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UK Renal Registry 18th Annual Report: Chapter 6 Comorbidities and Current Smoking Status amongst Patients starting Renal Replacement Therapy in England, Wales and Northern Ireland from 2013 to 2014

Retha Steenkamp[a], Fergus Caskey[abc]

[a]UK Renal Registry, Bristol, UK; [b]Southmead Hospital, Bristol, UK; [c]School of Social and Community Medicine, University of Bristol, UK

Key Words
Comorbidity · Completeness · Diabetes · Dialysis · Ethnicity · Prevalence · Renal replacement therapy · Smoking

Summary

- Data on comorbidity at the time of start of renal replacement therapy (RRT) were submitted to the UK Renal Registry (UKRR) for 7,786 (58.1%) incident patients between 2013 and 2014. In 2014, 11 centres provided data on 100% of new patients and eight provided data for less than 5% of new patients, highlighting the continued wide variation in the completeness of data returns.
- In 2014, comorbidity data completeness in Wales and Northern Ireland was around 90% compared with 53% in England.
- In patients with comorbidity data, about half (49.8%) had one or more comorbidities and in the subgroup of patients aged ⩾65 years, this increased to 63.1%.
- Diabetes mellitus (listed as primary renal disease or comorbidity) and ischaemic heart disease were the most common comorbid conditions, observed in 36% and 20% of patients respectively. Most comorbid conditions were more prevalent in patients aged ⩾65 years, but the prevalence rates for ischaemic heart disease and malignancy were substantially higher than the rest.
- In 2013–2014, 12.5% of incident RRT patients were recorded as being smokers at initiation of dialysis; this is a decrease from 14% in the previous two years (2011–2012).
- Amongst incident RRT patients of White origin, the prevalence of having at least one comorbid condition was approximately 14% and 7% higher than in incident patients of Black and South Asian origin, respectively.
- There was a higher prevalence of ischaemic heart disease and peripheral vascular disease in patients referred early to a nephrologist than amongst patients referred late. Malignancy was much more common in patients who were referred late.

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Reetha Steenkamp
UK Renal Registry, Southmead Hospital, Southmead Road,
Bristol, BS10 5NB, UK
Email: renalregistry@renalregistry.nhs.uk

Introduction

There is a high prevalence of comorbid disease in patients on RRT and the number and extent of comorbid illnesses in patients initiating dialysis is increasing [1–3]. Demand for RRT is still growing and the proportion of older patients (75+ years) on RRT is on the increase. With the rising median age of RRT patients, there is also a corresponding increase in comorbid conditions in these patients. The mortality risk in RRT patients is higher than in the general population and this risk is affected by pre-existing comorbid conditions at initiation of RRT.

The importance of comorbid conditions as predictors of mortality and other adverse outcomes in patients on RRT is well established in the literature [4–9]. This also applies when comparing survival in different treatment groups at centre [10–12] and international level [13]. The aim of this work is to describe the completeness of comorbidity data submitted to the UKRR and the prevalence of comorbid conditions and current smoking status in patients starting RRT.

Methods

Study population

Incident adult (⩾18 years) RRT patients from 2009 to 2014 in the centres submitting data to the UKRR were considered. Of these, patients who had data recorded on comorbid conditions were included in statistical analyses. Data on completeness of comorbidity returns from each centre and overall may differ from those in previous UKRR reports due to some centres retrospectively entering previously missing comorbidity data.

Centre exclusions

The Scottish Renal Registry (SRR) does not report on comorbidities and the nine centres in Scotland are not included in these analyses. There was concern that data extraction in four centres was inaccurate and these centres were excluded from this year's comorbidity analyses.

Definition of comorbidity and method of data collection

Clinical staff in each centre are responsible for recording in yes/no format on their renal information technology (IT) system the presence or absence of 13 comorbid conditions and information on current smoking (table 6.1) for each patient at the time of starting RRT. Definitions of each of these conditions are given in appendix B (www.renalreg.org/publications-reports/).

