Chapter 8
Adequacy of haemodialysis in UK renal centres in 2007: national and centre-specific analyses

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Key Words
Haemodialysis · Adequacy · Urea reduction ratio

Abstract
Background: Outcome in patients treated with haemodialysis (HD) is influenced by the delivered dose of dialysis. The UK Renal Association (RA) publishes Clinical Practice Guidelines which include recommendations for dialysis dose. The urea reduction ratio (URR) is a widely used measure of dialysis dose. ***Aim:*** To determine the extent to which patients received the recommended dose of HD in the UK. ***Methods:*** Seventy-one renal centres in the UK submit data electronically to the UK Renal Registry (UKRR). Two groups of patients were included in the analyses: the prevalent patient population on 31st December 2007 and the incident patient population for 2007. Centres returning data on <50% of their patient population were excluded from centre-specific comparisons. ***Results:*** Data regarding URR were available from 61 renal centres in the UK. Forty six centres provided URR data on more than 90% of prevalent patients. 81% of prevalent HD patients met the UK Clinical Practice Guideline for URR (>65%) in 2007. There has been an increase from 56% in 1998 to 81% in 2007 in the proportion of patients in the UK who achieved a URR >65%. The HD dose (URR) delivered to patients who have just started dialysis treatment is lower than that of patients who have been treated for longer and increases further with time. ***Conclusions:*** The delivered dose of HD for patients with established renal failure has increased over 9 years. There was considerable variation from one centre to another, with 8 centres attaining the RA clinical practice guideline in >90% of patients and 7 centres attaining the standard in <60% of patients.

Introduction

Amongst patients with established renal failure the delivered dose of HD is an important predictor of outcome [1] which has been shown to influence survival [2, 3]. It depends on treatment (duration & frequency of dialysis; dialyser size; dialysate and blood flow rate) and patient (size; weight; haematocrit and vascular access) characteristics [4]. The two widely accepted measures of urea clearance are Kt/V, the ratio between the product of urea clearance (K, in ml/min) and dialysis session duration (t, in minutes) divided by the volume of distribution of urea in the body (V, in ml); and URR,

derived solely from the percentage fall in serum urea (URR) during a dialysis treatment. Kt/V takes into account the contribution of ultrafiltration to urea clearance and is therefore a more accurate descriptor of urea clearance. However, accurate calculation of Kt/V requires iterative computerised modelling and although it can be estimated using one of several formulae, these all require additional data items over and above pre- and post-dialysis urea concentration, including the duration of the dialysis treatment and the ultrafiltration volume. URR has been shown to correlate with survival even though it does not take account of the contribution made by residual renal function and ultrafiltration to urea clearance [2].

Further analysis of the data [5] from the National Cooperative Dialysis Study [1] suggested that outcome was improved by maintaining a Kt/V greater than 1.2. However, the HEMO study [6] suggested that there was no benefit accrued by increasing HD dose further. In that study, survival of patients undergoing thrice weekly HD in whom a URR of 75% (equilibrated Kt/V of 1.45) was achieved was not significantly better than in those who had a URR of 65% (equilibrated Kt/V of 1.05), suggesting that there was a 'ceiling effect' to the survival benefit of higher dialysis doses when achieved using thrice weekly haemodialysis.

Based on published evidence, clinical practice guidelines have been developed by various national and regional organisations (www.kdigo.org). There is considerable uniformity between them with regard to the recommendations for minimum dose of dialysis although there are slight differences in the methodology advised [7, 8].

The UKRR is part of the RA and provides audit and analysis of renal replacement therapy in the UK. It receives quarterly electronic extracts covering a range of data items from information systems within each renal centre. As most centres do not report duration of dialysis or weight loss during dialysis, the UKRR has chosen URR rather than Kt/V for comparative audit of haemodialysis adequacy.

Several centres in the UK now use online measurement of ionic dialysance to measure small molecular clearance during HD relying on studies that have demonstrated a close linear relationship between this measure and conventional measures of urea clearance [9]. However, the UKRR strongly encourages these centres to continue to perform and report conventional pre- and post-dialysis measurements of blood urea concentration at least on a 3-monthly basis to allow comparative audit.

