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UK Renal Registry 19th Annual Report: Chapter 6 Adequacy of Haemodialysis in UK Adult Patients in 2015: National and Centre-specific Analyses

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Adequacy · Haemodialysis · Urea reduction ratio

Summary

- Data regarding the urea reduction ratio (URR) were available for analysis from 63 renal centres in the UK.
- Fifty centres provided URR data on more than 90% of prevalent haemodialysis (HD) patients.
- The proportion of patients in the UK who met the Renal Association clinical practice guideline for URR (>65%) increased from 77.7% in 2002 to 88.1% in 2015.
- There was persistent variation observed between centres, 20 centres attaining the RA clinical practice guideline in >90% of patients and 36 centres attaining the guideline in 70–90% of patients.
- Patients over the age of 70 years achieved a higher median URR (76.0%) compared to younger patients (<70 years, URR 75.0%).
- The overall proportion of prevalent HD patients with a URR >65% has continued to improve over time.
- Whilst the majority of UK patients achieved the target URR there was wide variation between centres in the percentage of patients achieving the current guideline target.

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Introduction

Following the National Co-operative Dialysis Study (NCDS) [1], dialyser urea clearance has been used to assess the amount of dialysis treatment delivered to patients with chronic kidney disease. The most widely accepted measures of dialysis urea clearance are the dimensionless Kt/V urea, the ratio between the product of dialyser urea clearance (K) and dialysis session duration (t) divided by the volume of urea distribution in the body (V) [1] and the urea reduction ratio (URR), the percentage fall in serum urea (URR) following a haemodialysis treatment. URR does not consider ultrafiltration or the size of the patient, and although Kt/V urea takes both into account, both URR and Kt/V urea can over-estimate dialyser urea clearance due to the rebound in serum urea concentration at the end of dialysis, particularly when higher blood pump speeds are used, and if blood sampling does follow approved protocols [2]. Whilst Kt/V provides a better estimate of urea clearance, it requires additional data items not routinely reported by most UK kidney dialysis centres [3, 4]. As such, the UK Renal Registry (UKRR) has historically presented analyses based on URR rather than Kt/V urea for comparative audit of haemodialysis adequacy as these data are more readily available.

Although observational studies have reported that urea dialyser clearance influences patient survival [5, 6], the prospective multicentre Haemodialysis (HEMO) study failed to demonstrate that a higher haemodialysis Kt/V urea target improved survival [7]. Despite debates as to the toxicity of urea, or whether urea clearance equates to the clearance of other azotaemic toxins [8], errors in estimating urea volume of distribution [9], or the effect of energy expenditure [10, 11], clinical guidelines base dialysis dosing on dialyser urea clearance [12–14]. Despite the limited number of randomised prospective trials, there is marked uniformity for the recommendations of the various national and international guideline committees for the minimum amount of dialyser urea clearance, although there are some differences in the methodology advised [12–14]. Table 6.1 lists the current Renal Association (RA) audit measures relevant to haemodialysis patients and whether the audit measure is currently reported in the UKRR annual report [12].

The main objective of this chapter is to examine the extent to which patients with chronic kidney disease treated with haemodialysis (HD) in the UK, received the minimum dose of HD as determined by URR, recommended in the current UK RA clinical practice guidelines [12].

The RA clinical practice guidelines for HD dose apply specifically to patients undergoing thrice weekly HD. In these patients, it is recommended that blood for biochemical measurement (including pre-dialysis urea for URR) should be taken before the mid-week dialysis session [12].

Methods

Seventy renal centres in the UK submitted data electronically to the UKRR on a quarterly basis. Cambridge renal centre (Addenbrooke's) was unable to submit 2015 data at patient level prior to the UKRR closing date for data submission, but provided summary numbers of patients starting RRT by treatment modality. This centre is therefore excluded from most analyses in this chapter.

Table 6.1. Summary of recommended Renal Association audit measures relevant to haemodialysis adequacy

Haemodialysis adequacy RA audit measures	Included in UKRR annual report?	Reason for non-inclusion
The proportion of patients in the main renal unit and its satellite units who are on twice weekly haemodialysis	No	Varying levels of reporting between centres
Cumulative frequency curves of urea reduction ratio measured using a standard method of post-dialysis sampling	Yes, but data not presented in the cumulative frequency format	
The proportion of patient non-attendances for haemodialysis sessions and the proportion of dialysis sessions shortened at the patient's request	No	Data not available
The proportion of thrice weekly haemodialysis sessions which have prescribed treatment times less than 4 hours	Yes	
The proportion of hospital (main and satellite unit) and home haemodialysis patients who are prescribed more frequent than thrice weekly haemodialysis	Partly	Not for home haemodialysis patients

The majority of these centres have satellite units but for the purposes of this study the data from the renal centres and their associated satellite units were amalgamated. Data from two groups of patients were analysed. Firstly, analysis was undertaken using data from the prevalent adult HD patient population as of the 30th September 2015. For this analysis, data for URR were taken from the 3rd quarter of 2015 unless that data point was missing in which case data from the 2nd quarter were taken. The prevalent population only included patients receiving HD who were alive on 30th September 2015. Data from those patients who had died before that date have not been included in the analysis. The second analysis involved adult incident patients who had commenced treatment with HD during 2014. For these patients, analysis was undertaken using the last recorded URR in the quarter in which the patient had started dialysis. The incident HD patient cohort was followed up for one year and the last recorded URR in the quarter after one year follow-up was used for this analysis.

Data from patients known to be receiving more or less than thrice weekly HD were omitted from the analysis for both the incident and prevalent population. Patients who had missing data for the number of dialysis sessions per week, were assumed to be dialysing thrice weekly. However, because not all centres report frequency of HD, it is possible that data from a small number of patients receiving HD at a different frequency were included in the analyses. Home HD patients were excluded from the analysis.