Patients were classified as having complete comorbidity data if there was at least one entry (yes/no) for any one or more of the comorbid conditions, excluding smoking. Comorbidities were grouped into broader categories for some analyses:

Table 6.1. Comorbid conditions listed in the UKRR dataset

Comorbid condition
• Angina
• Previous myocardial infarction (MI) within 3 months prior to start of RRT
• Previous MI more than 3 months prior to start of RRT
• Previous coronary artery bypass grafting (CABG) or coronary angioplasty (in some analyses the above four variables are combined under the term 'ischaemic heart disease')
• Cerebrovascular disease
• Diabetes (when not listed as the primary renal disease)
• Chronic obstructive pulmonary disease (COPD)
• Liver disease
• Claudication
• Ischaemic or neuropathic ulcers
• Non-coronary angioplasty, vascular graft, or aneurysm
• Amputation for peripheral vascular disease (in some analyses these four variables are combined under the term 'peripheral vascular disease')
• Smoking
• Malignancy

- 'Ischaemic heart disease' was defined as the presence of one or more of the following conditions: angina, MI in the three months prior to starting RRT, MI more than three months prior to starting RRT or CABG/angioplasty.
- 'Peripheral vascular disease' was defined as the presence of one or more of the following conditions: claudication, ischaemic or neuropathic ulcers, non-coronary angioplasty, vascular graft, aneurysm or amputation for peripheral vascular disease.
- 'Non-coronary vascular disease' was defined as the presence of cerebrovascular disease or any of the data items that comprise 'peripheral vascular disease'.

Specific consideration needs to be made regarding diabetes coding. The UKRR also collect data on primary renal disease (PRD), and have used these data alongside the comorbidity data to determine which patients had diabetes mellitus. The comorbidity screen is intended to capture those patients who have diabetes only when it is not the PRD, however some clinicians do enter 'yes' in the comorbidity field in such cases. Prior to statistical analyses, these fields were examined together to identify these cases and ensure diabetes was only counted as either the PRD or a comorbid condition for a certain individual.

Ethnicity data reporting

Some centres electronically upload ethnicity coding to their renal IT system from the hospital Patient Administration System (PAS) [14]. Ethnicity coding in PAS is based on self-reported ethnicity and uses a different system [14] to the remaining centres where coding of ethnicity is performed by clinical staff and recorded directly into the renal IT system (using a variety of coding systems). For all these analyses, data on ethnic origin were grouped into Whites, South Asians, Blacks and Others.

Appendix H (www.renalreg.org/publications-reports/) details the regrouping of the PAS codes into the above ethnic categories.

Statistical methods

The statistical methods for the two individual sections of this chapter are described separately.

1) Patient demographics

The proportion of patients starting RRT with various comorbidities was examined by age group (18–34, 35–44, 45–54, 55–64, 65–74 and ⩾75 years), primary renal disease, ethnic origin and first modality of RRT. Chi-squared, Fischer's exact and Kruskal-Wallis tests were used as appropriate to test for statistically significant differences between groups.

2) Late presentation (referral) and start of RRT

Referral time was defined as the number of days between the date first seen by a nephrologist and the date of starting RRT. Referral times of 90 or more days and less than 90 days define early and late presentation respectively. Data on referral time were incomplete and therefore only patients with data on comorbidity and referral time from centres with >75% data completeness for referral time were included in this analysis. Many UKRR analyses, including those presented here, rely on the accuracy of the date of start of RRT. A discussion of the issues around the definition of the start date is included in chapter 13 of the 2009 Annual Report [15].

Patient survival

Due to the high proportion of missing comorbidity data, survival analyses have been excluded from this year's annual report. Previous analyses by the UKRR have shown that the subgroup of patients with comorbidity data returned to the UKRR was a select group of patients that had outcomes different to those patients with missing comorbidity data and any subsequent models developed using this subgroup of patients could result in the introduction of bias into model results and possibly invalidate results [16, 17].

All statistical analyses were performed using SAS version 9.3.

Results

Completeness of comorbidity returns from each participating centre

Of the 38,339 patients starting RRT in 2009–2014, only 22,762 (59.4%) had comorbidity reported to the UKRR. Of the 13,390 incident RRT patients in 2013 and 2014, 7,786 individuals (58.1%) had comorbidity data reported (tables 6.2, 6.3). Table 6.2 highlights the continued wide variation in the completeness of data returns with 11 centres providing comorbidity data on 100% of patients and eight centres providing data for less than 5% of new patients in 2014. In 2014, comorbidity completeness in Wales and Northern Ireland was substantially higher (approximately 90%) compared with England (53%) (table 6.2).

