

## **CHAPTER 4**

### **METHOD AND LOCATION OF DIALYSIS**

**Leonie Excell  
and  
Stephen McDonald**



**Figure 4.1**

**Method and Location of Dialysis 1999 - 2003**

Mode of Treatment		1999	2000	2001	2002	2003	
<b>AUST</b>	<b>PD</b>	APD	264	390	501	612	726
		CAPD	1414	1346	1306	1173	1097
		<b>Total</b>	<b>1678</b>	<b>1736</b>	<b>1807</b>	<b>1785</b>	<b>1823</b>
	<b>HD</b>	Hospital	1636	1721	1808	2001	2091
		Home	706	742	773	777	772
		Satellite	2001	2211	2462	2702	2988
<b>Total</b>		<b>4343</b>	<b>4674</b>	<b>5043</b>	<b>5480</b>	<b>5851</b>	
<b>NZ</b>	<b>PD</b>	APD	52	81	112	135	152
		CAPD	619	600	604	635	617
		<b>Total</b>	<b>671</b>	<b>681</b>	<b>716</b>	<b>770</b>	<b>769</b>
	<b>HD</b>	Hospital	294	337	372	370	431
		Home	179	188	200	228	234
		Satellite	89	130	182	229	265
<b>Total</b>		<b>562</b>	<b>655</b>	<b>754</b>	<b>827</b>	<b>930</b>	

**AUSTRALIA**

During the past year, there was an increase of 409 (6%) in the total number of prevalent dialysis patients. There were 7,674 patients (386 per million) receiving dialysis treatment at the end of the year to 31<sup>st</sup> December, 2003.

The distribution of these patients across the modalities continues to slowly change (fig 4.1, 4.3). The majority (72%) were out of hospital: 33% were dialysing at home and 39% in satellite centres.

Fourteen percent of all prevalent dialysis patients were using continuous ambulatory peritoneal dialysis, 9.5% automated peritoneal dialysis, 27% hospital based haemodialysis, 39% satellite haemodialysis and 10% home haemodialysis.

Automated peritoneal dialysis continues to increase each year. In 2003 the increase was 19% (726 patients) compared to 612 patients in 2002 and 501 patients in 2001. Satellite haemodialysis increased by 10.5% and continuous ambulatory peritoneal dialysis continues to decrease; 6% (1,097 patients) in 2003 from 1,173 patients in 2002 and 1,306 in 2001.

Forty five percent of all dialysis patients were 65 years and older and 87 patients (1%) were 85 years or more, an increase of 14% in 2003. An increase occurred in all age groups 25 years or older, especially in the age groups 65-84 years (8%, 251 patients) (fig 4.4).

**Figure 4.2**

**State Distribution of Dialysis Dependent Patients 1999 - 2003**  
(per Million Population)

State	1999	2000	2001	2002	2003
Queensland	953 (272)	1044 (293)	1094 (301)	1200 (323)	1322 (348)
New South Wales *	2075 (333)	2161 (343)	2333 (366)	2428 (377)	2529 (390)
Aust. Capital Territory *	159 (321)	162 (324)	159 (313)	177 (343)	186 (358)
Victoria	1595 (340)	1704 (359)	1851 (385)	1935 (398)	1984 (403)
Tasmania	101 (214)	121 (257)	123 (260)	143 (303)	149 (312)
South Australia	377 (252)	396 (263)	434 (287)	457 (301)	505 (331)
Northern Territory	165 (856)	178 (910)	210 (1061)	232 (1172)	243 (1225)
Western Australia	596 (322)	644 (344)	646 (340)	693 (360)	756 (387)
<b>Australia</b>	<b>6021 (318)</b>	<b>6410 (335)</b>	<b>6850 (353)</b>	<b>7265 (370)</b>	<b>7674 (386)</b>
<b>New Zealand</b>	<b>1233 (321)</b>	<b>1336 (346)</b>	<b>1470 (379)</b>	<b>1597 (405)</b>	<b>1699 (424)</b>

