Increasing Dialysis Options for Patients with End-Stage Renal Disease

Executive Summary

Despite decades of experience and peer-reviewed literature supporting clinical and quality of life benefits of more frequent dialysis, the vast majority of end-stage renal disease (ESRD) patients in the United States receive in-center hemodialysis (HD) for 3-4 hours, three days a week. Not only does this schedule simply not provide optimal clinical benefit for some patients, it has a negative effect on quality of life for many others. RPA believes that one size does not fit all in this regard and that a more patient-centered approach to the care of people with ESRD is needed. Delivery of care structures, reimbursement models and payment policies must evolve and move forward to meet this need.

Overall mortality rates in dialysis patients have declined over the past 15 years, but adjusted rates of all-cause mortality are still 6.5-7.9 times greater for dialysis patients than for the general population [1]. Recent peer-reviewed literature suggests that clinical benefits are associated with longer and/or more frequent hemodialysis (HD). Furthermore, associations between longer treatment times (TT) and better patient outcomes have been documented by multiple investigators, in a variety of patient populations in the United States and elsewhere [2,3,4]. A greater number of hours of HD per week has been shown to result in improvements in several parameters, including hypertension, phosphorus control, erythropoiesis, quality of life, nutrition, and perhaps most notably, left ventricular hypertrophy (LVH) [5,6], the latter a key intermediate outcome associated with cardiac death [7]. A recent clinical trial randomized 200 adult maintenance hemodialysis patients to extended weekly (>24 hours) or standard (target 12-15 hours, maximum 18 hours) hours of hemodialysis for 12 months [6]. Patients in the extended weekly arm had lower phosphorus levels, lower potassium levels, and higher hemoglobin levels, and achieved these results with fewer BP-lowering agents and phosphate-binding medications.

It is also notable that longer TT has been associated with fewer hospitalizations, and decreased use of anti-hypertensives and phosphorus binders, suggesting the potential for global savings. [6,8]. A reduction in hospitalizations alone would impart significant savings to Part A Medicare and while the provision of more frequent dialysis would increase expenditures in Part B, a net savings to the system is suggested by experience elsewhere. RPA posits that this net savings alone offers a compelling argument for the desegregation of Medicare Part A and B, with the relative success of early alternative payment model demonstration projects in kidney disease supporting such change.
In addition to the clinical and fiscal benefits, more convenient dialysis schedules can improve quality of life for some patients [9]. Alternate treatment schedules allow patients to work, care for relatives, or go to school during the day. Quality of life scores in the randomized trial noted above were not higher in the extended weekly arm, but this may be because the majority of patients received eight or more hours of dialysis during the day. Eight hours of dialysis three days a week during the day is a hassle. If the eight hours are delivered at night when the patient can sleep, or in more frequent and shorter treatments of 2-3 hours 4-5 days a week, then the treatments interfere less with activities during the day, and a higher quality of life is possible. It is also crucial to recognize that the same patient may benefit from transitioning between different schedules and modalities throughout the course of their clinical ESRD trajectory.

This RPA position paper presents some of the evidence associating longer and/or more frequent treatments with improved clinical outcomes. The studies presented vary in sample size and in quality of evidence, but RPA believes that in aggregate they strongly suggest that patient benefit exists. Although longer or more frequent treatments may not be needed for all dialysis patients, there is consensus among the specialty that for certain conditions, such as congestive heart failure (CHF), pregnancy, and calciphylaxis, longer or more frequent schedules are justified [10]. While coverage policies currently support provision of more frequent hemodialysis for many, though not all, of the medical indications considered necessary and appropriate, barriers still exist with regard to the frequency with which additional treatments outside of the traditional thrice-weekly schedule will be covered. RPA strongly believes that payment policies that facilitate patient access to these alternative, more frequent and/or longer therapies should be expanded in both Medicare and Medicaid as well as by commercial payors. To realize the potential of these therapies, nephrologists should assess their patients who might benefit from more intensive hemodialysis. Funding in the forms of Medicare reimbursement and kidney-specific health services research should be provided to advance technologies that make longer and more frequent HD including those provided at home, more convenient, safe, and cost effective.

