66	80	80	65
	Maximum	210	210	245	210
Diastolic Blood Pressure, mmHg	N	1592	1688	1697	1692
	Mean	78.9	78.8	77.5	78.3
	SD	9.8	9.4	9.2	8.7
	Median	80	80	79	79
	Minimum	30	20	20	40
	Maximum	120	116	133	120

In 2009, Cyclosporine based regimes remained the mainstay of immunosuppressive therapy with 64% of patients receiving it. This showed a gradual declining trend which coincided with increasing trend in Tacrolimus usage. Tacrolimus based regimes accounted for 27%. There has been continuous increase in the use of Mycophenolate Mofetil as the second immunosuppressive agent with 60% of patients on it in 2009. During the same period, the use of Azathioprine declined to 22% in 2009. 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 and 2009.

In terms of non immunosuppressive medications, in year 2009 only 28% of patients were on ACE inhibitors or Angiotensin II receptor blockers (AIIRB) or both and this trend has been relatively static since 2006. Calcium Channel blockers appeared to be the mainstay of antihypertensive therapy with 42% of patients on ot whilst Beta Blockers use was reported in 39% of patients. Other antihypertensives were reported in 10% of patients. The widespread use of Calcium Channel blockers either as monotherapy or combination may be due to the use of the dihydropyridine group to minimise the dose of Cyclosporine, which remains the main immunosuppressive drug.

Table 13.3.3: Medication data, 2006-2009

Medication data	Single drug treatment								Combined drug treatment							
	2006		2007		2008		2009		2007		2007		2008		2009	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
All	1482	100	1665	100	1427	100	1739	100	1482	100	1665	100	1427	100	1739	100
(i) Immunosuppressive drug(s) treatment																
Prednisolone	8	1	9	1	6	0	6	0	1444	97	1611	97	1384	97	1638	94
Azathioprine	0	0	0	0	0	0	1	0	497	34	479	29	382	27	383	22
Cyclosporin A	5	0	8	0	2	0	15	1	1119	76	1191	72	983	69	1116	64
Tacrolimus (FK506)	0	0	4	0	3	0	14	1	254	17	348	21	344	24	473	27
Mycophenolate Mofetil (MMF)	0	0	1	0	2	0	0	0	708	48	907	54	775	54	1043	60
Rapamycin	0	0	0	0	1	0	0	0	7	0	33	2	30	2	32	2
Others	0	0	0	0	0	0	1	0	18	1	4	0	1	0	26	1
(ii) Non-Immunosuppressive drug(s) treatment																
Beta blocker	77	5	90	5	88	6	118	7	597	40	735	44	615	43	679	39
Calcium channel blocker	199	13	184	11	138	10	161	9	787	53	905	54	687	48	736	42
ACE inhibitor	39	3	38	2	29	2	40	2	292	20	384	23	287	20	309	18
AIIRB	27	2	18	1	17	1	21	1	141	10	210	13	141	10	146	8
Anti-lipid	156	11	95	6	89	6	115	7	679	46	732	44	627	44	706	41
Other anti-hypertensive	11	1	6	0	25	2	26	1	159	11	140	8	191	13	167	10

SECTION 13.4: TRANSPLANT OUTCOMES

13.4.1 Post-transplant complications

In the year 2009, sixty percent of patients were hypertensive prior to transplantation whereas 26% developed hypertension post transplantation. Twelve percent of patients had diabetes mellitus prior to transplant whereas only 5% of patients develorped post transplant diabetes mellitus. These trends have been quite the same since 2006. In terms of cardiovascular and cerebrovascular disease 3% had either or both prior to transplant whereas another 3% developed these complications post transplantation.

Table 13.4.1: Post-transplant complications, 2006-2009

Post transplant complications	Complication developed before transplant (regardless of complication after transplantation)								Complication developed only after transplantation							
	2006		2007		2008		2009		2006		2007		2008		2009	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
All patients	1592	100	1688	100	1704	100	1708	100	1592	100	1688	100	1704	100	1708	100
Diabetes (either as Primary Renal Disease or co-morbid)	218	14	232	14	233	14	211	12	124	8	113	7	119	7	88	5
Cancer	2	0	3	0	2	0	1	0	20	1	21	1	24	1	16	1
Cardiovascular disease + cerebrovascular disorder	73	5	72	4	67	4	51	3	45	3	54	3	72	4	56	3
Hypertension	1036	65	1063	63	1054	62	1025	60	354	22	451	27	413	24	448	26

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

13.4.2 Deaths and Graft loss

In 2008, 52 transplant recipients died and 40 lost their grafts. The rates of transplant death and graft loss have remained static for the past 10 years (Table 13.4.2). The main known causes of death have been infection and cardiovascular disease with 35% and 23% respectively. Another 21% of patients died at home, which is usually presumed to be cardiovascular death as well.

Cancer death rates have been significantly high since 2000 contributing to 13% of all death in 2007 and 19% in 2008. Death due to liver disease has remained relatively static.

In terms of graft loss, majority were due to rejection.

Table 13.4.2: Transplant Patients Death Rate and Graft Loss, 2000-2009

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number at risk	1218	1296	1385	1469	1554	1646	1715	1745	1760	1821
Transplant death	30	37	35	39	42	44	55	41	52	39
Transplant death rate %	3	3	3	3	3	3	3	2	3	2
Graft loss	32	40	39	42	44	21	38	38	40	34
Graft loss rate %	3	3	3	3	3	1	2	2	2	2
Acute rejection	0	0	0	3	19	14	18	12	14	20
Acute rejection rate %	0	0	0	0	1	1	1	1	1	1
All losses	62	77	74	81	86	65	93	79	92	73
All losses rate %	5	6	5	6	6	4	5	5	5	4

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

Figure 13.4.2(a): Transplant Recipient Death Rate, 2000-2009

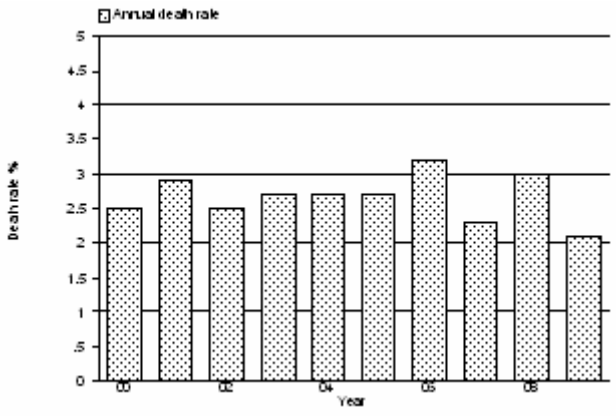


Figure 13.4.2(b): Transplant Recipient Graft Loss Rate, 2000 – 2009

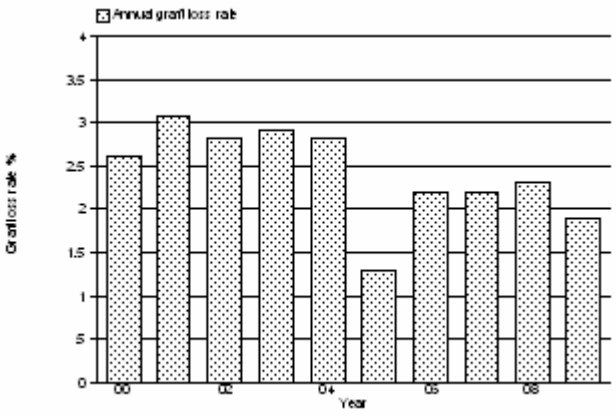


Table 13.4.3: Causes of Death in Transplant Recipients, 2000-2009

Year	2000		2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%	No.	%
Cardiovascular	10	30	7	16	5	14	12	27	6	14
Died at home	1	3	5	12	5	14	5	11	5	11
Infection	12	36	21	49	12	34	13	30	15	34
Graft failure	2	6	0	0	0	0	0	0	3	7
Cancer	2	6	6	14	5	14	7	16	8	18
Liver disease	1	3	2	5	3	9	3	7	3	7
Accidental death	1	3	1	2	1	3	1	2	0	0
Others	2	6	0	0	2	6	1	2	3	7
Unknown	2	6	1	2	2	6	2	5	1	2
TOTAL	33	100	43	100	35	100	44	100	44	100

