**National Quality Forum—Evidence (subcriterion 1a)**

**Measure Number** (*if previously endorsed*)**:** Click here to enter NQF number

**Measure Title**: Minimum Delivered Hemodialysis Dose

**IF the measure is a component in a composite performance measure, provide the title of the Composite Measure here:** Click here to enter composite measure #/ title

**Date of Submission**: 2/27/2015

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| **Instructions**  *For composite performance measures:*  *A separate evidence form is required for each component measure unless several components were studied together.*  *If a component measure is submitted as an individual performance measure, attach the evidence form to the individual measure submission.*   * Respond to all questions as instructed with answers immediately following the question. All information needed to demonstrate meeting the evidence subcriterion (1a) must be in this form. An appendix of *supplemental* materials may be submitted, but there is no guarantee it will be reviewed. * If you are unable to check a box, please highlight or shade the box for your response. * Maximum of 10 pages (*incudes questions/instructions*; minimum font size 11 pt; do not change margins). ***Contact NQF staff if more pages are needed.*** * Contact NQF staff regarding questions. Check for resources at [Submitting Standards webpage](http://www.qualityforum.org/Measuring_Performance/Submitting_Standards.aspx). |

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| **Note: The information provided in this form is intended to aid the Steering Committee and other stakeholders in understanding to what degree the evidence for this measure meets NQF’s evaluation criteria.**   1a. Evidence to Support the Measure Focus The measure focus is evidence-based, demonstrated as follows:   * Health outcome: [**3**](#Note3) a rationale supports the relationship of the health outcome to processes or structures of care. Applies to patient-reported outcomes (PRO), including health-related quality of life/functional status, symptom/symptom burden, experience with care, health-related behavior. * Intermediate clinical outcome: a systematic assessment and grading of the quantity, quality, and consistency of the body of evidence [**4**](#Note4)that the measured intermediate clinical outcome leads to a desired health outcome. * Process: [**5**](#Note5) a systematic assessment and grading of the quantity, quality, and consistency of the body of evidence [**4**](#Note4) that the measured process leads to a desired health outcome. * Structure: a systematic assessment and grading of the quantity, quality, and consistency of the body of evidence [**4**](#Note4) that the measured structure leads to a desired health outcome. * Efficiency: [**6**](#Note6) evidence not required for the resource use component.   **Notes**  **3.** Generally, rare event outcomes do not provide adequate information for improvement or discrimination; however, serious reportable events that are compared to zero are appropriate outcomes for public reporting and quality improvement.  **4.** The preferred systems for grading the evidence are the U.S. Preventive Services Task Force (USPSTF) [grading definitions](http://www.uspreventiveservicestaskforce.org/uspstf/grades.htm) and [methods](http://www.uspreventiveservicestaskforce.org/methods.htm), or Grading of Recommendations, Assessment, Development and Evaluation [(GRADE) guidelines](http://www.gradeworkinggroup.org/publications/index.htm).  **5.** Clinical care processes typically include multiple steps: assess → identify problem/potential problem → choose/plan intervention (with patient input) → provide intervention → evaluate impact on health status. If the measure focus is one step in such a multistep process, the step with the strongest evidence for the link to the desired outcome should be selected as the focus of measurement. Note: A measure focused only on collecting PROM data is not a PRO-PM.  **6.** Measures of efficiency combine the concepts of resource use and quality (see NQF’s [Measurement Framework: Evaluating Efficiency Across Episodes of Care](http://www.qualityforum.org/Publications/2010/01/Measurement_Framework__Evaluating_Efficiency_Across_Patient-Focused_Episodes_of_Care.aspx); [AQA Principles of Efficiency Measures](http://www.aqaalliance.org/files/PrinciplesofEfficiencyMeasurementApril2006.doc)). |

**1a.1.This is a measure of**: (*should be consistent with type of measure entered in De.1*)

Outcome

Health outcome: Click here to name the health outcome

Patient-reported outcome (PRO): Click here to name the PRO

*PROs include HRQoL/functional status, symptom/symptom burden, experience with care, health-related behaviors*

Intermediate clinical outcome (*e.g., lab value*): Kt/V

Process: Click here to name the process

Structure: Click here to name the structure

Other: Click here to name what is being measured

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**HEALTH OUTCOME/PRO PERFORMANCE MEASURE**  *If not a health outcome or PRO, skip to* [*1a.3*](#Section1a3)

**1a.2.** **Briefly state or diagram the path between the health outcome (or PRO) and the healthcare structures, processes, interventions, or services that influence it.**

N/A

**1a.2.1.** **State the rationale supporting the relationship between the health outcome (or PRO) to at least one healthcare structure, process, intervention, or service (*i.e., influence on outcome/PRO*).**

N/A

*Note: For health outcome/PRO performance measures, no further information is required; however, you may provide evidence for any of the structures, processes, interventions, or service identified above.*

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**intermediate outcome, PROCESS, or STRUCTURE PERFORMANCE measure**

**1a.3.****Briefly state or diagram the path between structure, process, intermediate outcome, and health outcomes**. Include all the steps between the measure focus and the health outcome.

