

Supplemental Material

Supplemental Table 1. Comprehensive description of the CMS and KCQA UF rate measures.⁶

	CMS Measure	KCQA Measure
Description	% of patients in the facility with an UF rate >13 mL/h/kg	% of patients in the facility with an average UF rate ≥13 mL/h/kg and an average treatment time <240 minutes
Time window	1 month	12 months
Numerator	Number of patient-months in the facility with an UF rate >13 mL/h/kg	Number of patient-months in the facility with an average UF rate ≥13 mL/h/kg and an average treatment time <240 minutes
Numerator details	<p>For the HD treatment that meets the inclusion criteria:</p> <ol style="list-style-type: none"> Calculate the UF rate (mL/h/kg): $\text{UF rate} = (\text{pre-dialysis weight} - \text{post-dialysis weight (mL)}) / \text{delivered TT (h)} / \text{post-dialysis weight (kg)}$ <ol style="list-style-type: none"> Sum the number of patients in each facility with an UF rate >13 mL/h/kg 	<p>For all HD treatments that meet the inclusion criteria:</p> <ol style="list-style-type: none"> Calculate the UF rate (mL/h/kg) for each HD treatment: $\text{UF rate}_{\text{Treat}} = (\text{pre-dialysis weight} - \text{post-dialysis weight (mL)}) / \text{delivered TT (h)} / \text{post-dialysis weight (kg)}$ <ol style="list-style-type: none"> Calculate each patient's average UF rate for all HD treatments during the week that the monthly Kt/V is drawn: $\text{UF rate}_{\text{Mean}} = (\text{UF rate}_1 + \dots \text{UF rate}_j) / j$ <p>j=Number of treatments during the week that the monthly Kt/V is drawn</p> <ol style="list-style-type: none"> Calculate each patient's average treatment time for all HD treatments during the week that the monthly Kt/V is drawn: $\text{TT}_{\text{Mean}} = (\text{TT}_1 + \dots \text{TT}_j) / j$ <p>j=Number of treatments during the week that the monthly Kt/V is drawn</p> <ol style="list-style-type: none"> Sum the number of patients in each facility with an average UF rate ≥13 mL/h/kg and an average treatment time <240 minutes
Denominator	Total number of adult, in-center HD patients at the reporting facility meeting selection criteria	Total number of adult, in-center HD patients at the reporting facility meeting selection criteria
Denominator details	Identify all patients ≥18 years in the dialysis facility during the reporting period whose primary treatment modality is in-center HD	Identify all patients ≥18 years in the dialysis facility during the reporting period whose primary treatment modality is in-center HD
Exclusions	<ol style="list-style-type: none"> PD or home HD patients Age <18 years Treatment without complete pre-weight, post-weight, and TT Patient present at reporting facility <30 days Patient at facility with <11 patients during month Patient with dialysis vintage <90 days No treatment with UF rate 0-50 mL/h/kg 	<ol style="list-style-type: none"> PD or home HD patients Age <18 years Treatment without complete pre-weight, post-weight, and TT Patient present at reporting facility <30 days Patient at facility with <11 patients during month <7 HD treatments during reporting month ≥4 HD treatments during the calculation period^a
Score type	Rate / proportion	Rate / proportion
Score interpretation	Lower score more favorable	Lower score more favorable
Algorithm	Scores are calculated on a monthly basis using the following algorithm:	Scores are calculated on a monthly basis and then averaged over a 12-month period using the following algorithm:

	<p>1. Sum the number of patients in the denominator for each facility month</p> <p>2. Sum the number of patients in the numerator for each facility month</p> <p>3. Calculate the facility's monthly score:</p> <p>Score = Numerator Population / Denominator Population</p>	<p>1. Sum the number of patients in the denominator for each facility month</p> <p>2. Sum the number of patients in the numerator for each facility month</p> <p>3. Calculate the facility's score for each month:</p> <p>Score_k = Numerator Population_k / Denominator Population_k k=Each month of the reporting year</p> <p>4. Calculate the facility's annual score: Annual Score = (Score₁ + ... Score_k) / k k=Number of months in the reporting year</p>
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^a The National Quality Forum reported an exclusion of >4 HD treatments during the calculation period in their documentation of the KCQA measure;⁶ however, the KCQA measure developers tested an exclusion of ≥4 HD treatments during the calculation period.²² As an exclusion of ≥4 HD treatments represented developer intent and is congruent with the standard practice of 3 weekly treatments, we evaluated the measure using an exclusion of ≥4 HD treatments.