Year	2005		2006		2007		2008		2009	
	No.	%	No.	%	No.	%	No.	%	No.	%
Cardiovascular	5	11	12	20	8	17	10	17	10	23
Died at home	6	13	7	12	5	11	12	21	9	21
Infection	25	56	24	40	15	33	20	34	15	35
Graft failure	0	0	0	0	4	9	0	0	1	2
Cancer	5	11	5	8	6	13	11	19	6	14
Liver disease	3	7	5	8	0	0	0	0	2	5
Accidental death	0	0	1	2	0	0	0	0	0	0
Others	0	0	2	3	1	2	4	7	0	0
Unknown	1	2	4	7	7	15	1	2	0	0
TOTAL	45	100	60	100	46	100	58	100	43	100

Table 13.4.4: Causes of Graft Failure, 2000-2009

Year	2000		2001		2002		2003		2004	
	No.	%	No.	%	No.	%	No.	%	No.	%
Rejection	19	59	25	61	23	56	21	48	31	70
Calcineurin toxicity	0	0	0	0	1	2	1	2	0	0
Other drug toxicity	0	0	0	0	0	0	0	0	0	0
Ureteric obstruction	0	0	0	0	0	0	0	0	0	0
Infection	1	3	2	5	0	0	2	5	1	2
Vascular causes	3	9	1	2	0	0	3	7	4	9
Recurrent/ de novo renal disease	0	0	2	5	2	5	2	5	1	2
Others	2	6	0	0	4	10	1	2	0	0
Unknown	7	22	11	27	11	27	14	32	7	16
TOTAL	32	100	41	100	41	100	44	100	44	100

Year	2005		2006		2007		2008		2009	
	No.	%	No.	%	No.	%	No.	%	No.	%
Rejection	15	68	26	67	26	68	22	61	15	68
Calcineurin toxicity	0	0	0	0	0	0	1	3	0	0
Other drug toxicity	0	0	0	0	0	0	0	0	0	0
Ureteric obstruction	0	0	0	0	1	3	0	0	0	0
Infection	1	5	2	5	1	3	1	3	1	5
Vascular causes	2	9	4	10	1	3	1	3	2	9
Recurrent/ de novo renal disease	0	0	1	3	0	0	0	0	0	0
Others	1	5	3	8	4	11	0	0	1	5
Unknown	3	14	3	8	5	13	11	31	3	14
TOTAL	22	100	39	100	38	100	36	100	22	100

13.5: PATIENT AND GRAFT SURVIVAL

Overall patient survival rates from 2000 to 2009 have been 95%, 90%, 87% and 79% at year 1, 3, 5 and 10 respectively. Overall graft survival rate has been 92%, 86%, 80% and 68% at year 1, 3, 5 and 10 respectively.

Table 13.5.1(a): Patient survival, 2000-2009

Interval (years)	No.	% Survival	SE
0	1483	100	-
1	1263	95	1
2	1102	92	1
3	962	90	1
4	805	89	1
5	639	87	1
6	462	85	1
7	321	82	1
8	200	82	1
9	95	79	2
10	1	79	2

*No.=Number at risk SE=standard error

Figure 13.5.1(a): Patient survival, 2000-2009

Table 13.5.1(b): Risk factors for transplant patient survival 2000-2009

Factors	N	Hazard Ratio	95% CI	P value
Year of transplant:				
2000-2004 (ref*)	830	1.00		
2005-2009	653	1.38	(0.92; 2.06)	0.121
Age at transplant:				
<20	153	0.42	(0.18; 0.97)	0.043
20-39 (ref*)	552	1.00		
40-54	680	1.97	(1.34; 2.90)	0.001
>=55	98	2.09	(1.20; 3.65)	0.010
Gender:				
Male (ref*)	937	1.00		
Female	546	0.90	(0.64; 1.26)	0.528
Primary diagnosis:				
Unknown primary (ref*)	755	1.00		
Diabetes mellitus	133	1.32	(0.85; 2.04)	0.218
GN/SLE	356	0.81	(0.54; 1.23)	0.321
Polycystic kidney	25	0.37	(0.05; 2.67)	0.323
Obstructive nephropathy	36	2.22	(0.95; 5.20)	0.066
Others	178	1.26	(0.80; 1.97)	0.314
Type of transplant:				
Commercial cadaver (ref*)	827	1.00		
Commercial live donor	60	1.09	(0.56; 2.11)	0.796
Living donor	324	0.83	(0.49; 1.38)	0.466
Cadaver	236	3.55	(2.44; 5.16)	<0.001
HbsAg:				
Negative (ref*)	1447	1.00		
Positive	36	1.86	(0.96; 3.62)	0.068
Anti-HCV:				
Negative (ref*)	1428	1.00		
Positive	55	1.67	(0.97; 2.85)	0.063

Figure 13.5.1(b): Risk factors for transplant patient survival 2000-2009
(adjusted for age, gender, primary diagnosis, type of transplant, HBsAg and Anti-HCV status)

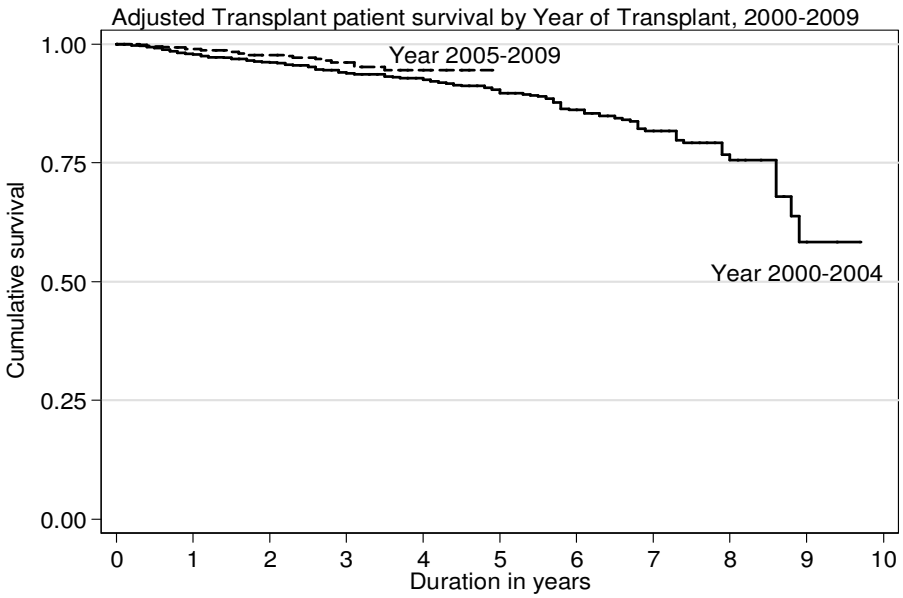


Table 13.5.2 (a): Graft survival, 2000-2009

Interval (years)	No.	% Survival	SE
0	0	100	-
1	1263	92	1
2	1102	88	1
3	962	86	1
4	805	83	1
5	639	80	1
6	462	77	1
7	321	73	2
8	200	72	2
9	95	68	2
10	1	68	2

