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UK Renal Registry 20th Annual Report: Chapter 6 Adequacy of Haemodialysis in UK Adult Patients in 2016: National and Centre-specific Analyses

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Keywords
Adequacy · Haemodialysis · Urea reduction ratio

Summary

- Data regarding the urea reduction ratio (URR) were available for analysis from 63 renal centres and 74% of the prevalent haemodialysis (HD) population in the UK.
- Fifty-one centres provided URR data on more than 90% of prevalent HD patients.
- The proportion of patients in the UK who met the Renal Association (RA) clinical practice guideline for URR (>65%) has been stable between 88–89% since 2011.
- The median URR has been stable over the same period (75%).
- There was persistent variation observed between centres, 15 centres attaining the RA clinical practice guideline in >90% of patients and 42 centres attaining the guideline in 70–90% of patients.
- Over 95% of the prevalent HD population received dialysis three times a week but 26% did less than four hours per session.
- Median URR was similar between patients irrespective of dialysis session duration.

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Introduction

Measures of dialyser urea clearance have been the basis for assessing dialysis adequacy since the National Co-operative Dialysis Study (NCDS) [1]. Observational studies have shown that the minimum amount of dialysis a patient receives affects mortality although higher urea clearance targets in randomised clinical trials have not been shown to improve survival [2–4]. Of the two commonly used measures of dialyser urea clearance, the UK Renal Registry (UKRR) has historically reported the urea reduction ratio (URR), the percentage fall in serum urea following a mid-week dialysis session. Whilst the alternative Kt/V is a better method for measuring dialysis dose because it takes account of the size of a patient and urea removal by ultrafiltration, it requires data items not routinely collected by all UK renal centres [5–6]. URR is the most commonly used measure of urea clearance in dialysis centres in Europe in daily practice [7] and predicts minimum dialysis dose in the majority of patients consistently with Kt/V [8]. Both measures can be influenced by failure to adhere to standardised sampling techniques and by urea rebound at the end of dialysis [9, 10].

The direct toxicity of urea and the extent to which dialyser urea clearance reflects the removal of other azotaemic toxins which may have greater impact on patient outcomes remains under debate. Increasing use of alternative dialysis regimens to the paradigm of thrice weekly short dialysis sessions upon which urea clearance models were developed may further challenge their validity as measures of dialysis adequacy in the future [11]. Despite such uncertainties, measures of urea clearance currently remain the basis for assessing dialysis adequacy in international guidelines which remain remarkably uniform in the minimum recommended amounts of dialyser urea clearance [12–14].

The UK Renal Registry (UKRR) collects data on patients with established renal failure (ERF) receiving haemodialysis (HD) from renal centres in England, Wales and Northern Ireland as well as from Scotland via the Scottish Renal Registry. This enables UK renal centres to compare performance to each other, to the national average and to the attainment of the minimum dose of HD, as defined by URR, in the Renal Association (RA) guidelines on dialysis adequacy.

Table 6.1 lists the current Renal Association audit measures relevant to haemodialysis patients and whether the audit measure is currently reported in the UKRR annual report [12]. Updated RA haemodialysis guidelines are due to be published in 2018.

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].

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

Haemodialysis adequacy RA audit measure	Included in UKRR annual report?	Reason for non-inclusion
The proportion of patients in the main renal centre and its satellite units who are on twice weekly haemodialysis	Partly	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 four 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

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 and 2016 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. The majority of UK 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 30 September 2016. The UKRR electronically receive quarterly data extracts with the latest available result for each quarter, from renal centres in England, Wales and Northern Ireland (E,W&NI). Data from Scotland were provided by the Scottish Renal Registry (SRR). For this analysis, data for URR were taken from the 3rd quarter of 2016 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 September 30 2016. 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 2015. 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.

From 2015, quarterly HD sessional data as specified in version 4.2 of the UKRR renal dataset were increasingly being returned by many renal centres. It is hoped that in future, the number of dialysis sessions per week and time per dialysis session data can be augmented using these data items. Two centres, London Guys and Stevenage only returned these data items within the HD sessional data; hence data for these items were fully retrieved from the HD sessional data. However, the quality of the sessional data varied across centres and therefore was not used to augment quarterly data for the remaining centres at this time.

Data from patients known to be receiving more than 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 ten 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].

The data were analysed using SAS 9.3.

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 73.7% ($N = 15{,}501$) of the total prevalent population ($N = 21{,}041$) treated with HD who met the inclusion criteria for these analyses.