The measure focus is measurement of spKt/V >= 1.2. This process leads to improvement in mortality as follows: Measure spKt/V--> Assess value-->Impact on mortality.

**1a.3.1.** **What is the source of the systematic review of the body of evidence that supports the performance measure?**

Clinical Practice Guideline recommendation – ***complete sections*** [***1a.4***](#Section1a4)***, and*** [***1a.7***](#Section1a7)

US Preventive Services Task Force Recommendation – ***complete sections*** [***1a.5***](#Section1a5) ***and*** [***1a.7***](#Section1a7)

Other systematic review and grading of the body of evidence (*e.g., Cochrane Collaboration, AHRQ Evidence Practice Center*) – ***complete sections*** [***1a.6***](#Section1a6) ***and*** [***1a.7***](#Section1a7)

Other – ***complete section*** [***1a.8***](#Section1a8)

*Please complete the sections indicated above for the source of evidence. You may skip the sections that do not apply.*

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**1a.4. CLINICAL PRACTICE GUIDELINE RECOMMENDATION**

**1a.4.1.** **Guideline citation** (*including date*) and **URL for guideline** (*if available online*):

National Kidney Foundation. KDOQI Clinical Practice Guidelines and Clinical Practice Recommendations for Hemodialysis Adequacy, Update 2006. http://www.kidney.org/professionals/KDOQI/guidelines\_commentaries

Clinical Practice Guidelines for Hemodialysis Adequacy: KDOQI Guideline 8. Pediatric Hemodialysis Prescription and Adequacy: 2006.

http://www2.kidney.org/professionals/KDOQI/guideline\_upHD\_PD\_VA/hd\_guide8.htm

**1a.4.2.** **Identify guideline recommendation number and/or page number** and **quote verbatim, the specific guideline recommendation**.

Adult:

4.1 The minimally adequate dose of HD given 3 times per week to patients with Kr less than 2 mL/min/1.73 m2 should be an spKt/V (excluding RKF) of 1.2 per dialysis session. (A)

Pediatric:

8.3.1 Children should receive at least the delivered dialysis dose as recommended for the adult population. (A)

**1a.4.3.** **Grade assigned to the quoted recommendation with definition of the grade:**

Grade A: It is strongly recommended that clinicians routinely follow the guideline for eligible patients. There is strong evidence that the practice improves health outcomes.

**1a.4.4. Provide all other grades and associated definitions for recommendations in the grading system.** (*Note: If separate grades for the strength of the evidence, report them in section 1a.7.*)

The rating system defined in the KDOQI Guidelines was used to grade the strength of the Guideline recommendation. KDOQI defined grades as follows:

Grade A: It is strongly recommended that clinicians routinely follow the guideline for eligible patients. There is strong evidence that the practice improves health outcomes.

Grade B: It is recommended that clinicians routinely follow the guideline for eligible patients. There is moderately strong evidence that the practice improves health outcomes.

Grade CPR: It is recommended that clinicians consider following the guideline for eligible patients. This recommendation is based on either weak evidence or on the opinions of the Work Group and reviewers that the practice might improve health outcomes.

**1a.4.5. Citation and URL for methodology for grading recommendations** (*if different from 1a.4.1*)**:**

National Kidney Foundation: DOQI Clinical Practice Guidelines for Hemodialysis Adequacy. Appendix 1. Methods for Evaluating Evidence. Update 2006.

http://www.kidney.org/professionals/KDOQI/guidelines\_commentaries

**1a.4.6. If guideline is evidence-based (rather than expert opinion), are the details of the quantity, quality, and consistency of the body of evidence available (e.g., evidence tables)?**

Yes **→ *complete section*** [***1a.7***](#Section1a7)

No **→ *report on another systematic review of the evidence in sections*** [***1a.6***](#Section1a6) ***and*** [***1a.7***](#Section1a7)***; if another review does not exist, provide what is known from the guideline review of evidence in*** [***1a.7***](#Section1a7)

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**1a.5.** **UNITED STATES PREVENTIVE SERVICES TASK FORCE RECOMMENDATION**

