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

**Measure Number** (*if previously endorsed*)**:** Not applicable; new measure

**Measure Title**: **Post-Dialysis Weight Above or Below Target Weight**

**IF the measure is a component in a composite performance measure, provide the title of the Composite Measure here:** Not applicable

**Date of Submission**: 2/26/2015

|  |
| --- |
| **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). |

|  |
| --- |
| **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*): Click here to name the intermediate outcome

Process: Average post-dialysis weight >1 kg above or below the prescribed target weight.

Structure: Click here to name the structure

Other: Click here to name what is being measured

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**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.**

**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*).**

*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.*

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**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.

Increased focus on the identification and correction of post-dialysis and target weight discrepancies will help attenuate large fluctuations in fluid balance and blood pressure that contribute to volume overload syndromes, hypertension, and cardiac hypertrophy and will decrease associated hospitalizations, readmissions, and 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.*

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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

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

**The Kidney Disease Outcomes Quality Initiative (KDOQI). Clinical practice guidelines for hemodialysis adequacy: Achievement of optimal “dry” weight (CPG 5.1). Am *J Kidney Dis.* 2006; Jul;48 (1 Suppl 1): S13-97.**

URL: http://www2.kidney.org/professionals/KDOQI/guideline\_upHD\_PD\_VA/1a.4.2.

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

**The ultrafiltration component of the HD prescription should be optimized with a goal to render the patient euvolemic and normotensive. This includes counseling the patient on sodium and fluid restriction, adequate ultrafiltration, and the use of diuretics in patients with RKF.**

The KDOQI panel noted that a patient's true dry weight, defined as the weight when fluid volume is optimal, can be determined accurately, but the method is not readily available in clinical settings (e.g., use of multiple-frequency bioimpedance spectroscopy). Instead, dry weight usually is determined clinically by evaluating level of blood pressure, evidence of fluid overload, and the patient's tolerance of ultrafiltration aimed to arrive at the estimated target weight. It should be noted that a patient can have fluid excess in the absence of gross clinical evidence of volume expansion, a phenomenon termed “silent overhydration.” During dialysis, as the patient's dry weight is approached, the rate at which the vascular compartment refills from fluid in the adjacent tissue spaces is reduced. If UFR is reduced toward the end of dialysis, the reduced compensatory refilling process may be adequate to support the patient's depleted blood volume, thereby avoiding hypotension and muscle cramping. When the blood volume is refilled and blood pressure improves, more rapid ultrafiltration can be resumed. For a fluid-overloaded dialysis patient, this step-by-step process of identifying, or “probing,” for the true dry weight through ultrafiltration—but without inducing hypotension—should be accomplished gradually over a number of dialysis treatments (usually over 4 to 12 weeks, but it may require as long as 6 to 12 months) until evidence of fluid overload is in abeyance.

To improve fluid removal during dialysis and reduce morbidity, monitoring blood volume during HD has been recommended. However, use of monitoring devices has met with varying degrees of success; some investigators have obtained satisfactory results, whereas other have had disappointing results. Further studies are required to clarify this important issue.

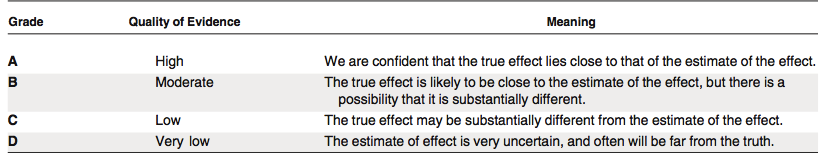
Hypotension during dialysis has many adverse effects and potential life-threatening consequences. By impairing tissue perfusion, low blood pressures can compromise dialysis adequacy. Hypotension induced by overzealous ultrafiltration also may contribute to loss of RKF and, in predisposed patients, coronary and/or cerebral ischemia. To avoid hypotension, dry weight should be systematically reevaluated after each dialysis treatment. It was suggested that a dialysis log summarizing the relevant information, such as body weights, blood pressures, and intradialytic incidents, is essential to provide a longitudinal dynamic view of ECF volume and blood pressure changes. Dry weight may change, for example, when a newly dialyzed patient becomes less uremic, regains appetite, and gains muscle and nonfluid weight (reflected by an increase in serum creatinine level), or when a patient has an intercurrent illness and loses muscle and tissue weight.

