Chapter 15: Co-morbidity in Incident Patients

Summary

- Only a minority of renal units provide adequate data on the co-morbidity of patients starting RRT.
- As a result, data is available on co-morbidity on only 42% of patients starting RRT in 2004.
- For those for whom co-morbidity data is available, over 50% of patients starting RRT in 1999–2004 had at least one co-morbid condition.
- The frequency of co-morbidity increases with age group up to 74, but is lower amongst patients starting RRT aged $\geqslant$75 years.
- Vascular co-morbidity is more common amongst patients whose primary diagnosis is diabetes mellitus.
- The population of patients on peritoneal dialysis at 90 days tends to be younger and to have less co-morbidity than those established on haemodialysis.
- Late referral is less of a problem amongst patients aged <44 years at start of RRT than amongst older patients.
- There was no excess of co-morbidity amongst patients referred for RRT within 3 months compared to those referred earlier.
- Estimated GFR at start of RRT tended to be higher amongst those with co-morbidity compared to those with no co-morbidity.
- Co-morbidity is a powerful predictor of early and late mortality amongst patients starting RRT; adjustment for co-morbidity is therefore critically important for comparisons of survival between renal units.

Co-morbidity data

Collation of data on co-morbidity requires clinicians to provide yes/no answers to the presence or absence of 14 conditions in patients at the time of starting renal replacement therapy. Data on smoking at the time of starting RRT has been collected as a marker for vascular (cardiac, cerebral and peripheral) risk. It is not a co-morbid condition although for the purposes of these analyses, it has been treated as such. Although the operational definitions for each of these conditions have been published annually in the Registry Report, these definitions have not been made available in the form of help screens, at least in the majority of those renal units using the Proton system; data therefore reflect individual clinicians' judgement on the presence or absence of each condition. The conditions are listed in Table 15.1.

Completion of co-morbidity returns requires a clinician's judgement and access to the patient's full medical history. The Registry does not have data on the accuracy of co-morbidity returns when compared with medical records for individual patients.

The analyses reported in this Chapter have been performed using all available data on the 20,110 patients starting RRT between 1999 and 2004, and therefore reflect **cumulative** results on all patients starting RRT for whom co-morbidity has been reported, rather than being confined to patients starting RRT in 2004. In future years it may be possible to compare co-morbidity amongst inception cohorts from each individual year.

Null entries are considered missing data rather than 'no'.

In all the figures where data are shown by the individual centre, the number adjacent to the name of the renal unit indicates the percentage of missing data at that time point.

Table 15.1: Co-morbid conditions listed in the Registry co-morbidity dataset

Angina
Previous MI within 3 months
Previous MI over 3 months ago
Previous CABG or coronary angioplasty
Heart failure
(in some analyses these 5 variables are combined under the term 'cardiovascular disease')
Cerebrovascular disease
Diabetes (when not listed as the cause of ERF)
Chronic obstructive pulmonary disease
Liver disease
Claudication
Ischaemic/neuropathic ulcers
Non-coronary angioplasty, vascular graft, or aneurysm
Amputation for peripheral vascular disease
(in some analyses, these 4 variables are combined under the term 'peripheral vascular disease')
Smoking
Malignancy

Beginning in 2004, the presence or absence of heart failure prior to the start of RRT was also recordable. However, very few units are, to date, reporting the presence or absence of heart failure, and so this variable has not been included in any of the analyses reported in this chapter. Definitions for each co-morbidity are given at the end of this chapter. For some analyses, the major categories of 'cardiovascular disease', cerebrovascular disease, and peripheral vascular disease, as defined in Table 15.1 were used.

Co-morbidity returns by renal units

Returns from the 49 centres reporting data for patients starting RRT in 2004 are given in Table 15.2. Twelve centres (Basildon, Bradford, Chelmsford, Dorset, Hammersmith and Charing Cross, King's, Norwich, Nottingham, Sunderland, Swansea, Wolverhampton, and York) returned data on co-morbidity on at least 90% of their patients. Of these, Chelmsford and Norwich were reporting data for the first time; Sunderland and York had improved from poorer returns on patients starting RRT in 2003, and the remainder performed well in previous years. These units, which vary in size and geographical catchment area, demonstrate that it is possible to provide data reliably. **The Registry will be contacting these centres asking for details of how they organise collection of data on co-morbidity, and will collate that information and with this information, write to Directors of all other centres as soon as possible.**

Twenty-one centres (Brighton, Cambridge, Carshalton, Clwyd, Coventry, Cardiff, Dudley, Guy's, Heartlands Birmingham, Middlesbrough, Newcastle, Oxford, Plymouth, Portsmouth, Preston, Queen Elizabeth Hospital Birmingham, Reading, Shrewsbury, Stevenage, Wirral, and Wrexham) provided data on co-morbidity on less than 10% of incident patients. Of these, most were either newly reporting or had never returned data on more than 10%, the exceptions being Middlesbrough (100% in 2002, 1% in 2004) and Portsmouth (56% in 2001, 8% in 2004). Again, these renal units will be contacted to determine what (if any) procedures they have in place to encourage clinicians to complete database entries on co-morbidity at start of RRT. All four centres that use the Mediqal database achieved returns of $\geqslant 90\%$; Mediqal operates a data validation routine that reminds clinicians on a quarterly basis about missing data items, and Mediqal do not submit data to the Registry until these data items have been completed.