**1a.5.1.** **Recommendation citation** (*including date*) and **URL for recommendation** (*if available online*):

N/A

**1a.5.2.** **Identify recommendation number and/or page number** and **quote verbatim, the specific recommendation**.

N/A

**1a.5.3.** **Grade assigned to the quoted recommendation with definition of the grade**:

N/A

**1a.5.4. Provide all other grades and associated definitions for recommendations in the grading system.** (*Note: the* *grading system for the evidence should be reported in section 1a.7.*)

N/A

**1a.5.5. Citation and URL for methodology for grading recommendations** (*if different from 1a.5.1*)**:**

N/A

***Complete section*** [***1a.7***](#Section1a7)

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**1a.6. OTHER SYSTEMATIC REVIEW OF THE BODY OF EVIDENCE**

**1a.6.1.** **Citation** (*including date*) and **URL** (*if available online*):

N/A

**1a.6.2.** **Citation and** **URL for methodology for evidence review and grading** (*if different from 1a.6.1*)**:**

N/A

***Complete section*** [***1a.7***](#Section1a7)

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**1a.7. FINDINGS FROM SYSTEMATIC REVIEW OF BODY OF THE EVIDENCE supporting the measure**

*If more than one systematic review of the evidence is identified above, you may choose to summarize the one (or more) for which the best information is available to provide a summary of the quantity, quality, and consistency of the body of evidence. Be sure to identify which review is the basis of the responses in this section and if more than one, provide a separate response for each review.*

**1a.7.1.** **What was the specific structure, treatment, intervention, service, or intermediate outcome addressed in the evidence review?**

The information in this section applies to the guideline for the adult patients.

As the guideline states, the minimally adequate dose of HD given 3 times per week to patients with Kr less than 2 mL/min/1.73 m2 should be an spKt/V (excluding RKF) of 1.2 per dialysis session.

**1a.7.2.** **Grade assigned for the quality of the quoted evidence with definition of the grade**:

The body of evidence was rated in the KDOQI Guidelines. Two of the studies were graded A, and the remaining were graded C.

**1a.7.3. Provide all other grades and associated definitions for strength of the evidence in the grading system.**

The rating system defined in the KDOQI Guidelines was used to grade the strength of the Guideline recommendation. KDOQI defined grades as follows:

Grade A: It is strongly recommended that clinicians routinely follow the guideline for eligible patients. There is strong evidence that the practice improves health outcomes.

Grade B: It is recommended that clinicians routinely follow the guideline for eligible patients. There is moderately strong evidence that the practice improves health outcomes.

Grade CPR: It is recommended that clinicians consider following the guideline for eligible patients. This recommendation is based on either weak evidence or on the opinions of the Work Group and reviewers that the practice might improve health outcomes.

**1a.7.4.** **What is the time period covered by the body of evidence? (*provide the date range, e.g., 1990-2010*). Date range**: 1999-2004

**QUANTITY AND QUALITY OF BODY OF EVIDENCE**

**1a.7.5.****How many and what type of study designs are included in the body of evidence**? (*e.g., 3 randomized controlled trials and 1 observational study*)

10. Included RCTs, retrospective and prospective cohort studies.

**1a.7.6.** **What is the overall quality of evidence across studies in the body of evidence**? (*discuss the certainty or confidence in the estimates of effect particularly in relation to study factors such as design flaws, imprecision due to small numbers, indirectness of studies to the measure focus or target population*)

The body of evidence show a correlation between delivered dose of HD and patient mortality and morbidity. Thus, this evidence directly supports this measure. Of the 11 studies, 5 measured dialysis dose using spKt/v [1,3,8,9,10], and 3 used URR[4,5,7]. The remaining studies used eKt/V [2,6]. Among the studies using spKt/V, one study was a randomized clinical trial (HEMO study) with 1846 patients, one was a prospective study with 740 patients, and the remaining were retrospective cohort studies with sample sizes of 1771 and 1151. Two of these studies found a significant improvement in mortality with increasing dose of spKt/V. The remaining study compared higher doses of spKt/v to the standard dose (spKt/V =1.2) and found higher doses did not improvement in mortality compared to the standard dose. Of the three studies measuring URR, one study found a significant association between increased URR and lower mortality among all patients, one also found higher URR was associated with lower mortality but only among women, and one study found no significant association between URR and mortality.