When centres with 0% completeness for comorbidity were excluded, the median percentage of comorbidity returns in 2014 was 81.3%; for centres returning comorbidity data there has been an improvement in completeness from 2009 of 8.5% (table 6.3), albeit with a decline in 2012 and in the most recent year (2014).

Table 6.2. Percentage completeness of comorbidity data returns on incident patients from individual renal centres 2009–2014

	Percentage completeness of comorbidity data					
Centre	2009	2010	2011	2012	2013	2014
England						
B Heart	63.6	78.7	94.7	92.1	93.9	99.0
B QEH	66.4	67.9	85.9	93.0	97.5	96.7
Basldn	89.3	91.4	95.5	90.6	100.0	89.1
Bradfd	96.4	92.4	100.0	98.6	98.4	100.0
Brightn	13.8	8.6	12.6	17.3	13.7	11.6
Bristol	86.5	96.4	95.0	89.2	97.7	84.5
Camb	3.0	0.0	0.8	2.4	3.7	4.7
Carlis	85.7	68.2	74.1	57.9	57.1	55.3
Carsh	79.7	73.6	80.7	59.0	30.1	11.4
Chelms	33.3	28.9	22.9	17.4	50.0	92.3
Colchr	4.4	0.0	0.0	0.0	0.0	100.0
Covnt	2.6	3.5	2.7	12.3	39.6	15.2
Derby	96.2	87.3	92.0	96.3	91.9	94.7
Donc	42.5	60.0	64.3	82.9	86.7	70.4
Dorset	90.4	95.8	100.0	94.5	100.0	100.0

Table 6.2. Continued

Centre	Percentage completeness of comorbidity data					
	2009	2010	2011	2012	2013	2014
Dudley	6.0	11.6	4.7	5.4	70.6	87.8
Exeter	47.9	70.5	88.4	100.0	90.0	93.5
Glouc	68.4	47.5	51.7	43.4	52.8	15.7
Hull	84.7	87.2	97.3	99.0	93.4	100.0
Ipswi	2.6	9.1	0.0	4.6	0.0	0.0
Kent	92.1	100.0	100.0	100.0	100.0	100.0
L Barts	86.9	78.5	77.6	77.6	71.0	55.2
L Guys	7.0	3.5	5.0	1.6	2.3	1.9
L Kings	100.0	100.0	98.6	100.0	100.0	100.0
L Rfree	18.3	25.6	35.9	46.0	35.8	22.3
L St.G	60.9	61.2	55.6	45.7	40.5	42.9
L West	3.9	1.9	3.9	2.0	1.0	0.3
Leeds	90.4	91.2	98.1	99.4	99.5	100.0
Leic	69.9	65.4	49.6	64.7	58.8	42.9
Liv Ain	71.1	77.1	63.8	65.1	56.9	56.7
Liv Roy	55.1	42.9	42.3	58.7	64.2	48.2
M RI	65.5	41.5	39.0	33.5	29.0	34.2
Middlbr	93.8	96.0	98.0	97.5	98.2	97.1
Newc	36.1	69.2	85.7	79.6	94.6	97.2
Norwch	23.9	45.9	51.2	41.3	18.2	43.0
Nottm	97.7	96.6	99.1	99.0	99.1	95.5
Oxford	93.7	97.0	98.9	99.4	99.4	95.2
Plymth	84.2	76.8	71.7	67.3	65.6	41.5
Ports	72.8	64.0	65.8	66.7	71.8	26.7
Prestn	50.3	44.3	21.6	11.0	9.3	4.6
Redng	67.0	70.8	84.5	91.8	86.3	92.5
Salford	0.0	0.7	0.0	0.0	0.0	0.0
Sheff	54.7	77.3	77.8	83.3	91.2	78.8
Shrew	89.6	10.5	9.8	13.8	11.9	18.5
Stevng	95.9	0.0	1.8	1.8	0.0	0.7
Sthend	95.7	77.8	86.2	100.0	88.1	76.7
Stoke	100.0	73.7	42.9	58.1	69.5	81.3
Sund	98.4	92.6	100.0	98.6	98.0	95.2
Truro	87.9	84.8	92.3	4.1	0.0	0.0
Wirral	1.6	1.7	5.0	2.3	0.0	30.4
Wolve	100.0	100.0	98.7	98.9	71.4	16.5
York	74.4	97.4	98.0	96.2	97.2	95.3
N Ireland						
Antrim	31.8	94.7	72.4	100.0	93.1	100.0
Belfast	50.9	55.7	50.0	67.7	83.3	77.8
Newry	100.0	95.2	100.0	94.1	100.0	94.7
Ulster	100.0	95.0	97.2	100.0	96.7	100.0
West NI	83.8	81.5	88.6	72.7	80.0	97.1
Wales						
Bangor	83.3	96.2	100.0	81.0	87.5	59.1
Cardff	44.6	57.7	66.7	62.9	83.0	89.9
Clwyd	72.0	71.4	82.4	95.5	100.0	55.2
Swanse	98.2	88.8	96.6	97.4	94.6	100.0
Wrexm	94.7	100.0	100.0	100.0	100.0	100.0
England	**59.2**	**57.1**	**58.8**	**58.8**	**58.2**	**52.8**
N Ireland	**66.7**	**77.3**	**77.0**	**80.0**	**88.6**	**90.7**
Wales	**69.1**	**74.5**	**81.2**	**80.5**	**89.4**	**89.4**
E, W & NI	**59.9**	**58.8**	**60.7**	**60.6**	**60.8**	**55.7**