Analyses of the data from both groups of patients included the calculation of the median URR and of the proportion of patients who had achieved the RA guideline (as outlined below) in each of the renal centres, the UK countries as well as for the UK as a whole. The median URR and proportion of patients who achieved the RA guideline were also calculated separately for males and females. The number of dialysis sessions per week and the time per dialysis session is shown by renal centre.

All patients with data were included in the statistical analyses at a national level, although centres with fewer than 20 patients, or providing less than 50% data completeness were excluded from the comparison between centres. The number preceding the centre name in each figure indicates the percentage of missing data for that centre.

The UK RA clinical practice guidelines [12] in operation at the time these data were collected, were as follows:

HD should take place at least three times per week in nearly all patients. Reduction of dialysis frequency to twice per week because of insufficient dialysis facilities is unacceptable.

Every patient receiving thrice weekly HD should have consistently:

- ***either URR >65%***
- ***or equilibrated Kt/V (eKt/V) of >1.2 (or single pool Kt/V of >1.3) calculated from pre- and post-dialysis urea values, duration of dialysis and weight loss during dialysis.***

To achieve a URR above 65% or eKt/V above 1.2 consistently in the vast majority of the HD population clinicians should aim for a minimum target URR of 70% or minimum eKt/V of 1.4 in individual patients.

The duration of thrice weekly HD in adult patients with minimal residual renal function should not be reduced below 4 hours without careful consideration.

Patients receiving HD twice weekly for reasons of geography should receive a higher sessional dose of HD. If this cannot be achieved, then it should be recognised that there is a compromise between the practicalities of HD and the patient's long-term health.

Measurement of the 'dose' or 'adequacy' of HD should be performed monthly in all hospital HD patients and may be performed less frequently in home HD patients. All dialysis units should collect and report this data to their regional network and the UKRR.

Post-dialysis blood samples should be collected either by the slow-flow method, the simplified stop-flow method, or the stop dialysate flow method. The method used should remain consistent within renal units and should be reported to the Registry.

The RA clinical practice guidelines for HD dose apply specifically to patients undergoing thrice weekly HD. In these patients, it is recommended that blood for biochemical measurement (including pre-dialysis urea for URR) should be taken before the mid-week dialysis session [12].

Results

Data completeness

Sixty three of the 71 UK renal centres submitted HD dose (URR) data to the UKRR (table 6.2). Data were available for 72.0% ($N = 14{,}866$) of the total prevalent population ($N = 20{,}653$) treated with HD who met the inclusion criteria for these analyses.

Fifty centres reported URR data on more than 90% of their patients. Seven centres reported URR data on less than 50% of prevalent patients (Brighton, Ipswich, Manchester Royal Infirmary, Newcastle, Reading, Shrewsbury and Sunderland). URR data were not received from eight centres (Cambridge, Carshalton, London St Bartholomew's, London Kings, London Royal Free, London St Georges, Liverpool Aintree and Liverpool Royal Infirmary).

Several centres had a reduction in the completeness of URR data submitted to the UKRR in 2015 compared with 2014, whereas others increased reporting, with an average change of 0.1% (range −99.1 to 99.4%). These changes may have occurred due to changes in computerised data bases and data extraction, or by centres moving to on-line Kt/V, or total Kt/V urea including residual renal urea clearance rather than URR as the preferred measure of haemodialysis dose.

Twelve centres, including all five centres in Wales, did not provide data on frequency of dialysis sessions, and 50 centres provided data on >90% of patients (table 6.3). Twelve centres did not provide data on dialysis session

Table 6.2. Percentage completeness of URR data returns for prevalent patients on HD by centre, on 30/9/2015

Centre	*N*	Percentage completeness	Centre	*N*	Percentage completeness
England					
B Heart	348	99.1	Sheff	471	94.9
B QEH	890	97.3	Shrew	162	1.9
Basldn	133	97.7	Stevng	398	98.5
Bradfd	199	99.0	Sthend	90	100.0
Brightn	352	11.1	Stoke	265	91.3
Bristol	445	100.0	Sund	193	1.6
Camb			Truro	115	85.2
Carlis	74	98.7	Wirral	157	99.4
Carsh	718	0.0	Wolve	273	93.0
Chelms	114	94.7	York	117	100.0
Colchr	111	92.8			
Covnt	320	99.7	**N Ireland**		
Derby	190	96.8	Antrim	107	100.0
Donc	148	98.0	Belfast	154	98.7
Dorset	249	86.4	Newry	74	85.1
Dudley	143	96.5	Ulster	86	100.0
Exeter	360	100.0	West NI	87	98.9
Glouc	208	100.0			
Hull	317	99.4	**Scotland**		
Ipswi	115	0.9	Abrdn	185	100.0
Kent	360	98.3	Airdrie	176	100.0
L Barts	918	0.0	D & Gall	46	97.8
L Guys	535	98.9	Dundee	159	100.0
L Kings	509	0.0	Edinb	241	99.6
L Rfree	652	0.0	Glasgw	512	99.4
L St.G	303	0.0	Inverns	64	98.4
L West	1,332	88.7	Klmarnk	123	100.0
Leeds	424	100.0	Krkcldy	139	99.3
Leic	783	99.0			
Liv Ain	141	0.0	**Wales**		
Liv Roy	274	0.0	Bangor	67	100.0
M RI	429	2.6	Cardff	428	100.0
Middlbr	303	100.0	Clwyd	70	100.0
Newc	255	15.3	Swanse	304	99.7
Norwch	277	98.2	Wrexm	97	100.0
Nottm	316	91.1			
Oxford	389	98.2	**England**	**17,534**	**67.1**
Plymth	120	95.0	**N Ireland**	**508**	**97.2**
Ports	491	99.0	**Scotland**	**1,645**	**99.6**
Prestn	485	80.0	**Wales**	**966**	**99.9**
Redng	275	10.6	**UK**	**20,653**	**72.0**
Salford	288	69.8			

Blank cells denote no data returned by the centre

times, and 45 centres provided data on >90% of patients (table 6.4).