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

Evidence Level A (defined as “High quality; confident that the true effect lies close to that of the estimate of the effect.”)

**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.*)

KDOQI grades for quality of evidence in guidelines:

****

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

Not applicable.

**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)?**

Not applicable; the KDOQI guideline was based on workgroup consensus/expert opinion.

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)

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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

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

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

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

**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.*)

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

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

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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

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

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

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

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**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?**

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

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

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

**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*)

**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*)

**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*)

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

**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**.

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**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?**

The process used to identify the evidence supporting this measure consisted of an extensive literature review, the clinical experience and expert consensus of KCQA members and the KCQA Feasibility/Testing Workgroup, and a retrospective review of pertinent database data from three large dialysis organizations with a correlation to existing measures of adverse outcomes (i.e., hospitalization and mortality) over the same time period.

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

The literature review identified the following 14 published, peer-reviewed articles. The publications include prospective randomized controlled, prospective cohort, cross-sectional, and retrospective review studies, as well as expert consensus opinion.

1. **Movilli E, Camerini C, Gaggia P, et al. Magnitude of end-dialysis overweight is associated with all-cause and cardiovascular mortality: A 3-year prospective study. *Am J Nephrol*. 2013;37:370–377.**

**Background:** The authors hypothesized that the difference between the prescribed end-dialysis body weight, defined end-dialysis over-weight (edOW; kg), and the body weight actually attained could impact survival in hemodialysis (HD) patients. The aim of this prospective observational study was to evaluate if edOW could influence survival in a cohort of prevalent HD patients, controlled for multiple dialysis and clinical risk factors and followed for 3 years.

**Methods:** One hundred and eighty-two patients (117 men, age 65 ± 13 years) on regular HD treatment for at least six months [median 48 months (range: 6–366)] were followed from January 1, 2008 to December 31, 2010. Eighty-four patients (46%) did not achieve their prescribed dry body weight (dBW); their median edOW was 0.4 kg (range: 0.1–1.4). Ninety-eight died during observation, mainly from cardiovascular reasons (69%). Multivariate Cox regression analysis was utilized to evaluate the effect edOW, ultrafiltration rate (UFR), interdialytic weight gain (IDWG), age, sex, dialytic vintage, cardiovascular disease, antihypertensive therapy, diabetes, duration of HD, dBW, BMI, mean arterial blood pressure, Kt/V, and protein catabolic rate (PCRn) had on mortality.

**Results:** Age (HR: 1.04; CI: 1.03–1.05; p <0.0001), IDWG (HR: 2.62; CI: 2.06–3.34; p < 0.01), UFR (HR: 1.13; CI: 1.09–1.16; p< 0.01), PCRn (HR: 0.02; CI: 0.01–0.04; p <0.001), and edOW (HR: 2.71; CI: 1.95–3.75; p < 0.02) were independently correlated to survival. The relative receiver operating characteristic curve identified a cutoff value of 0.3 kg for edOW in predicting death.

**Conclusions:** High edOW is independently associated with an increased long-term risk of all-cause and cardiovascular mortality in HD patients. Better survival was observed in patients with edOW <0.3 kg. For patients with higher edOW, longer or more frequent dialysis sessions should be considered in order to prevent the deleterious consequences of excessive body fluid expansion.