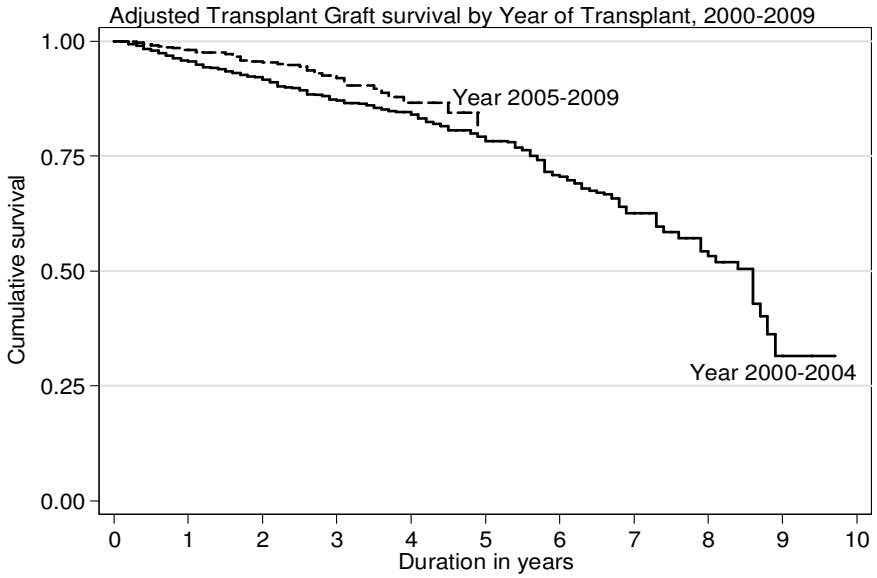
*No.=Number at risk SE=standard error

Figure 13.5.2 (a): Graft survival, 2000-2009

Table 13.5.2(b): Risk factors for transplant graft survival 2000 - 2009

Factors	N	Hazard Ratio	95% CI	P value
Year of transplant:				
2000-2004 (ref*)	830	1.00		
2005-2009	653	1.47	(1.07; 2.00)	0.016
Age at transplant:				
<20	153	0.86	(0.55; 1.34)	0.493
20-39 (ref*)	552	1.00		
40-54	680	1.26	(0.94; 1.67)	0.117
>=55	98	1.26	(0.79; 2.02)	0.329
Gender:				
Male (ref*)	937	1.00		
Female	546	0.89	(0.69; 1.16)	0.394
Primary diagnosis:				
Unknown primary (ref*)	755	1.00		
Diabetes mellitus	133	1.29	(0.89; 1.89)	0.181
GN/SLE	356	0.87	(0.63; 1.19)	0.378
Polycystic kidney	25	0.91	(0.33; 2.48)	0.851
Obstructive nephropathy	36	1.52	(0.73; 3.17)	0.267
Others	178	1.54	(1.10; 2.15)	0.011
Type of transplant:				
Commercial cadaver (ref*)	827	1.00		
Commercial live donor	60	1.14	(0.67; 1.92)	0.629
Living donor	324	0.94	(0.65; 1.35)	0.735
Cadaver	236	3.32	(2.47; 4.47)	<0.001
HbsAg:				
Negative (ref*)	1447	1.00		
Positive	36	1.68	(0.92; 3.05)	0.091
Anti-HCV:				
Negative (ref*)	1428	1.00		
Positive	55	1.71	(1.12; 2.60)	0.013

Figure 13.5.2(b): Adjusted Transplant Graft Survival related to Year of Transplant, 2000-2009 (adjusted for age, gender, primary diagnosis, type of transplant, HBsAg and Anti-HCV status)



Outcomes of renal transplantation from the 4 donor groups are shown in Figures 13.5.3 and 13.5.4. In terms of patient survival, live donor grafts maintained good survival rates with 96%, 94%, 93% and 90% at years 1, 3, 5 and 9 respectively. In terms of graft survival, commercial cadaver grafts performed similarly well with a survival of 95%, 89%, 83% and 72% at year 1, 3, 5 and 10 compared to 93%, 90%, 87% and 76% for the same intervals for live donor grafts.

Table 13.5.3: Unadjusted Patient survival by type of transplant, 2000-2009

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	827	100	-	63	100	-	321	100	-	236	100	-
1	761	96	1	54	98	2	271	96	1	159	86	2
2	684	93	1	50	95	3	234	95	1	130	80	3
3	620	92	1	44	93	4	195	94	1	99	77	3
4	524	90	1	37	93	4	163	93	2	78	77	3
5	415	87	1	29	89	5	127	93	2	67	74	3
6	290	86	1	18	78	7	97	92	2	59	72	4
7	188	82	2	13	68	9	73	92	2	48	72	4
8	109	82	2	8	68	9	47	92	2	36	69	4
9	53	81	2	5	68	9	20	90	3	17	63	5
10	1	81	2	-	-	-	-	-	-	-	-	-

*No.=Number at risk SE=standard error

Figure 13.5.3: Patient survival by type of transplant, 2000-2009

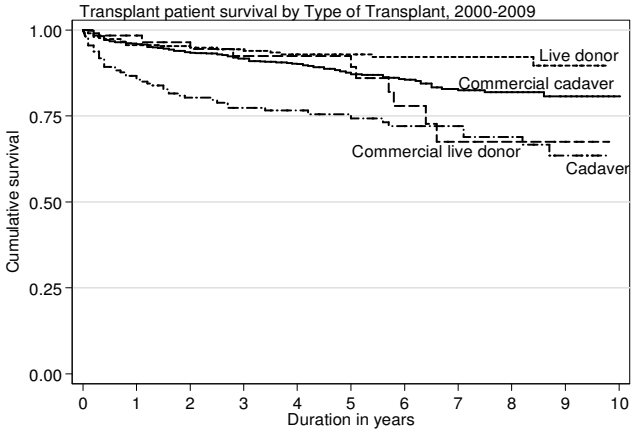


Figure 13.5.4: Graft survival by type of transplants, 2000-2009

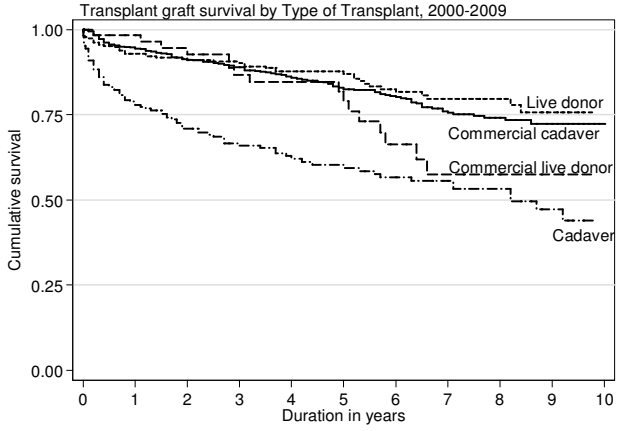


Table 13.5.4: Graft survival by type of transplant, 2000-2009

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	827	100	-	63	100	-	321	100	-	236	100	-
1	761	95	1	54	98	2	271	93	1	159	78	3
2	684	91	1	50	93	3	234	91	2	130	71	3
3	620	89	1	44	87	5	195	90	2	99	66	3
4	524	86	1	37	85	5	163	88	2	78	62	4
5	415	83	1	29	79	6	127	87	2	67	59	4
6	290	80	2	18	66	8	97	82	3	59	57	4
7	188	76	2	13	58	9	73	80	3	48	56	4
8	109	74	2	8	58	9	47	80	3	36	53	4
9	53	72	2	5	58	9	20	76	4	17	47	5
10	1	72	2	-	-	-	-	-	-	-	-	-

*No.=Number at risk SE=standard error

Patient and graft survival for living related transplants were compared for two cohorts. The 2000-2004 cohort and the 2005-2009 cohort were compared for patient survival (Figures 13.5.5) but both were comparable and survival remained excellent for both groups.

Graft survival for living related transplants (Figure 13.5.6) however was much better in patients in the 2005-2009 cohort even from the outset probably due to increased usage of newer immunosuppressive agents.

Table 13.5.5: Patient survival by year of transplant (Living related transplant, 2000-2009)

Year of Transplant Interval (years)	2000-2004			2005-2009		
	No.	% Survival	SE	No.	% Survival	SE
0	152	100	-	169	100	-
1	140	93	2	134	98	1
2	135	93	2	99	97	1
3	130	91	2	65	97	1
4	127	90	2	38	95	2
5	125	90	2	2	95	2
6	97	90	3	-	-	-
7	73	90	3	-	-	-
8	47	90	3	-	-	-
9	20	87	3	-	-	-
10	-	-	-	-	-	-

*No.=Number at risk SE=standard error

Figure 13.5.5: Patient survival by year of transplant (Living related transplant, 2000-2009)

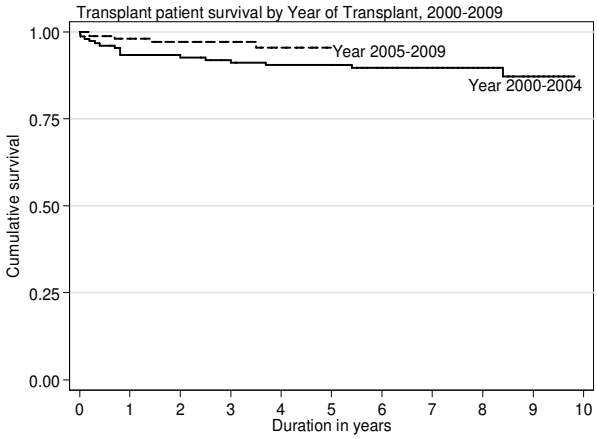


Figure 13.5.6: Graft survival by year of transplant (Living related transplant, 2000-2009)