Table 6.3. Summary of completeness of incident patient comorbidity returns (2009–2014)

	Year						Combined years
	2009	2010	2011	2012	2013	2014	
Renal centres included *N*	62	62	62	62	62	62	
New patients *N*	6,202	6,105	6,303	6,339	6,527	6,863	38,339
Patients with comorbid data entries *N*	3,716	3,591	3,826	3,843	3,965	3,821	22,762
Percentage of patients with comorbid data entries	59.9	58.8	60.7	60.6	60.8	55.7	59.4
Median percentage amongst only centres returning >0% comorbidity	72.8	73.7	79.2	77.6	86.5	81.3	77.8

Table 6.4. Number of reported comorbidities in patients starting RRT, as a percentage of those for whom comorbidity data were available 2013–2014

	Number of comorbidities					
	0	1	2	3	4	5+
Percentage	50.2	26.3	12.6	6.1	3.0	1.8

Prevalence of multiple comorbidity

Including all incident patients from the years 2013–2014 ($N = 13{,}390$), comorbidity data were available for 7,786 (58.1%). About half of these patients had one or more comorbidities (49.8%) (table 6.4), but in the subgroup of patients aged ⩾65 years, this increased to 63.1% (table 6.5).

Frequency of each comorbid condition

Table 6.5 lists the prevalence of specific comorbidities and the percentage of the total number of incident patients for whom data were available for the comorbid condition. Diabetes mellitus (either listed as the cause of PRD or as a comorbidity) and ischaemic heart disease were present in approximately 36% and 20% of patients respectively.

Prevalence of comorbidity by age group

The majority of comorbid conditions were more prevalent in patients 65 years and over and a substantially higher prevalence was evident for ischaemic heart disease and malignancy. The proportion of patients with myocardial infarction within three months prior to start of RRT, ischaemic/neuropathic ulcers and prior amputation were very similar in both younger and older patients, but actual percentages were quite small (table 6.5). Smoking, liver disease and diabetes listed as cause of primary renal disease were more common amongst patients under 65 years of age.

With age categorised in 10–year age groups, the prevalence of most comorbidities has increased markedly in patients across the age groups up to age group 55–64

Table 6.5. Frequency with which each comorbid condition was reported in incident RRT patients 2013–2014