1. Eknoyan G, Beck GJ, Cheung AK, et al: Effect of dialysis dose and membrane flux in maintenance hemodialysis. N Engl J Med347:2010-2019, 2002.
2. Depner T, Daugirdas J, Greene T, et al: Dialysis dose and the effect of gender and body size on outcome in the HEMO Study. Kidney Int 65:1386-1394, 2004.
3. Termorshuizen F, Dekker FW, van Manen JG, Korevaar JC, Boeschoten EW, Krediet RT: Relative contribution of residual renal function and different measures of adequacy to survival in hemodialysis patients: An analysis of the Netherlands Cooperative Study on the Adequacy of Dialysis (NECOSAD)-2. J Am Soc Nephrol 15:1061-1070, 2004.
4. Port FK, Wolfe RA, Hulbert-Shearon TE, McCullough KP, Ashby VB, Held PJ: High dialysis dose is associated with lower mortality among women but not among men. Am J Kidney Dis 43:1014-1023, 2004.
5. Port FK, Ashby VB, Dhingra RK, Roys EC, Wolfe RA: Dialysis dose and body mass index are strongly associated with survival in hemodialysis patients. J Am Soc Nephrol 13:1061-1066, 2002.
6. Wolfe RA, Ashby VB, Daugirdas JT, Agodoa LY, Jones CA, Port FK: Body size, dose of hemodialysis, and mortality. Am J Kidney Dis 35:80-88, 2000.
7. Chertow GM, Owen WF, Lazarus JM, Lew NL, Lowrie EG: Exploring the reverse J-shaped curve between urea reduction ratio and mortality. Kidney Int 56:1872-1878, 1999.
8. Leypoldt JK, Cheung AK, Carroll CE, et al: Effect of dialysis membranes and middle molecule removal on chronic hemodialysis patient survival. Am J Kidney Dis 33:349-355, 1999.
9. Salahudeen AK, Dykes P, May W: Risk factors for higher mortality at the highest levels of spKt/V in hemodialysis patients.Nephrol Dial Transplant 18:1339-1344, 2003.
10. Woods HF, Nandakumar M: Improved outcome for haemodialysis patients treated with high-flux membranes. Nephrol Dial Transplant 15:S36-S42, 2000 (suppl 1).

**ESTIMATES OF BENEFIT AND CONSISTENCY ACROSS STUDIES IN BODY OF EVIDENCE**

**1a.7.7.** **What are the estimates of benefit—magnitude and direction of effect on outcome(s) across studies in the body of evidence**? (*e.g., ranges of percentages or odds ratios for improvement/ decline across studies, results of meta-analysis, and statistical significance*)

Among the studies showing a significant improvement in mortality with increasing dose of spKt/V, relative risks (RR) were presented as spKt/V per increase of 1 unit and spKt/V per 0.1 unit, where spKt/V was analyzed as a continuous measure. The RR per 1 unit increase in spKt/V was 0.76 (95% CI: 0.64, 0.92; p=0.004) [3], and per 0.1 unit increase in spKt/V was 0.95; p<0.05 (no CI given) [8]. The HEMO trial found no significant difference in mortality among patients in the high dose group, with mean = 1.56 and SD=0.09, compared to the low dose group with mean=1.16 and SD=0.08 (RR=0.96; 95% CI: 0.84, 1.10) [1], thus supporting the current target spKt/V of 1.2. However, a subgroup analysis of the HEMO study [2] showed that survival rates in women randomized to the higher dose group were higher than women in the lower dose group (relative risk 0.81; p = 0.02) and this association persisted after adjusting for body size. In the remaining study, findings showed patients receiving the highest dialysis dose (spKt/V>2.4) compared to the standard dose group (spKt/V 1.2-1.3) had an increased risk of mortality (RR=2.5; p<0.05), although this may be suggestive of confounding by indication. No other significant associations between dose groups were found in this study [9]. All but one study showed a benefit for a minimum dose of dialysis when measured as spKt/V.

**1a.7.8.** **What harms were studied and how do they affect the net benefit (benefits over harms)?**

Studies evaluating higher doses of dialysis adequacy did not demonstrate additional benefit at spKt/V doses higher than the current target of 1.2. The increase in mortality at the highest dialysis dose is thought to be due to confounding by indication and does not suggest that higher dialysis dose is associated with increased mortality.

**UPDATE TO THE SYSTEMATIC REVIEW(S) OF THE BODY OF EVIDENCE**

**1a.7.9.** **If new studies have been conducted since the systematic review of the body of evidence, provide for each new study: 1) citation, 2) description, 3) results, 4) impact on conclusions of systematic review**.

N/A

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**1a.8 OTHER SOURCE OF EVIDENCE**

*If source of evidence is NOT from a clinical practice guideline, USPSTF, or systematic review, please describe the evidence on which you are basing the performance measure.*

**1a.8.1** **What process was used to identify the evidence?**

Evidence supporting the adult hemodialysis targets is listed in 1.a.7.6 The process for obtaining additional sources of evidence is outlined below.