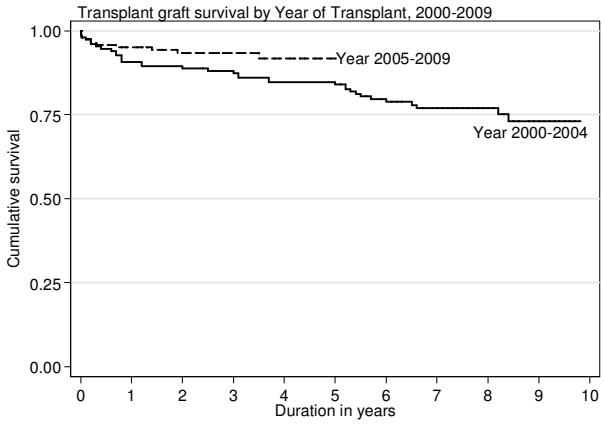


Table13.5.6: Graft survival by year of transplant (Living related transplant, 2000-2009)

Year of Transplant Interval (years)	2000-2004			2005-2009		
	No.	% Survival	SE	No.	% Survival	SE
0	152	100	-	169	100	-
1	140	90.73	2.36	134	95.1	1.69
2	135	88.74	2.57	99	93.38	2.05
3	130	87.4	2.7	65	93.38	2.05
4	127	84.69	2.94	38	91.71	2.61
5	125	84.01	2.99	2	91.71	2.61
6	97	78.86	3.39	-	-	-
7	73	76.94	3.57	-	-	-
8	47	76.94	3.57	-	-	-
9	20	73.12	4.3	-	-	-
10	-	-	-	-	-	-

*No.=Number at risk SE=standard error

In terms of commercial cadaveric transplantation, the comparison between the 2000-2004 cohort and 2005 – 2009 cohort was performed. Both patient and graft survival showed comparable results to living related transplants done within the country.

Table 13.5.7: Patient survival by year of transplant (Commercial cadaver transplant, 2000-2009)

Year of Transplant	2000-2004			2005-2009		
Interval (years)	No.	% Survival	SE	No.	% Survival	SE
0	523	100	-	304	100	-
1	488	95	1	273	97	1
2	468	93	1	216	95	1
3	454	91	1	168	94	1
4	433	89	1	91	94	1
5	414	86	2	1	94	1
6	290	86	2	-	-	-
7	188	83	2	-	-	-
8	109	82	2	-	-	-
9	53	81	2	-	-	-
10	1	81	2	-	-	-

*No.=Number at risk SE=standard error

Figure 13.5.7: Patient survival by year of transplant (Commercial cadaver transplant, 2000-2009)

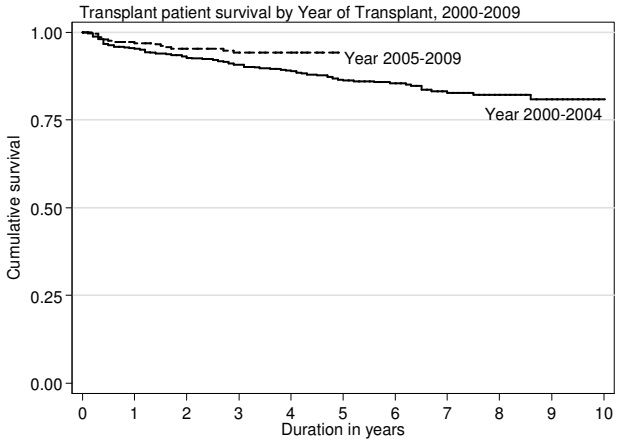


Figure 13.5.8: Graft survival by year of transplant (Commercial cadaver transplant, 2000-2009)

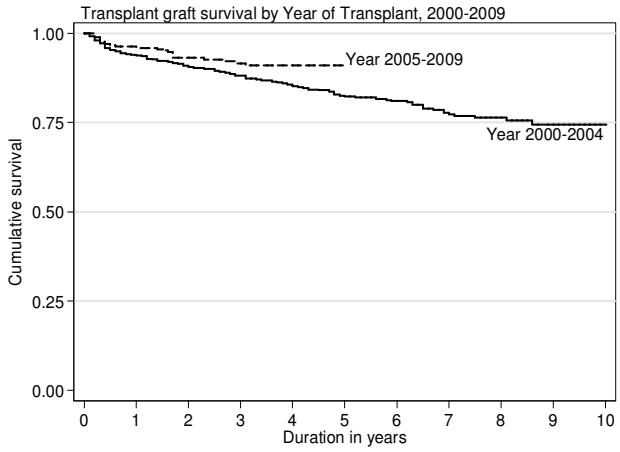


Table 13.5.8: Graft survival by year of transplant (Commercial cadaver transplant, 2000-2009)

Year of Transplant	2000-2004			2005-2009		
Interval (years)	No.	% Survival	SE	No.	% Survival	SE
0	523	100	-	304	100	-
1	488	94	1	273	96	1
2	468	91	1	216	93	2
3	454	88	1	168	92	2
4	433	85	2	91	91	2
5	414	82	2	1	91	2
6	290	81	2	-	-	-
7	188	77	2	-	-	-
8	109	76	2	-	-	-
9	53	75	2	-	-	-
10	1	75	2	-	-	-

*No.=Number at risk SE=standard error

SECTION 13.6: CARDIOVASCULAR RISK IN RENAL TRANSPLANT RECIPIENTS

13.6.1 Risk factors for ischaemic heart disease

In 2009, 87.2% of patients were hypertensive, 17.7% were diabetic and 46.7% had renal insufficiency fulfilling CKD III and above. Forty-two percent of patients had 2 cardiovascular risk factors while 5.5% had all 3 major risk factors.

Table 13.6.1: Risk factors for IHD in renal transplant recipients at year 2006, 2007, 2008 and 2009

	2006	2007	2008	2009
Diabetes	21 (1.4)	25 (1.6)	18 (1.1)	28 (1.8)
Hypertension**	454 (31.0)	589 (37.3)	663 (41.7)	644 (41.1)
CKD	177 (12.1)	127 (8.1)	117 (7.4)	155 (9.9)
Diabetes + Hypertension**	156 (10.7)	177 (11.2)	203 (12.8)	163 (10.4)
Diabetes + CKD	18 (1.2)	11 (0.7)	22 (1.4)	18 (1.1)
CKD + Hypertension**	490 (33.5)	516 (32.7)	457 (28.8)	474 (30.2)
Diabetes + CKD + Hypertension**	147 (10.0)	132 (8.4)	109 (6.9)	86 (5.5)

**Hypertension: BP systolic > 140 and BP diastolic > 90
OR have either Beta blocker / Calcium channel blocker / ACE inhibitor / AIIRB / Other anti-hypertensive drugs
GFR (mL/min/1.73m2) = 1.2*(140-age(year))*weight(kg) / creatinine (µmol/L) if male
GFR (mL/min/1.73m2) = 0.85*(1.2*(140-age(year))*weight(kg) / creatinine (µmol/L) if female
CKD stage III-GFR, 30-60
CKD stage IV-GFR, 15-30
CKD stage V-GFR, <15

Figure 13.6.1(a): Venn Diagram for Pre and Post Transplant Complications (in %) at year 2006

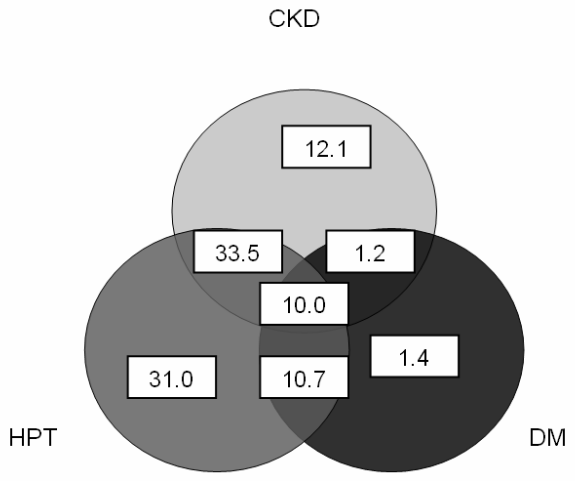


Figure 13.6.1(b): Venn Diagram for Pre and Post Transplant Complications (in %) at year 2007