\* NSW population excludes residents of the Southern Area Health Service  
 \*ACT population includes residents of the Southern Area Health Service (Medical services in the ACT service the Southern Area Region)

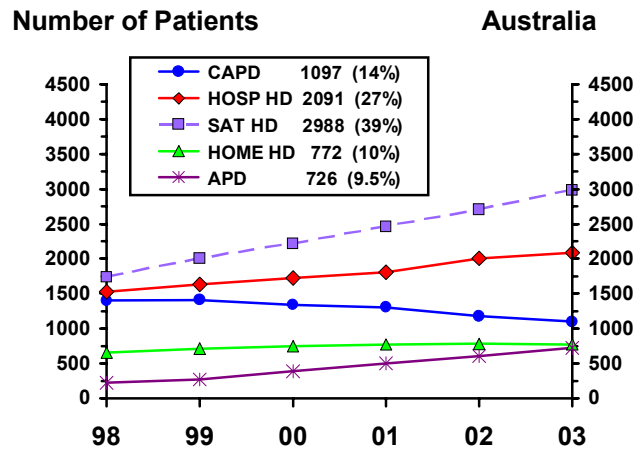
The differences with age, dialysis method and location are shown in the Appendix (page 6). For those <15 years, peritoneal dialysis was used in 89% (68% in 2002), for 25-34 years 21%, for 65-84 years 25% and >=85 years 16%.

The number of patients rose in all States. The number of dialysis patients in relation to population in each State is shown in Figure 4.2.

In relation to State population, the highest prevalence rate of dialysis patients was in the Northern Territory (1,225 per million), with rates in other States similar; range 312 to 403 per million (fig 4.2).

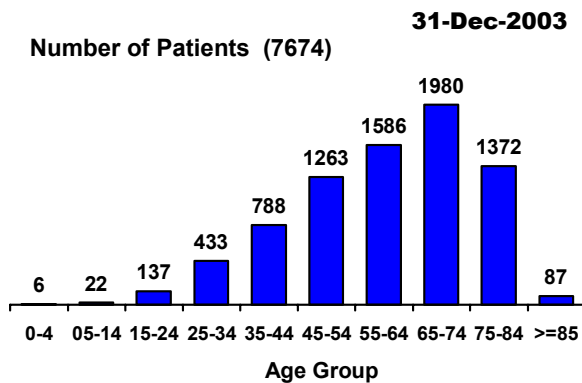
**Figure 4.3**

**Method and Location of Dialysis 1998 - 2003**

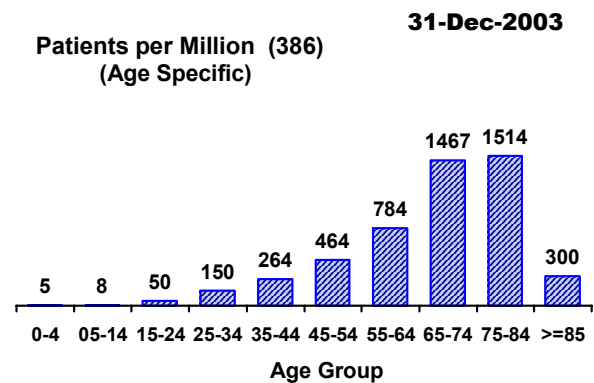


**Figure 4.4**

**Prevalent Dialysis Patients (Australia)**



**Prevalent Dialysis Patients (Australia)**





**NEW ZEALAND**

Figures 4.1, 4.2, 4.5 and 4.6.

There was a 6% increase in dialysis patient numbers from 2002 to 2003, mainly in the age groups 45-54, 55-64, 65-74 and 75-84 years. Fifty nine percent of patients were treated with a form of home dialysis (of whom 77% were peritoneal dialysis patients).