Fifty-one centres reported URR data on more than 90% of their patients. Six centres reported URR data on less than 50% of prevalent patients (Carshalton,

Table 6.2. Percentage completeness of URR data returns for prevalent patients on HD by centre, on 30/9/2016

Centre	*N*	% completeness	Centre	*N*	% completeness
England					
B Heart	333	99.7	Sheff	497	94.2
B QEH	884	99.7	Shrew	165	1.2
Basldn	134	96.3	Stevng	399	98.5
Bradfd	214	99.5	Sthend	87	98.9
Brightn	374	99.5	Stoke	279	93.9
Bristol	441	100.0	Sund	199	1.5
Camb	0	0.0	Truro	132	89.4
Carlis	86	100.0	Wirral	146	96.6
Carsh	745	0.3	Wolve	270	88.2
Chelms	110	94.6	York	151	100.0
Colchr	113	92.9			
Covnt	338	96.2	**N Ireland**		
Derby	181	99.5	Antrim	111	96.4
Donc	171	95.9	Belfast	161	98.8
Dorset	254	91.7	Newry	69	79.7
Dudley	162	95.7	Ulster	94	100.0
Exeter	396	100.0	West NI	100	100.0
Glouc	222	100.0			
Hull	302	99.3	**Scotland**		
Ipswi	122	0.0	Abrdn	186	99.5
Kent	358	98.9	Airdrie	181	97.8
L Barts	952	0.0	D & Gall	39	97.4
L Guys	571	98.1	Dundee	167	98.8
L Kings	521	0.0	Edinb	256	99.2
L Rfree	636	0.0	Glasgw	528	100.0
L St.G	312	0.0	Inverns	76	98.7
L West	1,348	88.4	Klmarnk	111	100.0
Leeds	422	100.0	Krkcldy	131	100.0
Leic	788	99.5			
Liv Ain	152	0.0	**Wales**		
Liv Roy	262	0.0	Bangor	59	100.0
M RI	431	2.6	Cardff	429	99.8
Middlbr	293	100.0	Clwyd	66	98.5
Newc	264	23.1	Swanse	310	99.4
Norwch	291	99.0	Wrexm	103	96.1
Nottm	323	91.6			
Oxford	379	98.9	**England**	**17,864**	**69.2**
Plymth	121	96.7	**N Ireland**	**535**	**96.3**
Ports	479	99.4	**Scotland**	**1,675**	**99.3**
Prestn	500	81.4	**Wales**	**967**	**99.2**
Redng	280	15.4	**UK**	**21,041**	**73.7**
Salford	274	66.4			

Manchester RI, Newcastle, Reading, Shrewsbury, Sunderland). URR data were not received from eight centres (Cambridge, Ipswich, London St Bartholomew's, London Kings, London Royal Free, London St Georges, Liverpool Aintree, Liverpool Royal Infirmary).

There was little change in the overall completeness of URR data submitted to the UKRR from most centres in 2016 compared with 2015, with an average change of 1.2% (range: −5.4% to 88.4%). Any centre change may have occurred due to changes in computerised data bases and data extraction, or by centres moving to online Kt/V, or total Kt/Vurea including residual renal urea clearance rather than URR as the preferred measure of haemodialysis dose.

Eleven centres did not provide data on frequency of dialysis sessions, and 49 centres provided data on

>90% of patients (table 6.3). Eleven centres did not provide data on dialysis session times, and 45 centres provided data on >90% of patients (table 6.4). In those centres not returning data, there appeared to be a common IT provider and locally collected data was not received by the UKRR. Ways of overcoming this problem in the future are being sought.

Of the total incident patient population ($N = 4,879$) who started HD during 2015 and meeting the inclusion criteria for URR analyses, 47.0% ($N = 2,298$) had URR data available during the first quarter of treatment (data not shown). This was an increase from 43% in the 2014 incident population. Eight centres did not provide data for the first quarter of treatment, and 41 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 69–82% (figure 6.1a). There was evidence that the median URR for female HD patients at 78% (centre range 73–85%) (figure 6.1b) was greater than that of male HD patients, with a median URR at 74% (centre range 68–80%) (figure 6.1c).

There was evidence that the median sessional URR was lower for patients aged <70 years (median 75%) compared to older patients ⩾70 years (median 76%). 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% was lower than for male patients aged ⩾70 years (median URR 74%).

The current UK RA clinical guideline target is to achieve a minimum sessional URR of 65%, and this was achieved in 87.5% of HD prevalent patients (centre range 70.8–95.7%) (figure 6.2). A higher number of female patients achieved this minimum target (92.1%,

Table 6.3. Number of dialysis sessions for prevalent patients on HD by centre, on 30/9/2016

Centre	*N*	% completeness	%		
			<3 sessions	3 sessions	>3 sessions
England					
B Heart	362	79.0	9.4	89.9	0.7
B QEH	884	0.0			
Basldn	149	95.3	1.4	89.4	9.2
Bradfd	222	100.0	3.2	96.4	0.5
Brightn	378	99.5	0.5	98.9	0.5
Bristol	460	100.0	3.5	95.9	0.7
Carlis	88	97.7	2.3	97.7	0.0
Carsh	755	99.7	1.1	98.7	0.3
Chelms	124	100.0	8.9	88.7	2.4
Colchr	113	98.2	0.0	100.0	0.0
Covnt	338	2.1			
Derby	181	43.1			
Donc	173	98.3	0.6	98.8	0.6
Dorset	259	99.6	1.9	98.1	0.0
Dudley	166	89.2	2.7	97.3	0.0
Exeter	415	99.8	3.9	95.4	0.7
Glouc	222	0.0			
Hull	302	0.3			
Ipswi	133	100.0	8.3	91.7	0.0
Kent	371	98.9	1.4	96.5	2.2
L Barts	952	0.0			
L Guys	600	99.2	3.9	95.1	1.0
L Kings	521	100.0	0.0	100.0	0.0
L Rfree	636	0.0			
L St.G	315	97.1	1.0	99.0	0.0
L West	1,365	63.5	1.0	98.0	0.9
Leeds	458	99.6	7.9	92.1	0.0
Leic	796	99.5	1.0	99.0	0.0