	Age <65 years		Age ⩾65 years		% overall prevalence
Comorbidity	*N*	(%)	*N*	(%)	
Any comorbidity present	1,400	(36.2)	2,477	(63.1)	49.8
Angina	238	(6.3)	568	(14.9)	10.6
MI in past 3 months	60	(1.6)	119	(3.1)	2.4
MI >3 months ago	237	(6.3)	557	(14.7)	10.5
CABG/angioplasty	225	(5.9)	476	(12.4)	9.2
Cerebrovascular disease	318	(8.4)	536	(14.0)	11.2
Diabetes (not listed as PRD)	261	(6.9)	519	(13.5)	10.2
Diabetes listed as PRD	1,079	(28.5)	905	(23.8)	26.1
COPD	167	(4.4)	414	(10.8)	7.6
Liver disease	171	(4.5)	78	(2.0)	3.3
Claudication	126	(3.3)	305	(8.0)	5.7
Ischaemic/neuropathic ulcers	157	(4.1)	134	(3.5)	3.8
Angioplasty/vascular graft	83	(2.2)	215	(5.6)	3.9
Amputation	118	(3.1)	81	(2.1)	2.6
Smoking	546	(14.8)	383	(10.3)	12.5
Malignancy	262	(6.9)	767	(19.9)	13.4

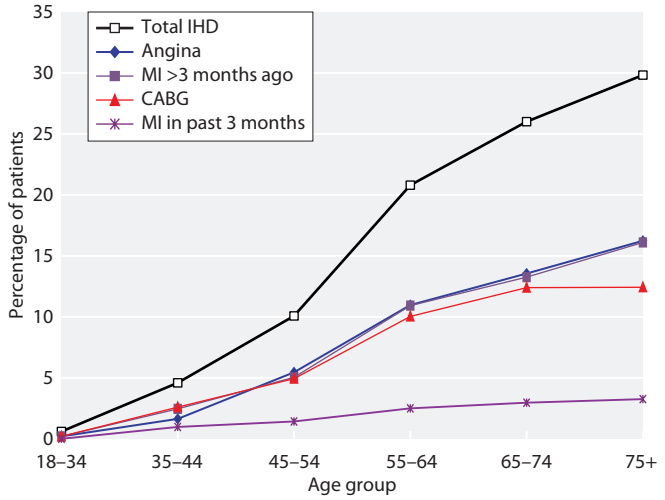

Fig. 6.1. Prevalence of ischaemic heart disease amongst incident patients 2013–2014 by age at start of RRT

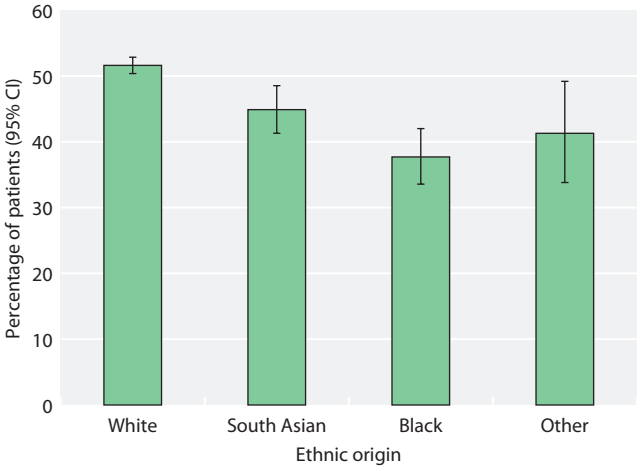

Fig. 6.3. Presence of comorbid conditions at the start of RRT by ethnic origin amongst patients starting RRT 2013–2014

(figures 6.1, 6.2). Ischaemic heart disease (IHD) increased sharply in patients aged 55 years and older and the presence of PVD decreased in patients aged 75 years and older. The prevalence of smoking status and the comorbidities claudication, ischaemic/neuropathic ulcers and amputation have reduced slightly in older patients.

Prevalence of comorbidity by ethnic origin

Figures 6.3 and 6.4 illustrate the presence of comorbidity by ethnic origin and age group. There was evidence that the prevalence of comorbid conditions in patients of White origin was significantly higher than the other ethnic groups. The prevalence of having at least one comorbid condition recorded amongst incident RRT patients of White origin was about 14% and 7% higher respectively than in incident patients from Black and South Asian origin (figure 6.3). Figure 6.4 shows the higher prevalence of comorbid conditions in patients of White origin in the younger and older age groups, with fairly similar prevalence across the ethnic groups for those aged 45–54 and 55–64 (figure 6.4).

Diabetes mellitus as PRD was much more frequently reported in South Asian (44.8%) patients than in White (23.0%) or Black (33.7%) patients. Diabetes as a comorbid condition was more frequently reported in White patients (table 6.6). The reported prevalence of PVD, COPD, malignancy and smoking was highest in individuals of White ethnicity, whereas IHD and cerebrovascular disease were most prevalent in South Asian patients (table 6.6).