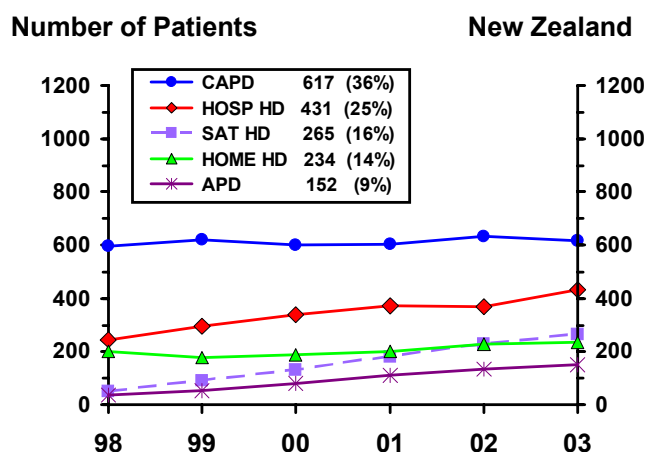
Home automated peritoneal dialysis continues to increase (152 patients in December 2003 from 135 patients in 2002 and 112 in 2001).

Continuous ambulatory peritoneal dialysis, whilst still the dominant mode of all dialysis, decreased from 40% in 2002 to 36% in 2003.

Together, satellite and hospital haemodialysis accounted for 40% of patients in 2003, increasing from 38% in 2002. Satellite haemodialysis has increased 16% (265 patients in 2003, from 228 patients in 2002).

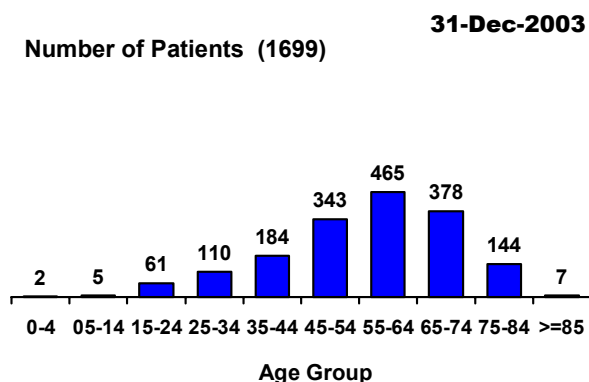
**Figure 4.5**

**Method and Location of Dialysis 1998 - 2003**

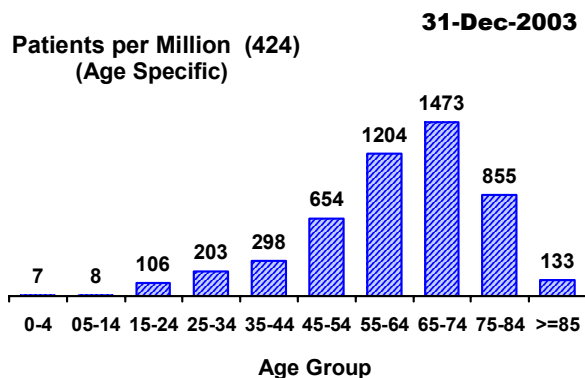


**Figure 4.6**

**Prevalent Dialysis Patients (New Zealand)**



**Prevalent Dialysis Patients (New Zealand)**



## LATE REFERRAL RELATED TO TREATMENT

Late referral (referral to a nephrologist <3 months prior to first dialysis or transplant) has remained around 25% of all cases (fig 4.7). Rates vary only slightly with age.

**Figure 4.7**

<b>Late Referral - All Modes of Treatment including Pre-emptive Transplants 1-Jan-1999 to 31-Dec-2003</b>							
Country	Age Groups						TOTAL
	0-18	19-44	45-64	65-74	75-84	>=85	
<b>AUSTRALIA</b>							
NO	175 (79%)	1246 (73%)	2568 (77%)	1841 (76%)	1066 (71%)	50 (72%)	<b>6946 (75%)</b>
YES	47 (21%)	462 (27%)	774 (23%)	582 (24%)	437 (29%)	19 (28%)	<b>2321 (25%)</b>
<b>TOTAL</b>	<b>222 (100%)</b>	<b>1708 (100%)</b>	<b>3342 (100%)</b>	<b>2423 (100%)</b>	<b>1503 (100%)</b>	<b>69 (100%)</b>	<b>9267 (100%)</b>
<b>NEW ZEALAND</b>							
NO	47 (65%)	298 (74%)	801 (76%)	326 (72%)	125 (69%)	7 (70%)	<b>1604 (74%)</b>
YES	25 (35%)	106 (26%)	255 (24%)	128 (28%)	56 (31%)	3 (30%)	<b>573 (26%)</b>
<b>TOTAL</b>	<b>72 (100%)</b>	<b>404 (100%)</b>	<b>1056 (100%)</b>	<b>454 (100%)</b>	<b>181 (100%)</b>	<b>10 (100%)</b>	<b>2177 (100%)</b>