The main objective of this study is to determine the extent to which patients undergoing HD treatment for established renal failure in the UK receive the dose of HD recommended in the UK RA Clinical Practice Guidelines [8].

The term Established Renal Failure (ERF) used throughout this chapter is synonymous with the terms of End Stage Renal Failure (ESRF) and End Stage Renal Disease (ESRD) which are in more widespread international usage. Within the UK, patient groups have disliked the term 'End Stage' which formerly reflected the inevitable outcome of this disease.

Methods

Seventy-one renal centres in the UK submit data electronically to the UKRR on a quarterly basis. 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. Two groups of patients were included in the analyses. Firstly, analysis was undertaken using data from the prevalent HD patient population on 31st December 2007. For this analysis, data for URR were taken from the last quarter of 2007 unless that data point was missing in which case data from the 3rd quarter were taken. As the prevalent population only included those patients alive on December 31st, data from those patients who had died before that date have not been included in the analysis. The second analysis involved the patients who had started treatment with HD (incident patient population) during 2007. For these patients analysis was undertaken using the last recorded URR during the quarter in which the patient had started dialysis.

Analysis of the data from both groups of patients included calculation of the median URR and of the proportion of patients who had achieved the RA standard (as outlined below) in each of the renal centres as well as for the country as a whole.

All patients with data were included in the statistical analysis 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 UK RA Clinical Practice Guidelines [8] 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 haemodialysis 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 dialysis twice weekly for reasons of geography should receive a higher sessional dose of dialysis. If this cannot be achieved, then it should be recognised that there is a compromise between the practicalities of dialysis 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 [8].

Data from patients known to be receiving more or less than thrice weekly HD were omitted from analysis. However, because not all centres report frequency of HD, it is possible that data from a small number of patients receiving HD less or more frequently than thrice weekly were included in the analyses.

A further potentially confounding factor is the methodology used for taking the post dialysis blood sample. Advice given to renal centres following a postal survey in 2002 [10] aimed to achieve uniformity and this was reflected in the RA standards [11]. No reliable data were available to clarify whether the important variations in post-dialysis sampling methodology that were identified at that time persist.

Results

Data completeness

Data regarding HD dose (URR) were available from 61 of the 71 renal centres which submitted data to the UKRR (table 8.1). The prevalent patient population with complete data was 11,932. There were 2,256 incident patients for whom data were available for URR during the 3 months after they had started treatment with HD.

Forty six centres submitted data on at least 90% of patients treated with HD. Eleven centres were included in the analysis but returned data from less than 90% of patients – Chelmsford (88%), Norwich (86%), Dudley (85%), Kilmarnock (85%), Southend (84%), Wrexham (83%), Preston (82%), Wolverhampton (80%), Carshalton (75%), Oxford (75%) and Manchester Hope (53%). Twelve centres (Brighton, Cambridge, Derby, Dundee, London Barts, London Kings, London Royal Free, London West, Manchester Royal Infirmary, Newcastle, Stoke and Wirral) reporting on less than 50% of prevalent patients were not included in the centre level analyses although the patients were included in the national analyses. The number preceding the centre name in each figure indicates the percentage of missing data from that centre.

Table 8.1. Percentage completeness of URR data returns

Centre	% complete	Centre	% complete
Abrdn	98	L Rfree	0
Airdrie	91	L St G	0
Antrim	98	L West	30
B Heart	92	Leeds	94
B QEH	95	Leic	98
Bangor	94	Liv Ain	96
Basldn	98	Liv RI	91
Belfast	94	M Hope	53
Bradfd	97	M RI	0
Brightn	0	Middlbr	95
Bristol	99	Newc	0
Camb	45	Newry	99
Cardff	91	Norwch	86
Carlis	95	Nottm	98
Carsh	75	Oxford	75
Chelms	88	Plymth	95
Clwyd	91	Ports	96
Covnt	96	Prestn	82
D&Gall	96	Redng	98
Derby	0	Sheff	95
Derry	100	Shrew	91
Donc	100	Stevng	92
Dorset	95	Sthend	84
Dudley	85	Stoke	0
Dundee	1	Sund	96
Dunfn	98	Swanse	98
Edinb	98	Truro	98
Exeter	96	Tyrone	96
Glasgw	95	Ulster	99
Glouc	95	Wirral	31
Hull	93	Wolve	80
Inverns	99	Wrexm	83
Ipswi	100	York	98
Kent	0	**England**	**68**
Klmarnk	85	**N Ireland**	**97**
L Barts	0	**Scotland**	**86**
L Guys	91	**Wales**	**93**
L Kings	0	**UK**	**72**