Table 6.3. Continued

Centre	*N*	% completeness	% <3 sessions	% 3 sessions	% >3 sessions
Liv Ain	155	99.4	0.6	98.1	1.3
Liv Roy	306	97.4	0.3	85.2	14.4
M RI	436	35.3			
Middlbr	294	23.5			
Newc	271	100.0	1.1	97.4	1.5
Norwch	298	99.7	1.0	97.6	1.3
Nottm	344	99.7	0.6	93.9	5.5
Oxford	379	100.0	0.0	100.0	0.0
Plymth	121	0.0			
Ports	523	99.0	5.0	91.5	3.5
Prestn	500	0.0			
Redng	280	97.9	0.0	100.0	0.0
Salford	329	99.7	1.5	83.2	15.2
Sheff	514	99.8	3.3	96.7	0.0
Shrew	174	100.0	3.4	94.8	1.7
Stevng	466	99.2	13.0	85.5	1.5
Sthend	107	99.1	18.9	81.1	0.0
Stoke	290	98.3	2.1	96.1	1.8
Sund	216	100.0	0.9	92.1	6.9
Truro	145	91.0	6.8	90.2	3.0
Wirral	165	97.0	0.6	88.1	11.3
Wolve	270	7.0			
York	161	85.7	0.0	92.8	7.2
N Ireland					
Antrim	111	96.4	0.0	100.0	0.0
Belfast	164	98.2	0.6	98.1	1.2
Newry	76	100.0	9.2	90.8	0.0
Ulster	99	100.0	3.0	94.9	2.0
West NI	111	99.1	1.8	90.0	8.2
Scotland					
Abrdn	204	98.0	1.5	91.0	7.5
Airdrie	182	91.2	0.6	99.4	0.0
D & Gall	45	95.6	2.3	86.0	11.6
Dundee	172	97.7	0.0	97.0	3.0
Edinb	261	92.7	0.8	97.9	1.2
Glasgw	534	93.6	0.4	98.8	0.8
Inverns	80	98.8	1.3	94.9	3.8
Klmarnk	113	94.7	0.0	98.1	1.9
Krkcldy	135	96.3	1.5	96.9	1.5
Wales					
Bangor	59	0.0			
Cardff	429	0.0			
Clwyd	66	0.0			
Swanse	310	0.0			
Wrexm	103	0.0			
England	**18,482**	**70.2**	**2.8**	**95.2**	**2.0**
N Ireland	**561**	**98.6**	**2.4**	**95.3**	**2.4**
Scotland	**1,726**	**94.7**	**0.7**	**96.9**	**2.4**
Wales	**967**	**0.0**	**0.0**	**0.0**	**0.0**
UK	**21,736**	**69.7**	**2.6**	**95.4**	**2.0**

Blank cells denote no data returned by the centre or <10 patients in the renal centre or data completeness was <50%

Table 6.4. Time per dialysis session for prevalent patients on HD by centre, on 30/9/2016

Centre	*N*	% completeness	% per dialysis session		
			<4 hours	4–5 hours	>5 hours
England					
B Heart	333	77.8	14.3	85.7	0.0
B QEH	884	0.0			
Basldn	134	94.8	37.0	63.0	0.0
Bradfd	214	99.1	25.9	74.1	0.0
Brightn	374	97.9	7.1	92.9	0.0
Bristol	441	100.0	24.0	76.0	0.0
Carlis	86	97.7	8.3	91.7	0.0
Carsh	745	98.5	11.2	88.4	0.4
Chelms	110	100.0	40.0	60.0	0.0
Colchr	113	98.2	0.9	99.1	0.0
Covnt	338	3.6			
Derby	181	43.1			
Donc	171	98.3	24.4	75.6	0.0
Dorset	254	100.0	8.7	91.3	0.0
Dudley	162	88.9	14.6	85.4	0.0
Exeter	396	100.0	51.0	49.0	0.0
Glouc	222	0.0			
Hull	302	1.3			
Ipswi	122	100.0	10.7	89.3	0.0
Kent	358	99.7	56.6	43.4	0.0
L Barts	952	0.0			
L Guys	571	99.1	30.9	68.9	0.2
L Kings	521	100.0	39.0	61.0	0.0
L Rfree	636	0.0			
L St.G	312	87.5	4.4	95.6	0.0
L West	1,348	63.5	18.5	79.6	2.0
Leeds	422	100.0	20.9	79.1	0.0
Leic	788	78.3	9.9	86.7	3.4
Liv Ain	152	100.0	21.7	78.3	0.0
Liv Roy	262	99.2	8.5	91.2	0.4
M RI	431	34.6			
Middlbr	293	100.0	38.6	61.4	0.0
Newc	264	100.0	18.6	79.9	1.5
Norwch	291	99.7	58.3	41.7	0.0
Nottm	323	99.7	6.2	93.8	0.0
Oxford	379	100.0	29.6	70.4	0.0
Plymth	121	0.0			
Ports	479	0.0			
Prestn	500	0.2			
Redng	280	96.8	19.9	80.1	0.0
Salford	274	95.3	13.4	86.6	0.0
Sheff	497	88.7	84.8	15.0	0.2
Shrew	165	100.0	44.8	55.2	0.0
Stevng	399	99.5	81.4	18.6	0.0
Sthend	87	98.9	48.8	51.2	0.0
Stoke	279	100.0	11.8	88.2	0.0
Sund	199	83.9	21.6	78.4	0.0
Truro	132	97.0	65.6	33.6	0.8
Wirral	146	100.0	25.3	74.0	0.7
Wolve	270	7.0			
York	151	85.4	10.9	89.1	0.0