Abbreviations: CMS=Centers for Medicare & Medicaid Services, KCQA=Kidney Care Quality Alliance, UF=ultrafiltration, UFR=ultrafiltration rate, TT=treatment time, HD=hemodialysis.

Supplemental Table 2. Detailed description of additional facility treatment time calculation with the application of a 13 mL/h/kg UF rate threshold.

Actual Data						Calculated Data for 13 mL/h/kg UF rate threshold			
HD tmt	Pre-HD weight (kg)	Previous treatment post-HD weight (kg)	Interdialytic weight gain (kg)	Prescribed TT (min)	Prescribed UF rate (mL/h/kg)	Additional TT required (min)	New prescribed TT (min)	Cumulative additional TT (min)	UF rate (mL/h/kg) after TT extension
1	91.8	87.7	4.1	180	15.4	37	217	37	12.9
2	93.3	88.8	4.5	180	16.4	56	236	93	12.9
3	95.0	91.0	4.0	180	14.5	24	204	117	12.9
4	95.2	92.0	3.2	180	11.7	0	180	117	---
5	96.3	91.0	5.3	180	19.3	60	240	177	14.6
6	92.5	89.0	3.5	180	13.0	3	180	180	---
7	92.0	89.9	2.1	180	7.8	0	180	180	---
8	93.9	90.1	3.8	180	14.1	16	196	196	12.9
9	92.2	88.9	3.3	180	12.2	0	180	196	---
10	91.7	89.9	1.8	180	6.7	0	180	196	---
11	91.5	89.2	2.3	180	8.7	0	180	196	---
12	92.5	87.7	4.8	180	18.0	60	240	256	13.7
13	94.3	88.9	5.4	180	19.8	60	240	316	15.2

In order to calculate the weekly additional TT needed to meet a 13 mL/h/ UF rate threshold, treatments were restricted to those occurring in January 2012. All treatments from the week of the monthly Kt/V were isolated and the prescribed UF rate for each treatment was calculated as follows: (pre-dialysis weight from current treatment – post-dialysis weight from previous treatment (mL))/ prescribed TT (h)/ post-dialysis weight from previous treatment (kg). For treatments with a prescribed UF rate <13 mL/h/kg, no additional TT was assigned. For treatments with a prescribed UF rate ≥13 mL/h/kg, the additional TT (in minutes) needed to achieve the UF rate threshold was calculated as follows: ((pre-dialysis weight from current treatment – post-dialysis weight from previous treatment (mL))/ (post-dialysis weight from previous treatment (kg)*12.9))*60 – prescribed TT (min). Additional TTs were then summed for each patient and subsequently for each facility. An example of this calculation applied to an individual patient for all January 2012 treatments is shown in the table.

Abbreviations: HD=hemodialysis, tmt=treatment, TT=treatment time, UF=ultrafiltration.

Supplemental Table 3. Individual and facility-level UF rate measures calculated with varied operational definitions.^a