Of the total incident patient population ($N = 4,591$) who started HD during 2014 and meeting the inclusion criteria for URR analyses, 43% ($N = 1,976$) had URR data available during the first quarter of treatment (data not shown). Ten centres did not provide data for the first quarter of treatment, and 42 centres provided data on >90% of incident patients during the first year.

Achieved URR

The median URR for prevalent HD patients was 75%, but ranged between centres from 70–83% (figure 6.1a). There was evidence that the median URR for female

Table 6.3. Number of dialysis sessions for prevalent patients on HD by centre, on 30/9/2015

Centre	*N*	Percentage completeness	Percentage		
			<3 sessions	3 sessions	>3 sessions
England					
B Heart	389	77.9	11.6	86.5	2.0
B QEH	890	0.0			
Basldn	141	97.2	0.0	94.2	5.8
Bradfd	210	99.5	5.3	94.7	0.0
Brightn	355	99.4	0.6	99.2	0.3
Bristol	465	100.0	3.2	95.7	1.1
Camb					
Carlis	75	93.3	1.4	98.6	0.0
Carsh	726	99.6	0.6	98.9	0.6
Chelms	131	97.7	11.7	86.7	1.6
Colchr	111	100.0	0.0	100.0	0.0
Covnt	320	1.9			
Derby	190	52.6	0.0	100.0	0.0
Donc	149	94.6	0.7	99.3	0.0
Dorset	260	99.6	3.9	95.8	0.4
Dudley	146	98.6	2.1	97.9	0.0
Exeter	383	99.7	4.2	94.0	1.8
Glouc	208	0.0			
Hull	317	1.0			
Ipswi	123	100.0	6.5	93.5	0.0
Kent	371	98.4	2.2	97.0	0.8
L Barts	918	0.0			
L Guys	576	97.9	4.1	92.7	3.2
L Kings	509	100.0	0.0	100.0	0.0
L Rfree	652	0.0			
L St.G	305	92.5	0.7	99.3	0.0
L West	1,342	55.4	0.9	98.7	0.4
Leeds	456	99.8	6.4	93.0	0.7
Leic	792	98.5	1.2	98.8	0.0
Liv Ain	147	97.3	0.7	95.8	3.5
Liv Roy	318	98.4	0.3	85.9	13.7
M RI	431	23.9			
Middlbr	304	21.7			
Newc	261	100.0	1.1	97.7	1.1
Norwch	284	99.7	1.4	97.5	1.1
Nottm	335	100.0	0.3	94.3	5.4
Oxford	389	99.2	0.0	100.0	0.0
Plymth	120	0.0			
Ports	545	98.2	6.4	89.9	3.7
Prestn	485	0.0			
Redng	277	98.2	0.4	99.3	0.4
Salford	347	99.7	1.7	82.9	15.3
Sheff	486	99.2	3.1	96.9	0.0
Shrew	177	100.0	5.1	91.5	3.4
Stevng	428	99.5	4.7	93.0	2.3
Sthend	105	100.0	14.3	85.7	0.0
Stoke	278	98.2	1.5	95.2	3.3
Sund	205	98.5	0.0	94.1	5.9
Truro	135	92.6	13.6	84.0	2.4
Wirral	169	96.5	0.6	92.6	6.7
Wolve	273	8.8			
York	129	99.2	0.8	90.6	8.6

Table 6.3. Continued

Centre	*N*	Percentage completeness	Percentage		
			<3 sessions	3 sessions	>3 sessions
N Ireland					
Antrim	108	98.2	0.0	99.1	0.9
Belfast	162	100.0	0.6	95.1	4.3
Newry	79	100.0	6.3	93.7	0.0
Ulster	90	100.0	2.2	95.6	2.2
West NI	101	100.0	2.0	86.1	11.9
Scotland					
Abrdn	196	96.9	1.1	94.2	4.7
Airdrie	177	94.9	0.6	99.4	0.0
D & Gall	47	100.0	0.0	97.9	2.1
Dundee	162	98.2	0.0	98.1	1.9
Edinb	248	98.8	0.8	97.1	2.0
Glasgw	516	94.2	0.4	99.2	0.4
Inverns	70	87.1	0.0	90.2	9.8
Klmarnk	123	97.6	0.0	100.0	0.0
Krkcldy	142	94.4	1.5	97.8	0.7
Wales					
Bangor	67	0.0			
Cardff	428	0.0			
Clwyd	70	0.0			
Swanse	304	0.0			
Wrexm	97	0.0			
England	**18,138**	**68.9**	**2.7**	**95.2**	**2.2**
N Ireland	**540**	**99.6**	**1.9**	**94.1**	**4.1**
Scotland	**1,681**	**95.8**	**0.6**	**97.8**	**1.7**
Wales	**966**	**0.0**			
UK	**21,325**	**68.7**	**2.4**	**95.4**	**2.2**

Blank cells denote no data returned by the centre

HD patients at 78% (centre range 72.0–86.5%) (figure 6.1b) was significantly greater than that of male HD patients, with a median URR at 74% (centre range 68–80%) (figure 6.1c).

The median sessional URR was lower for patients aged <70 years (median 75%) compared to older patients (⩾70 years, median 76%), and there was evidence that this difference was significant. Similarly, the median sessional URR was lower for both genders in the younger age group (<70 years) compared to the older age group (⩾70 years of age): median URR of 77% for females <70 years of age compared to a median URR of 78% for female patients aged ⩾70 years. Similarly, for male patients aged <70 years of age the median URR of 73.0% was lower than for male patients aged ⩾70 years (median URR 74.3%).

The current UK RA clinical guideline target is to achieve a minimum sessional URR of 65%, and this was achieved in 88.1% of HD prevalent patients (centre range 73.5–97.3%) (figure 6.2). Again, more female patients achieved this minimum target (92.3%, centre range 83.9–100.0%) compared to male patients (85.5%, centre range 63.4–96.5%) and there was evidence that this difference was significant.