The 2009 clinical pediatric dialysis adequacy TEP conducted a literature search, where we retrieved a total of 190 articles using several sources. First, we retrieved 79 articles using a PubMed search of articles with human subjects, published in English since January 1, 2005. The search terms were: [(pediatric OR pediatrics OR children) and (dialysis OR hemodialysis OR peritoneal dialysis) and (adequacy OR "dialysis dose" OR "dose monitoring" OR "residual renal function" OR "urea clearance" OR "solute clearance" OR "phosphate clearance" OR "amino acid clearance" OR "folate clearance" OR "Kt/V" OR "peritoneal equilibration test" OR ("ultrafiltration" and peritoneal)) and NOT (cvvhd OR "continuous veno venous" OR transplant OR "kidney transplant" OR transplantation)].

Second, we reviewed 61 citations from the Kidney Disease Outcomes Quality Initiative Guidelines on pediatric peritoneal dialysis and hemodialysis. Third, we reviewed the tables of contents of the journal Pediatric Nephrology and retrieved two articles from early on-line publishing that had not yet been included in PubMed. Finally, we reviewed the citations in 14 articles previously identified; this found an additional 65 articles for review. Duplicate articles were excluded. A total of 124 articles were found to be relevant for measure development. Four articles listed below [1-4] were determined to be relevant to this specific measure.

In May 2014, an additional review of the literature for new evidence performed. Additional evidence pertaining to the adult [5-8] and pediatric [9-12] achievement of adequate dialysis are included in the citations below as a result of that search. While these articles don’t provide additional information on the Kt/V target specified in this measure (1.2), they do provide support for the concept of providing adequate dialysis to ensure improved outcomes for dialysis patients.

**1a.8.2.** **Provide the citation and summary for each piece of evidence.**

1. Lowrie EG, et al. Effect of the hemodialysis prescription of patient morbidity: report from the National Cooperative Dialysis Study. N Engl J Med 305:1176–1181, 1981.

Abstract: This report summarizes morbidity in 151 patients in a cooperative trial designed to evaluate the clinical effects of different dialysis prescriptions. Four treatment groups were divided along two dimensions: dialysis treatment time (long or short), and blood urea nitrogen (BUN) concentration averaged with respect to time (TACurea) (high or low). Dietary protein was not restricted. There was no difference in mortality between the groups. Withdrawal of patients from the high-BUN groups for medical reasons was significantly greater than withdrawal from the lowBUN groups. Hospitalization was also greater in the high-BUN groups, but dialysis treatment time had no significant effects.

The data indicate that the occurrence of morbid events is affected by the dialysis prescription. Increased morbidity appears to accompany prescriptions associated with a relatively high BUN. Conversely, morbidity may be decreased by prescriptions associated with more efficient removal of urea if the dietary intake of protein and other nutrients is adequate. (N Engl J Med. 1981; 305:1176–81.)

1. Owen WF Jr, et al. The urea reduction ratio and serum albumin concentration as predictors of mortality in patients undergoing hemodialysis. N Engl J Med 329:1001–1006, 1993.  
     
    BACKGROUND:

Among patients with end-stage renal disease who are treated with hemodialysis, solute clearance during dialysis and nutritional adequacy are determinants of mortality. We determined the effects of reductions in blood urea nitrogen concentrations during dialysis and changes in serum albumin concentrations, as an indicator of nutritional status, on mortality in a large group of patients treated with hemodialysis.

METHODS:

We analyzed retrospectively the demographic characteristics, mortality rate, duration of hemodialysis, serum albumin concentration, and urea reduction ratio (defined as the percent reduction in blood urea nitrogen concentration during a single dialysis treatment) in 13,473 patients treated from October 1, 1990, through March 31, 1991. The risk of death was determined as a function of the urea reduction ratio and serum albumin concentration.

RESULTS:

As compared with patients with urea reduction ratios of 65 to 69 percent, patients with values below 60 percent had a higher risk of death during follow-up (odds ratio, 1.28 for urea reduction ratios of 55 to 59 percent and 1.39 for ratios below 55 percent). Fifty-five percent of the patients had urea reduction ratios below 60 percent. The duration of dialysis was not predictive of mortality. The serum albumin concentration was a more powerful (21 times greater) predictor of death than the urea reduction ratio, and 60 percent of the patients had serum albumin concentrations predictive of an increased risk of death (values below 4.0 g per deciliter). The odds ratio for death was 1.48 for serum albumin concentrations of 3.5 to 3.9 g per deciliter and 3.13 for concentrations of 3.0 to 3.4 g per deciliter. Diabetic patients had lower serum albumin concentrations and urea reduction ratios than nondiabetic patients.

CONCLUSIONS:

Low urea reduction ratios during dialysis are associated with increased odds ratios for death. These risks are worsened by inadequate nutrition.