Table 6.4. Continued

Centre	*N*	% completeness	% per dialysis session		
			<4 hours	4–5 hours	>5 hours
N Ireland					
Antrim	111	97.3	14.8	85.2	0.0
Belfast	161	100.0	16.8	83.2	0.0
Newry	69	100.0	52.2	47.8	0.0
Ulster	94	100.0	12.8	87.2	0.0
West NI	100	99.0	58.6	41.4	0.0
Scotland					
Abrdn	186	98.4	5.5	92.3	2.2
Airdrie	181	98.9	13.4	83.8	2.8
D & Gall	39	100.0	20.5	79.5	0.0
Dundee	167	97.6	7.4	92.0	0.6
Edinb	256	92.6	38.4	61.6	0.0
Glasgw	528	99.4	6.5	89.1	4.4
Inverns	76	98.7	17.3	82.7	0.0
Klmarnk	111	92.8	0.0	93.2	6.8
Krkcldy	131	96.2	27.0	73.0	0.0
Wales					
Bangor	59	0.0			
Cardff	429	0.0			
Clwyd	66	0.0			
Swanse	310	0.0			
Wrexm	103	0.0			
England	**17,864**	**66.2**	**27.5**	**72.1**	**0.4**
N Ireland	**535**	**99.3**	**28.1**	**71.9**	**0.0**
Scotland	**1,675**	**97.3**	**13.9**	**83.7**	**2.5**
Wales	**967**	**0.0**			
UK	**21,041**	**66.5**	**25.9**	**73.4**	**0.7**

Blank cells denote no data returned by the centre or <10 patients in the renal centre or data completeness was <50%

centre range 76.0–100.0%) compared to male patients (84.6%, centre range 67.5–95.3%).

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 it has plateaued around 88% (figure 6.3). Similarly, the median URR in UK haemodialysis patients rose from 71% to stabilise at 75% since 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, marked improvement in the proportion of patients receiving the sessional target dose of haemodialysis has plateaued in recent years.

Changes in URR for incident patients

The median sessional URR during the first quarter after starting haemodialysis treatment in the UK was 67.0% (centre range 58.5–76.0%) (figure 6.5a) for incident HD patients in 2015. At the end of one-year follow-up, the median URR had increased to 73.0% (centre range 68.0–83.0%) (figure 6.5b). More centres are included in the analysis this year due to the threshold for centre inclusion being relaxed to include centres returning data for at least ten patients rather than a minimum of 20 patients.

There was evidence that the median sessional URR during the first three months after starting haemodialysis