Achieved URR

The median URR (72% for UK; centre range 65%–77%) and percentage (81% for UK; centre range 47%–97%) of reported patients attaining the RA Standard of a URR >65% from 57 renal centres are shown in figures

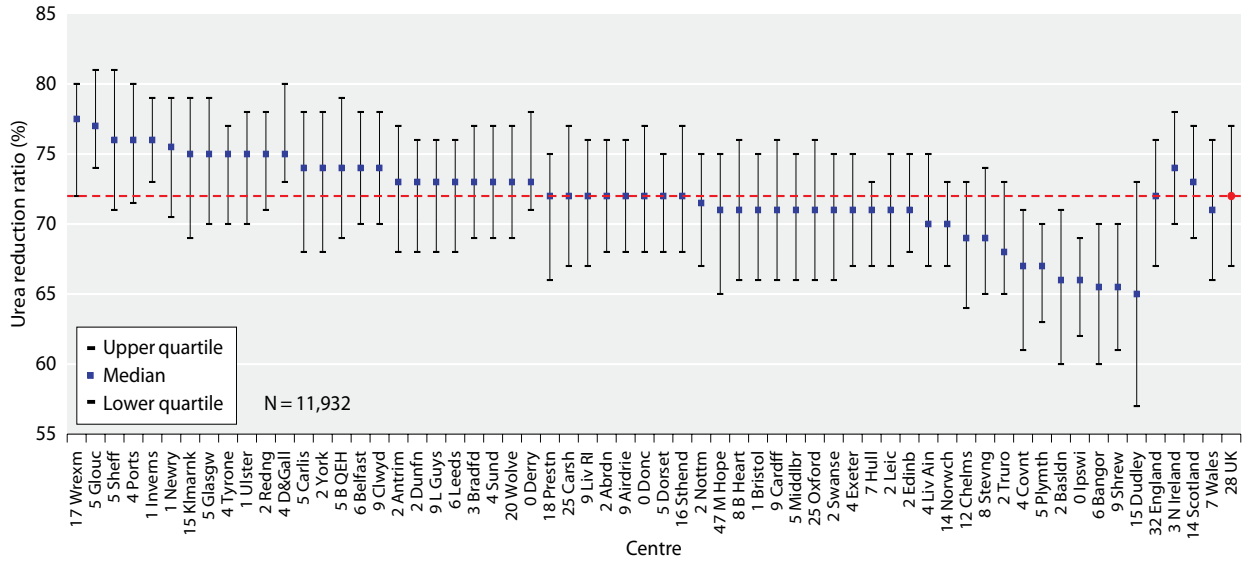

Fig. 8.1. Median URR achieved in each centre, 2007

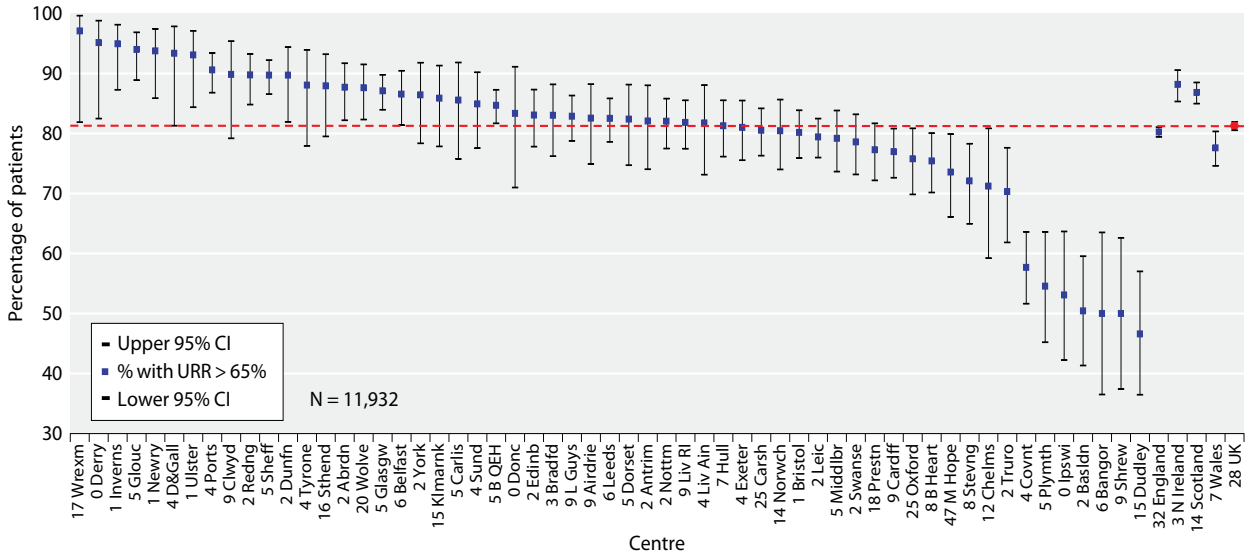

Fig. 8.2. Percentage of patients with URR >65% in each centre, 2007

8.1 and 8.2. Figure 8.3 illustrates the close relationship between the two. With one exception (Derry; median URR 73%) all centres which attained the RA Standard in more than 90% of patients had a median URR of 75% or more. All centres which achieved a URR >65% in