1. Gorman G, et al. Clinical outcomes and dialysis adequacy in adolescent hemodialysis patients. Am Journal Kidney Dis; 47: 285-93, 2006.

BACKGROUND:

The National Kidney Foundation-Kidney Disease Outcomes Quality Initiative guidelines recommend that adult hemodialysis (HD) patients receive a minimum dialysis dose by single-pooled Kt/V (spKt/V) of 1.2 or greater. There are no data to support a minimum spKt/V dose for children on HD therapy. We aim to determine the association of spKt/V with mortality and hospitalization in adolescents.

METHODS:

Clinical characteristics of adolescent HD patients aged 12 to 18 years old included in the 2000/2001 End-Stage Renal Disease Clinical Performance Measures Project were linked to US Renal Data System data from October 1, 1999, to October 15, 2001. Hospitalization risks after adjustment for time on dialysis therapy, access, hemoglobin level, albumin level, and height were determined by means of Poisson regression. spKt/V was analyzed by the adult target (< versus > or = 1.2) and by intervals.

RESULTS:

There were 613 patients with 477 patient-years of follow-up, during which there were 14 deaths and 185 hospitalizations covering 1,108 days. After adjustment, patients with an spKt/V less than 1.2 had increased hospitalization risk (1.59; 95% confidence interval, 0.98 to 2.56; P = 0.06) compared with those with an spKt/V of 1.2 or greater. Compared with patients with an spKt/V of 1.2 to 1.4, patients with an spKt/V less than 1.2 had increased adjusted risk for hospitalization (2.46; 95% confidence interval, 1.23 to 4.94; P = 0.01). Increases in spKt/V beyond 1.4 were not associated with improved outcomes.

CONCLUSION:

Applying the current adequacy guideline to adolescent HD patients is justified by the increased hospitalization risk of those who fail to attain an spKt/V of 1.2 or greater. However, attaining an spKt/V in excess of 1.4 was not associated with greater benefit.

1. Fischbach M, et al. Intensified and daily hemodialysis in children might improve statural growth. Pediatr Nephrol 21:1746–1752, 2006.

Abstract: In children conventional hemodialysis does not often improve growth. We determined linear growth in five children on in-center intensified and daily hemodialysis (IDd) regimen, with a mean age of 8 years 7 months at enrollment. Four of five were on growth hormone started for a median of 28.5 months before IDd. IDd was delivered 5 to 6 times weekly, for three hours each session. Mean follow up of IDd was 18.6 months. Dropout from IDd was kidney transplantation (n=4) or transfer to another center (n=1). IDd and free diet improved appetite, thereby protein intake, was above 2 g/kg/BW. Median weekly Kt/V(urea) was 9.1 (8.7 to 10.4). Predialysis phosphorus blood levels were higher at the start (2.04+/-0.34 mmol/L) than at end of IDd (1.39+/-0.41 mmol/L) without need for carbonate of calcium in four of five cases. During conventional dialysis ht SDS decreased from -0.8 to -1.44, which occurred predominantly before rhGH start. Conversion to IDd significantly increased growth velocity to a mean of 13 cm/year (10.3-18) with a mean change of +1.84 ht SDS/year (0.4 to 2.7). This preliminary report suggests the potential efficacy of IDd regimen in promising growth velocity, either directly from a higher dialysis dose or indirectly through an improved nutritional status.

1. Ulusoy S, Güngör E, Gül S et al. Do hemodialysis adequacy data reflect reality? Artif Organs. 2013 Feb;37(2):189-95. doi: 10.1111/j.1525-1594.2012.01537.x. Epub 2012 Oct 9.

Abstract: Hemodialysis (HD) adequacy requires monitoring in line with standards and at appropriate intervals. However, the use of inappropriate or incorrectly applied techniques in the determination of HD adequacy can lead to highly unfortunate results. This study was intended to identify the path to a solution by determining how far HD adequacy in HD centers in our region reflects reality. Three hundred and thirty HD patients from eight centers were included. On the first visit, predialysis and postdialysis blood collection with the centers' own methods being used were observed and errors were recorded. Kt/V1 was calculated from pre- and postdialysis blood specimens taken by the units themselves. On the second visit, one session later, pre- and postdialysis blood samples were collected in line with guidelines by ourselves, the authors, and Kt/V2 was calculated from these samples. The eight units' total Kt/V2 value was significantly lower compared with Kt/V1 (<0.0001). The level of patients in all centers with Kt/V1 <1.2 was 13.5%, and that of patients with Kt/V2 <1.2 was 22.1%. No center, apart from one unit, managed to complete the collection of blood specimens as recommended by the guidelines. With one exception, blood collection for HD adequacy was not performed using proper technique in any center. This simple but easily overlooked situation, HD being regarded as adequate though in fact it is not, may lead to patients not being treated effectively and accurately and to a rise in mortality and morbidity in the long term.