Changes in URR over time

From 2002 there was an initial progressive increase in the percentage of patients achieving the current RA clinical practice guidelines (URR >65%) until 2011, after which there has been a plateau (figure 6.3). Similarly, the median URR in UK haemodialysis patients has risen from 71% to 75% during the same time period,

Table 6.4. Time per dialysis session for prevalent patients on HD by centre, on 30/9/2015

Centre	*N*	Percentage completeness	Percentage per dialysis session		
			<4 hours	4–5 hours	>5 hours
England					
B Heart	348	70.4	11.8	87.8	0.4
B QEH	890	0.0			
Basldn	133	97.0	38.0	61.2	0.8
Bradfd	199	98.0	25.1	74.9	0.0
Brightn	352	99.4	6.6	93.4	0.0
Bristol	445	100.0	20.0	80.0	0.0
Camb					
Carlis	74	93.2	11.6	88.4	0.0
Carsh	718	96.9	10.2	89.5	0.3
Chelms	114	97.4	40.5	59.5	0.0
Colchr	111	100.0	2.7	97.3	0.0
Covnt	320	3.8			
Derby	190	52.6	2.0	98.0	0.0
Donc	148	94.6	28.6	71.4	0.0
Dorset	249	100.0	10.8	89.2	0.0
Dudley	143	98.6	9.9	90.1	0.0
Exeter	360	100.0	48.9	51.1	0.0
Glouc	208	0.0			
Hull	317	2.2			
Ipswi	115	93.0	3.7	96.3	0.0
Kent	360	100.0	57.8	41.9	0.3
L Barts	918	0.0			
L Guys	535	90.8	19.5	80.0	0.4
L Kings	509	100.0	47.3	52.7	0.0
L Rfree	652	0.0			
L St.G	303	80.5	3.3	96.7	0.0
L West	1,332	55.8	16.4	82.1	1.5
Leeds	424	100.0	23.6	76.2	0.2
Leic	783	81.6	11.3	86.5	2.2
Liv Ain	141	98.6	27.3	72.7	0.0
Liv Roy	274	99.6	9.5	90.1	0.4
M RI	429	23.5			
Middlbr	303	99.7	38.1	61.9	0.0
Newc	255	100.0	10.2	87.8	2.0
Norwch	277	99.6	60.1	39.9	0.0
Nottm	316	100.0	9.2	90.8	0.0
Oxford	389	99.2	29.3	70.5	0.3
Plymth	120	0.0			
Ports	491	0.0			
Prestn	485	0.4			
Redng	275	96.4	13.2	86.8	0.0
Salford	288	97.2	22.9	77.1	0.0
Sheff	471	83.2	88.0	11.5	0.5
Shrew	162	99.4	52.2	47.2	0.6
Stevng	398	100.0	67.6	32.4	0.0
Sthend	90	100.0	45.6	54.4	0.0
Stoke	265	100.0	13.2	86.8	0.0
Sund	193	81.9	17.7	82.3	0.0
Truro	115	96.5	60.4	39.6	0.0
Wirral	157	100.0	24.8	74.5	0.6
Wolve	273	8.8			
York	117	98.3	7.0	93.0	0.0

Table 6.4. Continued

Centre	*N*	Percentage completeness	Percentage per dialysis session		
			<4 hours	4–5 hours	>5 hours
N Ireland					
Antrim	107	98.1	13.3	86.7	0.0
Belfast	154	100.0	16.2	83.8	0.0
Newry	74	100.0	44.6	55.4	0.0
Ulster	86	100.0	17.4	82.6	0.0
West NI	87	100.0	57.5	42.5	0.0
Scotland					
Abrdn	185	96.2	2.8	94.9	2.2
Airdrie	176	96.6	14.7	83.5	1.8
D & Gall	46	89.1	9.8	90.2	0.0
Dundee	159	98.1	13.5	86.5	0.0
Edinb	241	98.8	34.0	66.0	0.0
Glasgw	512	95.7	5.7	90.4	3.9
Inverns	64	85.9	23.6	76.4	0.0
Klmarnk	123	97.6	0.8	93.3	5.8
Krkcldy	139	94.2	30.5	68.7	0.8
Wales					
Bangor	67	0.0			
Cardff	428	0.0			
Clwyd	70	0.0			
Swanse	304	0.0			
Wrexm	97	0.0			
England	**17,534**	**64.7**	**26.7**	**72.9**	**0.4**
N Ireland	**508**	**99.6**	**27.1**	**72.9**	**0.0**
Scotland	**1,645**	**96.0**	**13.8**	**84.0**	**2.2**
Wales	**966**	**0.0**			
UK	**20,653**	**65.0**	**25.2**	**74.2**	**0.6**

Blank cells denote no data returned by the centre, <20 patients in the renal centre or data completeness was <50%