Background

Hemodialysis began as a treatment for patients with acute renal failure. Maintenance hemodialysis evolved into three sessions per week of 3-5 hours per session for chronic renal failure [11]. In the 1970s the demand for HD increased, legislation funding HD through the Medicare program was passed, and the time per session was shortened [12,13].

The landmark National Cooperative Dialysis Study (NCDS) was performed in the 1970s and published in 1981 [14]. In the NCDS, patients were randomized using a 2x2 study design into 4 groups by treatment time, 4.5 to 5 hours vs. 2.5 to 3.5 hours, and by time averaged blood urea concentration (TAC). The NCDS looked at the clinical effects of each of the four dialysis prescriptions. There was no difference in mortality between the groups during the study. However, TAC_urea essentially determined the clinical outcomes of patient morbidity or withdrawal from the study. In addition, after the intervention portion of the study ended and patients returned to their usual treatment schedules, the dose of dialysis delivered during the study had a “lasting effect”, in that patients who received a lower TAC_urea during the study had a higher mortality, even after the study ended. There was also a non-significant trend toward lower morbidity and hospitalization in the groups that received longer
treatment times. The groups in the NCDS were relatively small, and the study may not have been powered to detect a difference in survival.

Following the NCDS, clinicians focused on small solute clearance to assess adequacy. The development of high efficiency dialyzers allowed for greater small solute clearance in shorter amounts of time, adequacy goals based on urea clearance could be achieved more quickly, and TT subsequently decreased. Shorter TT were favored by commercial providers because they allowed for more treatments per day. However, studies performed over time indicated that shorter TT were associated with poorer patient outcomes, which led to the development of guidelines stipulating the delivery of a minimum target Kt/V_{urea}, usually 1.2 delivered in thrice weekly treatments [15].

Kt/V_{urea} as a measure of dialysis adequacy, or dose, has remained the standard practice because it is easy to calculate even when using variable volume formulae or shorter dialysis times. Also, Kt/V_{urea} is assumed to be a reasonable surrogate for clearance of low-molecular weight uremic “toxins”, other than urea [14]. The HEMO trial studied the effects of dialysis dose and level of dialyzer membrane flux on mortality and morbidity [16]. The HEMO trial found no major patient benefit to either higher dialysis dose (single pool Kt/V_{urea} 1.71, equilibrated Kt/V_{urea} 1.53 vs. standard dose single pool Kt/V_{urea} 1.32, equilibrated Kt/V_{urea} 1.16), or high flux vs. low flux membranes. These results suggested that the high mortality associated with HD could not be reduced by relatively small increases in solute clearance.

The motivation for careful, intense study of practice patterns such as adequacy metrics and dialyzer flux, is that mortality in dialysis patients in the United States has always been remarkably high. Although overall mortality rates have declined over the past 15 years, adjusted rates of all-cause mortality are still 6.5-7.9 times greater for dialysis patients than for the general population [1].