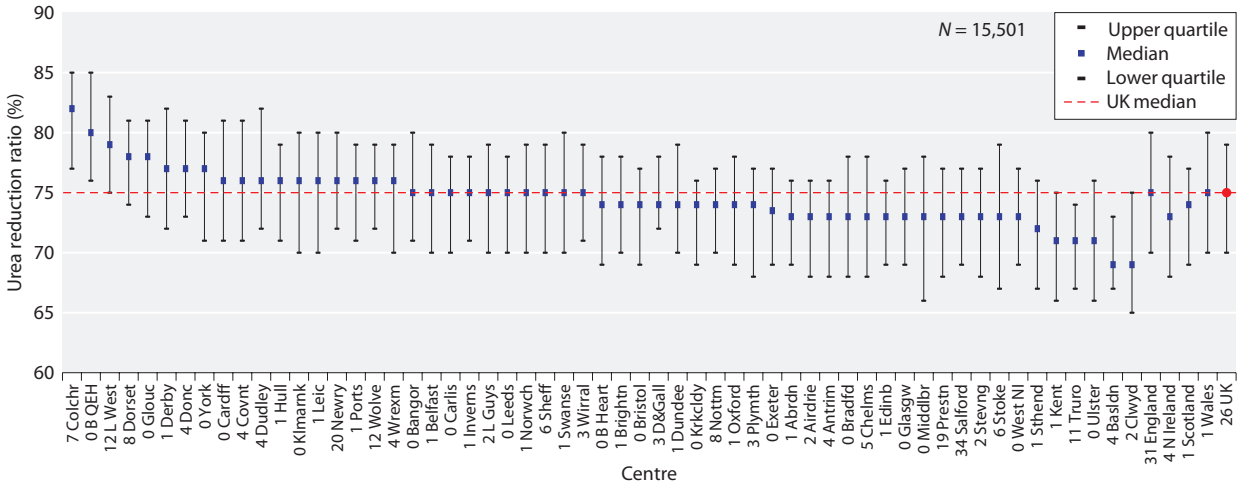

Fig. 6.1a. Median URR achieved in prevalent patients on HD by centre, 30/9/2016

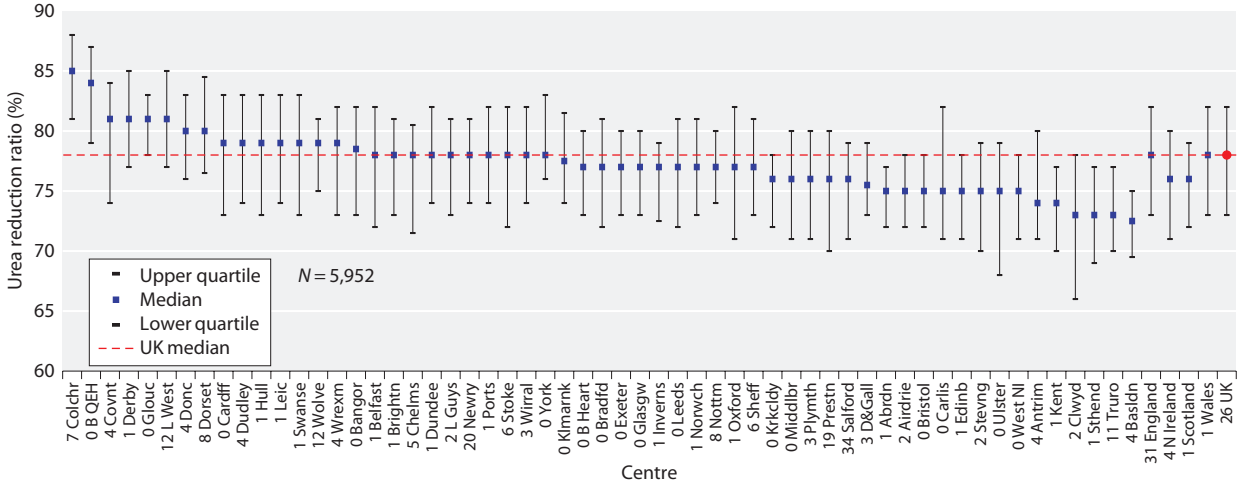

Fig. 6.1b. Median URR achieved in female prevalent patients on HD by centre, 30/9/2016

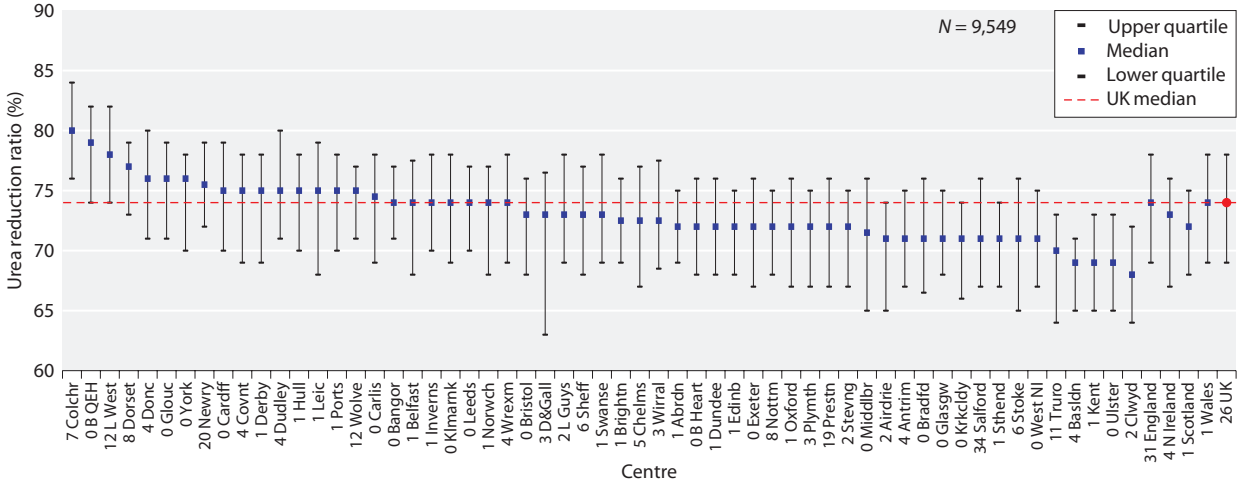

Fig. 6.1c. Median URR achieved in male prevalent patients on HD by centre, 30/9/2016