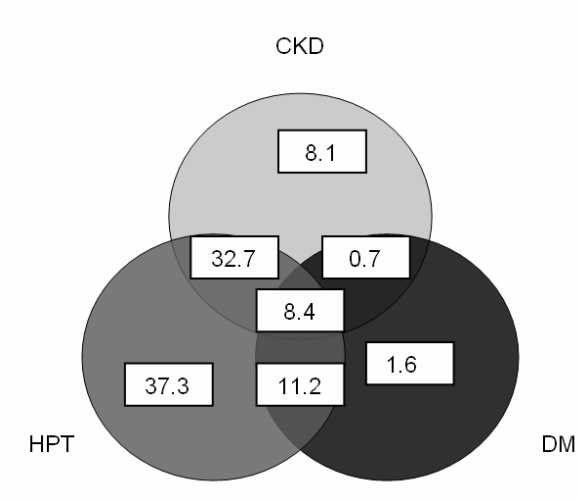


Figure 13.6.1(c): Venn Diagram for Pre and Post Transplant Complications (in %) at year 2008

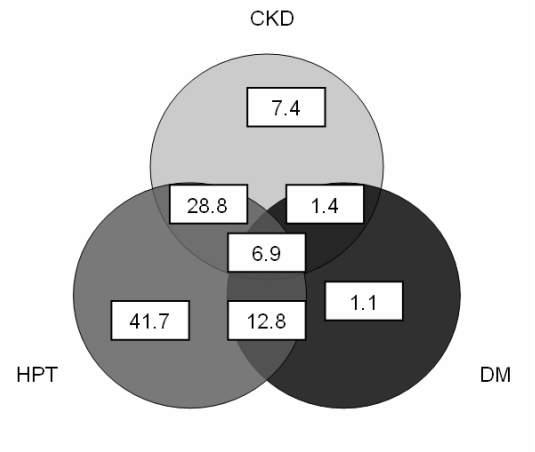
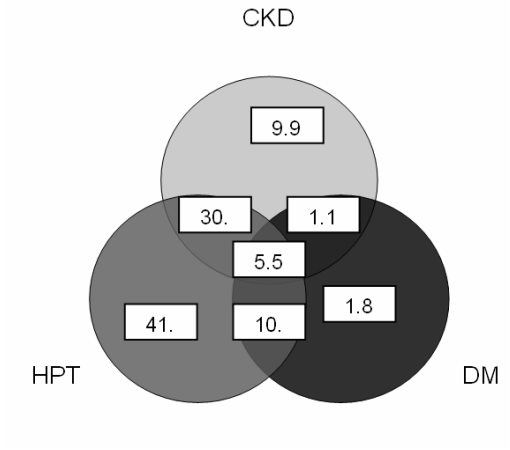


Figure 13.6.1(d): Venn Diagram for Pre and Post Transplant Complications (in %) at year 2009



13.6.2: Blood Pressure classification according to JNC VI criteria, 2006-2009

In 2009, 20% of renal transplant recipients had stage I hypertension whereas 4% had stage II hypertension and 0.6% had stage III hypertension despite being on treatment. In terms of diastolic hypertension 12% had stage I hypertension, 1.6% of patients had stage II diastolic hypertension and 0.3% of patients had stage III diastolic hypertension despite being on treatment.

Table 13.6.2(a): Systolic BP, 2006-2009

Year	2006		2007		2008		2009	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Systolic BP<120	249	(15.64)	240	(14.22)	289	(17.03)	269	(15.90)
Systolic BP 120-129	395	(24.81)	392	(23.22)	377	(22.22)	375	(22.16)
Systolic BP 130-139	483	(30.34)	531	(31.46)	611	(36.00)	636	(37.59)
Systolic BP 140-159	353	(22.17)	409	(24.23)	335	(19.74)	340	(20.09)
Systolic BP 160-179	93	(5.84)	99	(5.86)	75	(4.42)	62	(3.66)
Systolic BP >=180	19	(1.19)	17	(1.01)	10	(0.59)	10	(0.59)

Figure 13.6.2(a): Systolic BP, 2006-2009

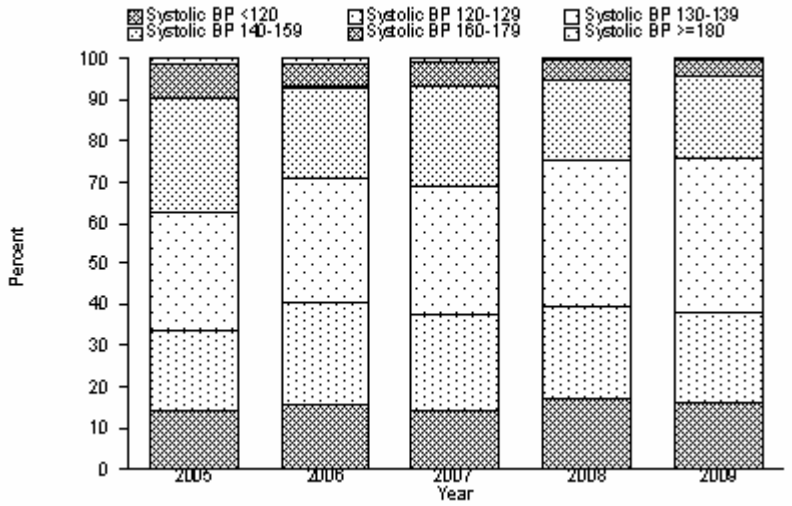


Table 13.6.2(b): Diastolic BP, 2006-2009

Year	2006		2007		2008		2009	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Diastolic BP<80	624	(39.20)	699	(41.41)	897	(52.86)	854	(50.47)
Diastolic BP 80-84	586	(36.81)	610	(36.14)	525	(30.94)	527	(31.15)
Diastolic BP 85-89	73	(4.59)	74	(4.38)	50	(2.95)	84	(4.96)
Diastolic BP 90-99	244	(15.33)	261	(15.46)	198	(11.67)	195	(11.52)
Diastolic BP 100-109	61	(3.83)	39	(2.31)	22	(1.30)	27	(1.60)
Diastolic BP >=110	4	(0.25)	5	(0.30)	5	(0.29)	5	(0.30)

Figure 13.6.2(b): Diastolic BP, 2006-2009

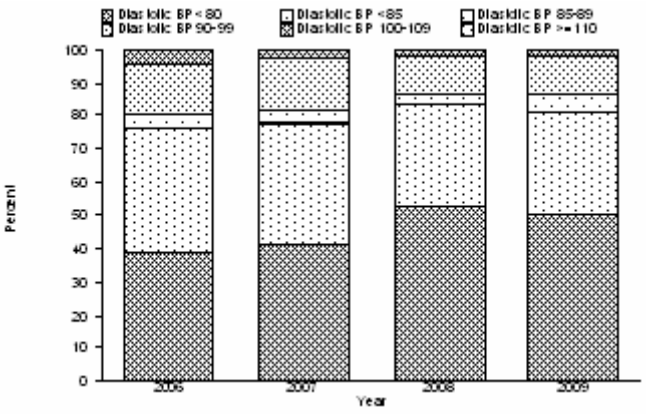
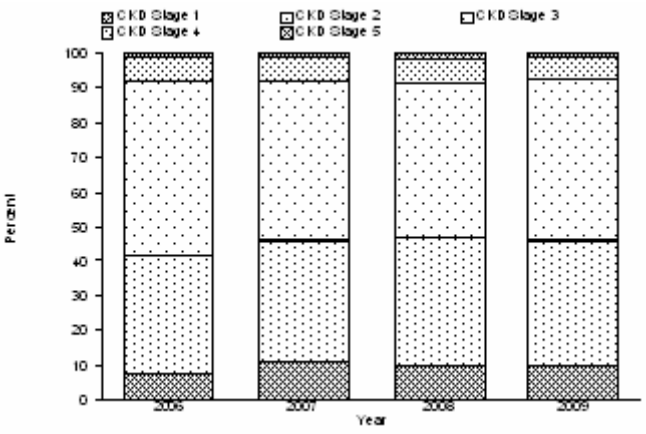


Table 13.6.3 shows the CKD Stage classification by year and in 2009, 46.4% of renal transplant recipients had CKD Stage III whilst another 7% had CKD Stage IV. CKD Stage V (impending renal replacement therapy) was found in 1.1% of renal transplant recipients.