1. **Hecking M, Karaboyas A, Antlanger M, et al. Significance of interdialytic weight gain versus chronic volume overload: Consensus opinion. *Am J Nephrol.* 2013;38(1)78-90.**

**Abstract:** Predialysis volume overload is the sum of interdialytic weight gain (IDWG) and residual postdialysis volume overload. It results mostly from failure to achieve an adequate volume status at the end of the dialysis session. Recent developments in bioimpedance spectroscopy and possibly relative plasma volume monitoring permit noninvasive volume status assessment in hemodialysis patients. A large proportion of patients have previously been shown to be chronically volume overloaded predialysis (defined as >15% above 'normal' extracellular fluid volume, equivalent to >2.5 liters on average), and to exhibit a more than twofold increased mortality risk. By contrast, the magnitude of the mortality risk associated with IDWG is much smaller and only evident with very large weight gains. Here the authors review the available evidence on volume overload and IDWG, and question the use of IDWG as an indicator of 'nonadherence' by describing its association with postdialysis volume depletion. The authors also demonstrate the relationship between IDWG, volume overload, and predialysis serum sodium concentration, and comment on salt intake, and conclude that discriminating between volume overload and IDWG will likely lead to a more appropriate management of fluid withdrawal during dialysis. By consensus, the authors agreed that this discrimination should be among the primary goals for dialysis caretakers today and consequently recommended objective measures of volume status beyond mere evaluations of IDWG.

# Agarwal R. Hypervolemia is associated with increased mortality among hemodialysis patients. *Hypertension.* 2010;56(3):512-517.

**Abstract:** Among chronic hemodialysis patients, 217 hospitalizations per 1,000 patient-years are attributed to congestive heart failure; some are attributable to unrecognized hypervolemia. Hypervolemia can be detected by relative plasma volume (RPV) monitoring. The purpose of this study was to examine among 308 patients on long-term hemodialysis the value of slope of RPV compared with either ultrafiltration (UF) volume or UF rate index in determining all-cause mortality. RPV slopes were calculated by least-squares regression. These slopes were related to all-cause mortality in unadjusted and adjusted Cox proportional hazards models. Over a median follow-up of 30 months (interquartile range: 14 to 54 months) 96 patients (31%) died, yielding a crude mortality rate of 113/1000 patient-years. We found the following: (1) RPV slope measurements were of prognostic significance (hazard ratio of flatter slopes [>1.39%/h]: 1.72; P=0.01); (2) the UF volume alone was not prognostically informative (hazard ratio of higher UF volume [>2.7 L of dialysis]: 0.78; P=0.23); (3) the UF rate index alone was also not prognostically informative (hazard ratio of higher UF rate index [>8.4 mL/kg per hour]: 0.89; P=0.6); and (4) the prognostic relationship of RPV slope to mortality was independent of conventional and unconventional cardiovascular risk factors including the UF volume, UF rate, or UF volume per kilogram of post-weight. RPV monitoring yields information that is prognostically important and independent of several risk factors including UF volume, aggressiveness of UF, and interdialytic ambulatory blood pressure. Its use to assess excess volume-related morbidity among chronic hemodialysis patients should be tested in randomized, controlled trials.

# Agarwal R, Alborzi P, Satyan S, and Light RP. Dry-weight reduction in hypertensive hemodialysis patients (PRIP): A randomized, controlled trial. *Hypertension.* 2009;53(3):500-507.

# Abstract: Volume excess is thought to be important in the pathogenesis of hypertension among hemodialysis patients. To determine whether additional volume reduction will result in improvement in blood pressure (BP) among hypertensive patients on hemodialysis and to evaluate the time course of this response, we randomly assigned long-term hypertensive hemodialysis patients to ultrafiltration or control groups. The additional ultrafiltration group (n=100) had the dry weight probed without increasing time or duration of dialysis, whereas the control group (n=50) only had physician visits. The primary outcome was change in systolic interdialytic ambulatory BP. Postdialysis weight was reduced by 0.9 kg at four weeks and resulted in -6.9 mm Hg (95% CI: -12.4 to -1.3 mm Hg; P=0.016) change in systolic BP and -3.1 mm Hg (95% CI: -6.2 to -0.02 mm Hg; P=0.048) change in diastolic BP. At eight weeks, dry weight was reduced 1 kg, systolic BP changed -6.6 mm Hg (95% CI: -12.2 to -1.0 mm Hg; P=0.021), and diastolic BP changed -3.3 mm Hg (95% CI: -6.4 to -0.2 mm Hg; P=0.037) from baseline. The Mantel-Hanzel combined odds ratio for systolic BP reduction of >10 mm Hg was 2.24 (95% CI: 1.32 to 3.81; P=0.003). There was no deterioration seen in any domain of the kidney disease quality of life health survey despite an increase in intradialytic signs and symptoms of hypotension. The reduction of dry weight is a simple, efficacious, and well-tolerated maneuver to improve BP control in hypertensive hemodialysis patients. Long-term control of BP will depend on continued assessment and maintenance of dry weight.