As a result of poor data returns from many renal units, information on co-morbidity at the start of RRT is only available in 1,979 of the 4,704 incident patients in 2004; Table 15.3 gives

Table 15.2: Completeness of co-morbidity returns from individual units on incident patients (1999–2004)

Treatment centre	1999		2000		2001		2002		2003		2004	
	No. incident patients	% returns co-morbidity	No. incident patients	% returns co-morbidity	No. incident patients	% returns co-morbidity	No. incident patients	% returns co-morbidity	No. incident patients	% returns co-morbidity	No. incident patients	% returns co-morbidity
Bangor	–	–	–	–	31	47	29	57	33	42	36	50
Barts	–	–	–	–	–	–	–	–	–	–	187	64
Basildon	–	–	–	–	–	–	–	–	53	100	43	100
Bradford	–	–	–	–	61	93	62	100	75	84	62	92
Brighton	–	–	–	–	–	–	–	–	–	–	113	0
Bristol	118	90	148	94	152	91	123	82	162	83	166	72
Cambridge	–	–	–	–	93	5	74	4	95	1	103	0
Carlisle	27	44	28	39	28	4	26	19	31	0	29	10
Carshalton	111	10	119	12	119	16	171	3	199	3	167	2
Chelmsford	–	–	–	–	–	–	–	–	–	–	52	100
Clwyd	–	–	–	–	16	0	20	0	12	0	13	0
Coventry	92	–	88	0	104	0	95	1	76	0	77	0
Cardiff	137	1	139	1	154	0	181	0	164	2	181	1
Derby	–	–	55	40	–	–	–	–	61	72	65	51
Dorset	–	–	–	–	–	–	–	–	67	99	57	100
Dudley	43	0	40	0	34	0	25	4	41	0	55	0
Exeter	82	32	72	40	98	34	82	50	98	50	116	41
Gloucester	59	3	48	98	50	98	57	68	57	86	55	89
Guys	–	–	126	2	111	1	140	1	93	1	104	0
H&CX	–	–	–	–	–	–	176	99	152	100	196	100
Heartlands	82	0	86	0	85	0	61	2	102	0	98	0
Hull	64	2	81	2	74	0	105	5	80	89	109	85
Ipswich	–	–	–	–	–	–	42	38	35	31	46	15
Kings	–	–	–	–	–	–	117	87	108	100	114	96
Leeds	82	85	160	91	162	86	147	85	169	80	175	70
Leicester	164	80	175	76	185	90	152	88	168	96	165	85
Liverpool	–	–	–	–	183	58	148	49	113	60	126	43
ManWst	–	–	–	–	–	–	–	–	141	29	105	34
Middlesbrough	92	1	86	70	81	90	111	100	103	0	101	1
Newcastle	–	–	–	–	–	–	106	1	100	3	101	0
Norwich	–	–	–	–	–	–	–	–	–	–	99	100
Nottingham	128	24	114	71	121	66	87	99	114	98	107	95
Oxford	142	0	159	3	169	1	165	0	181	1	159	1
Plymouth	68	1	59	0	64	3	79	3	64	0	61	3
Portsmouth	–	–	–	–	143	56	141	46	139	38	119	8
Preston	106	1	116	1	136	1	112	0	98	1	84	0
QEH	–	–	–	–	–	–	–	–	–	–	195	0
Reading	–	–	50	0	63	0	40	0	68	0	67	0
Sheffield	133	24	137	82	153	87	156	61	159	55	169	37
Shrewsbury	–	–	–	–	–	–	–	–	–	–	54	0
Stevenage	103	1	101	1	125	2	88	1	113	0	79	0
Southend	43	2	39	10	35	29	33	48	43	37	41	37
Sunderland	46	0	46	0	38	5	56	46	56	61	51	90
Swansea	–	–	92	77	112	73	113	82	131	96	95	93
Truro	–	–	–	–	37	54	58	66	47	87	60	82
Wirral	–	–	–	–	–	–	40	0	53	0	68	0
Wolverhampton	75	97	78	100	75	99	97	100	89	99	101	96
Wrexham	51	0	54	0	35	0	42	0	33	0	30	0
York	–	–	40	93	37	92	68	76	57	82	48	90
Totals	**2,048**		**2,536**		**3,164**		**3,625**		**4,033**		**4,704**	

Table 15.3: Summary of co-morbidity returns (1999–2004) on incident patients

	Years						
	1999	2000	2001	2002	2003	2004	Totals
Number of renal units	23	28	34	39	43	49	
Total number of new patients	2,048	2,536	3,164	3,625	4,033	4,704	20,110
Number of patients with co-morbid data entries	501	995	1,325	1,589	1,842	1,979	8,231
Percentage of co-morbid returns							
Mean of centres returning co-morbidity	24	39	42	44	46	42	41
Median of centres returning co-morbidity	10	40	55	50	66	71	26

data on the proportion of incident patients starting RRT each year for whom data on co-morbidity was reported to the Registry.

The total number of patients for whom data is available for the years 1999–2003 differs slightly from the numbers given in previous Reports; this is because some centres that joined the Registry in 2004 provided retrospective data on co-morbidity on patients starting RRT in previous years. Chapter 16 in the 2004 Report also gave erroneous data on the numbers of patients starting RRT in Clwyd (28, rather than 9) and Wolverhampton (93, rather than 92).

The analyses in the remainder of this chapter are confined to those in whom data on co-morbidity is available.