Table 13.6.3: CKD stages, 2006-2009

Year	2006		2007		2008		2009	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
CKD stage 1	116	(7.33)	180	(10.78)	164	(9.81)	165	(9.94)
CKD stage 2	535	(33.80)	593	(35.51)	626	(37.44)	601	(36.20)
CKD stage 3	802	(50.66)	761	(45.57)	738	(44.14)	770	(46.39)
CKD stage 4	108	(6.82)	113	(6.77)	118	(7.06)	106	(6.39)
CKD stage 5	22	(1.39)	23	(1.38)	26	(1.56)	18	(1.08)

Figure 13.6.3: CKD stages by year

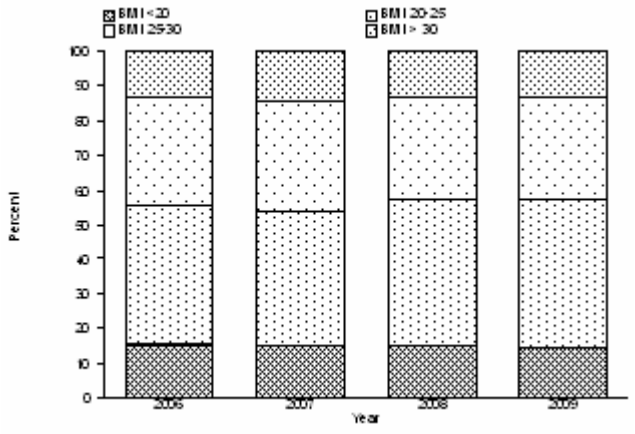


In terms of BMI for 2009, 57% of renal transplant recipients had BMIs of 25 or below. However 29% were overweight and another 13.3% were obese. There seems to be a slow but steady increase in numbers of obese patients over the last few years.

Table 13.6.4: BMI, 2006-2009

Year	2006		2007		2008		2009	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
BMI <20	242	(15.20)	254	(15.05)	251	(14.79)	243	(14.36)
BMI 20-25	648	(40.70)	659	(39.04)	724	(42.66)	726	(42.91)
BMI 25-30	496	(31.16)	532	(31.52)	502	(29.58)	498	(29.43)
BMI > 30	206	(12.94)	243	(14.40)	220	(12.96)	225	(13.30)

Figure 13.6.4: BMI by year

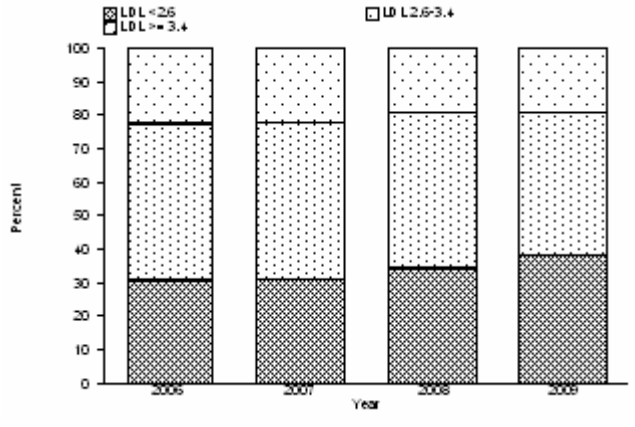


LDL cholesterol has been identified as the primary lipid target for prevention of coronary heart disease by NCEP with a log linear relationship between risk of CHD and level of LDL cholesterol. In terms of renal transplant recipients in 2009 38% have LDL levels below 2.6 mol/l and this shows an increasing 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.

Table 13.6.5(a): LDL, 2006-2009

Year	2006		2007		2008		2009	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
LDL < 2.6	492	(30.90)	528	(31.28)	585	(34.47)	646	(38.18)
LDL 2.6-3.4	738	(46.36)	779	(46.15)	779	(45.90)	714	(42.20)
LDL >= 3.4	362	(22.74)	381	(22.57)	333	(19.62)	332	(19.62)

Figure 13.6.5(a): LDL, 2006-2009



In terms of other cholesterol parameters for 2009, 56% had total cholesterol levels >= 5.2 and 9% had HDL cholesterol levels <1.0.

Table 13.6.5(b): Total Cholesterol, 2006-2009

Year	2006		2007		2008		2009	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Total Cholesterol <4.1	160	(10.05)	210	(12.44)	208	(12.26)	233	(13.77)
Total Cholesterol 4.1-5.1	490	(30.78)	539	(31.93)	529	(31.17)	506	(29.91)
Total Cholesterol 5.1-6.2	700	(43.97)	721	(42.71)	728	(42.90)	720	(42.55)
Total Cholesterol 6.2- 7.2	173	(10.87)	159	(9.42)	160	(9.43)	159	(9.40)
Total Cholesterol > 7.2	69	(4.33)	59	(3.50)	72	(4.24)	74	(4.37)

Figure 13.6.5(b): Total Cholesterol, 2006-2009

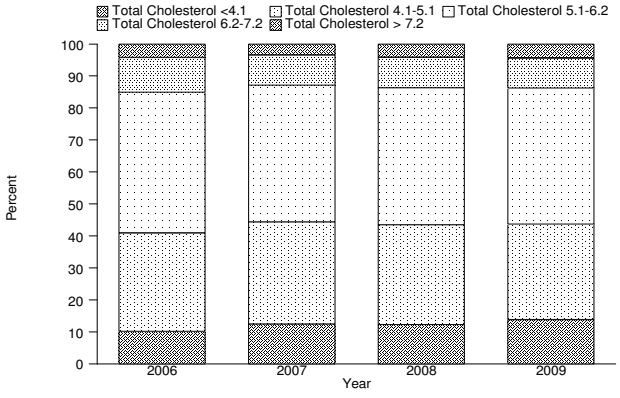


Figure 13.6.5(c): HDL by year

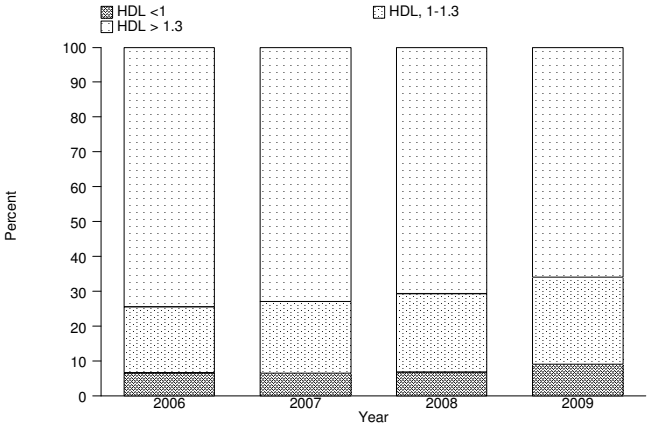


Table 13.6.5(c): HDL, 2006-2009

Year	2006		2007		2008		2009	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
HDL <1	104	(6.53)	108	(6.40)	114	(6.72)	153	(9.04)
HDL 1-1.3	302	(18.97)	350	(20.73)	382	(22.51)	421	(24.88)
HDL >1.3	1186	(74.50)	1230	(72.87)	1201	(70.77)	1118	(66.08)

Eighty-one percent of patients in 2009 were on antihypertensives and the majority were on more than 1 antihypertensive drug with 29% on 2 antihypertensives and 17% on 3 antihypertensives. Five percent of patients still had systolic BP of > 160 mmHg and 16% had diastolic BP of > 90 mmHg despite being given antihypertensive(s), however, this is an improvement from previous years.