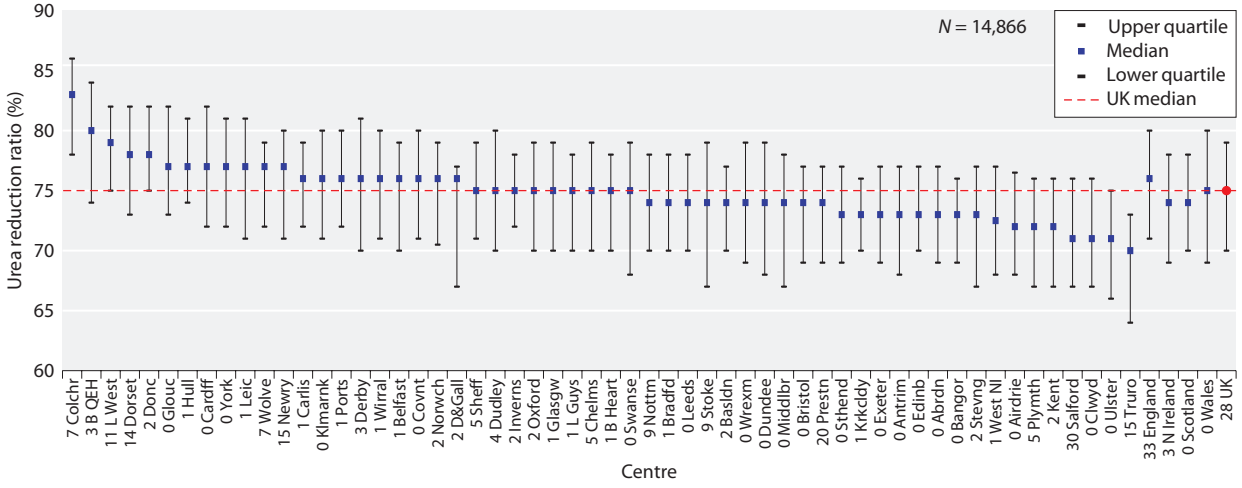

Fig. 6.1a. Median URR achieved in prevalent patients on HD by centre, 30/9/2015

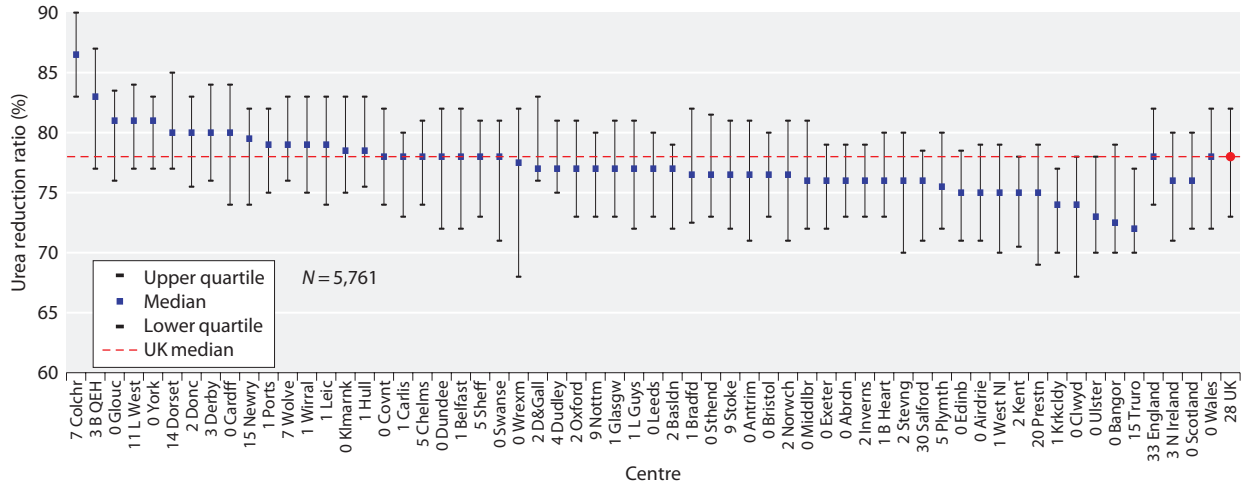

Fig. 6.1b. Median URR achieved in female prevalent patients on HD by centre, 30/9/2015

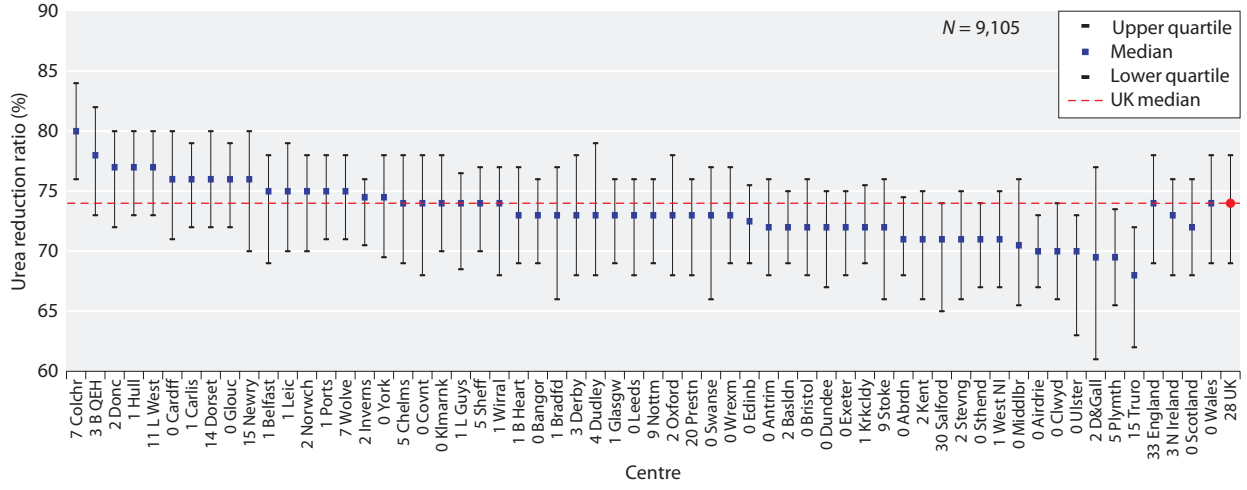

Fig. 6.1c. Median URR achieved in male prevalent patients on HD by centre, 30/9/2015