Frequency of co-morbidity returned

Table 15.4 outlines the total and age-dependent frequencies of each co-morbid condition separately in the 7,306 patients who survived at least 90 days on RRT and for whom co-morbidity data were available. Cardiovascular diseases, chronic obstructive pulmonary disease (COPD) and malignancy were more common in

Table 15.4: Frequency of co-morbidity amongst 7,306 patients starting RRT in 1999–2004 who survived to 90 days

	Age <65 years		Age ⩾65 years		Total % incidence
Co-morbidity	No patients	%	No patients	%	
Cardiovascular disease	564	14.8	1,129	32.6	23.2
Angina	420	11.0	858	24.9	17.6
MI in past 3 months	70	1.8	107	3.1	2.4
MI >3 months	221	5.8	534	15.5	10.4
CABG/angioplasty	163	4.3	225	6.6	5.4
Cerebrovascular disease	243	6.4	509	14.7	10.3
Diabetes (not a cause of ERF)	182	4.9	319	9.4	7.0
Diabetes as primary disease	874	22.8	561	16.2	19.6
Diabetes of either category	1,056	27.6	880	25.3	26.5
COPD	161	4.3	346	10.1	7.0
Liver disease	97	2.5	59	1.7	2.2
Malignancy	236	6.2	535	15.5	10.6
Peripheral vascular disease	360	9.4	589	17.0	13.0
Claudication	233	6.1	478	13.9	9.8
Ischaemic/neuropathic ulcers	136	3.6	107	3.1	3.4
Angioplasty/vascular graft	79	2.1	162	4.7	3.3
Amputation	88	2.3	57	1.7	2.0
Smoking	752	20.8	471	14.3	17.7
No co-morbidity present	2,104	54.9	1,222	35.2	45.5

patients aged >65 at start of RRT; diabetes and smoking were less commonly reported amongst older patients than in younger patients.

These data allow comparison with US and other international Registries which only report data on patients who survive at least 90 days on RRT.

Co-morbidity totals

Table 15.5 gives data on the number of co-morbidities recorded for each patient starting RRT in 1999–2004 for whom data were available. Nearly half of these patients started RRT without any of the listed co-morbid conditions.

Table 15.5: Cumulative co-morbidity present at the start of RRT

	Number of co-morbidities					
Total	0	1	2	3	4	5+
%	44.6	26.6	14.2	7.6	3.9	3.1

Frequency of co-morbidities by age band

As in previous reports, the frequency of recorded cardiovascular co-morbidity (Figures 15.1 and 15.2) increased with age up until 74 years; the frequency of recorded co-morbidities amongst incident patients aged 75 or more was less than for the 65–74 age group for all co-morbidities (Figures 15.1, 15.2 and 15.3)

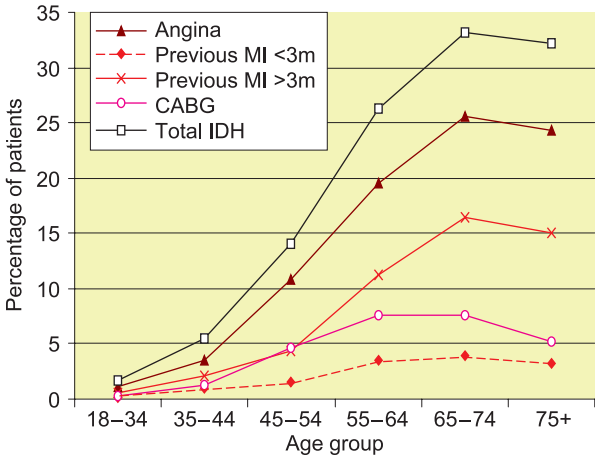

Figure 15.1: Frequency of cardiovascular co-morbidities in incident RRT patients (1999–2004) by age group

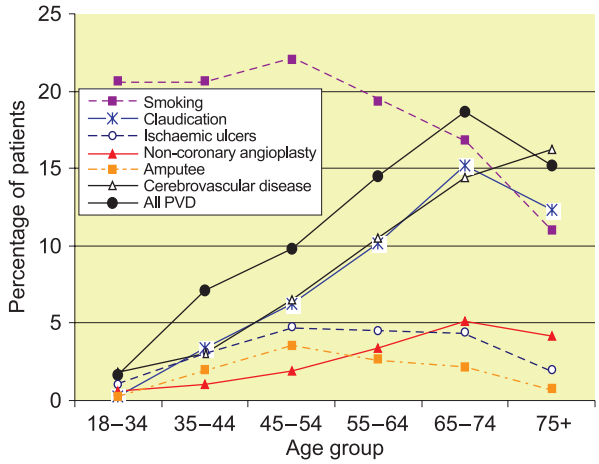

Figure 15.2: Frequency of cerebrovascular and peripheral vascular co-morbidities in incident RRT patients (1999–2004) by age group

other than stroke, malignancy and diabetes when not the primary cause of renal disease. There are several possible explanations for these findings. Firstly, it is possible that negative selection of over 75 year olds with co-morbidity occurs, such that such patients are less likely to be referred to, or accepted by, renal units than patients aged 65–74 with similar degrees of co-morbidity. Secondly, it is possible that patients over 75 with co-morbidity are more likely to choose a palliative care option than those aged

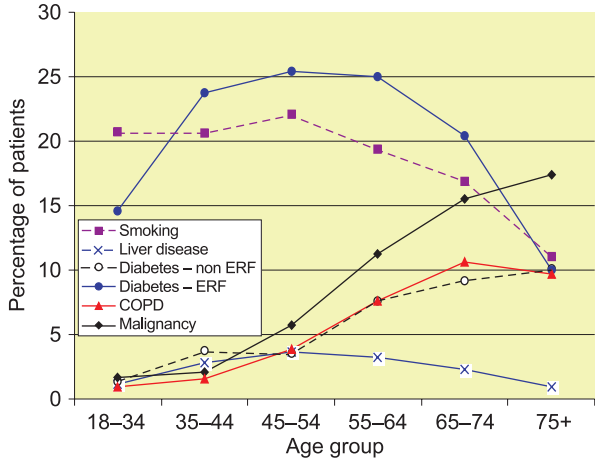

Figure 15.3: Frequency of other co-morbid conditions in incident RRT patients (1999–2004) by age group

Abbreviations: ERF: established renal failure. COPD: chronic obstructive pulmonary disease. 'Diabetes – non ERF' describes patients who were recorded as having diabetes but whose cause of ERF was recorded as non-diabetic kidney disease; 'Diabetes – ERF' describes patients who were recorded as having diabetes and whose cause of ERF was recorded as diabetes

65–74. The Registry does not have reliable data on patients receiving conservative/palliative care for ERF. All renal units have the ability to record on the timeline that a patient has entered a conservative care pathway, so it should be possible to capture these data in future.