Table 13.6.6(a): Treatment for hypertension, 2006-2009

Year	No.	% on anti-hypertensives	% on 1 anti-hypertensive drug	% on 2 anti-hypertensives	% on 3 anti-hypertensives
2006	1592	86	34	26	17
2007	1688	85	25	31	21
2008	1697	78	25	28	19
2009	1692	81	29	29	17

Table 13.6.6(b): Distribution of Systolic BP without anti-hypertensives, 2006-2009

Year	No.	Mean	SD	Median	LQ	UQ	% Patients ≥ 60mmHg
2006	189	123.8	14.4	120	117	130	4
2007	196	125.2	16.5	120	113	134	4
2008	178	123.7	15.5	120	110	130	3
2009	229	124	15.3	120	111	130	3

Table 13.6.6(c): Distribution of Diastolic BP without anti-hypertensives, 2006-2009

Year	No.	Mean	SD	Median	LQ	UQ	% patients ≥ 90mmHg
2006	189	76.4	10.3	80	70	80	11
2007	196	76.6	10.0	80	70	80	12
2008	177	75.1	10.0	80	70	80	10
2009	229	77.4	9.1	80	70	80	12

Table 13.6.6(d): Distribution of Systolic BP on anti-hypertensives, 2006-2009

Year	No.	Mean	SD	Median	LQ	UQ	% Patients ≥ 160mmHg
2006	1334	131.7	16.3	130	120	140	8
2007	1389	132.6	16.0	130	120	140	8
2008	1269	129.9	16.6	130	120	140	6
2009	1221	131.0	15.9	130	120	140	5

Table 13.6.6(e): Distribution of Diastolic BP on anti-hypertensives, 2006-2009

Year	No.	Mean	SD	Median	LQ	UQ	% Patients ≥ 90 mmHg
2006	1334	79.2	9.9	80	70	86	22
2007	1388	79.1	9.6	80	70	85	20
2008	1255	77.6	10	80	70	80	16
2009	1219	78.3	9.5	80	70	82	16

SECTION 13.7: QOL INDEX SCORE IN RENAL TRANSPLANT RECIPIENTS

1231 patients who were transplanted between 2000-2009 were analysed for QoL index score. They reported median QoL index score of 10 (Table 13.7.1 and Figure 13.7.1). 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 13.7.2 and Figure 13.7.2), 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 13.7.3 and Figure 13.7.3) and age (Table 13.7.4 and Figure 13.7.4). 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 13.7.4 and Figure 13.7.4). This trend of high QoL index score among renal transplant patients was maintained over the last 10 years (Table 13.7.5 and Figure 13.7.5).

Table 13.7.1: Cumulative distribution of QoL-Index score in relation to Dialysis Modality, Transplant recipient patients 2000- 2009

Dialysis modality	QoL score
Number of patients	1231
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 13.7.1: Cumulative distribution of QoL-Index score in relation to Dialysis Modality, Transplant recipient patients 2000 - 2009

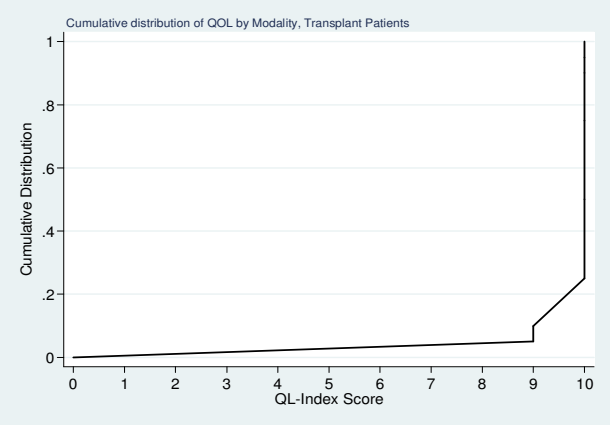


Figure 13.7.2: Cumulative distribution of QoL-Index score in relation to Diabetes mellitus, Transplant recipient patients 2000 – 2009

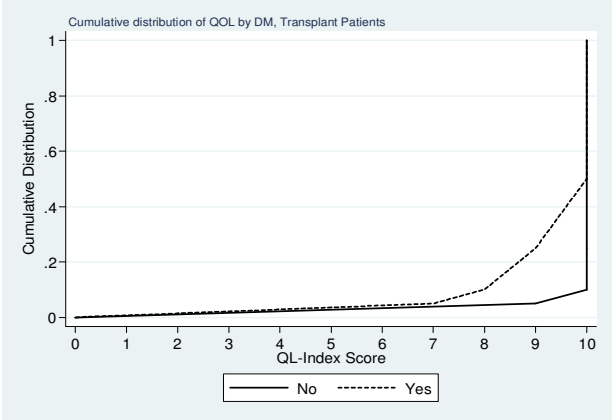


Table 13.7.2: Cumulative distribution of QoL-Index score in relation to Diabetes mellitus, Transplant recipient patients 2000 - 2009

Diabetes mellitus	No	Yes
Number of patients	1166	65
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

Table 13.7.3: Cumulative distribution of QoL-Index score in relation to Gender, Transplant recipient patients 2000 - 2009

Gender	Male	Female
Number of patients	767	464
Centile		
0	0	0
0.05	9	8
0.1	9	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 13.7.3: Cumulative distribution of QoL-Index score in relation to Gender, Transplant recipient patients 2000 - 2009

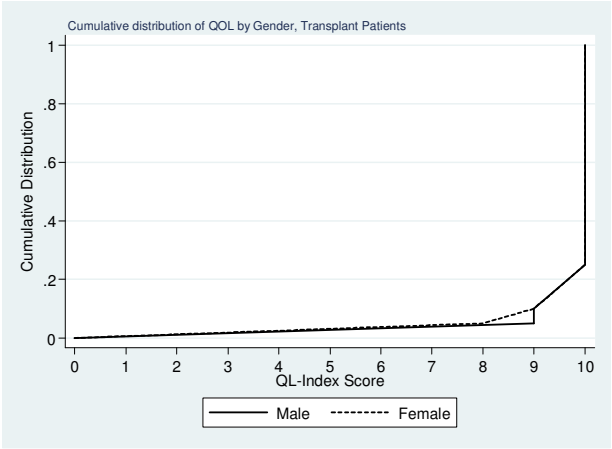


Figure 13.7.4: Cumulative distribution of QoL-Index score in relation to Age, Transplant recipient patients 2000 - 2009

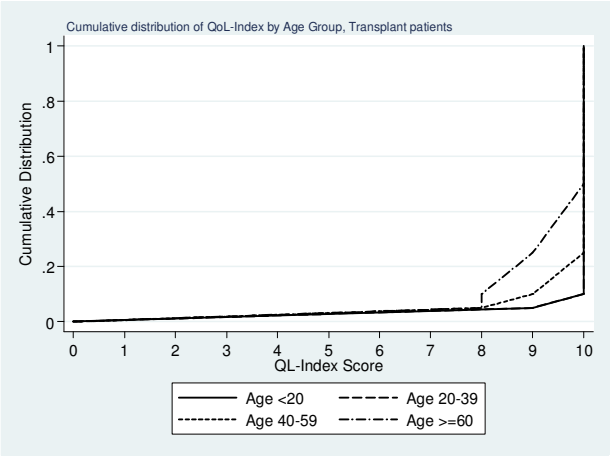


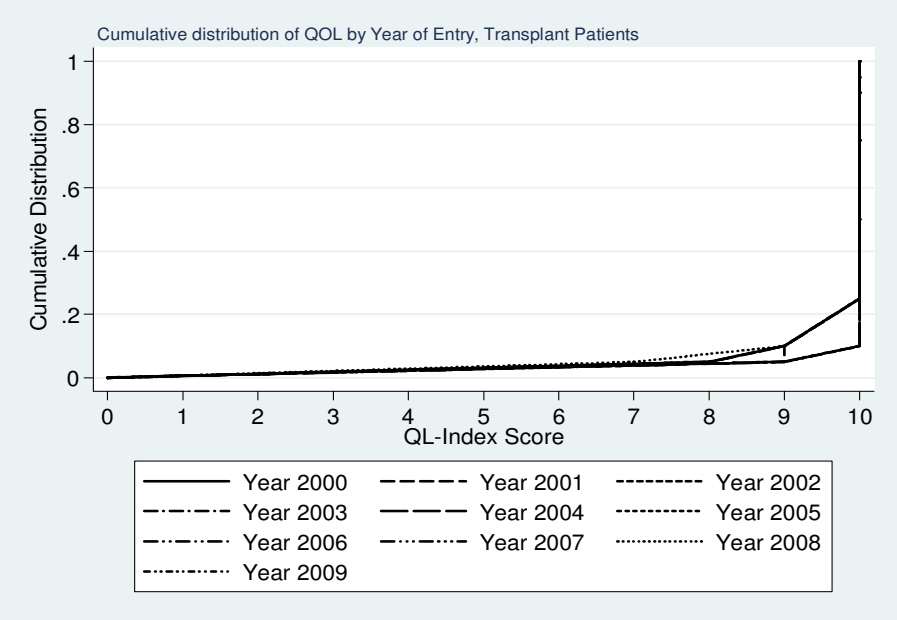
Table 13.7.4: Cumulative distribution of QoL-Index score in relation to Age, Transplant recipient patients 2000-2009

Age group (years)	<20	20-39	40-59	>=60
Number of patients	129	481	541	80
Centile				
0	0	0	0	0
0.05	9	9	8	8
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

Table 13.7.5: Cumulative distribution of QoL-Index score in relation to Year of entry, Transplant recipient patients 2000 - 2009

Year of Entry	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number of patients	110	126	144	136	167	145	133	91	99	80
Centile										
0	0	0	0	0	0	0	0	0	0	0
0.05	8	9	9	8	9	9	9	8	7	8
0.1	9	9	10	9	10	10	10	9	9	9
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 13.7.5: Cumulative distribution of QoL-Index score in relation to Year of entry, Transplant recipient patients 2000 - 2009



APPENDIX I

DATA MANAGEMENT

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 2009, there were 45 new known haemodilaysis centres in Malaysia i.e. an average of 3.75 new centres per month. Three centres had ceased operation. HD centre data submission increases by 58 centres (13%) compared to last year.