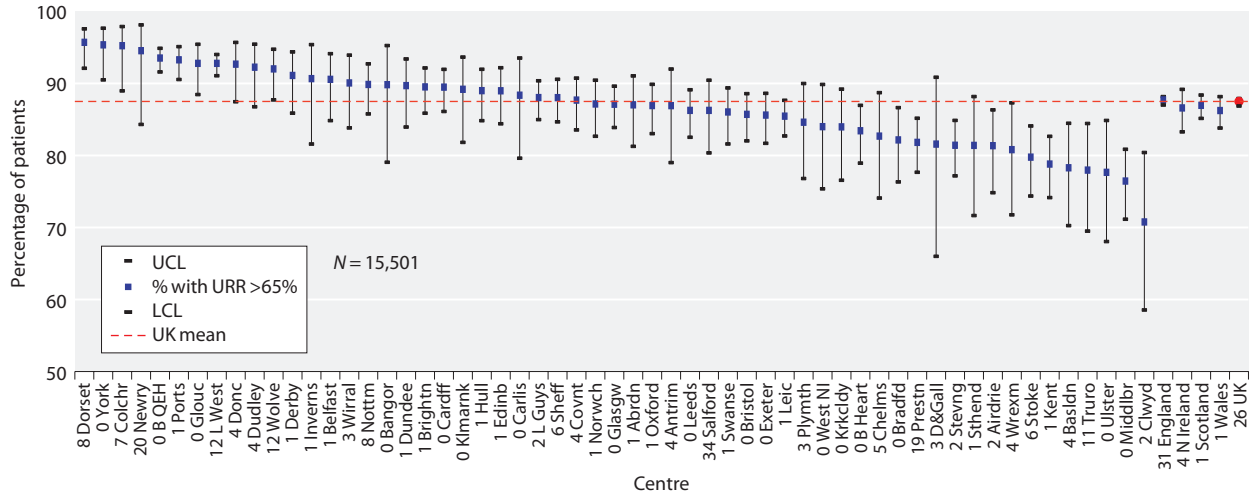

Fig. 6.2. Percentage of prevalent patients on HD with URR >65% by centre, 30/9/2016

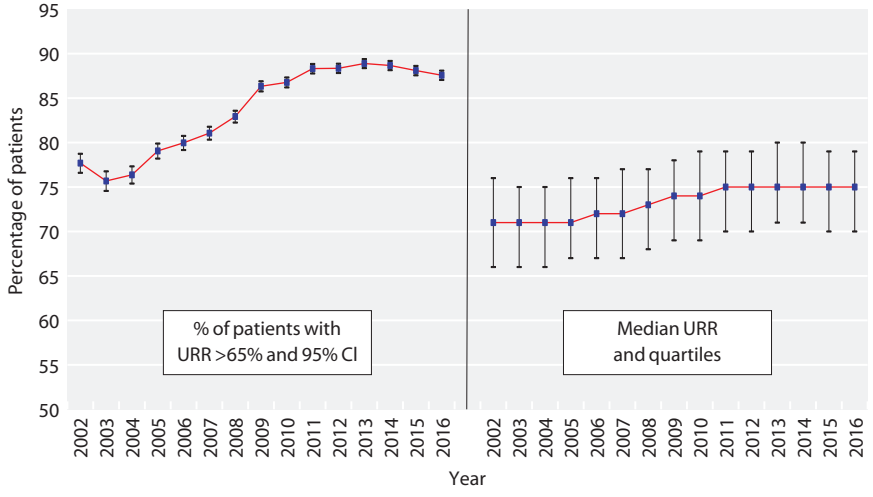

Fig. 6.3. Change in the percentage of prevalent patients on HD with URR >65% and the median URR between 2002 and 2016

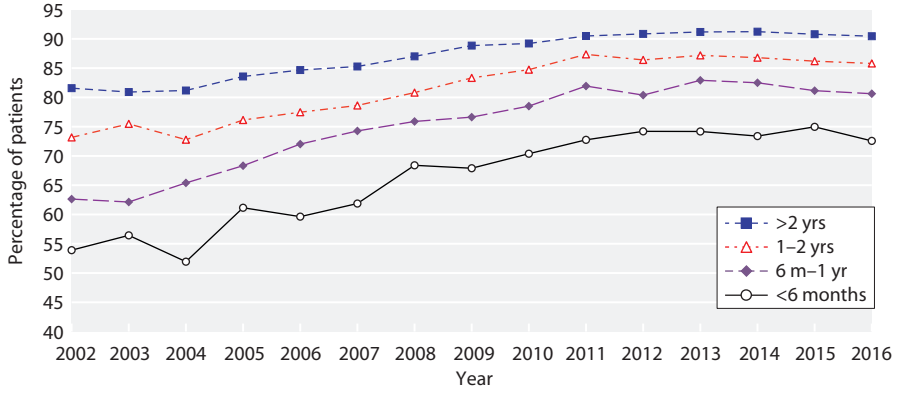

Fig. 6.4. Percentage of prevalent patients on HD achieving URR >65% by time on RRT between 2002 and 2016