Diabetes and co-morbidity

Of the 8,044 patients starting RRT in 1999–2004 for whom co-morbidity returns and a primary diagnosis were available, 1,612 (20%) had a diagnosis of diabetes mellitus as the cause of ERF. Table 15.6 outlines the incidence of co-morbidity for patients with and without diabetes and documents the expected higher prevalence of vascular disease amongst diabetic patients starting RRT compared with non-diabetic patients. The proportion of diabetic and non-diabetic patients who are current smokers when starting RRT is similar. Markedly fewer diabetics than non-diabetics have a history of previous malignancy; this is possibly due to negative selection, ie lower rates of referral or acceptance of patients with stage 5 CKD who have a history of both diabetes mellitus and malignancy.

Table 15.6: Percentage of patients with or without diabetes (either as primary diagnosis or as co-morbidity) who have co-morbid conditions other than diabetes

Co-morbidity	Non-diabetics	Diabetics
Cardiovascular disease	22.0	30.8
Cerebrovascular disease	9.9	14.8
Peripheral vascular disease	10.4	25.7
Smoking	17.3	18.1
COPD	7.7	5.9
Malignancy	13.2	4.7
Liver disease	2.3	2.0

Dialysis modality and co-morbidity

Amongst patients starting RRT who survived to 90 days there was a smaller proportion of the patients treated with peritoneal dialysis aged over 75 years than there was of the patients treated with haemodialysis.

Table 15.7 compares the proportions of patients on HD and PD with each of the co-morbidities for which data were collected and also gives the median age for patients with each type of co-morbidity. Data on co-morbidity were available for 44% of HD and 42% of PD patients. All common co-morbidities are more frequent amongst those treated with HD than with PD which is in keeping with the overall age profile of the populations on HD and PD (Figure 15.4).

Table 15.7: Proportions of co-morbid conditions present in patients starting HD or PD in 1999–2004

	HD		PD		
Co-morbidity	%	Median age	%	Median age	p value
Angina	19	71	16	67	0.0002
MI – more than 3 months ago	11	71	11	68	0.57
MI – within 3 months	3	70	2	67	0.01
CABG	5	68	6	66	0.14
Cerebrovascular disease	12	72	9	66	<0.0001
Diabetes non-ERF	8	71	5	68	<0.0001
COPD	8	71	4	65	<0.0001
Smoking	18	63	17	55	0.22
Liver disease	3	59	1	58	<0.0001
Malignancy	13	72	7	70	<0.0001
Claudication	11	71	8	66	0.001
Ischaemic/neuropathic ulcers	4	65	2	56	<0.0001
Angioplasty of non coronary vessels	4	71	3	65	0.019
Amputation	2	62	1	54	0.001

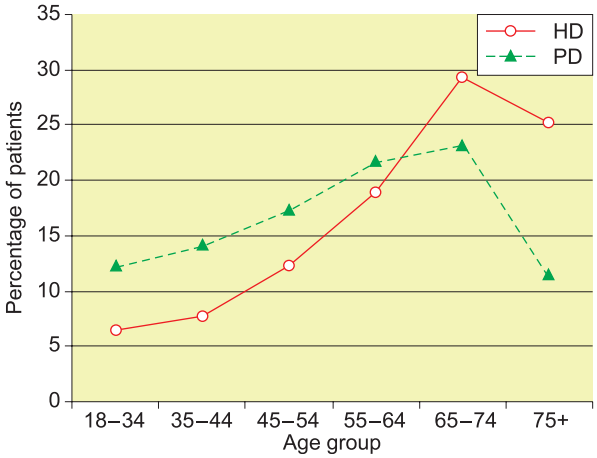

Figure 15.4: Age distribution of patients starting RRT in 1999–2004 who were receiving either HD or PD at 90 days after start of RRT, excluding those who had recovered kidney function

Timing of referral to a nephrologist and co-morbidity

Data on the time between first referral to a nephrologist in a dialysis centre and the start of RRT were available for 6,564 patients starting RRT in 1999–2004 (Figure 15.5). The duration of time between being seen for the first time by a nephrologist and starting renal replacement therapy was shorter with increasing age after age 44, even though most new patients are elderly – suggesting that efforts to improve timely referral of patients for consideration of RRT should focus on older patients. How many of the 'late referrals' were due to predictable, progressive CKD and how many to an unpredictable acute decline in kidney function on the background of previously stable CKD, however, is uncertain.

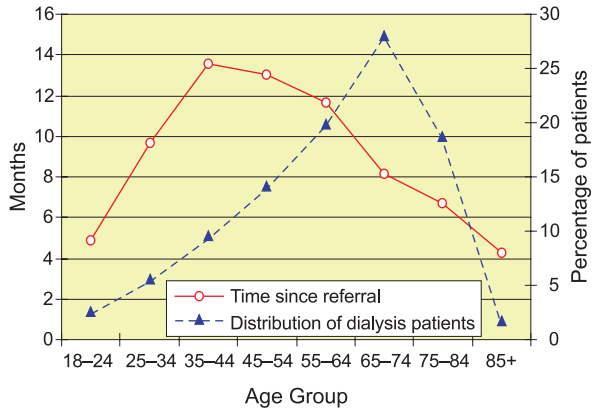

Figure 15.5: Duration of pre-dialysis nephrological care and the proportion of new dialysis patients per age band