at least 80% of patients had a median URR of at least 70%. The 7 centres with a median URR of 67% or less achieved the RA Standard for HD dose in less than 60% of their patients.

Changes in URR over time

The change in both the percentage attainment of the RA clinical practice guidelines (URR >65%) and the median URR for England, Wales and Scotland from

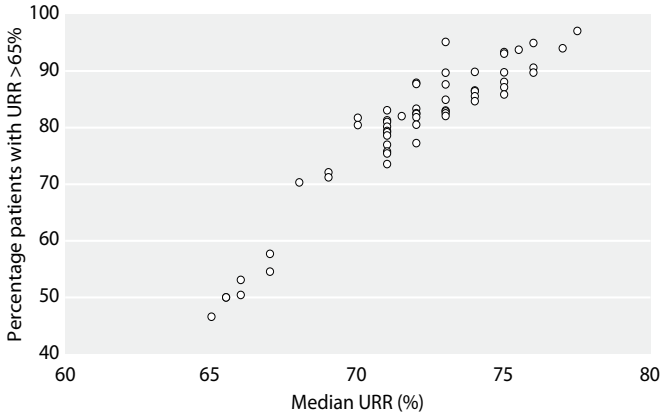

Fig. 8.3. Relationship between achievement of the Renal Association Standard for URR and the median URR in each centre, 2007

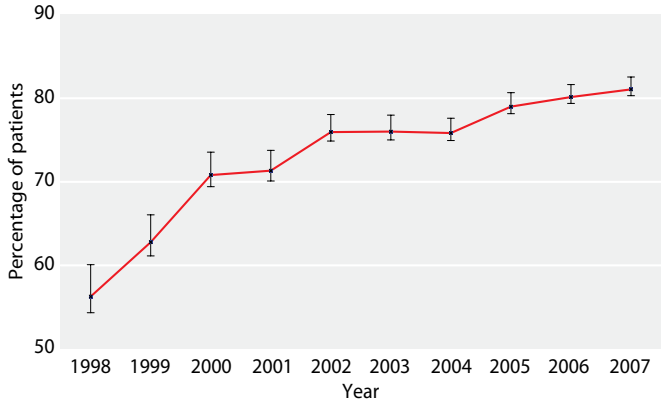

Fig. 8.4. Change in the percentage of patients with URR >65% between 1998 and 2007 in England, Wales and Scotland