Late referral is associated with substantially higher rates of central venous catheter use at first dialysis (among the group who commenced HD) (fig 4.8).

**Figure 4.8**

<b>Late Referral Haemodialysis as Initial Modality 1-Oct-2003 to 31-Mar-2004</b>			
Access in Use at First Dialysis	Country		TOTAL
	AUST	NZ	
<b>Late Referral = NO</b>			
Native	233 (52%)	39 (49%)	<b>272 (51%)</b>
Synthetic	16 (4%)	1 (1%)	<b>17 (3%)</b>
Tunnelled CVC	128 (29%)	18 (23%)	<b>146 (28%)</b>
Non-Tunnelled CVC	72 (16%)	22 (28%)	<b>94 (18%)</b>
<b>Total</b>	<b>449 (100%)</b>	<b>80 (100%)</b>	<b>529 (100%)</b>
<b>Late Referral = YES</b>			
Native	23 (11%)	3 (8%)	<b>26 (10%)</b>
Synthetic	2 (<1%)	1 (3%)	<b>3 (1%)</b>
Tunnelled CVC	119 (56%)	13 (33%)	<b>132 (53%)</b>
Non-Tunnelled CVC	67 (32%)	23 (58%)	<b>90 (36%)</b>
<b>Total</b>	<b>211 (100%)</b>	<b>40 (100%)</b>	<b>251 (100%)</b>

CVC = Central Venous Catheter



The proportion of late referral by each year, state and racial origin is shown in Figures 4.9 to 4.11.

Over the last five years, the proportion of patients

presenting late for renal replacement therapy (<3 months prior to RRT commencement) has remained constant at approximately 25% for both Australia and New Zealand.

**Figure 4.9**

<b>Late Referral - All Modes of Treatment including Pre-emptive Transplants By Year 1-Jan-1999 to 31-Dec-2003</b>						
Country	Years					TOTAL
	1999	2000	2001	2002	2003	
<b>AUSTRALIA</b>						
NO	1328 (76%)	1321 (75%)	1470 (77%)	1395 (73%)	1432 (73%)	6946 (75%)
YES	422 (24%)	434 (25%)	441 (23%)	503 (27%)	521 (27%)	2321 (25%)
<b>TOTAL</b>	<b>1750 (100%)</b>	<b>1755 (100%)</b>	<b>1911 (100%)</b>	<b>1898 (100%)</b>	<b>1953 (100%)</b>	<b>9267 (100%)</b>
<b>NEW ZEALAND</b>						
NO	283 (75%)	304 (72%)	352 (75%)	339 (73%)	326 (73%)	<b>1604 (74%)</b>
YES	92 (25%)	117 (28%)	117 (25%)	124 (27%)	123 (27%)	<b>573 (26%)</b>
<b>TOTAL</b>	<b>375 (100%)</b>	<b>421 (100%)</b>	<b>469 (100%)</b>	<b>463 (100%)</b>	<b>449 (100%)</b>	<b>2177 (100%)</b>