Table 15.8: Frequency of specific co-morbidities amongst patients referred late (0–89 days) compared with those referred early (>89 days)

	Referral period (days)		
	0–89	⩾90	p value
Heart disease	19.3	24.6	<0.0001
Peripheral vascular disease	9.9	14.1	<0.0001
Cerebrovascular disease	8.4	11.5	0.002
Diabetes (not cause of ERF)	5.9	7.1	0.1109
COPD	6.7	7.1	0.6276
Liver disease	2.5	1.9	0.2139
Malignancy	13.7	8.5	<0.0001
Smoking	15.9	18.4	0.0458

Table 15.8 gives the frequency with which co-morbidity was present in patients referred to a nephrologist in a dialysis centre according to the timing of referral (less than or greater than 3 months). In contrast to some previously published reports, these data do not support the contention that late-referred patients carry a higher co-morbidity burden than those referred earlier; in fact, significantly more patients in the group referred early had cardiovascular disease, peripheral vascular disease, cerebrovascular disease and malignancy than in the group referred late.

Frequency of co-morbidity by ethnicity

There were 6,731 patients with data returns for both ethnic origin and co-morbidity; 7.8% were of South Asian origin, 3.2% African–Caribbean, 0.4% Chinese, 2.4% 'Other', and 86.2% White. Table 15.9 compares major co-morbidities amongst South Asian, African–Caribbean, and White patients. Smoking and malignancy were more commonly reported amongst White patients; stroke was less common amongst South Asians; and cardiovascular disease less common amongst African–Caribbean patients.

Diabetes (whether listed as the cause of renal failure or not) was more common amongst each ethnic minority population than in the White population (Figure 15.6).

Figure 15.7 shows the age distribution of incident patients according to ethnic origin; by

Table 15.9: Major co-morbidities amongst South Asian, African–Caribbean, and White patients starting RRT 1999–2004

	South Asian	Black	White	p value
Number of patients	526	213	5,804	0.0065
% with co-morbidity				
Smoking	7.8	8.4	19.5	<0.0001
CVA	7.3	10.4	11.2	0.0194
PVD	10.1	4.7	14.3	<0.0001
Cardiovascular disease	24.2	17.5	24.7	0.055
Liver disease	4.0	1.4	2.2	0.0165
COPD	4.3	4.3	8.2	0.001
Malignancy	3.2	5.2	12.2	<0.0001

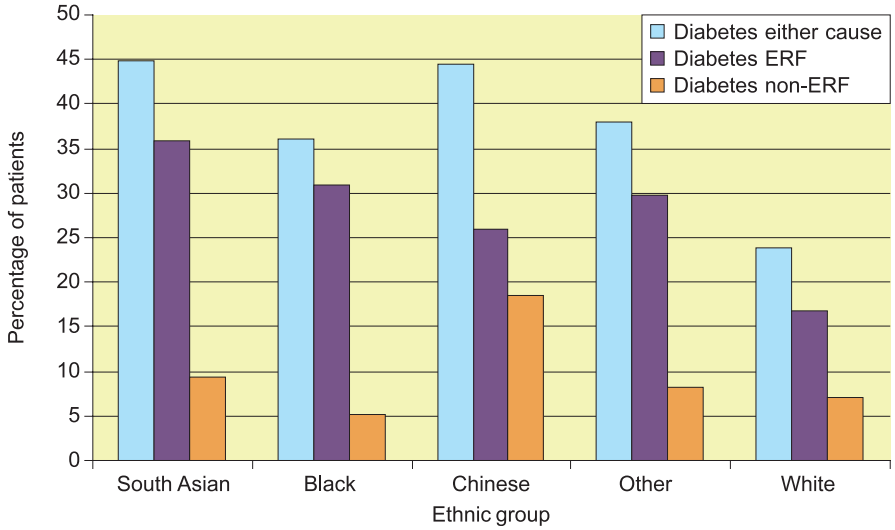

Figure 15.6: Frequency of diabetes by ethnic group

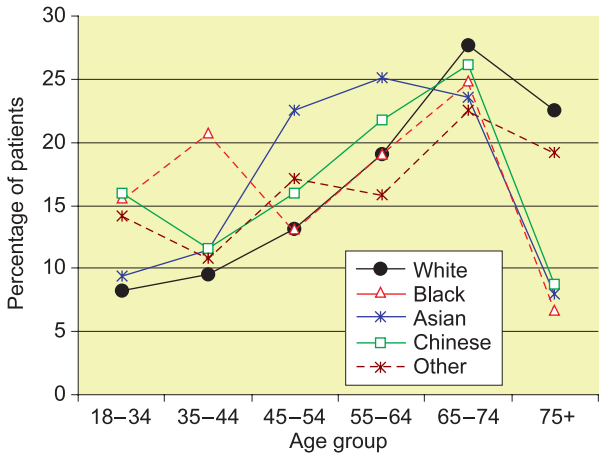

Figure 15.7: Age distribution of incident patients by ethnic group

comparison with White patients there was a smaller proportion of African–Caribbean, South Asian, and Chinese patients starting RRT aged 75 years or over. This is consistent with the younger age structure of these ethnic minority populations in the UK.