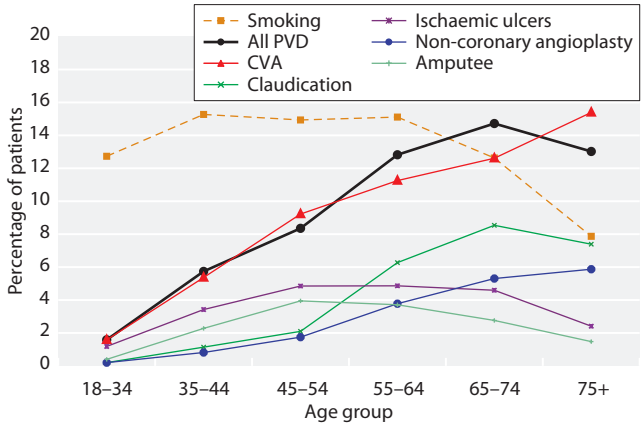

Fig. 6.2. Prevalence of non-coronary vascular disease amongst incident patients 2013–2014 by age at start of RRT

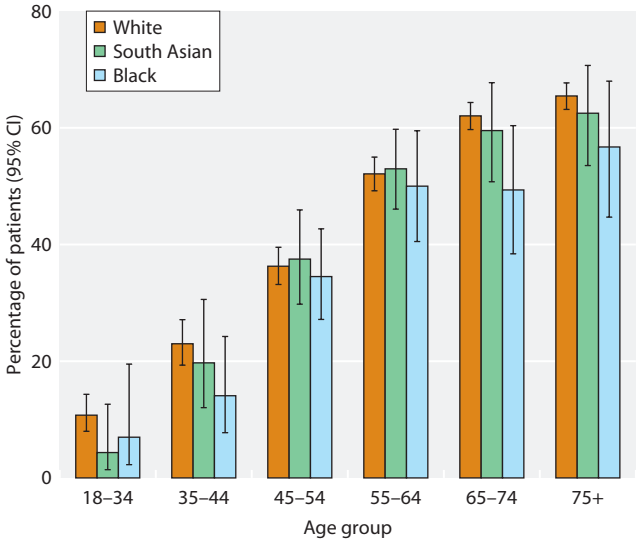

Fig. 6.4. Percentage of patients with comorbidity by ethnic origin in each age group at the start of RRT 2013–2014

Table 6.6. Prevalence of comorbidities amongst incident patients starting RRT 2013–2014 by ethnic group, as percentages of the total number of patients in that ethnic group for whom comorbidity data were available

	White		South Asian		Black		Other	
Comorbidity	*N*	%	*N*	%	*N*	%	*N*	%
Ischaemic heart disease	1,218	(20.2)	189	(26.4)	53	(10.6)	18	(11.8)
Cerebrovascular disease	658	(10.9)	100	(14.0)	56	(11.3)	16	(10.5)
Diabetes (not listed as PRD)	650	(10.7)	69	(9.6)	27	(5.4)	18	(11.8)
Diabetes (listed as PRD)	1,389	(23.0)	320	(44.8)	168	(33.7)	45	(30.2)
COPD	515	(8.5)	36	(5.0)	13	(2.6)	3	(2.0)
Liver disease	187	(3.1)	24	(3.3)	22	(4.4)	12	(7.8)
Peripheral vascular disease	751	(12.5)	36	(5.1)	39	(7.9)	10	(6.7)
Smoking	816	(13.7)	42	(6.1)	40	(8.6)	15	(10.2)
Malignancy	907	(14.9)	35	(4.9)	42	(8.4)	16	(10.5)

Prevalence of comorbidity amongst patients with diabetes mellitus

Table 6.7 describes comorbidity amongst patients with and without diabetes (as either primary renal disease or comorbidity). As would be expected, patients with diabetes mellitus had a higher prevalence of peripheral vascular disease (19.4% compared to 6.2% in non-diabetic patients). Similarly, there was a substantially higher prevalence of ischaemic heart disease (28.3% and 14.8% respectively) and cerebrovascular disease (15.6% and 8.5% respectively) in diabetic patients. Similar proportions of diabetic and non-diabetic patients were smokers and had liver disease at the time of initiation of RRT (table 6.7). Malignancy was much more common in non-diabetic patients and may reflect 'competing risks', with diabetic patients tending to die at a younger age with cardiovascular disease, rather than developing malignancy in older age.