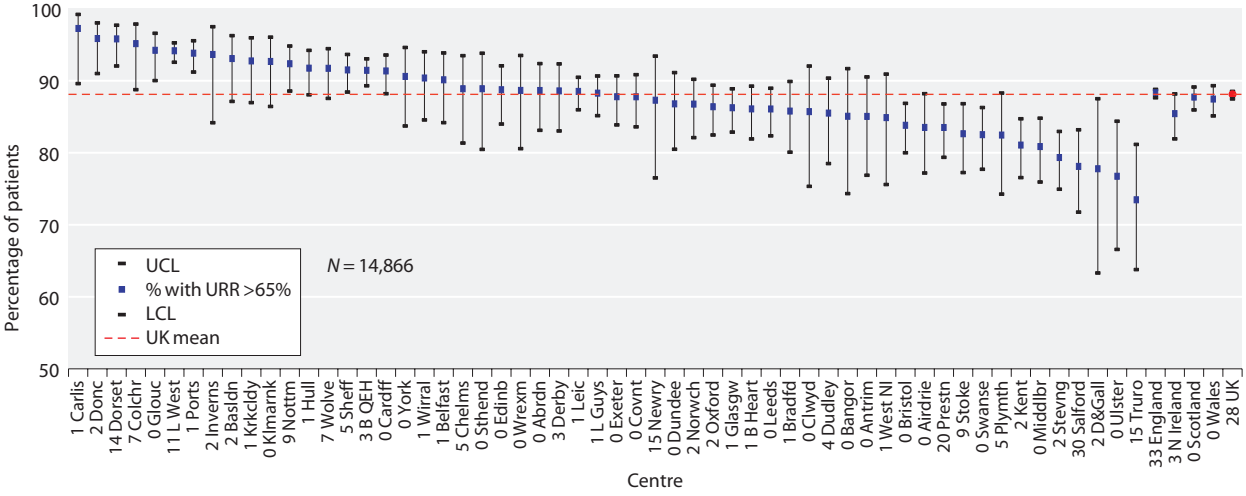

Fig. 6.2. Percentage of prevalent patients on HD with URR >65% by centre, 30/9/2015

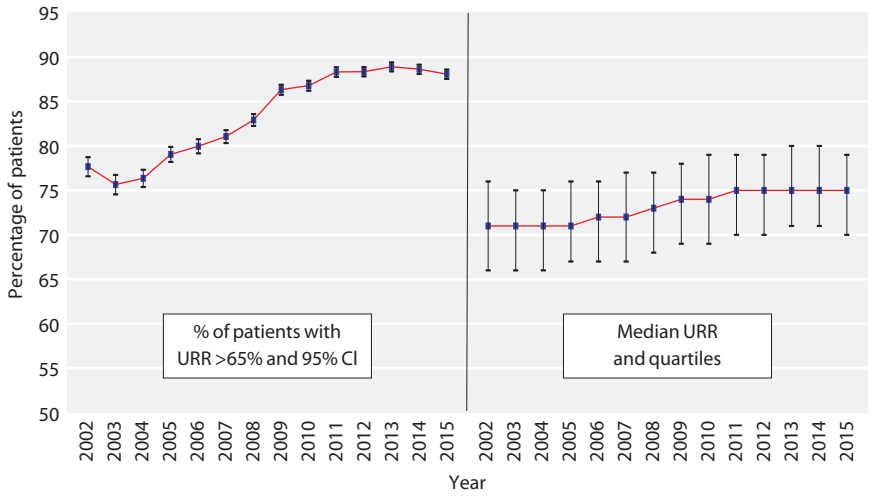

Fig. 6.3. Change in the percentage of prevalent patients on HD with URR >65% and the median URR between 2002 and 2015

with no substantial change in the median sessional URR from 2011.

Variation of achieved URR with time on dialysis

The proportion of patients who attained the UK RA clinical guideline for URR was greater for those who had been treated by haemodialysis for two years or longer compared to those who had been dialysing for <6 months (figure 6.4). For all strata of dialysis vintage, there has been an improvement in the proportion of patients receiving the sessional target dose of haemodialysis over the last 13 years, with the greatest increase in those dialysing for <6 months where the proportion of patients achieving the URR target increased from 54% to 75% from 2002 to 2015.

Changes in URR for incident patients

The median sessional URR during the first quarter after starting haemodialysis treatment in the UK was 68.0% (centre range 57.0–75.0%) (figure 6.5a) for incident HD patients in 2014. At the end of one year follow-up, the median URR had significantly increased to 74.0% (centre range 69.0–80.0%) (figure 6.5b).

There was evidence that the median sessional URR during the first three months after starting haemodialysis was significantly lower for patients aged <70 years (median URR 67.0%) compared to patients older than ⩾70 years (median URR 69.0%). Similarly, at the end of the first year of haemodialysis the median sessional URR was again lower for patients aged <70 years (median URR 73.0%) vs ⩾70 years of age (median URR 75.0%).

Haemodialysis session duration for prevalent HD patients

For those centres which returned data, the vast majority of prevalent patients (74.2%) dialysed between 4–5 hours, with 25.2% dialysing <4 hours per session, and only 0.6% dialysing for more than 5 hours (table 6.4). Median URR was similar for patients dialysing longer (⩾4 hours) vs shorter dialysis sessions (<4 hours).

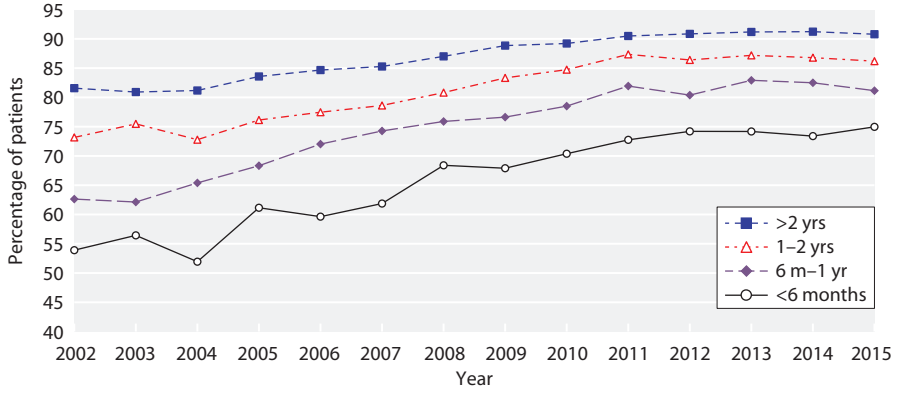

Fig. 6.4. Percentage of prevalent patients on HD achieving URR >65% by time on RRT between 2002 and 2015