**Figure 4.10**

<b>Late Referral - All Modes of Treatment including Pre-emptive Transplants By Australian States and Country 1-Jan-1999 to 31-Dec-2003</b>										
Late Referral	Australian States								AUSTRALIA	NEW ZEALAND
	QLD	NSW	ACT	VIC	TAS	SA	NT	WA		
NO	1290 (73%)	2121 (73%)	150 (76%)	1785 (78%)	131 (78%)	541 (79%)	193 (69%)	735 (74%)	<b>6946 (75%)</b>	<b>1604 (74%)</b>
YES	479 (27%)	773 (27%)	48 (24%)	494 (22%)	36 (22%)	147 (21%)	87 (31%)	257 (26%)	<b>2321 (25%)</b>	<b>573 (26%)</b>
<b>TOTAL</b>	<b>1769 (100%)</b>	<b>2894 (100%)</b>	<b>198 (100%)</b>	<b>2279 (100%)</b>	<b>167 (100%)</b>	<b>688 (100%)</b>	<b>280 (100%)</b>	<b>992 (100%)</b>	<b>9267 (100%)</b>	<b>2177 (100%)</b>

Aboriginal, Maori and Polynesian patients have higher rates of late presentation than other groups.

**Figure 4.11**

<b>Late Referral - All Modes of Treatment including Pre-emptive Transplants By Race 1-Jan-1999 to 31-Dec-2003</b>							
Country	Race						TOTAL
	Asian	Aboriginal	Caucasoid	Maori	Pacific Isl	Other	
<b>AUSTRALIA</b>							
NO	489 (70%)	482 (62%)	5775 (77%)	29 (64%)	104 (59%)	67 (78%)	6946 (75%)
YES	206 (30%)	291 (38%)	1718 (23%)	16 (36%)	71 (41%)	19 (22%)	2321 (25%)
<b>TOTAL</b>	<b>695 (100%)</b>	<b>773 (100%)</b>	<b>7493 (100%)</b>	<b>45 (100%)</b>	<b>175 (100%)</b>	<b>86 (100%)</b>	<b>9267 (100%)</b>
<b>NEW ZEALAND</b>							
NO	100 (81%)	1 (100%)	826 (79%)	462 (68%)	212 (65%)	3 (50%)	<b>1604 (74%)</b>
YES	23 (19%)	-	216 (21%)	217 (32%)	114 (35%)	3 (50%)	<b>573 (26%)</b>
<b>TOTAL</b>	<b>123 (100%)</b>	<b>1 (100%)</b>	<b>1042 (100%)</b>	<b>679 (100%)</b>	<b>326 (100%)</b>	<b>6 (100%)</b>	<b>2177 (100%)</b>

Patients in Australia and New Zealand that present late are more likely to receive haemodialysis as their initial RRT modality (fig 4.12).

Somewhat surprisingly, there was no difference in most parameters in Australia. In contrast, late referral in New Zealand was associated with worse calcium phosphate product, lower haemoglobin and lesser EPO use (fig 4.13).

**Figure 4.12**
**Late Referral - Initial Treatment and Treatment at 90 days  
All Modes of Treatment including Pre-emptive Transplants  
1-Jan-1999 to 31-Dec-2003**

Country	Late Referral	Mode of Treatment			TOTAL
		Haemodialysis	All Peritoneal Dialysis	Transplants	
<b>AUSTRALIA</b>					
Initial Treatment	NO	4848 (72%)	1858 (81%)	240 (98%)	<b>6946 (75%)</b>
	YES	1879 (28%)	437 (19%)	5 (2%)	<b>2321 (25%)</b>
	<b>TOTAL</b>	<b>6727 (100%)</b>	<b>2295 (100%)</b>	<b>245 (100%)</b>	<b>9267 (100%)</b>
Treatment at 90 Days	NO	4113 (75%)	2325 (75%)	308 (96%)	<b>6746 (75%)</b>
	YES	1390 (25%)	792 (25%)	14 (4%)	<b>2196 (25%)</b>
	<b>TOTAL</b>	<b>5503 (100%)</b>	<b>3117 (100%)</b>	<b>322 (100%)</b>	<b>8942 (100%)</b>
<b>NEW ZEALAND</b>					
Initial Treatment	NO	860 (66%)	685 (84%)	59 (100%)	<b>1604 (74%)</b>
	YES	444 (34%)	129 (16%)	-	<b>573 (26%)</b>
	<b>TOTAL</b>	<b>1304 (100%)</b>	<b>814 (100%)</b>	<b>59 (100%)</b>	<b>2177 (100%)</b>
Treatment at 90 Days	NO	677 (72%)	835 (76%)	68 (96%)	<b>1580 (75%)</b>
	YES	270 (29%)	267 (24%)	3 (4%)	<b>540 (25%)</b>
	<b>TOTAL</b>	<b>947 (100%)</b>	<b>1102 (100%)</b>	<b>71 (100%)</b>	<b>2121 (100%)</b>