Late presentation and comorbidity

Table 6.8 shows the presentation time for patients with specific comorbidities. In total in 2013–2014, 5,600 patients contributed data to this analysis. Patients referred to a nephrologist early had a higher prevalence of peripheral vascular disease and ischaemic heart disease. There was a much higher proportion of patients with malignancy in the late referral group and more patients with liver disease were also referred late.

Age and comorbidity in patients by treatment modality at start of RRT

Although all comorbidities were more prevalent in patients receiving haemodialysis as their initial modality of treatment than in those starting on peritoneal dialysis (table 6.9), substantial differences were noted for the comorbid conditions angina, cerebrovascular disease, diabetes (not listed as PRD), COPD and malignancy. The median age for incident patients initiating treatment on haemodialysis was substantially higher than those patients starting treatment on peritoneal dialysis (67.5 years and 60.5 years respectively). For patients with a pre-emptive transplant, the median age of patients with comorbidity data was 51.8 years, which was substantially lower than the corresponding age for dialysis patients (66.1 years). For most of the comorbid conditions, the median age of patients on haemodialysis (HD) was

Table 6.7. Number and percentage of patients with and without diabetes (either as primary disease or comorbidity) who have other comorbid conditions, incident patients starting RRT during 2013–2014

	Non-diabetic patients		Diabetic patients	
Comorbidity	*N*	(%)	*N*	(%)
Ischaemic heart disease	667	(14.8)	725	(28.3)
Cerebrovascular disease	382	(8.5)	399	(15.6)
COPD	299	(6.6)	220	(8.6)
Liver disease	145	(3.2)	85	(3.3)
Peripheral vascular disease	280	(6.2)	492	(19.4)
Smoking	548	(12.5)	332	(13.4)
Malignancy	696	(15.4)	245	(9.6)

Table 6.8. Percentage prevalence of specific comorbidities amongst patients presenting late (<90 days) compared with those presenting early (⩾90 days) (2013–2014 incident patients)

	Late referral		Early referral	
Comorbidity	*N*	(%)	*N*	(%)
Ischaemic heart disease	144	14.3	1,104	21.4
Cerebrovascular disease	89	8.8	598	11.5
Peripheral vascular disease	86	8.5	634	12.3
Diabetes (not listed as PRD)	112	11.1	520	10.0
Liver disease	50	5.0	151	2.9
Malignancy	223	21.9	640	12.3
COPD	87	8.6	394	7.6
Smoking	141	13.3	627	11.8

higher than for patients on peritoneal dialysis (PD) (table 6.9). A much lower percentage of the transplanted patients had comorbid conditions present compared to non-transplanted patients (19.6% and 52.0% respectively) (table 6.10). The prevalence of comorbidities was higher in non-transplanted incident patients, especially IHD and cerebrovascular disease. The only exception was liver disease where the prevalence

Table 6.9. Number (and percentage) of incident patients with comorbid conditions starting PD and HD in 2013–2014

	HD			PD		
Comorbidity	*N*	(%)	Median age	*N*	(%)	Median age
Angina	676	(12.3)	72.4	119	(7.6)	68.1
MI in past 3 months	148	(2.7)	70.8	28	(1.8)	70.0
MI >3 months ago	648	(11.8)	72.6	132	(8.4)	68.4
CABG/angioplasty	552	(10.0)	71.0	133	(8.4)	68.9
Cerebrovascular disease	716	(13.0)	70.5	120	(7.6)	66.6
Diabetes (not listed as PRD)	643	(11.6)	70.2	113	(7.1)	68.7
COPD	500	(9.1)	72.1	70	(4.4)	68.4
Liver disease	205	(3.7)	61.2	30	(1.9)	58.2
Claudication	338	(6.1)	72.2	91	(5.7)	68.3
Ischaemic/neuropathic ulcers	237	(4.3)	64.1	50	(3.2)	60.4
Angioplasty/vascular graft	245	(4.4)	73.4	49	(3.1)	67.3
Amputation	159	(2.9)	61.8	37	(2.3)	64.7
Smoking	711	(13.3)	63.2	182	(11.7)	56.8
Malignancy	871	(15.7)	73.8	140	(8.8)	70.0