1998 to 2007 are shown in figures 8.4 and 8.5. Northern Ireland has only provided complete data since 2005 and has therefore been excluded from these two analyses. The results show that the proportion of patients attaining the RA standard has increased from 56% to 81% from 1998 to 2007 (figure 8.4) and over the same time period the median URR has risen from 67% to 72% (figure 8.5). The UKRR is aiming to provide centre-specific reports within the near future. This will enable centres to view their own longitudinal trends for data such as these.

Variation of achieved URR with time on dialysis

The proportion of patients who attained the RA Standard increased in parallel with the time since those patients started dialysis (figure 8.6). Of those dialysed for less than six months, 62% had a URR >65% whilst 85% of patients who had been dialysed for more than two years attained the standard in 2007.

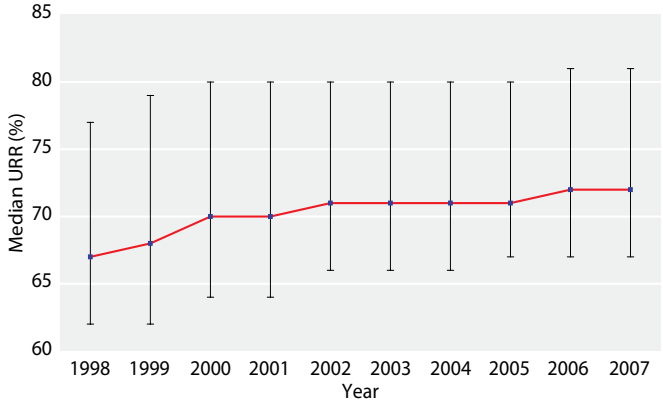

Fig. 8.5. Change in median URR between 1998 and 2007 in England, Wales and Scotland

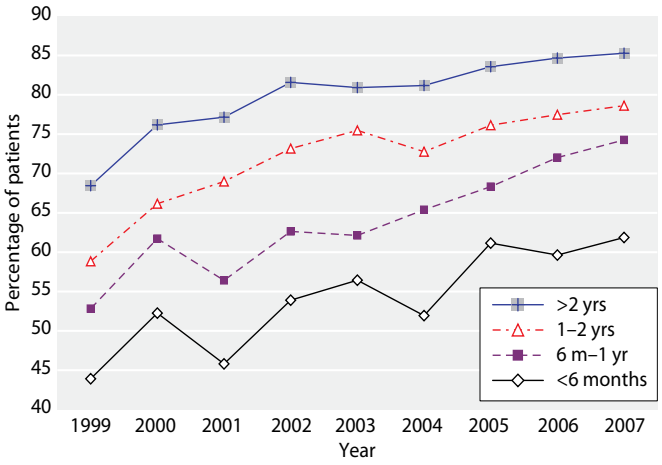

Fig. 8.6. Percentage of prevalent haemodialysis patients achieving URR >65% against duration on haemodialysis between 1999 and 2007

The median URR during the first quarter after starting HD treatment of the incident HD population in the UK in 2007 was 64% (figure 8.7).

Discussion

The proportion of patients achieving the RA standard for URR has increased steadily during the 8 years since 1998. This observation is also consistent when patients are grouped on the basis of length of time since starting HD treatment. In 2007 over 80% of patients in the UK achieved the target of a URR >65% and of patients who had been treated with HD for more than 2 years more than 85% achieved the target. The figure for patients during the first 6 months after starting treatment was lower (64%) but in these patients a high proportion will have residual renal function to compensate.

There was a wide range (47%–97%) of achievement between different centres which is likely to reflect genuine differences in HD dose although inconsistency in sampling methodology for the post dialysis urea sample may play a part [10].

The median URR of patients undergoing HD in the UK in 2007 was 72% (centre range of 65%–77%). In order to consistently achieve a URR >65% the UK RA clinical practice guidelines recommend that clinicians should aim for a minimum target URR of 70% and this approach is supported by the findings in this study.