**Figure 4.13**
**Late Referral  
Haemodialysis as Initial Modality  
1-Oct-2003 to 31-Mar-2004**

		AUSTRALIA			NEW ZEALAND		
		Late Referral		Total	Late Referral		Total
		No	Yes		No	Yes	
Phosphate [mmol/l] (%) CARI	0 - 1.7	308 (66%)	98 (61%)	<b>406 (65%)</b>	41 (53%)	13 (43%)	<b>54 (51%)</b>
	1.8 - 2.1	86 (19%)	29 (18%)	<b>115 (18%)</b>	21 (27%)	7 (23%)	<b>28 (26%)</b>
	>= 2.2	71 (15%)	34 (21%)	<b>105 (17%)</b>	15 (20%)	10 (33%)	<b>25 (23%)</b>
	<b>Total</b>	<b>465</b>	<b>161</b>	<b>626</b>	<b>77</b>	<b>30</b>	<b>107</b>
		Pearson chi2 (2) = 2.9857 Pr = 0.225			Pearson chi2 (2) = 2.3216 Pr = 0.313		
Calcium x Phosphate Product (%)	0 - 4.1	290 (63%)	94 (61%)	<b>384 (63%)</b>	38 (49%)	17 (57%)	<b>55 (51%)</b>
	4.2 - 5.7	127 (28%)	44 (29%)	<b>171 (28%)</b>	32 (42%)	4 (13%)	<b>36 (34%)</b>
	>= 5.8	42 (9%)	16 (10%)	<b>58 (9%)</b>	7 (9%)	9 (30%)	<b>16 (15%)</b>
	<b>Total</b>	<b>459</b>	<b>154</b>	<b>613</b>	<b>77</b>	<b>30</b>	<b>107</b>
		Pearson chi2 (2) = 0.3053 Pr = 0.858			Pearson chi2 (2) = 11.6486 Pr = 0.003		
Haemoglobin [g/l] (%)	0 - 89	25 (5%)	8 (5%)	<b>33 (5%)</b>	7 (9%)	9 (29%)	<b>16 (15%)</b>
	90 - 109	127 (27%)	49 (30%)	<b>176 (28%)</b>	21 (27%)	14 (45%)	<b>35 (32%)</b>
	>= 110	316 (68%)	104 (65%)	<b>420 (67%)</b>	49 (64%)	8 (26%)	<b>57 (53%)</b>
	<b>Total</b>	<b>468</b>	<b>161</b>	<b>629</b>	<b>77</b>	<b>31</b>	<b>108</b>
		Pearson chi2 (2) = 0.6509 Pr = 0.722			Pearson chi2 (2) = 14.1080 Pr = 0.001		
Transferrin Saturation (%)	0 - 19	124 (28%)	51 (35%)	<b>175 (30%)</b>	12 (20%)	7 (37%)	<b>19 (24%)</b>
	20 - 29	149 (34%)	46 (31%)	<b>195 (33%)</b>	24 (40%)	6 (32%)	<b>30 (38%)</b>
	>= 30	166 (38%)	49 (34%)	<b>215 (37%)</b>	24 (40%)	6 (32%)	<b>30 (38%)</b>
	<b>Total</b>	<b>439</b>	<b>146</b>	<b>585</b>	<b>60</b>	<b>19</b>	<b>79</b>
		Pearson chi2 (2) = 2.3706 Pr = 0.306			Pearson chi2 (2) = 2.2409 Pr = 0.326		
Erythropoietin (%)	No	28 (6%)	6 (4%)	<b>34 (5%)</b>	10 (13%)	9 (29%)	<b>19 (18%)</b>
	Yes	443 (94%)	156 (96%)	<b>599 (95%)</b>	67 (87%)	22 (71%)	<b>89 (82%)</b>
	<b>Total</b>	<b>471</b>	<b>162</b>	<b>633</b>	<b>77</b>	<b>31</b>	<b>108</b>
		Pearson chi2 (1) = 1.1911 Pr = 0.275			Pearson chi2 (1) = 3.9249 Pr = 0.048		