Renal function at commencement of dialysis and co-morbidity

Estimated GFR (eGFR), using the 4-variable MDRD equation, was calculated for patients starting RRT using the last available

Table 15.10: Mean eGFR at start of RRT and presence of co-morbidity

	Co-morbidity present		Co-morbidity absent		
	Mean	95% CI	Mean	95% CI	p value
All patients	8.9	8.7–9.1	9.4	9.2–9.5	0.002
Angina	9.9	9.6–10.2	9.0	8.8–9.2	<0.0001
MI in past 3 months	10.6	9.5–11.6	9.1	9.0–9.3	0.001
MI >3 months ago	9.5	9.2–9.9	9.1	9.0–9.3	0.020
CABG/angioplasty	10.3	9.7–10.9	9.1	9.0–9.2	0.000
Cerebrovascular disease	9.3	8.9–9.7	9.1	9.0–9.3	0.113
Diabetes (not cause of ERF)	10.2	9.6–10.8	9.1	8.9–9.2	<0.0001
Diabetes as primary disease	10.3	9.9–10.7	8.9	8.7–9.1	<0.0001
Diabetes of either category	10.3	9.9–10.6	8.8	8.6–8.9	<0.0001
COPD	9.9	9.4–10.5	9.1	9.0–9.3	0.001
Liver disease	9.9	8.8–11.0	9.1	9.0–9.3	0.077
Malignancy	9.3	8.8–9.7	9.1	9.0–9.3	0.154
Claudication	10.0	9.6–10.5	9.1	8.9–9.2	<0.0001
Ischaemic/neuropathic ulcers	9.9	9.1–10.6	9.1	9.0–9.3	0.026
Angioplasty/vascular graft	9.9	9.2–10.7	9.1	9.0–9.3	0.021
Amputation	10.2	9.4–11.1	9.1	9.0–9.3	0.019
Smoking	8.9	8.6–9.2	9.3	9.1–9.5	0.845

measurement of serum creatinine concentration prior to start of RRT (excluding a small number of patients for whom no creatinine result was available within 14 days prior to start of RRT). eGFR was then compared between patients starting RRT with co-morbidity and those without. (Table 15.10) Residual kidney function assessed using this formula was significantly higher at the start of RRT amongst patients with any form of cardiovascular disease, diabetes (whether or not listed as the cause of ERF) and peripheral vascular disease – suggesting that clinicians tend to start RRT earlier in patients with these co-morbidities. This analysis takes no account of the timing of referral.

Haemoglobin at commencement of dialysis and co-morbidity

The mean haemoglobin concentration immediately prior to the start of RRT was also compared between patients starting RRT with and without co-morbidity (Table 15.11). In contrast to the data on eGFR, mean haemoglobin concentration was similar in patients with and without co-morbidity, although haemoglobin was higher in patients with a history of myocardial infarction >3 months ago and coronary revascularisation and lower in those with liver disease and ischaemic/neuropathic ulcers.

Table 15.11: Mean haemoglobin at start of RRT and presence of co-morbidity

	Co-morbidity present		Co-morbidity absent		
	Mean	95% CI	Mean	95% CI	p value
No co-morbidity	10.1	10.1–10.2	10.1	10.0–10.1	0.113
Angina	10.1	10.1–10.2	10.1	10.1–10.1	0.994
MI in past 3 months	10.1	9.8–10.3	10.1	10.1–10.2	0.667
MI >3 months ago	10.4	10.2–10.5	10.1	10.0–10.1	0.005
CABG/angioplasty	10.4	10.2–10.5	10.1	10.1–10.1	0.037
Cerebrovascular disease	10.1	10.0–10.2	10.1	10.1–10.2	0.402
Diabetes (not cause of ERF)	10.1	10.0–10.3	10.1	10.1–10.1	0.701
Diabetes as primary disease	10.0	9.9–10.1	10.1	10.1–10.2	0.892
Diabetes of either category	10.1	10.0–10.1	10.1	10.1–10.2	0.807
COPD	10.0	9.8–10.1	10.1	10.1–10.2	0.061
Liver disease	9.6	9.4–9.9	10.1	10.1–10.2	0.001
Malignancy	10.0	9.9–10.1	10.1	10.1–10.2	0.029
Claudication	10.1	10.0–10.2	10.1	10.1–10.2	0.747
Ischaemic/neuropathic ulcers	9.8	9.6–10.0	10.1	10.1–10.2	0.008
Angioplasty/vascular graft	10.3	10.1–10.5	10.1	10.1–10.1	0.275
Amputation	9.9	9.6–10.2	10.1	10.1–10.2	0.110
Smoking	10.0	9.9–10.1	10.1	10.1–10.2	0.097

Renal transplantation and co-morbidity

This analysis was confined to data on incident patients in each of the years 1999–2004 from centres that had achieved >80% completeness of co-morbidity returns in that year (see Table 15.2). Figure 15.8 gives the age distribution of patients who had received a transplant by the end of 2004 compared with the age distribution of those who remained un-transplanted. Patients who died within this time period without receiving a transplant, were included in the analysis within the non-transplanted group.

Younger patients were more likely to be transplanted and only 3 of 1,289 patients aged >75 years at start of RRT underwent transplantation.

Table 15.12 gives the co-morbidity data for the same dataset and as expected, those undergoing transplantation were considerably less likely to have co-morbid conditions than those remaining on HD or PD.

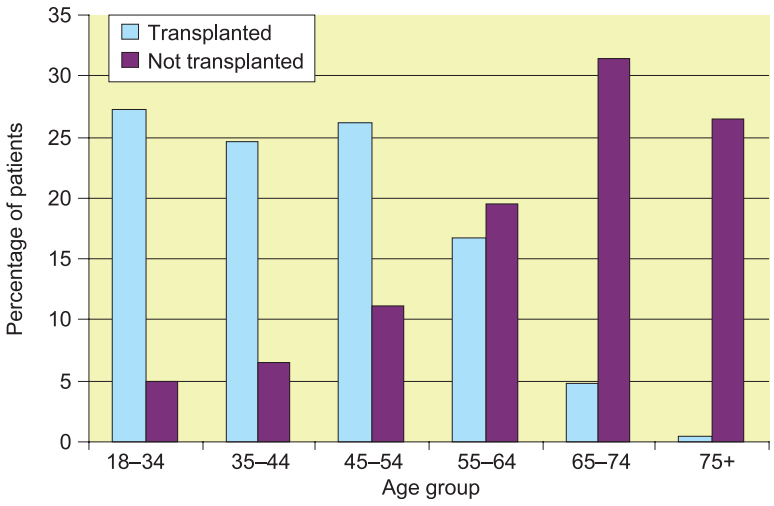

Figure 15.8: Age distribution of incident RRT cohort who had received a transplant and those who had remained on dialysis