1. **Lai CT, Wu CJ, Chen HH, et al. Absolute interdialytic weight gain is more important than percent weight gain for intradialytic hypotension in heavy patients. *Nephrology*. 2012;17(3):230-236.**

**Aim:** Few published reports have mentioned the difference between absolute interdialytic weight gain (IDWG) and IDWG/DW (IDWG%), and subsequent effects on daily dialysis. The aim of this study was to evaluate the difference between absolute IDWG and IDWG% in new hemodialysis patients.

**Method:** The authors retrospectively reviewed the records of 255 patients who had recently received conventional hemodialysis for at least one year at the same center from 1997 to 2008. The first four weeks after starting hemodialysis was defined as the pre-study period. Data were collected for 5–56 weeks.

**Results:** IDWG% value remained relatively constant in the first year of hemodialysis despite most patients having certain residual renal function. For hemodialysis outcomes, both absolute IDWG and IDWG% were significantly correlated with intradialytic hypotension (IDH) in men and heavy women. After dividing patients into four strata according to gender and median dry weight, stepwise multivariate linear regression analysis showed that absolute IDWG, rather than IDWG%, was an independent risk factor for IDH in heavy men (Beta = 0.585, P < 0.001) and heavy women (Beta= 0.458, P < 0.001).

**Conclusions:** Absolute IDWG, rather than IDWG%, is an independent risk factor for IDH in heavy hemodialysis patients and that higher absolute IDWG needs to be strictly controlled despite the corresponding IDWG% possibly being relatively small in heavy hemodialysis patients.

1. **Hur E, Usta M, Toz H, et al. Effect of fluid management guided by bioimpedance spectroscopy parameters in hemodialysis patients: A randomized controlled trial. *Am J Kidney Dis.* 2013:61(6)957-965.**

**Background:** Fluid overload is the main determinant of hypertension and left ventricular hypertrophy in hemodialysis patients. However, assessment of fluid overload can be difficult in clinical practice. We investigated whether objective measurement of fluid overload with bioimpedance spectroscopy is helpful in optimizing fluid status.

**Study Design:** Prospective, randomized, and controlled study.

#### Setting & Participants: 156 hemodialysis patients from two centers were randomly assigned to two groups.

#### Intervention: Dry weight was assessed by routine clinical practice and fluid overload was assessed by bioimpedance spectroscopy in both groups. In the intervention group (n = 78), fluid overload information was provided to treating physicians and used to adjust fluid removal during dialysis. In the control group (n = 78), fluid overload information was not provided to treating physicians and fluid removal during dialysis was adjusted according to usual clinical practice.

#### outcomes: The primary outcome was regression of left ventricular mass index during a 1-year follow-up. Improvement in blood pressure and left atrial volume were the main secondary outcomes. Changes in arterial stiffness parameters were additional outcomes.

#### Measurements: Fluid overload was assessed twice monthly in the intervention group and every three months in the control group before the mid- or end-week hemodialysis session. Echocardiography, 48-hour ambulatory blood pressure measurement, and pulse wave analysis were performed at baseline and 12 months.

#### Results: Baseline fluid overload parameters in the intervention and control groups were 1.45 ± 1.11 (SD) and 1.44 ± 1.12 L, respectively (P = 0.7). Time-averaged fluid overload values significantly decreased in the intervention group (mean difference, -0.5 ± 0.8 L), but not in the control group (mean difference, 0.1 ± 1.2 L), and the mean difference between groups was -0.5 L (95% CI, -0.8 to -0.2; P = 0.001). Left ventricular mass index regressed from 131 ± 36 to 116 ± 29 g/m2 (P < 0.001) in the intervention group, but not in the control group (121 ± 35 to 120 ± 30 g/m2; P = 0.9); mean difference between groups was -10.2 g/m2 (95% CI, -19.2 to -1.17 g/m2; P = 0.04). In addition, values for left atrial volume index, blood pressure, and arterial stiffness parameters decreased in the intervention group, but not in the control group.