Table 6.10. Comorbidity amongst incident patients (2013–2014) who underwent transplantation (by the end of 2014) compared to those who remained on dialysis or died

	Not transplanted (HD or PD)			Transplanted		
Comorbidity	*N*	%	Median age	*N*	%	Median age
Patients with comorbidity data	7,255	59.3	66.1	531	46.3	51.8
No comorbidity present	3,482	48.0	59.6	427	80.4	49.9
Ischaemic heart disease	1,495	21.1	71.5	27	5.2	60.7
Cerebrovascular disease	836	11.8	70.0	18	3.4	51.6
Diabetes (not listed as PRD)	756	10.6	70.0	24	4.6	59.8
COPD	570	8.0	71.3	11	2.1	61.3
Liver disease	235	3.3	61.1	14	2.7	60.8
Peripheral vascular disease	847	12.0	69.4	11	2.1	47.1
Smoking	893	12.9	61.6	36	6.9	50.2
Malignancy	1,011	14.2	73.0	18	3.4	57.9

between transplanted and non-transplanted patients was similar.

Discussion

Data completeness in the UKRR and the pattern of missing comorbidity data

Comorbidity data completeness continues to be a cause for concern with overall completeness of comorbidity reporting to the UKRR falling by about 5% in 2014 to 56%. Missing comorbidity data led to difficulties in performing comparisons between renal centres. Research by the UKRR has shown that patients with missing comorbidity data generally have worse survival than those patients without the comorbid condition, indicating that there is a high unmeasured prevalence of comorbid conditions for patients with missing comorbidity data. Some renal IT systems have at times defaulted missing comorbidity data to mean that the comorbid condition was absent. Comorbidity data from these centres were excluded from the annual report and any subsequent statistical analyses. Treating missing comorbidity entries as an indication of the absence of the comorbidity (i.e. a tick only if yes policy) should be discouraged as it is not only impossible to distinguish between missing comorbidity data and the absence of comorbid conditions [16, 17], but also leads to an attenuation of the effect of comorbidity on survival [17]. If the subset of patients with complete comorbidity data is not representative of all incident RRT patients in the UK, then analyses will be biased as comorbidity data are not representing the actual situation in the country accurately and comorbidities will not be comparable at international level [18]. Missing data also hamper case-mix adjustment and can introduce selection bias in model estimates with a resulting lack of generalisability of results. Case-mix adjustment is integral to quality reporting [19, 20], risk adjustment in clinical research [21, 22], resource allocation and management of patients with comorbid conditions in day to day practice [23].

Improving comorbidity data completeness

The first choice for improving comorbidity data completeness would be improving the collection of data by identifying good practice and incentivising it in all renal centres. In addition to this, a separate regular linkage with administrative hospital episodes data in each of the UK countries may be possible in the future, enabling additional information on many prognostic risk factors like comorbid conditions to be obtained. Comorbid conditions identified from administrative hospital episodes data will be used to augment the UKRR comorbidity data where there are missing data in the UKRR database. Currently only comorbidities at start of RRT are collected by the UKRR. A regular data linkage with administrative hospital episodes data would allow the identification of accrued comorbidities after start of RRT. This would be an important area of research as studies have shown that not only comorbidities at start of RRT but also the change in comorbid conditions were associated with outcome [24]. In addition to this, multiple imputation, a statistical approach of handling missing data, may also be implemented. Research by the UKRR has shown that multiple imputation is a viable option for imputing missing data in the UKRR database.

Expansion of comorbidity data collected

From January 2016, renal centres will be expected to expand the collection of comorbidity data by recording comorbidity data continuously from the pre-dialysis stage, not just when the patient starts RRT, which is currently the case. The expansion of comorbidity data collected will greatly improve the understanding of the comorbidity burden in patients before starting RRT and those on treatment for many years and will enhance survival analysis.

It is very important to improve comorbidity data completeness. Robust comorbidity data are central to health care systems, to audit renal centre outcomes adjusted for comorbid conditions and for patient driven decision making based on accurate risks and benefits of health care treatments adjusted for comorbid conditions.

Conflicts of interest: the authors declare no conflicts of interest

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