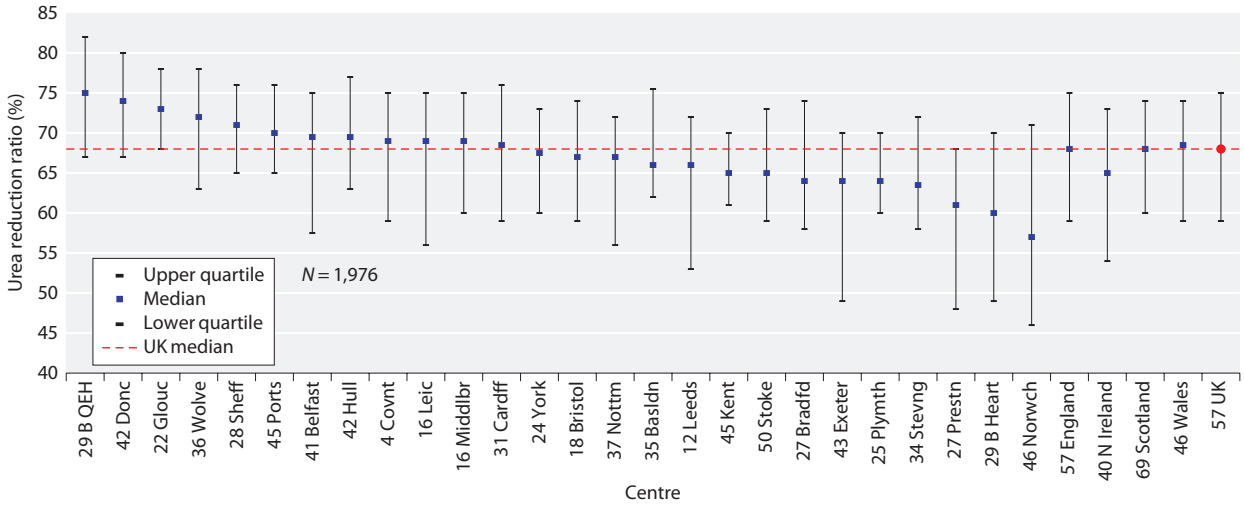

Fig. 6.5a. Median URR in the first quarter of starting RRT in incident patients who started HD in 2014

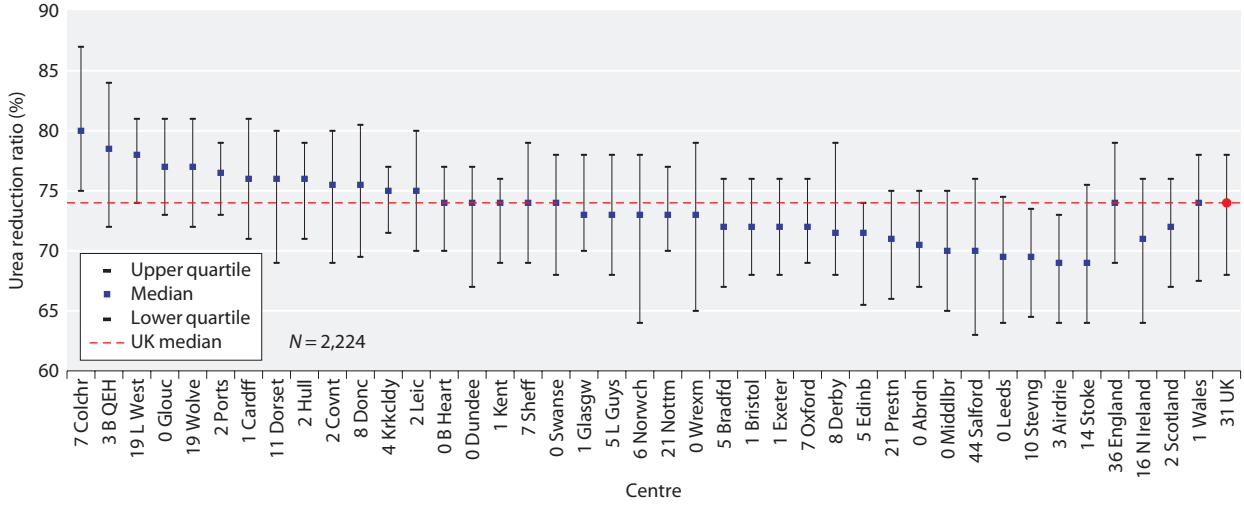

Fig. 6.5b. Median URR one year after starting RRT for incident patients who started HD in 2014

Haemodialysis session frequency for prevalent HD patients

Dialysis frequency data was available for 68.7% of patients (table 6.3). Although 95.4% of all prevalent haemodialysis patients dialysed thrice weekly, 2.4% dialysed less frequently and 2.2% more than thrice weekly, there were marked differences in centre practices. Centres reported dialysing between 0–14.3% of patients twice weekly or less, and between 0–15.3% more than thrice weekly. Four centres reported dialysing >10% of patients less than thrice weekly and three centres more often than thrice weekly. There was little evidence that sessional URR differed with dialysis frequency (median URR 74.0% for prevalent HD patients dialysising <3 times per week versus a median URR of 75.0% for patients dialysing ⩾3 times per week.

Discussion

The original NCDS trial studying different low flux dialyser urea clearance targets, recruited a much younger and less comorbid cohort of patients than currently dialysing in UK centres [1]. That trial showed no difference in one year mortality, but more patients dropped out of the trial with lower sessional dialyser urea clearances possibly affecting the results [1]. As such, patient well-being appears to depend on achieving a minimum

dialyser urea clearance target, but it remains unclear as to whether higher dialyser urea clearance targets increase patient survival [3, 5–7].

The current UK RA clinical guidelines recommend a minimum dialyser urea clearance of >66% [12], in keeping with many other international guideline recommendations [13, 14]. It is reassuring that the proportion of UK haemodialysis patients achieving this target URR has increased from 2002, with now more than 88% of the prevalent HD population achieving the guideline target in 2015. This improvement in delivered dialysis dose reflects improvements in not only clinical practice and haemodialysis technology [15], but also enhanced coverage and quality of the data collected by the UKRR from renal centres over time.