#### Conclusions: Assessment of fluid overload with bioimpedance spectroscopy provides better management of fluid status, leading to regression of left ventricular mass index, decrease in blood pressure, and improvement in arterial stiffness.

# Chazot C, Wabel P, Chamney P, et al. Importance of normohydration for the long-term survival of haemodialysis patients. *Nephrol Dial Transplant.* 2012;27(6):2404-2410.

**Background:** Fluid overload and hypertension are among the most important risk factors for haemodialysis (HD) patients. The aim of this study was to analyze the impact of fluid overload for the survival of HD patients by using a selected reference population from Tassin [France].

**Methods:** A positively selected HD population (n = 50) from Tassin (Lyon-France) was used as a reference for fluid status and all-cause mortality. This population was compared to one dialysis centre from Giessen (Germany), which was separated into a non-hyperhydrated (n = 123) and a hyperhydrated (n = 35) patient group. The hydration status (ΔHS) of all patients was objectively measured with whole-body bioimpedance spectroscopy in 2003. All-cause mortality was analysed after a 6.5-year follow-up.

**Results:** Most of the reference patients from Tassin were normohydrated (ΔHS = 0.25 ± 1.15 L) at the start of the HD session. The hydration status of the Tassin patients was not different to the non-hyperhydrated Giessen patients (ΔHS = 0.8 ± 1.1 L) but significantly lower than in the hyperhydrated Giessen group (ΔHS = 3.5 ± 1.2 L). Multivariate adjusted all-cause mortality was significantly increased in the hyperhydrated patient group (hazard ratio = 3.41)—no difference in mortality could be observed between the Tassin and the non-hyperhydrated group from Giessen-even considering the fact that Tassin patients presented a significantly lower blood pressure.

**Conclusions:** Fluid overload has a very high predictive value for all-cause mortality and seems to be one of the major killers in the HD population. Patients might strongly benefit from active management of fluid overload.

# Agarwal R. Epidemiology of interdialytic ambulatory hypertension and the role of volume excess. *Am J Nephrol.* 2011;34(4):381-390.

# Background: The epidemiology of hypertension among hemodialysis (HD) patients is difficult to describe accurately because of difficulties in the assessment of blood pressure (BP).

# Methods: Using 44-hour interdialytic ambulatory BP measurements, the authors describe the epidemiology of hypertension in a cohort of 369 patients. To seek correlates of hypertension control, antihypertensive agents were withdrawn among patients with controlled hypertension and ambulatory BP monitoring was repeated.

# Results: Hypertension (defined as an average ambulatory systolic BP ≥135 mm Hg or diastolic BP ≥85 mm Hg, or the use of antihypertensive medications) was prevalent in 82% of the patients and independently associated with epoetin use, lower body mass index, and fewer years on dialysis. Although 89% of the patients were being treated, hypertension was controlled adequately in only 38%. Poor control was independently associated with greater antihypertensive drug use. Inferior vena cava (IVC) diameter in expiration was associated with increased risk of poorly controlled hypertension both in cross-sectional analysis and after withdrawal of antihypertensive drugs.

# Conclusions: Interdialytic hypertension is highly prevalent and difficult to control among HD patients. End-expiration IVC diameter is associated with poor control of hypertension in cross-sectional analyses as well as after washout of antihypertensive drugs. Among HD patients, an attractive target for improving hypertension control appears to be the reduction of extracellular fluid volume.

# Passauer J, Petrov H, Schleser A, et al. Evaluation of clinical dry weight assessment in haemodialysis patients using bioimpedance spectroscopy: A cross-sectional study. *Nephrol Dial Transplant.* 2010;25(2):545-551.