Month	Delivered UF rate from monthly Kt/V day		Delivered UF rate from last treatment of the month			Mean delivered UF rate from week of Kt/V	
	Patient-level	Facility-level	Patient-level	Facility-level	Last dialysis days of month	Patient-level	Facility-level
	UF rate (mL/h/kg) (mean ± SD)	Percentage of facility patients with UF rate >13 mL/h/kg (mean ± SD)	UF rate (mL/h/kg) (mean ± SD)	Percentage of facility patients with UF rate >13 mL/h/kg (mean ± SD)		UF rate (mL/h/kg) (mean ± SD)	Percentage of facility patients with UF rate >13 mL/h/kg (mean ± SD)
January	9.8 ± 5.5	22.3 ± 10.8	10.3 ± 5.6	25.8 ± 10.9	Mon/Tues	9.7 ± 4.6	19.9 ± 10.2
February	9.9 ± 5.5	22.8 ± 10.6	9.7 ± 5.5	21.7 ± 9.9	Tues/Wed	9.7 ± 4.6	19.8 ± 9.8
March	9.7 ± 5.4	22.1 ± 10.7	9.0 ± 5.2	17.9 ± 9.2	Fri/Sat	9.6 ± 4.5	18.9 ± 9.7
April	9.7 ± 5.3	22.0 ± 10.7	9.7 ± 5.3	22.8 ± 10.4	Fri/Sat	9.5 ± 4.5	18.6 ± 9.9
May	9.7 ± 5.3	21.6 ± 10.6	9.0 ± 5.2	17.8 ± 8.8	Wed/Thurs	9.5 ± 4.4	18.1 ± 9.5
June	9.6 ± 5.3	21.4 ± 10.6	8.7 ± 5.2	16.1 ± 8.2	Fri/Sat	9.4 ± 4.4	17.8 ± 9.4
July	9.5 ± 5.3	20.8 ± 10.3	10.0 ± 5.4	24.3 ± 10.4	Mon/Tues	9.3 ± 4.5	17.1 ± 9.0
August	9.5 ± 5.3	21.0 ± 10.1	8.8 ± 5.2	17.2 ± 8.6	Thurs/Fri	9.3 ± 4.4	17.5 ± 9.2
September	9.5 ± 5.2	21.1 ± 10.0	8.9 ± 5.1	17.3 ± 8.6	Fri/Sat	9.4 ± 4.4	17.8 ± 9.2
October	9.7 ± 5.3	22.1 ± 10.6	9.6 ± 5.4	20.9 ± 9.5	Tues/Wed	9.5 ± 4.4	18.2 ± 9.5
November	9.8 ± 5.3	22.3 ± 10.9	9.1 ± 5.2	18.2 ± 9.1	Thurs/Fri	9.6 ± 4.5	18.5 ± 9.7
December	9.7 ± 5.2	21.9 ± 10.6	9.4 ± 5.3	21.1 ± 9.9	Sat/Mon	9.4 ± 4.4	17.9 ± 9.5

Month	Mean delivered UF rate for month (≥7 treatments required)		Mean delivered UF rate from week of Kt/V (≥2 treatments required)		Prescribed UF rate from monthly Kt/V day	
	Patient-level	Facility-level	Patient-level	Facility-level	Patient-level	Facility-level
	UF rate (mL/h/kg) (mean ± SD)	Percentage of facility patients with UF rate >13 mL/h/kg (mean ± SD)	UF rate (mL/h/kg) (mean ± SD)	Percentage of facility patients with UF rate >13 mL/h/kg (mean ± SD)	UF rate (mL/h/kg) (mean ± SD)	Percentage of facility patients with UF rate >13 mL/h/kg (mean ± SD)
January	9.8 ± 4.0	18.5 ± 10.6	9.7 ± 4.5	19.8 ± 10.3	10.0 ± 5.9	23.4 ± 13.5
February	9.7 ± 3.9	17.6 ± 10.2	9.7 ± 4.5	19.7 ± 10.0	10.2 ± 5.9	25.1 ± 13.9
March	9.5 ± 3.9	16.7 ± 10.0	9.6 ± 4.4	18.9 ± 9.9	10.1 ± 5.9	24.4 ± 13.7
April	9.6 ± 3.9	17.0 ± 10.1	9.6 ± 4.4	18.4 ± 9.9	10.1 ± 5.8	24.6 ± 14.1
May	9.5 ± 3.9	16.0 ± 9.6	9.5 ± 4.3	18.0 ± 9.6	10.0 ± 5.8	24.0 ± 13.8
June	9.3 ± 3.8	15.5 ± 9.4	9.4 ± 4.3	17.7 ± 9.5	10.1 ± 5.9	24.3 ± 13.7
July	9.4 ± 3.9	15.7 ± 9.3	9.3 ± 4.3	16.9 ± 9.2	9.9 ± 5.8	24.0 ± 12.9
August	9.4 ± 3.8	15.3 ± 9.2	9.3 ± 4.3	17.4 ± 9.4	9.9 ± 5.8	23.9 ± 13.5
September	9.4 ± 3.8	15.9 ± 9.3	9.4 ± 4.3	17.8 ± 9.4	9.9 ± 5.8	23.1 ± 13.1
October	9.6 ± 3.9	16.7 ± 9.8	9.5 ± 4.3	18.1 ± 9.6	10.2 ± 5.9	25.3 ± 14.0
November	9.6 ± 3.8	16.3 ± 9.9	9.6 ± 4.4	18.5 ± 9.9	10.3 ± 5.9	26.2 ± 14.0
December	9.5 ± 3.8	16.2 ± 9.6	9.5 ± 4.3	18.0 ± 9.6	10.3 ± 5.9	25.2 ± 13.8

^a Estimation of monthly mean UF rates and mean percentage of facility patients with a UF rate > 13 mL/h/kg is presented for the 2012 CMS cohort (148,950 unique patients treated in 1,902 dialysis facilities) for 6 alternative operational definitions.