This high mortality rate for patients on dialysis as compared to the general population is chiefly cardiovascular (CV) [17-20]. Non-traditional CV risk factors such as metabolic bone disease, chronic inflammation, and oxidative stress contribute [21-23]. The high mortality rate has persisted despite a progressive increase in average Kt/V_{urea} over the past two decades, from 1.11 in 1991 to 1.52 in 2002. In addition, the proportion of patients with a Kt/V_{urea} less than 1.2 decreased from 34% in the period 1996-2001 to 10% in the period 2002-2004 [24]. Even with these notable increases in small solute clearance, the complications of hypertension [18, 25], malnutrition [26,27], congestive heart failure [18], and bone and mineral disorders [24, 28] remain unabatedly high, suggesting that dialysis adequacy cannot be measured simply in terms of Kt/V_{urea}. Indeed, many of the identified toxins that accumulate in chronic kidney disease are highly protein bound and can only be cleared with the clinical approach of more dialysis time per week [29]. It is likely that in order to truly improve survival and quality of life, adequacy measures must take into account additional clinical factors impacted by dialysis treatments, such as extracellular volume (ECV) control, phosphorus control, removal of protein bound toxins, and nutrition. Finally, according to the USRDS, the major cause of mortality remains sudden cardiac death (SCD). SCD likely occurs because of arrhythmias related to large and rapid shifts in potassium. Rapid potassium shifts are minimized by longer treatments with slower blood flows which may decrease the risk for SCD.
Many believe that at least part of the high morbidity in prevalent HD patients can be attributed to the non-physiologic nature of the conventional thrice-weekly hemodialysis schedule, and thus there is continued interest in modification of the current standard thrice-weekly dialysis treatment schedule, during the day. Intermittent hemodialysis allows toxins, salts, and water to accumulate in the body during the interdialytic period, some of which accumulate and deposit in tissues, exacerbating tissue damage. The intermittency of thrice-weekly hemodialysis also permits large fluctuations in the levels of these toxins and in extracellular volume, commonly referred to as the “unphysiology of dialysis.” Such imbalances may be particularly hazardous in patients with underlying cardiomyopathy, cardiac arrhythmias, and coronary disease. More frequent renal replacement therapy is believed by many as necessary to achieve better body homeostasis, improved elimination of toxins, and better outcomes. Finally, the reduction in LVH associated with more hours of dialysis/week, shown in the FHN trial with a relatively small sample size and only one year of follow-up, suggests that modification of standard HD regimens with increased time, increased frequency, and perhaps adequacy evaluation by metrics other than $Kt/V_{urea}$, could reduce cardiac mortality. Several alternative dialysis strategies such as short daily hemodialysis [SDHD], long nocturnal daily hemodialysis [LNDHD], long conventional hemodialysis [LHD], in-center nocturnal hemodialysis [INHD], long intermittent dialysis [LID], and hemodialfiltration [HDF], both in a conventional three times a week and in a daily modality, are being actively investigated.

**Terminology**

- Conventional hemodialysis (CHD): intermittent hemodialysis (IHD) performed in a dialysis center for 3-5 hours per session, three times weekly
- Quotidian dialysis: daily hemodialysis treatments that can be performed as:
  - Nocturnal hemodialysis (NHD): performed while a patient sleeps for sessions lasting as long as 8-9 hours
  - Short-daily hemodialysis (SDHD): performed daily but with a shortened duration of 2-3 hours
- In-center nocturnal hemodialysis [INHD]: performed for 7-8 hours overnight 3 nights a week
- Long intermittent dialysis (LID): includes either nocturnal or daytime sessions that are long (6-9 hours) but performed 3 sessions/week

**Quantification of Solute Removal**

Comparisons of solute clearance between peritoneal dialysis (PD) and CHD have demonstrated roughly equivalent patient survival, especially in the first years of dialysis, despite the fact that weekly solute clearances with PD are lower than with CHD [30]. The standardized $Kt/V$ ($stdKt/V$) was formulated to give a uniform measure of dialysis dose across different modalities [31,32]. The $stdKt/V$ is calculated based on mid-week predialysis blood urea nitrogen (BUN) level. In this formulation, dialysis regimens with the same mid-week pre-dialysis BUN have the same weekly $stdKt/V$. The differences in the $stdKt/V$ among the various modalities are outlined below:
• CHD and PD: weekly stdKt/V is roughly 2.0 (corresponds to a single session IHD spKt/V of 1.2)
• NHD: weekly stdKt/V of 4-5 (spKt/V of about 1.8-2.5/treatment)
• SDHD: weekly stdKt/V of 2.0 (spKt/V of 0.53-0.56/treatment, eKt/V of 0.38/treatment)

An important effect of dialysis is the removal of middle molecular weight molecules that may represent uremic toxins (such as β-2 microglobulin) not measured by urea kinetics [33]. Longer treatment times may remove a greater amount of these potential toxins. For example, in one study the weekly dialysate β-2 microglobulin mass clearance increased from 127 to 585 mg when the patient was switched from CHD to NHD [34]. Furthermore, removal of smaller, protein-bound substances such as indole-3-acetic acid and acid indoxy sulfate are increased on SDHD as compared to CHD [35].

Clinical Benefits of More Intensive Hemodialysis

RPA believes that in aggregate the relevant literature indicates clear clinical benefit to the provision of more intensive dialysis to certain sub-populations of ESRD patients. The following discussion provides a partial listing of these clinical benefits, broken out by organ system or clinical indication.