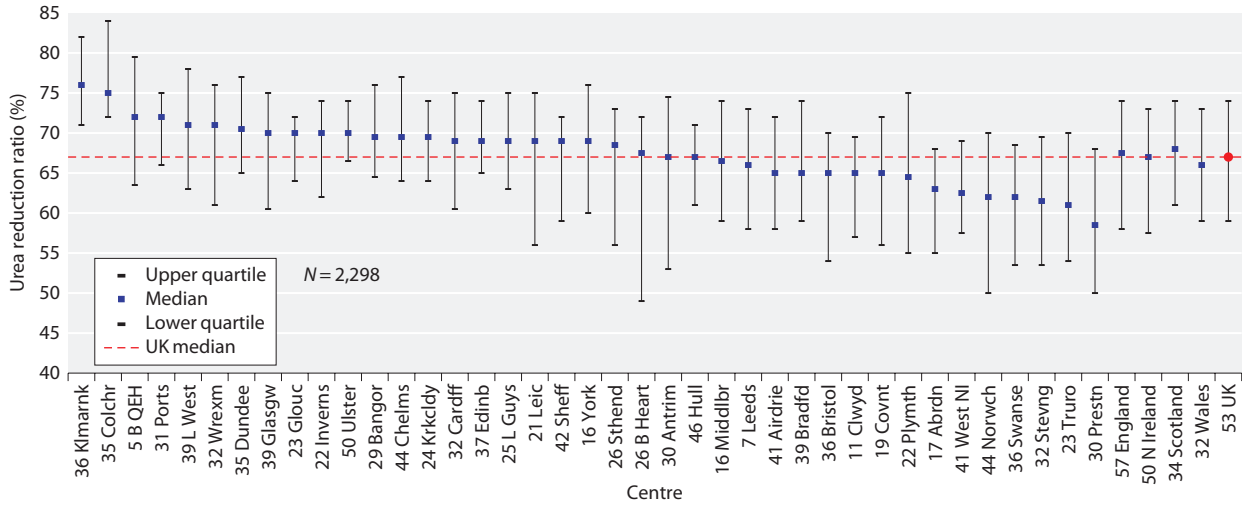

Fig. 6.5a. Median URR in the first quarter of starting RRT in incident patients who started HD in 2015

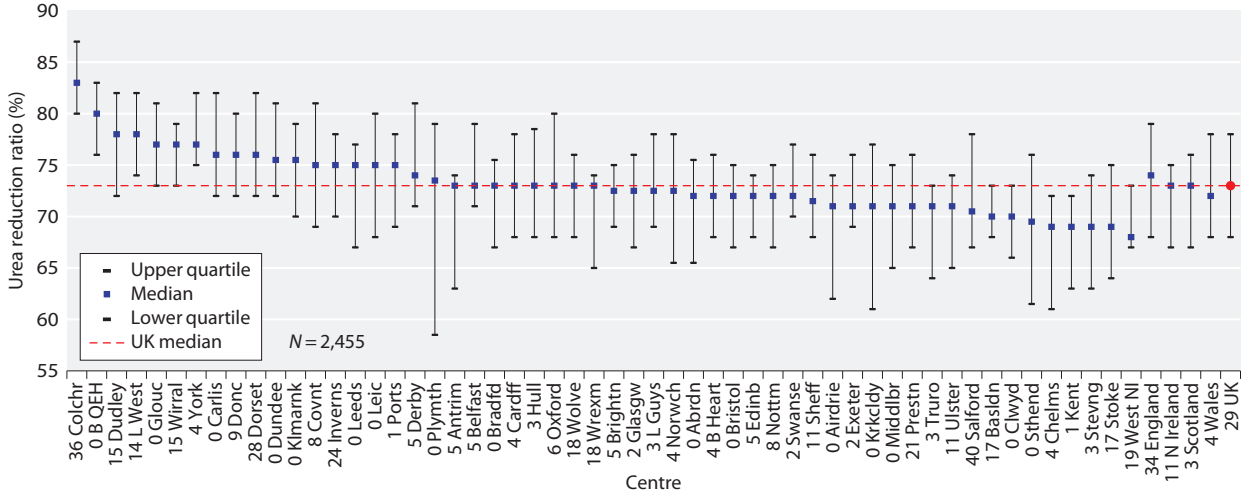

Fig. 6.5b. Median URR one year after starting RRT for incident patients who started HD in 2015

was lower for patients aged <70 years (median URR 66.0%) 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%) versus ⩾70 years of age (median URR 74.0%).

Haemodialysis session duration for prevalent HD patients

For those centres which returned data, the majority of prevalent patients (73.4%) dialysed between 4–5 hours, with 25.9% dialysing less than four hours per session, and only 0.7% dialysing for more than five hours (table 6.4). However, there were marked differences between centres, with between 1–85% of patients reported to be dialysing less than four hours. Median URR was similar for patients dialysing longer (⩾4 hours) versus shorter dialysis sessions (<4 hours).

Haemodialysis session frequency for prevalent HD patients

Dialysis frequency data were available for 69.7% of patients (table 6.3) in 2016 compared with 68.7% in 2015. Although 95.4% of all prevalent haemodialysis patients dialysed thrice weekly, there were marked differences in centre practices. Centres reported dialysing between 0.0–18.9% of patients twice weekly or less, and between 0.0–15.2% more than thrice weekly. Two centres

reported dialysing >10% of patients less than thrice weekly and four centres more often than thrice weekly. The sessional URR was lower with lower dialysis frequency (median URR 71.6% for prevalent HD patients dialysing <3 times per week versus a median URR of 75.0% for patients dialysing ⩾3 times per week).