There was a drop by 13% of the PD centre data submission attributed to interest shown by the private centres. These centres still has very small number of patients or no patient at all based on the year end centre survey update.

Renal transplant management was returned to NRR in June 2009. The total number of the known transplant follow-up centres drop by 17.1% after performed the centre survey and confirmation that the centre do not have post renal transplant follow-up services.

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.

Table I: Data submission, 2009

	At December Known centres (N)	Agreed to Participate (N)	Submit data (N)	Submit annual returns (N)	2009 Submitted (%)
Haemodialysis	560	545	504	445	92.5
Chronic PD	37	37	31	31	83.8
Transplant	58	58	44	42	75.9
All modality	654	640	579	518	90.5

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). Seventh Report of the Malaysian Dialysis and Transplant Registry 2009. Kuala Lumpur 2010

A distinction is made between use of NRR results (as presented in NRR published report) and use of NRR data in a publication. The former is ordinary citation of published work. NRR, of course encourages such citation whether in the form of presentation or other write-ups. The latter constitutes original research publication. NRR position is as follows:

- The NRR does not envisage independent individual publication based entirely on NRR published results, without further analyses or additional data collection.

- NRR however agrees that investigator shall have the right to publish any information or material arising in part out of NRR work. In other words, there must be additional original contribution by the investigator in the work intended for publication.

- NRR encourages the use of its data for research purpose. Any proposed publication or presentation (e.g. manuscript, abstract or poster) for submission to journal or scientific meeting that is based in part or entirely on NRR data should be sent to the NRR prior to submission. NRR will undertake to comment on such documents within 4 weeks. Acknowledgement of the source of the data would also be appreciated.

- Any formal publication of a research based in part or entirely on NRR data in which the input of NRR exceeded that of conventional data management and provision will be considered as a joint publication by investigator and the appropriate NRR personnel.

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

Distribution of report

The 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 AND STATISTICAL METHODS DEFINITIONS

APPENDIX II: ANALYSIS SETS, STATISTICAL METHODS AND DEFINITIONS

Analysis sets

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

1. Dialysis patients notification between 2000 and 2009
   This analysis set consists of patients commencing dialysis between 2000 and 2009. This analysis set was used for the analysis in Chapter 1, 2 and 3.

   Patients who were less than 20 years old at the start of dialysis between 2000 and 2009 were used for the analysis in Chapter 5.

   Since 1993, the MDTR 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 2000 onwards when the data were more complete. Remaining missing data in this analysis set was imputed using first available observation carried backward or last observation carried forward. This analysis set was used for the analysis in Chapters 6 to 12. However, the generated variable that has been imputed is prescribed Kt/V for HD patients. Prescribed Kt/V was generated using the formula below:

   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 11.

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 modality and patient's kidney transplant failed and he received dialysis, then for RRT count, the patients will be counted twice. However, if the patients receive transplant between the dialysis, then the dialysis after transplant will be counted if the transplant last for more than 90 days while if it is 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 5.

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

4. Centre Survey data
   Section 2.2 in the report was based on annual centre survey data between 2000 to 2009 rather than individual patient data reported to the Registry.

5. Peritonitis data
   Analysis was confined to chronic PD patients who were on peritoneal dialysis from 31st December 1999. This analysis set was used for the analysis in Section 12.4.

6. Renal transplant data
   This analysis set was confined to patients who had undergone renal transplantation from 2000-2009. This data was obtained from National Transplant Registry (NTR). This analysis set was used for the analysis in Chapter 13.

7. Diabetes Mellitus
   Patients are considered to have diabetes mellitus (DM) as the cause of ESRD if the primary cause of ESRD is notified as DM or as unknown but the comorbid is DM.

Statistical methods

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

1. Primary Renal Disease
Patients are considered to have diabetes mellitus (DM) as the cause of ESRD if the primary cause of ESRD is notified as DM or as unknown but the co-morbid is DM.
Apply in Chapter 2, 3 and 13.

2. Adjusted Mortality of dialysis patients
Cox proportional hazards model was considered for mortality of the patients adjusted with demographic and laboratory variables. This analysis was used in Chapter 3 and 12.

3. 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 in Chapter 4, 6, 7, 8, 9, 11 & 12.

4. 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 2009. Centre response rate to survey was 100%. Standard error estimates are not reported because no sample was taken. Results on distribution by state are also expressed in per million state-population since states obviously vary in their population sizes. State population data are based on 2008 census projection. It is very difficult to estimate the amount of cross boundary patient flow; this source of error is therefore not accounted for in computing states estimates. However, we minimize the bias by combining states (Kedah and Perlis) based on geographical considerations. HD treatment capacity is derived by assuming on average patients underwent 3 HD sessions per week and a centre can maximally operate 2.5 shifts per day. A single HD machine can therefore support 5 patients' treatment. Obviously HD treatment capacity is calculated only for centre HD. The ratio of the number of centre HD capacity to number of centre HD patient is a useful measure of utilization of available capacity. This analysis was used in Chapter 2.

5. Centre variation
To compare the variation of the intermediate results between centres, graphs 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. An accompanying table gives the summary statistics like minimum, 5th percentile, lower quartile, median,

upper quartile, 95th percentile and maximum value among centres over year.
Centres with intermediate results for <10 patients were combined into one composite centre. This analytical method was used in Chapter 6, 7, 8, 9, 10 11 & 12.

Death rate calculation

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 disease 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 rate. 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

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 3.

Standardized mortality rate

The cohort considered for this analysis were patients who were on dialysis in 2008 and new patients in 2008 by modality.

SMR is a ratio between the observed number of death with the expected, based on the age group, diabetic, serum album group, diastolic blood pressure group and hemoglobin group rates in a standard population and the age group, diabetic, serum album group, diastolic blood pressure group and hemoglobin group distribution of the study population. If the ratio observed : expected death is greater the 1.0, we conclude that there is “excess death” in the study population. SMR was generated using the following formula:

SMR = observed death / expected death

Risk adjusted mortality rate

When the mortality rate are risk adjusted, the information beomes morecomparable among the hospitals because the data is adjusted to take into account variations in patients’ severity of renal disease and their risk of mortality. SMR was generated using the following formula:

RAMR = SMR x AvMR where AvMR is the average of the overall observed mortality rate

Risk ratio

Risk ratio is 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 survived 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 first modality. Duration survival for patients will be calculated from the date commencing the first modality till first modality outcome. Hence duration after the change modality or transplant will not be considered. Death occurring during the first modality will be considered in the analysis since patients will be censored for change of modality before death.

ii. Survival not censored for change of modality based on first modality. Duration survival for patients will be calculated from the date commencing the first modality till 31 Dec 2009 for patients who were still on RRT. For patients who died, duration of survival will be calculated from date commencing the first modality till date of final outcome which is death. All death outcomes whether occurring during first modality or after change in modality will be considered for this analysis.

Survival of incident patients by centre

1-year survival

The cohort considered for this analysis was considered from 2000-2008. Many patients commencing dialysis in 2009 would still not have completed one year.

5-year survival

The cohort considered for this analysis was considered from 2000-2004. 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 2000-2008. The figure is included to assess whether survival probability adjusted to age 60 and diabetes of each centre is likely to be different from the national average. Centres with patients less 10 will be excluded from the analysis. This plot was used in Chapter 3.

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.