1. Eloot S, Van Biesen W, Vanholder R. A sad but forgotten truth: the story of slow-moving solutes in fast hemodialysis. Semin Dial. 2012 Sep-Oct;25(5):505-9. doi: 10.1111/j.1525-139X.2012.01107.x. Epub 2012 Aug 26.

Abstract: When trying to optimize hemodialysis adequacy, it can be questioned whether one should focus on the dialyzer or on the patient. Another crucial question is whether the currently applied dialysis adequacy parameter, Kt/V(urea) , is a reliable marker. For the small and water-soluble solutes, recent advances in convective strategies and/or new dialyzer designs do not add much removal capacity. Depending on their specific kinetics, generally quite different from those of urea, small solute removal benefits from longer or more frequent dialysis. Clearance of beta-2-microglobulin (β(2) M), a marker of middle molecule removal pattern, is improved with dialysis using more open and permselective membranes, as well as by using high convective volume strategies. Furthermore, longer and more frequent dialyses have highly favorable removal characteristics because they facilitate the retarded transport between plasmatic and extraplasmatic compartments over which these molecules are distributed. As β(2) M may not be representative of other middle molecules, future kinetic analyses of alternative middle molecules will be of the utmost interest. Protein-bound solute clearance is improved by convective techniques, but not by more open dialyzer pores. Knowledge of their kinetics should be helpful in interpreting the observation that frequent (but not longer) dialysis enhances protein-bound solute removal. Hence, further technical improvements in dialyzers will have only a minor impact on dialysis adequacy, as retarded solute movement in the patient plays a decisive role. As urea kinetics is not representative of the kinetics of protein-bound compounds, middle molecules, nor even of other small and water-soluble solutes, it becomes self-evident that urea clearance is a poor predictor of many aspects of dialysis adequacy.

1. Lacson E Jr, Xu J, Suri RS et al. Survival with three-times weekly in-center nocturnal versus conventional hemodialysis. J Am Soc Nephrol. 2012 Apr;23(4):687-95. doi: 10.1681/ASN.2011070674. Epub 2012 Feb 23.

Abstract: Whether the duration of hemodialysis treatments improves outcomes remains controversial. Here, we evaluated survival and clinical changes associated with converting from conventional hemodialysis (mean=3.75 h/treatment) to in-center nocturnal hemodialysis (mean=7.85 h/treatment). All 959 consecutive patients who initiated nocturnal hemodialysis for the first time in 77 Fresenius Medical Care facilities during 2006 and 2007 were eligible. We used Cox models to compare risk for mortality during 2 years of follow-up in a 1:3 propensity score-matched cohort of 746 nocturnal and 2062 control patients on conventional hemodialysis. Two-year mortality was 19% among nocturnal hemodialysis patients compared with 27% among conventional patients. Nocturnal hemodialysis associated with a 25% reduction in the risk for death after adjustment for age, body mass index, and dialysis vintage (hazard ratio=0.75, 95% confidence interval=0.61-0.91, P=0.004). With respect to clinical features, interdialytic weight gain, albumin, hemoglobin, dialysis dose, and calcium increased on nocturnal therapy, whereas postdialysis weight, predialysis systolic blood pressure, ultrafiltration rate, phosphorus, and white blood cell count declined (all P<0.001). In summary, notwithstanding the possibility of residual selection bias, conversion to treatment with nocturnal hemodialysis associates with favorable clinical features, laboratory biomarkers, and improved survival compared with propensity score-matched controls. The potential impact of extended treatment time on clinical outcomes while maintaining a three times per week hemodialysis schedule requires evaluation in future clinical trials.

1. Fissell R, Schulman G, Pfister M, Zhang L, Hung AM. Novel dialysis modalities: do we need new metrics to optimize treatment? J Clin Pharmacol. 2012 Jan;52(1 Suppl):72S-8S. doi: 10.1177/0091270011414576.