Discussion

Haemodialysis is a life-sustaining treatment for patients with end stage kidney disease. In addition to the clearance of azotaemic toxins, the dialysis prescription encompasses volume control, maintenance of acid-base status and mono- and di-valent ion homeostasis. Dialysis adequacy is defined in the current RA and international clinical guidelines by dialyser urea clearance. Target dialyser urea clearance of 70% is recommended to consistently achieve the minimum URR of >65% in as many patients as possible [12–14]. A minimum dialysis adequacy appears to be necessary for patient well-being [1], but the benefits of higher clearance and the optimal dialysis dose have not been well defined [2–5]. The older, more comorbid demographic of the current dialysis cohort may differ from previously studied populations although UKRR data has consistently, somewhat paradoxically, shown higher sessional urea clearance amongst older patients [15–17]. Muscle mass declines with age [15], and dialysis patients with less muscle mass are less physically active [16] and have lower energy expenditure [17]. So, one may have expected higher dialyser urea clearances delivered to the younger rather than older patients [18]. This apparent greater dialyser urea clearance in the older patient may be due to a mathematical confounder, in that it is easier to achieve a higher percentage urea clearance in a smaller patient with a lower pre-dialysis serum urea concentration compared to that in a heavier patient with a higher starting urea [19], and this confounder not only affects urea reduction ratio, but also Kt/Vurea [20, 21]. As there is an association between muscle mass and body surface area, then as Kt/Vurea underestimates clearance in patients with increased body mass index, and overestimates clearance in those with smaller body mass index [22], an adjustment for body surface area or energy expenditure may be more appropriate [18, 23].

Men and women differ in size, body composition and in their rates of resting energy expenditure all of which can contribute to lower dialyser urea clearance being needed in women to achieve a higher URR [16, 18]. Observational studies and post hoc analyses of the HEMO study have suggested that women may benefit from a greater dialyser urea clearance than men [24, 25], and for the same urea dialyser clearance women would receive a lower effective clearance [20]. However, neither UK RA nor other clinical guidelines advocate different targets based on gender [12]. It is therefore reassuring that in the UK, the median sessional URR remained higher for women than men to prevent lower dialysis dosing [20].

Following increases in the proportion of UK haemodialysis patients achieving target URR from 2002 until 2010, this has since stabilized around 88% for the prevalent population. Standardised sampling technique and improved haemodialysis technology may have contributed to the earlier improvement [26]. The subsequent plateau in target attainment likely reflects the reality that not all established dialysis patients will consistently achieve the target URR, for example due to poorly functioning vascular access, cardiovascular intolerance on the day of urea sampling, or patients receiving palliative dialysis [21]. However, the marked inter-centre variability in the proportion of patients achieving the URR minimum of >65%, ranging from 70.7–95.7% of patients suggests a centre practice effect. Our current analysis makes no adjustment for centre differences in terms of patient case-mix, patient non-adherence to dialysis session length or practice differences such as high flux dialysis or haemodiafiltration. Residual renal function is not accounted for in the URR calculation and centre practice differences around early versus delayed start dialysis as well as whether centres practice an incremental approach to initiating dialysis may account for some of the differences observed [27]. The effect of residual renal function most likely accounts for the increase in URR observed in the incident haemodialysis patients from the first quarter to the final quarter URR returns, as shown by one centre increasing from <60% to >70%.

In the UK, centres receive sessional payments, initially introduced to encourage more frequent dialysis. However, only some 2% of patients dialysing in England were reported to dialyse more than thrice weekly although there was variation between centres, as four centres reported dialysing over 10% of their patients more frequently. The UK Renal Association clinical guidelines recommend that patients should have thrice weekly dialysis [12], and although on average only around 3% of patients dialysed twice or less frequently, again practice varied markedly with centres reporting a range of 0% to 19%. The UKRR were unable to determine

whether this was due to patient-case mix, centres taking into account residual renal function, or resource limitations; although on enquiry to individual centres it would appear to be a combination of patient-case mix [21], centres measuring residual renal function and practicing incremental dialysis [27].

The UK Renal Association clinical guidelines recommend that patients without residual renal function should dialyse for four hours [12]. Most prevalent patients dialysed between 4–5 hours, however over a quarter (25.9%) dialysed for shorter times (<4 hours) and less than 1% dialysing for longer (>5 hours). Further marked inter-centre variability was noted in session duration with a wide range (0.0–84.8%) of patients dialysing for less than four hours. Twenty six of the 53 centres that provided data on time dialysed (49%), dialysed more than 20% of patients for <4 hours. The guidelines date from a time when low-flux dialysers were the standard, and prior to the improvements in dialyser technology and introduction of other modalities such as haemodiafiltration [26]. However, although greater urea clearance can potentially be achieved with shorter session times, this does not imply that other azotaemic toxins [28–31], as well as sodium would be equally cleared [32]. Once again, the UKRR were unable to determine whether centres with higher proportions of patients having shorter dialysis sessions was due to patient case-mix, patient wishes, intolerance of dialysis, or clinician factors, including considering residual renal function.

The pros and cons of using URR as a measure of dialysis adequacy continue to be debated [11, 21, 30, 31]. It does not account for the clearance of other larger molecules, nor does it reflect other important aspects of dialysis such as session length, volume control, sodium balance and the correction of metabolic acidosis all of which can potentially impact patient outcomes [29, 32]. However, no consensus has yet emerged on alternative markers of HD adequacy [33]. Practically, URR has been relatively simple to collect and the resulting data completeness has made it the easier to analyse for the UKRR.

It is planned to work with centres to ensure dialysis session data can be used to augment the overall data completeness. As data collection expands, Kt/V and dialysis prescription practice will be used to improve the analysis.

Conflicts of interest: the authors declare no conflicts of interest

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