Abbreviations: UF=ultrafiltration, CMS=Centers for Medicare & Medicaid Services, SD=standard deviation.

Supplemental Table 4. Patient subgroups according to varied UF rate thresholds as of the first 2012 reporting month.

	CMS Measure				KCQA Measure			
	Total # patients	Percentage of patients with UF rate >10 mL/h/kg (# patients)	Percentage of patients with UF rate >13 mL/h/kg (# patients)	% Difference (# patients)	Total # patients	Percentage of patients with UF rate ≥10 mL/h/kg (# patients)	Percentage of patients with UF rate ≥13 mL/h/kg (# patients)	% Difference (# patients)
Full cohort	148,950	40.6% (60,502)	21.3% (31,719)	19.3% (28,783)	151,937	37.4% (56,758)	18.0% (27,298)	19.4% (29,460)
History of heart failure	38,506	45.4% (17,487)	24.8% (9,535)	20.6% (7,952)	37,609	44.4% (16,686)	22.6% (8,482)	21.8% (8,204)
Pre-HD systolic BP <100 mmHg ^a	3,087	36.5% (1,126)	19.4% (600)	17.1% (526)	3,310	32.8% (1,087)	16.0% (531)	16.8% (556)
History of IDH ^b	30,045	40.5% (12,168)	20.7% (6,218)	19.8% (5,950)	30,251	37.1% (11,221)	17.4% (5,259)	19.7% (5,962)
History of IDH among patients with pre-HD SBP ≥100 mmHg ^c	27,088	40.9% (11,075)	20.9% (5,649)	20.0% (5,426)	27,033	37.7% (10,196)	17.6% (4,771)	20.1% (5,425)

^a Pre-HD SBP <100 mmHg in >30% of treatments in the prior month.

^b Nadir SBP <90 mmHg in >30% of treatments in the prior month.

^c Nadir SBP <90 mmHg and pre-HD SBP ≥100 mmHg in >30% of treatments in the prior month.

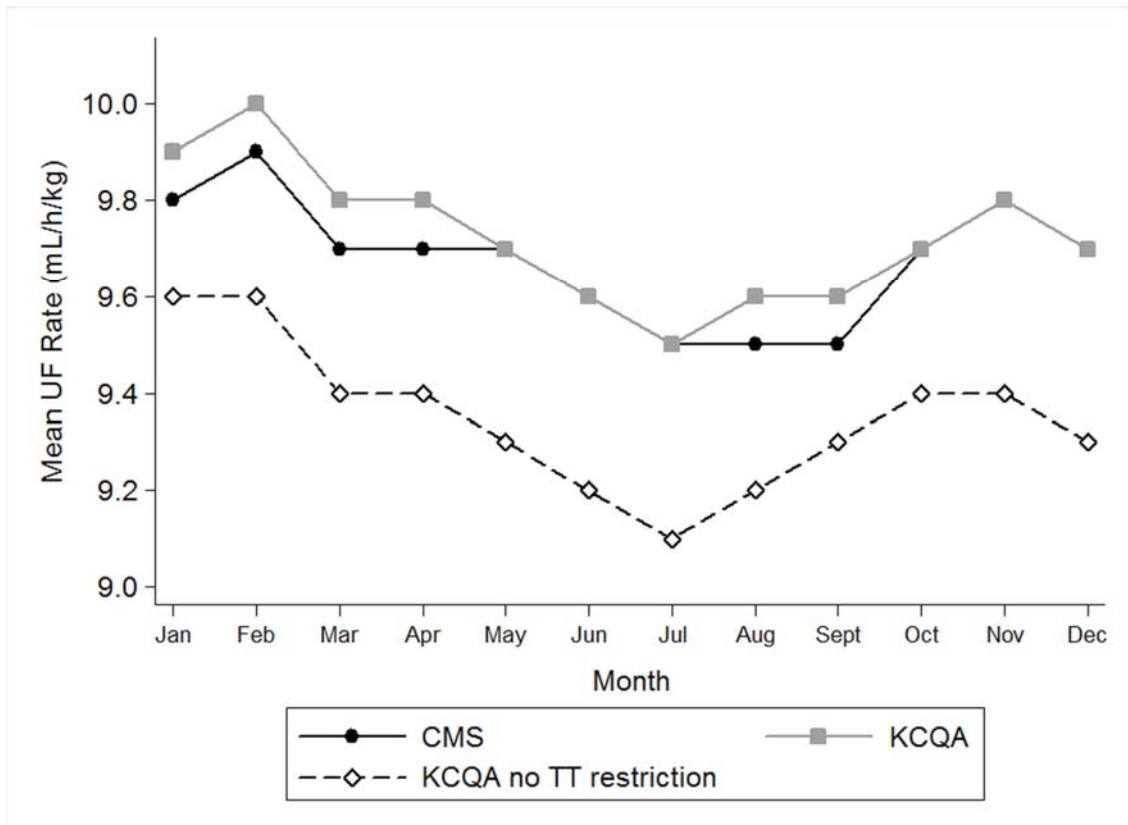
Abbreviations: CMS=Centers for Medicare & Medicaid Services, KCQA=Kidney Care Quality Alliance, UF=ultrafiltration, HD=hemodialysis, BP=blood pressure, IDH=intradialytic hypotension.