Abstract: Delivered dose of hemodialysis has long been an important predictor of mortality. The limitations of conventional hemodialysis treatments have led to a renewed interest in more frequent and longer hemodialysis treatments. As alternative hemodialysis schedules have become more prevalent, a need for modified metrics to measure adequacy has emerged. In addition, there is an interest in finding measures of hemodialysis adequacy that are more reliable in certain subgroups of patients, such as women, ethnic minority groups, or people with small body size. Finally, extended hemodialysis schedules suggest a need for metrics that can measure the clearance of solutes other than urea, such as middle-size molecules, and solutes for which clearance depends on intercompartmental transport across membranes. New metrics to quantify clearance in extended and alternate hemodialysis schedules are needed. As new metrics are developed, it is anticipated that they will also contribute to more accurate assessments of associations between clinical outcomes and delivered dose of dialysis in more intensive, nontraditional hemodialysis schedules. This review provides a historical prospective of dialysis dose and adequacy and describes the need for new metrics from both solute type and dialysis dose prospective as alternative hemodialysis schedules have emerged and become more prevalent.

1. Daugirdas JT. Dialysis dosing for chronic hemodialysis: beyond Kt/V. Semin Dial. 2014 Mar;27(2):98-107.

Abstract: Current views regarding hemodialysis adequacy reach beyond indices of small solute removal such as Kt/V. Nevertheless, new Kt/V-based constructs such as the standard Kt/V, which adjusts not only for dialysis frequency, but which also represents removal of sequestered solutes rather than easily removed urea, continue to be useful. The scaling of dialysis dose to measures of size other than body water results in higher recommended doses of dialysis for children, small patients, and women, compared with the current body water-based scaling approach. Aside from small solute removal, increasing weekly time on dialysis results in slower removal of fluid with better tolerance and with increased removal of phosphorus, although both salt and water and phosphorus control often respond to efforts to reduce intake. The intermediate term benefits of removing larger middle molecules such as beta-2-microglobulin appear to be modest, and the benefits of removal of protein-bound uremic toxins remain to be proved in controlled trials.

1. Kaur A, Davenport A. Hemodialysis for infants, children, and adolescents. Hemodial Int. 2014 Apr 14. doi: 10.1111/hdi.12163. [Epub ahead of print]

Abstract: Children with chronic kidney disease stage 5 requiring dialysis can be treated by peritoneal or hemodialysis. In the United Kingdom nearly twice as many children receive peritoneal dialysis compared with hemodialysis. Technical aspects of pediatric hemodialysis are challenging and include the relative size of extracorporeal circuit and child's blood volume, assessment of adequacy, technical and complications of vascular access. Alternatives to standard hospital-based hemodialysis are also increasingly available. Optimizing nutritional status with the support of specialist pediatric dietitians is key to the management of children receiving hemodialysis. The effects of chronic illness on growth and school achievement, as well as the psychological, emotional, and social development of the child should not be underestimated. This review focuses on the above elements and highlights common pediatric practice in the United Kingdom.

1. Dunne N, Campbell M, Fitzpatrick M, Callery P. Comparison of Kt/V and urea reduction ratio in measuring dialysis adequacy in paediatric haemodialysis in England.J Ren Care. 2014 Jun;40(2):117-24. doi: 10.1111/jorc.12059. Epub 2014 Mar 20.

Abstract:  
Background: The National Kidney Foundation-Dialysis Outcomes Quality Initiative (KDOQI) guidelines and the Renal Association recommend the use of either Kt/V or urea reduction ratio (URR) to measure haemodialysis adequacy.   
Objectives: To determine the methods used to measure paediatric haemodialysis adequacy and to assess consistency between calculations of single pool Kt/V (spKt/V) and URR.   
Design: A service evaluation was conducted to establish current practices in measuring dialysis adequacy. A prospective longitudinal study was conducted to compare spKt/V and URR. Participants: Thirty-two children were recruited consisting of 13 males and 19 females in five paediatric dialysis centres.   
Results: Inconsistencies were reported of the method of post-urea sampling with 4 of the 10 centres using the KDOQI recommended sampling method. Five dialysis centres reported using URR and five reported using spKt/V. There were substantial differences between the two measures. Using URR suggested that up to 44% of children did not receive adequate dialysis, whereas measurement by spKt/V suggested no more than 6% of the same dialysis sessions were not adequate.   
Conclusion: One standard measure should be used to assess dialysis adequacy in paediatric centres in England. KDOQI guidelines were not consistently followed in obtaining a post-urea blood sample and this procedure should be standardised.

1. Cadnapaphornchai MA, Teitelbaum I. Strategies for the preservation of residual renal function in pediatric dialysis patients. Pediatr Nephrol. 2014 May;29(5):825-36; quiz 832. doi: 10.1007/s00467-013-2554-0. Epub 2013 Jul 19.

Abstract: In adults with end-stage renal disease (ESRD), the preservation of residual renal function (RRF) has been shown to be associated with decreased mortality and improved control of complications of chronic kidney disease. However, less is known on the benefits of RRF in the pediatric dialysis population. The purpose of this article is to review the clinical significance of RRF and to discuss strategies for the preservation of RRF in children with ESRD.