### ERYTHROPOIETIN

Only 4% of patients in Australia now have a Hb level  $\leq 90$  gm/l; whereas in New Zealand it has decreased from 21% in 2003 to 10% in March 2004. Twenty per cent of Australian patients and 12% of New Zealand patients receiving erythropoietic agents have Hb levels  $\geq 130$  gm/l. While the mean Hb in Australia has been stable for some time, there has been a recent increase in reported Hb in New Zealand (fig 4.14).

There have been substantial changes in usage of erythropoietic agents in New Zealand over the past few surveys, reflecting changing regulations regarding government subsidy of these agents. This is reflected in the pattern of usage reported (fig 4.15).

Figure 4.14

Mean Haemoglobin Among Dialysis Patients by Survey

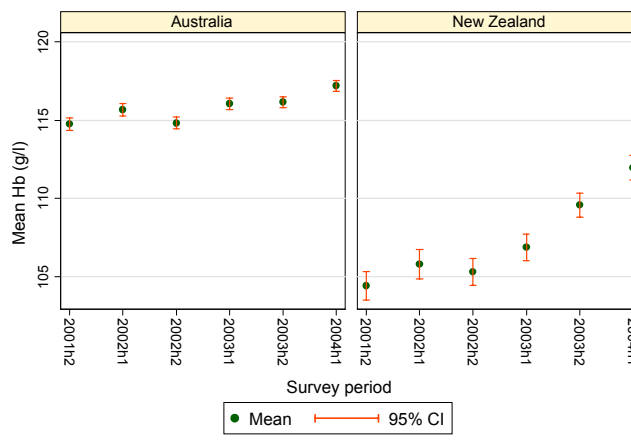
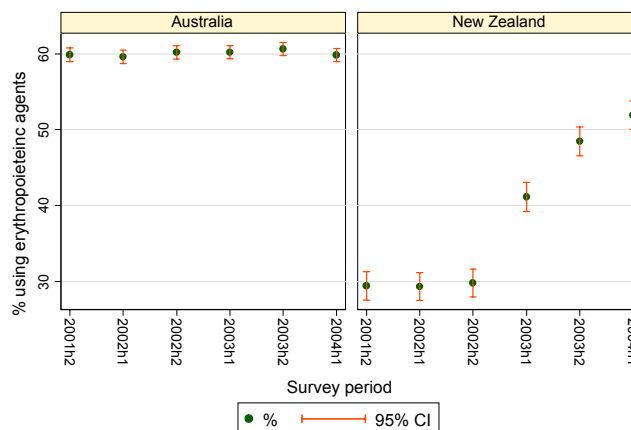


Figure 4.15

Use of Erythropoietic Agents by Survey





More detailed tabular data on the reported ferritin concentration and transferrin saturation are presented in Figures 4.16 and 4.17. The associations in this cross-sectional data

are complex, with an inverse association between ferritin and haemoglobin. These issues were explored in a recent publication (McDonald SP et al *Hemodialysis Int* 2004; 8:257-264).