Furthermore, recent studies have suggested that prescription of a target Kt/V of 1.2 in females and small males underestimates the required dose [12].

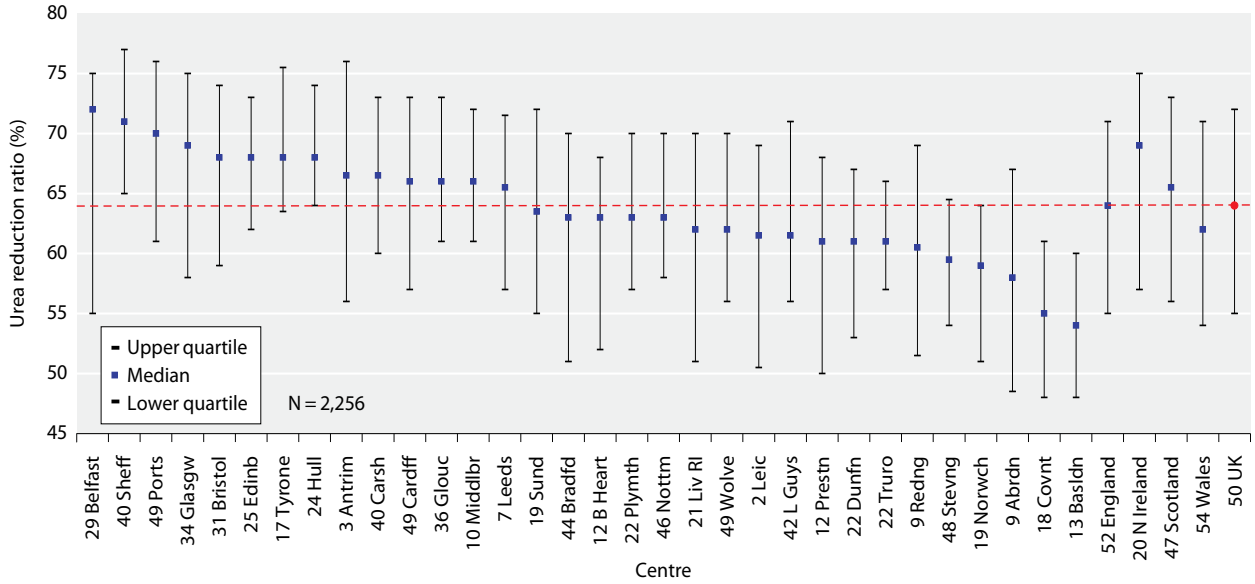

Fig. 8.7. Median URR in the first quarter after starting RRT in patients who started haemodialysis in 2007

These observations support the K-DOQI guidelines for HD which advise an increase in the minimum dialysis dose target for women and small men [13].

Some commentators [14] have cast doubt on the utility of measures of urea clearance for the measurement of HD dose, justifying these doubts by reference to the studies that show that body size confounds the relationship between URR and outcome [12]; studies that show that outcome is better with longer treatment times, independent of urea removal [4, 15–19]; and that clearance of 'middle molecules' is also important in determining outcomes [20, 21]. However, no consensus has yet emerged on alternative markers of HD dose. The findings of the HEMO study [6] should not be interpreted as showing that urea clearance is unimportant; only that there may be a 'ceiling effect' above which greater urea clearance, achieved using thrice weekly dialysis, has no additional benefit.

The failure to demonstrate any beneficial effect on survival by increasing HD dose above a URR of 65% [6] has raised doubts about the validity of URR and Kt/V as the appropriate measures to assess HD dose [14]. The impact of duration and frequency of HD independent of dialysis dose as measured by Kt/V or URR is uncertain [4, 15]. There is some evidence that longer treatment time improves survival [16, 17] and that care should be taken when using Kt/V or reduction ratios as the only parameters to quantify HD adequacy [18, 19]. Furthermore, it may be that urea is not the most appropriate retention product to use for measuring HD dose and that alternate marker molecules should be used [20, 21]. Both topics warrant further investigation.

Conflict of interest: none

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