Table 15.12: Incidence of co-morbidity in patients who had not been transplanted and in those who had been transplanted

	Not transplanted		Transplanted	
Co-morbidity	**Number**	**%**	**Number**	**%**
Number of patients	4,884	100.0	767	100.0
Without co-morbidities	1,882	38.5	505	65.8
Cardiovascular disease	1,149	25.8	33	5.0
Peripheral vascular disease	657	14.8	19	2.9
Cerebrovascular disease	507	11.4	26	4.0
Diabetes (not cause of ERF)	365	8.3	15	2.3
COPD	361	8.1	14	2.1
Liver disease	110	2.5	3	0.5
Malignancy	551	12.4	10	1.5
Smoking	734	17.2	90	14.8

Survival analysis and co-morbidity

Survival within 90 days of commencing RRT

The Registry collects data on all patients with a 'timeline' entry that indicates that they have started RRT for ERF. Patients who present acutely and continue to require RRT with no evidence of recovery of function can be reclassified by their clinicians as having had ERF from the time of first RRT if there is no recovery of function. This enables the Registry, unlike most other national Registries, to collect data on factors affecting outcome, including survival, in the first 90 days after initiation of RRT for ERF; most other Registries start the collection of data at 90 days after first RRT.

The results of univariate analysis of the association between the presence of reported co-morbidity and the risk of death within the first 90 days of commencing RRT, stratified by age, are given in Table 15.13. In both age-groups, all types of vascular disease are highly predictive of death, as is malignancy; liver disease is only significantly predictive of death in younger patients, but this may be due to small numbers – the Registry contains data on only 59 patients who were over 65 years old with liver disease.

Table 15.13: Univariate analysis, co-morbidity hazards of death by day 90

	Age <65		Age ⩾65	
Co-morbidity	**Hazard ratio**	**p value**	**Hazard ratio**	**p value**
Angina	2.4	0.0002	1.2	0.076
Cardiovascular disease*	2.3	0.0003	1.2	0.065
Vascular disease**	2.9	<0.0001	1.3	0.01
Diabetes (not as cause of ERF)	1.3	0.557	1.2	0.222
Diabetes as primary disease	1.4	0.107	0.7	0.038
Diabetes of either category	1.4	0.077	0.9	0.343
COPD	2.3	0.02	1.2	0.368
Liver disease	6.6	<0.0001	1.1	0.87
Malignancy	4.0	<0.0001	1.6	<0.0001
Claudication	2.1	0.019	1.2	0.286
Ischaemic/neuropathic ulcers	4.4	<0.0001	2.0	0.001
Smoking	0.7	0.251	1.2	0.313

*At least one of angina, myocardial infarction at any time, angioplasty/vascular graft.
**At least one of cerebrovascular disease, claudication, ischaemic/neuropathic ulcer, angioplasty/vascular graft, amputation.

Table 15.14: Cox regression survival analysis of the first 90 days of RRT

Variable	p value	Hazard ratio	95% CI
Age	<0.0001	1.1	1.0–1.1
MI in past 3 months	<0.0001	2.2	1.5–3.2
MI more than 3 months ago	0.016	1.4	1.1–1.7
Malignancy	<0.0001	1.9	1.5–2.3
Liver disease	0.0001	2.5	1.6–4.0
Ischaemic/neuropathic ulcers	<0.0001	2.5	1.7–3.5

On multivariate analysis, six factors independently predicted death within the first 90 days (Table 15.14).

Survival 1yr after 90 days of commencing RRT

To allow comparison with data from other national registries, the Registry has also analysed factors associated with survival amongst patients surviving at least 90 days after start of RRT. On univariate analysis (Table 15.15), stratified for age, all categories of vascular disease were associated with an increased risk of death amongst patients starting RRT under the age of 65 years, as was diabetes, COPD, liver disease, and malignancy. Amongst patients starting RRT over the age of 65 years, all of these categories were still significantly associated with an increased risk of death with the exception of diabetes as a cause of ERF, liver disease, and claudication; however, in this age group, smoking was significantly associated with increased risk of death.

Cox regression multivariate analysis (Table 15.16) was performed. The variables considered in the model were: age, angina, MI in previous 3 months, MI more than 3 months ago, coronary artery bypass grafting (CABG)/ angioplasty, liver disease, malignancy, claudication, ischaemic/neuropathic ulcers, angioplasty/vascular graft, amputation, and smoking. Those variables that were found to be significantly important in the model are included in Table 15.16. Recent MI was no longer significantly associated with increased risk of death (presumably because of an association with other cardiovascular markers). Diabetes is a powerful predictor of an increased risk of death after the first 90 days, as expected.