**Figure 4.16**

<b>Patients Having EPO Haemoglobin and Ferritin Concentration Alive on All Modes of Dialysis at 31-Mar-2004</b>						
Haemoglobin	Ferritin Levels					Total
	00-49	50-99	100-199	200-499	500-on	
<b>AUSTRALIA</b>						
<=89	13 (5%)	15 (4%)	43 (5%)	91 (4%)	130 (5%)	<b>292 (4%)</b>
90-109	68 (23%)	99 (25%)	199 (24%)	649 (26%)	692 (27%)	<b>1707 (26%)</b>
110-129	135 (45%)	185 (46%)	400 (48%)	1294 (51%)	1305 (50%)	<b>3319 (50%)</b>
130-149	75 (25%)	89 (22%)	173 (21%)	443 (18%)	443 (17%)	<b>1223 (18%)</b>
>=150	6 (2%)	14 (3%)	19 (2%)	39 (1%)	21 (1%)	<b>99 (2%)</b>
<b>Total</b>	<b>297 (100%)</b>	<b>402 (100%)</b>	<b>834 (100%)</b>	<b>2516 (100%)</b>	<b>2591 (100%)</b>	<b>6640 (100%)</b>
<b>NEW ZEALAND</b>						
<=89	2 (3%)	9 (9%)	11 (6%)	52 (11%)	39 (11%)	<b>113 (10%)</b>
90-109	24 (43%)	29 (31%)	60 (33%)	167 (35%)	164 (45%)	<b>444 (38%)</b>
110-129	18 (32%)	39 (41%)	90 (49%)	199 (41%)	131 (36%)	<b>477 (40%)</b>
130-149	11 (20%)	14 (15%)	20 (11%)	60 (12%)	27 (7%)	<b>132 (11%)</b>
>=150	1 (2%)	4 (4%)	3 (1%)	4 (1%)	3 (1%)	<b>15 (1%)</b>
<b>Total</b>	<b>56 (100%)</b>	<b>95 (100%)</b>	<b>184 (100%)</b>	<b>482 (100%)</b>	<b>364 (100%)</b>	<b>1181 (100%)</b>

**Figure 4.17**

<b>Patients Having EPO Haemoglobin and Transferrin Saturation Alive on All Modes of Dialysis at 31-Mar-2004</b>					
Haemoglobin	Transferrin Levels				Total
	00-19	20-24	25-29	30-on	
<b>AUSTRALIA</b>					
<=69	4 (<1%)	1 (<1%)	2 (<1%)	10 (<1%)	<b>17 (&lt;1%)</b>
70-89	104 (6%)	35 (3%)	46 (4%)	84 (4%)	<b>269 (4%)</b>
90-109	551 (33%)	324 (26%)	279 (23%)	507 (22%)	<b>1661 (26%)</b>
110-129	744 (45%)	674 (53%)	632 (52%)	1196 (51%)	<b>3246 (50%)</b>
130-149	244 (15%)	215 (17%)	240 (20%)	495 (21%)	<b>1194 (18%)</b>
>=150	19 (1%)	16 (1%)	22 (2%)	38 (2%)	<b>95 (1%)</b>
<b>Total</b>	<b>1666 (100%)</b>	<b>1265 (100%)</b>	<b>1221 (100%)</b>	<b>2330 (100%)</b>	<b>6482 (100%)</b>
<b>NEW ZEALAND</b>					
<=69	1 (<1%)	-	1 (1%)	1 (<1%)	<b>3 (&lt;1%)</b>
70-89	32 (13%)	15 (9%)	11 (6%)	31 (8%)	<b>89 (9%)</b>
90-109	120 (50%)	45 (28%)	69 (40%)	121 (32%)	<b>355 (37%)</b>
110-129	67 (28%)	76 (48%)	65 (38%)	172 (45%)	<b>380 (40%)</b>
130-149	20 (8%)	21 (13%)	23 (13%)	49 (13%)	<b>113 (12%)</b>
>=150	2 (1%)	3 (2%)	2 (1%)	5 (1%)	<b>12 (1%)</b>
<b>Total</b>	<b>242 (100%)</b>	<b>160 (100%)</b>	<b>171 (100%)</b>	<b>379 (100%)</b>	<b>952 (100%)</b>

