Data Standard	**Single Treatment Net UFR Scaled to Body Weight**
Alternate Name(s)	Net Ultrafiltration Rate (UFR)
Description	The ultrafiltration rate is the rate of volume removal during hemodialysis. UFR reflects the net volume of removed fluid divided by body size measurement (e.g., weight) and the duration of dialysis. We follow the convention of normalizing the UFR to the post-dialysis body weight.
Rationale	Ultrafiltration is a key aspect of the dialysis procedure. UFR must be optimized to the needs of each patient (symptom management) and must be sufficient to manage inter-dialytic fluid gains. However, several observational studies have found that higher levels of UFR (> 10-13 ml/hr/kg) are associated with excess mortality risk.[1-5]
Data Source(s)	Hemodialysis treatment-level data
Required Data Elements	• Pre-dialysis weight (kg) • Post-dialysis weight (kg). The weighing conditions should be comparable for the pre- and post-dialysis weight (e.g., the same scale, identical clothing worn, use of a wheelchair, etc.) • Delivered treatment time (minutes). The delivered treatment time reflects the total time of administered dialysis (i.e., excludes time for intermittent dialysis discontinuation if blood returned)
Derived Data Elements	*If weight measured in pounds (lbs):* $\text{Net Fluid Removal (ml)} = [\text{Pre-Dialysis Weight (lbs)} - \text{Post-Dialysis Weight (lbs)}] \times 0.45\ \text{lbs/kg} \times 1000\ \text{ml/kg}$ *If weight measured in kilograms (kg):* $\text{Net Fluid Removal (ml)} = [\text{Pre-Dialysis Weight (kg)} - \text{Post-Dialysis Weight (kg)}] \times 1000\ \text{ml/kg}$ Note: Net ultrafiltration as written above will yield a positive number in the usual situation when the post-dialysis weight is less than the pre-dialysis weight. By convention, net ultrafiltration is usually expressed as net fluid removal and assumes a positive sign when fluid weight is removed. In the less common situation where the post-dialysis weight exceeds the pre-dialysis weight, the calculated value will be negative. Researchers should design data collection to clearly distinguish between fluid removal and gain.

Calculation Method	**Single Treatment UFR** $$\text{UFR (ml/hr/kg)} = \frac{\text{Net Fluid removal (ml)}}{\text{Delivered treatment time (min)} \cdot \text{Post-dialysis weight (kg)}} \cdot \frac{60 \text{ min}}{\text{hour}}$$ The typical unit of measure is ml/hr/kg, rounded to the first decimal point (e.g., 7.8321 rounds to 7.8).
Exclusions	• Hemodialysis treatments without the required data elements
Additional Desirable Data Elements for Collection	• Specific hemodialysis modality: in-center hemodialysis, home hemodialysis, home nocturnal hemodialysis, or in-center nocturnal hemodialysis (i.e., >6-hour treatment time in-center). • Prescribed dialysis frequency at the time of UFR measure (i.e., dialysis prescription at time of UFR measure) • Observed dialysis frequency within 7 days and inclusive of the date of the UFR measure (i.e., observed number of treatments in the 6 days before the UFR measurement and on the date of the UFR measurement) • Dialytic interval associated with the single treatment UFR measure (e.g., 2 days, 3 days, etc.). UFR often tracks with inter-dialytic fluid gains and will tend to be higher after a longer dialysis interval (e.g., Monday or Tuesday sessions).
Notes	• For calculation purposes, treatment time should exclude any time during the procedure when the patient is not connected to the machine and receiving dialysis. For example, the treatment time should be adjusted if dialysis is temporarily interrupted (e.g., to allow the patient to use bathroom facilities). • Net fluid removal integrates all fluid changes including total machine ultrafiltration, other fluid losses (e.g., unreturned blood) and administered fluid and differs from total machine ultrafiltration. • Measurement during unusual treatment times (e.g., <90 minutes) will yield a non-representative UFR and should be considered for exclusion. • Treatments with intra-dialytic weight change with a weight reduction of 20 percent or more or a weight gain of 10 percent or more may represent inaccurate or erroneous data entry. Investigators should specify exclusion criteria for intra-dialytic weight changes. • The literature regarding use of UFR in children is considered incomplete. • Alternate expressions of the UFR have been advocated. Alternative expressions include normalization using body surface area (BSA) instead of post-dialysis weight and excluding the body size adjustment altogether. • UFR estimates may also need to be interpreted in the context of extreme body weights, and investigators can consider appropriate exclusions based on body weight.

	• The UFR method quantifies the average rate of fluid removal over the dialysis session. The instantaneous UFR during the procedure can deviate substantially from the average. The implications of transient variation in UFR are not well understood. • UFR can be calculated for a single treatment or averaged over a longer time period such as one week or 30 days. If calculating UFRs across multiple treatments, consider excluding treatments that are atypical (e.g., unusually short or long treatment times). • To aggregate and calculate the average UFR for any time period (e.g., 3 treatments, 30-days, etc.), first calculate the UFR for each individual treatment and then calculate the average by summing the UFRs across treatments and dividing by the number of treatments. • UFR would be a negative value in the relatively unusual situation where fluid is added during the procedure, usually due to fluid administration. Researchers should design data collection to distinguish between net fluid loss and gain. Depending on the situation and specific analysis, researchers can decide whether to exclude these values, set these values to zero or use the negative value. • For the purposes of research, the individual data elements and the calculated UFR should be collected. For example, the interpretation of the UFR may depend on body size when body size is measured in kgs.

Example Measure Calculation	The following is an example of how to calculate individual treatment-level net UFR scaled to body weight and ascertain additional important data elements for data collection:
	
	• In-center hemodialysis modality, prescribed thrice weekly dialysis
	• UFR calculation for dialysis treatment on Monday (April 8, 2019):
	  ○ Pre-dialysis weight 73 kg, Post-dialysis weight 70 kg, Total treatment time 240 minutes
	  ○ Prior dialysis treatments were on Friday (April 5, 2019) and Wednesday (April 3, 2019)
	
	$\text{UFR (ml/hr/kg)} = \frac{3000}{240 \cdot 70} \cdot \frac{60 \text{ min}}{\text{hour}} = 10.7$
	
	The interdialytic interval is 3 days and the observed number of treatments within the last 7 days is 3.

Acronyms	BSA Body surface area UFR Ultrafiltration rate

References

1. Saran R, Bragg-Gresham JL, Levin NW, et al. Longer treatment time and slower ultrafiltration in hemodialysis: associations with reduced mortality in the DOPPS. *Kidney Int.* 2006;69(7):1222-1228.
2. Movilli E, Gaggia P, Zubani R, et al. Association between high ultrafiltration rates and mortality in uraemic patients on regular haemodialysis. A 5-year prospective observational multicentre study. *Nephrol Dial Transplant.* 2007;22(12):3547-3552.
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4. Assimon MM, Wenger JB, Wang L, Flythe JE. Ultrafiltration Rate and Mortality in Maintenance Hemodialysis Patients. *Am J Kidney Dis.* 2016;68(6):911-922.
5. Kim TW, Chang TI, Kim TH, et al. Association of Ultrafiltration Rate with Mortality in Incident Hemodialysis Patients. *Nephron.* 2018;139(1):13-22.