#### Background: Dry weight assessment (DWA) is essential to efficient therapy of hemodialysis (HD) patients. However, so far objective methods for DWA have not been applicable to daily routine. Thus, exact fluid management in HD remains difficult and is often based on clinical criteria. The aims of this study were (1) to objectively define pre- and post-dialytic ranges of extracellular volume in a large cohort of HD patients (in whom DWA had been defined according to clinical criteria), (2) to compare the hydration status between diabetic and non-diabetic patients, and (3) to assess a patient subgroup that might benefit from correction of target weight.

**Methods:** Fluid overload (FO) was measured prior to a mid-week HD session in 370 randomly selected HD patients (50% with diabetes) from five dialysis centers. A new bioimpedance spectroscopy (BIS) device that implies a validated body composition model was applied. This tool allows correct quantification of extracellular FO or deficiency in comparison to a healthy reference population (normal range -1.1 to 1.1 L according to the 10th and 90th percentile of measurements). In addition, weight and blood pressure were recorded before and after treatment.

**Results:** Pre-dialytic FO ranged from -0.5 to 4 L and post-dialytic FO from -2.5 to 2 L (10th and 90th percentile of measurements), indicating that on average the hydration status of healthy subjects is considered as the optimal target weight in HD patients. Comparison of FO between diabetic and non-diabetic patients revealed no difference. Based on the consideration that an FO <-1.1 L before and >1.1 L after HD indicates inadequate DWA, we identified 98 (26%) patients who might benefit from correction of target body weight.

**Conclusion:** BIS is an interesting, objective method to support clinical DWA. Further studies should be performed to investigate beneficial clinical effects of this approach.

# Ritz E. Left ventricular hypertrophy in renal disease: Beyond preload and afterload. *Kidney Int.* 2009;75(8):771-773.

**Abstract:** To explain ventricular concentric and/or eccentric hypertrophy in chronic kidney disease, past studies suggested that this was the result of increased preload and/or afterload. Using a renal ablation model of the mouse with documented absence of hypertension, Siedlecki et al. provide evidence for the involvement of the mammalian target of rapamycin (mTOR) pathway. He suggests that load-independent primary stimuli trigger or contribute to ventricular hypertrophy and fibrosis in uremia.

1. **Charra B, Laurent G, Chazot C, et al. Clinical assessment of dry weight. *Nephrol Dial Transplant.* 1996; 11 Suppl 2:16-19.**

**Abstract:** Unsatisfactory control of blood pressure (BP) leading to an increased rate of cardiovascular events is the main cause of mortality in hemodialysis. BP control has deteriorated since hemodialysis session times have been reduced. Inadequate BP control most often is due to a failure to achieve and maintain dry weight. Dry weight and normotension have been gradually omitted in the goals of dialysis, satisfactory dialysis being reduced to an 'adequate' urea Kt/V. Ideal dry body weight needs a reappraisal. What is dry weight? How should it be clinically assessed, established and maintained in patients? The problems encountered in estimating dry weight can be solved at the bedside in most cases. The additional laboratory, echography and impedancemetry methods are research tools that hopefully can be made simpler and lower in cost so they can be used everyday at the bedside. In the mean time, with the exception of ambulatory blood pressure measurement, one must rely on careful and repeated clinical observation to determine and maintain dry weight.

# Whigham LD, Schoeller DA, Johnson LK, and Atkinson RL. Effect of clothing weight on body weight. *International Journal of Obesity.* 2013;37:160-161.

#### BACKGROUND: In clinical settings, it is common to measure weight of clothed patients and estimate a correction for the weight of clothing, but we can find no papers in the medical literature regarding the variability in clothing weight of adults with weather, season and gender.

#### METHODS: Fifty adults (35 women) were weighed four times during a 12-month period with and without clothing. Clothing weights were determined and regressed against minimum, maximum and average daily outdoor temperature.

#### RESULTS: The average clothing weight (±s.d.) throughout the year was significantly greater in men than in women (1.2±0.3 vs 0.8±0.3 kg, P<0.0001). The average within-person minimum and the average within-person maximum clothing weights across the year were 0.9±0.2 and 1.5±0.4 kg for men, and 0.5±0.2 and 1.1±0.4 kg for women, respectively. The within-person s.d. in clothing weight was 0.3 kg for both men and women. Over the 55 °C range in the lowest to the highest outdoor temperatures, the regressions predicted a maximal change in clothing weight of only 0.4 kg in women and 0.6 kg in men.