Supplemental Table 5. Facility characteristics of western region units compared to other regions.^a

	Western Region	Non-Western Region
N (%)	359 (20.5)	1,391 (79.5)
Monthly unit size (patients)	92 ± 51	65 ± 35
Monthly unit size (patients)		
≤25	28 (7.8)	154 (11.1)
26-50	53 (14.8)	388 (27.9)
51-100	127 (35.4)	651 (46.8)
>100	151 (42.1)	198 (14.2)
Age <50 years	19.4 ± 7.0	19.1 ± 7.8
Black race	13.4 ± 13.8	40.9 ± 30.7
Black race >50% of facility patients	7 (1.9)	531 (38.2)
Hispanic ethnicity	31.1 ± 22.2	9.2 ± 17.1
Hispanic ethnicity >25% of facility patients	187 (52.1)	143 (10.2)
Heart failure balance >25% of facility patients	249 (69.4)	763 (54.9)
Body mass index (kg/m ²)	27.2 ± 1.4	28.2 ± 1.5
Body mass Index (kg/m ²)		
<18.5	5.3 ± 3.3	4.7 ± 3.4
18.5-24.9	37.9 ± 7.5	33.5 ± 7.9
25.0-29.9	28.5 ± 5.8	27.8 ± 6.9
≥30	28.3 ± 8.2	34.0 ± 8.6