Table 15.15: Univariate analysis, co-morbidity hazards of death by 1 year after 90 days

	Age <65		Age 65+	
Co-morbidity	Hazard ratio	p value	Hazard ratio	p value
Angina	1.8	0.0003	1.2	0.043
Cardiovascular disease*	2.0	<0.0001	1.3	0.003
Vascular disease**	2.6	<0.0001	1.4	0.001
Diabetes (not as cause of ERF)	2.2	0.0004	1.4	0.008
Diabetes as primary disease	2.5	<0.0001	1.1	0.651
Diabetes of either category	2.8	<0.0001	1.2	0.03
COPD	1.8	0.0227	1.4	0.011
Liver disease	2.8	0.0002	1.5	0.152
Malignancy	4.6	<0.0001	1.3	0.05
Claudication	2.3	<0.0001	1.2	0.089
Ischaemic/neuropathic ulcers	3.6	<0.0001	2.2	<0.0001
Smoking	1.3	0.0621	1.3	0.04

*At least one of angina, myocardial infarction at any time, angioplasty/vascular graft
**At least one of cerebrovascular disease, claudication, ischaemic/neuropathic ulcer, angioplasty/vascular graft, amputation

Table 15.16: Cox regression survival analysis for the 1 year after 90 days

Variable	p value	Hazard ratio	95% CI
Age	<0.0001	1.0	1.0–1.1
MI more than 3 months ago	0.002	1.4	1.1–1.7
Smoking	0.026	1.3	1.0–1.5
COPD	0.027	1.3	1.0–1.7
Cerebrovascular disease	0.007	1.3	1.1–1.6
Malignancy	<0.0001	1.8	1.4–2.1
Liver disease	0.004	1.9	1.2–2.9
Ischaemic/neuropathic ulcers	<0.0001	2.2	1.6–2.9
Diabetes of either category	<0.0001	1.5	1.3–1.8

Discussion

Data returns on co-morbidity remain disappointingly incomplete. The data that are available contain few surprises and are similar to findings in previous reports from the Registry. Although there is no reason to suspect that those centres that provide complete or near-complete co-morbidity returns have a different case-mix to those that provide incomplete returns, this remains a possibility, and limits ability to draw detailed conclusions from the data. However, there is no doubt that co-morbidity is an important determinant of the outcome of dialysis, and may contribute to the marked differences in survival of incident patients between centres (Chapter 14).

There are several options for improving the ability of the Registry to obtain reliable and complete data on co-morbidity.

1. Learn from the best: it is intended to find out how those centres that obtain complete or near-complete returns organise this aspect of data collection, in the hope that there may be simple lessons for poor-performing centres that wish to improve their reporting of co-morbidity.
2. Improve motivation: it is clear that a very low priority is given by some Unit Directors for collection of co-morbidity data.
   a. The most powerful motivation to improve reporting of co-morbidity would be to publish de-anonymised survival statistics for each renal unit. This strategy has been used successfully by other Registries (eg those reporting survival after cardiac surgery); Renal units that have lower than average unadjusted survival, in particular, would be motivated to report co-morbidity accurately in the expectation that their survival statistics would compare more favourably with other units' after adjustment for co-morbidity.
   b. It is possible that the Healthcare Commission will be able to exert pressure on renal units via Chief Executives to ensure complete Registry returns.
3. Use alternative or additional sources of data: for instance, it might be possible to obtain data on co-morbidity from NHS Hospital Episode Statistics and in future from the Secondary Use Services function of Connecting for Health.

Of all the comparisons undertaken by the Registry, those on survival are arguably the most important. If there are real differences in survival rates between renal units that remain after adjustment for co-morbidity, it is critically important that these are discovered, acknowledged, and the reasons explored, so that lessons can be learnt about how to reduce these differences. If revealing the identity of individual renal units in survival analyses is the only way to motivate clinicians to report the simple dataset required for assessment of co-morbidity, then it may be time to take this step.

Appendix to Chapter 15

Important changes to co-morbidity definitions in 2003

The non-coronary angioplasty group has been widened to include other vascular grafts and arterial stents. The new definitions are given below:

Angioplasty, stenting, vascular graft, aneurysm (all non-coronary)

This category now includes vascular grafts (eg aortic bifurcation grafts), arterial stents and aneurysms.

Episode of heart failure (right or left) prior to RRT

This is whether or not it was only the result of fluid overload.

Co-morbidity definitions

Angina

A history of chest pain on exercise with or without ECG changes, exercise tolerance test, radionucleotide imaging or angiography.

Previous MI within the past 3 months

The rise and fall of a biomarker (CK, CK-MB or Troponin) together with one of either ischaemic symptoms, pathologic Q waves, ischaemic ECG changes or a coronary intervention. This definition is from both the European Society of Cardiology and the American College of Cardiology.

Previous MI more than 3 months ago

From the time of the start of RRT.

Previous CABG or coronary angioplasty

Episode of heart failure (right or left)

This is whether or not it was only caused by fluid overload.

Cerebrovascular disease

Any history of strokes (of whatever cause) and including transient ischaemic attacks caused by carotid disease.

Diabetes (not causing established renal failure)

This includes diet-controlled diabetics.

Chronic obstructive pulmonary disease

This is defined as a slowly progressive airways disorder characterised by obstruction of the expiratory airflow, which does not change markedly over several months, it may be accompanied by airway hyper-reactivity and may be partially reversible.

N.B. Chronic bronchitis and emphysema may occur in the absence of airflow obstruction. Asthma patients may rarely develop airflow obstruction that does not improve with steroids.

Liver disease

Persistent enzyme evidence of hepatic dysfunction *or* biopsy evidence *or* hepatitis B e antigen or hepatitis C antigen (polymerase chain reaction) positive serology.

Malignancy

Defined as any history of malignancy (even if curative), for example the removal of a melanoma; excludes basal cell carcinoma.

Claudication

Current claudication based on a history, with or without Doppler or angiographic evidence.

Ischaemic/neuropathic ulcers

The current presence of these ulcers.

Angioplasty, stenting, vascular graft, vascular aneurysm (all non-coronary)

This category now includes vascular grafts (eg aortic bifurcation grafts) and renal artery stents.

Amputation for peripheral vascular disease

Smoking

Being a current smoker or having a history of smoking within the previous year.