Observational studies and post hoc analyses of the HEMO study and observational studies have suggested that women may benefit from a greater dialyser urea clearance than men [16, 17]. Neither UK RA nor other clinical guidelines advocate different targets based on gender [12]. Typically, women are smaller than men and have lower dietary intakes, as such serum urea concentrations are lower, and as such less dialyser urea clearance is required to achieve a similar URR compared to a larger male. However, this effect of an over estimation of delivered dialysis dose also applies to Kt/V urea [18, 19]. Although women may be smaller and have a different body composition to men, they have a relatively greater resting energy expenditure [10, 20], and as such it has been suggested to adjust dialyser urea clearance for body surface area rather than body water [21]. It is therefore reassuring that in the UK, the median sessional URR was higher for women than men.

Previous studies have not investigated whether urea dialyser clearance targets should be adjusted for age. Over the last fifteen years the average age of patients dialysing in UK dialysis centres has steadily increased. It was found that the sessional urea clearance delivered to older prevalent patients was greater than that for younger patients. Body composition changes with age as muscle mass declines [22], and as such both resting and total energy expenditure tend to decline with age along with dietary intake [10]. As such it would be expected that younger more active patients would require greater clearances than older patients. Although the results paradoxically suggest lower clearances delivered to younger patients, these results may be confounded by higher pre-dialysis serum urea values in the younger patients, and differences in body composition [23, 24].

A difference between centres in achieving the URR sessional urea clearance target of >65% for prevalent HD patients, ranging from 73.5–97.3% of patients was noted. This is most likely to reflect genuine differences in patient mix between centres and centre level clinical practice. As such, understanding differences in patient populations (inner city compared to rural, ethnicity, age, comorbidity and centre practices including incremental approaches to dialysis [25], vascular access, and use of high flux dialysis and haemodiafiltration [26]) are important in understanding variation between centres.

Reimbursement for haemodialysis changed some years ago to payment per session to encourage the delivery of more frequent dialysis compared to the thrice weekly paradigm [27]. Despite financial encouragement to provide more frequent dialysis, most UK centres continue to provide thrice weekly dialysis to the clear majority of patients, although three of 71 (4.2%) centres now provide more frequent dialysis schedules to more than 10% of their prevalent HD patients, and nine centres (12.7%) treat >5% of patients with more frequent dialysis.

Interestingly, sessional URR was not significantly lower for more frequent dialysis compared to thrice weekly dialysis. However, as only 2.2% of patients dialysed more frequently it is unclear as to whether UK dialysis centres alter dialysis times when dialysing patients more frequently [28]. On the other hand, between 0–14.3% patients in different dialysis centres dialyse less than thrice weekly. Not all UK dialysis centres measure residual renal function on a regular basis, and the question arises as to whether this difference in practice reflects differences in centre practices in terms of measuring residual renal function and adding this clearance to dialyser clearance [29].

The great majority of prevalent patients dialysed between 4–5 hours, with 25.2% dialysing for shorter times (<4 hours) and 0.6% dialysing for longer (>5 hours). Again, centre practices showed marked differences, with a wide range (0.8–88.0%) of patients dialysing for less than four hours. Twenty-seven of the 55 centres that provided data on time dialysed (49.1%), dialysed >20% of patients for <4 hours. The median URR was similar whether patients dialysed for four hours or more, or less than four hours, suggesting potential differences in centre practices in terms of blood pump speeds, dialysate flow rates and dialyser surface area. However the differences in centre practices, in terms of shorter dialysis session times and reduced frequency of dialysis sessions, may additionally reflect some centres taking

into account residual renal function, centres reducing the amount of dialysis delivered to the elderly, but equally may also be due to the limitation of the provision of haemodialysis services, and these fundamental differences in centre practices require further investigation.

Most patients initiating HD have residual renal function, and as such some centres practice an incremental approach to patients starting HD [30]. Sessional URR increased with dialysis vintage in the incident patient group, with the median URR ranging from 57–75% between centres during the first three months of dialysis, which then increased to 69–80% after 12 months, suggesting that most UK centres practised some form of incremental dialysis, increasing dialysis session clearance as residual renal function declined. Observational studies have reported that preservation of residual renal function is associated with improved survival [31], however maintaining patients overhydrated on the basis that this may preserve residual renal function does not appear to sustain residual renal function [32], and indeed may potentially increase cardiovascular mortality. As most of the UK centres do not regularly measure residual renal function, the authors are unable to comment on differences in centre practices to initiating dialysis and outcomes.

How much individualisation of dialysis prescription based on residual renal function is practiced across UK renal centres remains to be determined. More importantly, studies are required to determine whether preservation of residual renal function improves patient survival. Similarly, there is a need to establish whether centre dialysis practices affect loss of residual renal function. Incompleteness of data returns by all centres, including dialysis session information and other important factors limits the interpretation of the data.

Although there is debate as to the relative toxicity of urea, and how representative urea clearance is of other azotaemic toxin clearances [8], dialyser urea clearance remains the standard for dialysis dosing. Other factors need to be considered, as the dialysis prescription should also include volume control, sodium and divalent cation balance and correction of metabolic acidosis. As such, using sessional dialyser urea clearance dose based simply on urea clearance has been criticised by some [17, 18], arguing that patient survival can be improved by longer sessional times [33, 34] and that clearance of 'middle molecules' have an important impact [35, 36]. However, no consensus has yet emerged on alternative markers of HD adequacy [37]. The UKRR has historically reported URR, predominantly for logistical reasons with the URR being the easiest measure to calculate, and the measure of dialysis adequacy that is most complete when returned to the UKRR. However, limitations of the URR must be recognised.

The new UKRR dataset, distributed to renal centres, should help contribute to further improvements in both URR data capture, as well as Kt/V reporting in addition to data on dialysis prescription practice.

Conflicts of interest: the authors declare no conflicts of interest

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