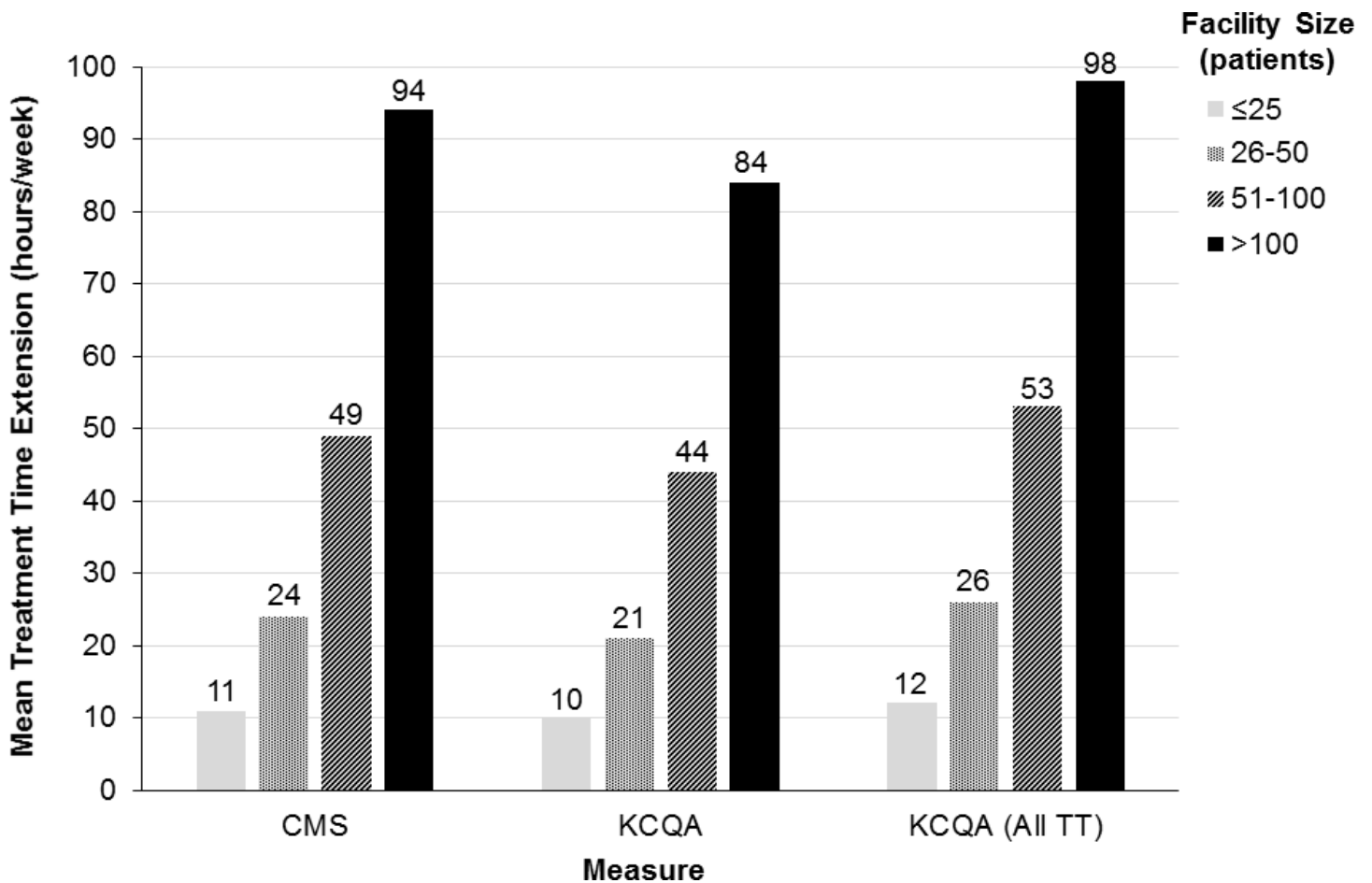
^a CMS facility characteristics for January 2012.

Supplemental Figure 1. Monthly mean UF rates across 2012 under CMS and KCQA measure specifications.



Abbreviations: CMS=Centers for Medicare & Medicaid Services, KCQA=Kidney Care Quality Alliance, UF=ultrafiltration, TT=treatment time.

Supplemental Figure 2. Weekly required additional facility treatment time with the application of a 13 mL/h/kg UF rate threshold without a total treatment time cap stratified by facility size.



The additional TT required to lower prescribed UF rates <13 mL/h/kg was computed at the facility level and stratified by facility size. Total TT was capped at 4 hours per KCQA specifications. For these analyses, prescribed UF rate (mL/h/kg) was calculated using the formula: (pre-dialysis weight from current treatment – post-dialysis weight from previous treatment (mL))/ prescribed TT (h)/ post-dialysis weight from previous treatment (kg). For treatments with a prescribed UF rate <13 mL/h/kg, no additional TT was assigned. For treatments with a prescribed UF rate ≥13 mL/h/kg, the additional TT (in minutes) needed to achieve the UF rate <13 mL/h/kg was calculated as follows: ((pre-dialysis weight from current treatment – post-dialysis weight from previous treatment (mL))/ (post-dialysis weight from previous treatment (kg)*12.9))*60 – prescribed TT (min). Total TT was capped at 4 hours per treatment such that the UF rate remained ≥13 mL/h/kg for treatments in which UF rate reduction to rates <13 mL/h/kg would result in extension of TT beyond 4 hours. Additional patient TTs were then summed for the month at the patient and then facility levels. Detailed methods for estimation of TT extension are described in Supplemental Table 2

Abbreviations: TT=treatment time, UF=ultrafiltration, KCQA=Kidney Care Quality Alliance.