#### CONCLUSION: The clothing weight of men is significantly greater than that of women, but there is little variability throughout the year. Therefore, a clothing adjustment of approximately 0.8 kg for women and 1.2 kg for men is appropriate regardless of outdoor temperature.

1. **Zoccali C, Benedetto FA, Mallamaci F, et al. Left ventricular mass monitoring in the follow-up of dialysis patients: Prognostic value of left ventricular hypertrophy progression. *Kidney Int.* 2004;65:1492–1498.**

#### BACKGROUND: Regression of left ventricular hypertrophy (LVH) in the setting of a well-planned intervention study has been associated with longer survival in hemodialysis patients. Whether changes in left ventricular mass (LVM) in clinical practice predict survival and cardiovascular events in these patients is still unknown.

#### METHODS: In a prospective study in 161 hemodialysis patients we tested the prognostic value of changes in LVM on survival and incident cardiovascular events. Echocardiography was performed twice, 18 +/- 2 SD months apart. Changes in LVM occurring between the first and the second echocardiographic study were then used to predict mortality and cardiovascular events during the ensuing 29 +/- 13 months. The prognostic value of LVM changes was tested in a multivariate Cox's model with LVM index (LVMI) [expressed as LVM/height(2.71)], included as a covariate to control for regression to the mean.

#### RESULTS: The rate of increase of LVMI was significantly (P= 0.029) higher in patients with incident cardiovascular events than in those without such events. Accordingly, cardiovascular event-free survival in patients with changes in LVMI below the 25th percentile was significantly (P= 0.004) higher than in those with changes above the 75th percentile. In a multiple Cox regression analysis, including age, diabetes, smoking, homocysteine, 1 g/m(2.7)/month increase in LVMI was associated with a 62% increase in the incident risk of fatal and nonfatal cardiovascular events [hazard ratio 1.62 (95% CI 1.13-2.33), P= 0.009].

#### CONCLUSION: Changes in LVMI have an independent prognostic value for cardiovascular events and provide scientific support to the use of repeated echocardiographic studies for monitoring cardiovascular risk in dialysis patients.

1. **Burton JO, Jefferies HJ, Selby NM, and McIntyre CW. Hemodialysis-induced cardiac injury: Determinants and associated outcomes. *Clin J Am Soc Nephrol.* 2009;4:914–920.**

#### BACKGROUND AND OBJECTIVES: Hemodialysis (HD)-induced myocardial stunning driven by ischemia is a recognized complication of HD, which can be ameliorated by HD techniques that improve hemodynamics. In nondialysis patients, repeated ischemia leads to chronic reduction in left ventricular (LV) function. HD may initiate and drive the same process. In this study, we examined the prevalence and associations of HD-induced repetitive myocardial injury and long-term effects on LV function and patient outcomes.

#### DESIGN, SETTING, PARTICIPANTS, & MEASUREMENTS: Seventy prevalent HD patients were assessed for evidence of subclinical myocardial injury at baseline using serial echocardiography and followed up after 12 mo. Intradialytic blood pressure, hematologic and biochemical samples, and patient demographics were also collected at both time points.

#### RESULTS: Sixty-four percent of patients had significant myocardial stunning during HD. Age, ultrafiltration volumes, intradialytic hypotension, and cardiac troponin-T (cTnT) levels were independent determinants associated with its presence. Myocardial stunning was associated with increased relative mortality at 12 mo (P = 0.019). Cox regression analysis showed increased hazard of death in patients with myocardial stunning and elevated cTnT than in patients with elevated cTnT alone (P < 0.02). Patients with myocardial stunning who survived 12 mo had significantly lower LV ejection fractions at rest and on HD (P < 0.001).

#### CONCLUSIONS: HD-induced myocardial stunning is common, and may contribute to the development of heart failure and increased mortality in HD patients. Enhanced understanding of dialysis-induced cardiac injury may provide novel therapeutic targets to reduce currently excessive rates of cardiovascular morbidity and mortality.