Cardiovascular Benefits

Several studies, including one randomized controlled trial, have examined the changes in cardiovascular parameters associated with more intensive dialysis therapies. The effects studied have included surrogate outcome measures for mortality such as blood pressure control and left ventricular hypertrophy.

**Blood pressure control**

Several studies performed in patients undergoing both SDHD as well as NHD have clearly demonstrated that blood pressure goals are more readily met by patients receiving dialysis through these modalities as compared to patients on CHD [36-41]. These studies include one randomized controlled trial (RCT) [36]. In many cases, blood pressure control was achieved with either fewer medications or with cessation of all blood pressure medications. While the mechanism of improved blood pressure control is uncertain, one study in patients undergoing SDHD showed improved control in extracellular fluid volume [42].

**Left Ventricular Mass and Geometry**

Four separate studies, including a RCT, have shown reduction in left ventricular mass index (LVMI) as measured by either echocardiography or magnetic resonance imaging [6,36,40,42,43]. In several of these studies CHD patients were converted to either SDHD or NHD and then followed prospectively. In an additional smaller study, patients with impaired left ventricular function on CHD were switched to NHD with subsequent modest improvements in left ventricular ejection [44].

Slower ultrafiltration rates (UFR), made possible by longer treatment times, have been linked to lower mortality [45]. One group of researchers found associations between frequent hemodialysis schedules and reduced levels of dialysis-induced cardiac injury [46].
Longer and/or more frequent dialysis treatments may minimize LVH by minimizing cardiac stunning and thus damage from rapid UFRs, and these findings are consistent with the FHN results.

*Other cardiovascular effects*
Small studies have also demonstrated partial restoration of heart rate variability during sleep when patients were converted to NHD [47] as well as improvement in baroreceptor sensitivity and decreases in sympathetic nervous system activity [48].

**Malnutrition and Inflammation**

Several studies have investigated the effects of more intensive dialysis on markers of nutrition and inflammation. This is critical as the loss of amino acids into the dialysate with more intensive dialysis can be as high as 10 grams per day [49].

Two studies have demonstrated increases in appetite, weight gain and increases in muscle mass when patients are converted to daily dialysis [50,51]. A more detailed study of nitrogen kinetics in patients on NHD revealed that despite the larger amounts of amino acids lost in the dialysate, there was no decline in total body nitrogen as measured by in-vivo neutron activation [49]. However, studies looking at serum albumin levels have been conflicting, with several studies showing an improvement in serum albumin levels and others showing no effect [37,50-52].

Mechanistically, the improvement in nutritional parameters may be secondary to improved appetite, more regular eating schedule, and the liberalization of diet that often occur when patients are switched to either SDHD or NHD [50,53,54]. There may also be an effect of more intensive dialysis to decrease the inflammatory milieu associated with ESRD as levels of interleukin (IL)-6 and C-reactive protein have been shown to decrease in one study of patients undergoing daily hemodialysis [55].

**Phosphate and Bone Metabolism**

Overall, daily hemodialysis is associated with significant improvements in net phosphate removal. With NHD delivered 4-7 nights a week, phosphate removal is approximately twice that of CHD. Many, if not the majority, of patients no longer require phosphate binders or dietary phosphorus restriction. In fact, many patients require supplementation of phosphate in the dialysate [36,38,56,57]. There is evidence that NHD delivered only 3 nights a week for 7-8 hours also leads to a decline in phosphorus levels [58]. With SDHD, serum phosphate levels tend to fall when the daily sessions are longer than 2 hours and most of these patients still require phosphate binders [52, 59]. It should also be mentioned that in one study, patients converted from CHD to NHD demonstrated improved levels of both 1-25 (OH)₂ and 25-(OH) vitamin D independent of supplementation [60].

The benefits of more intensive hemodialysis on serum phosphate control have led to the proposal that NHD may be a treatment for tumoral calcinosis or calciphylaxis. A single case report demonstrated significant improvement in tumoral calcinosis in a patient transitioned from CHD to daily nocturnal home HD [61].
Anemia and Erythropoietin Dosage

There has been conflicting data on whether intensification of hemodialysis is associated with either increases in serum hemoglobin or increased responsiveness to erythropoietin (EPO). In this regard, many of the studies are small and likely underpowered to detect any difference [62, 52, 63, 36, 64].

Sleep Disorders

Patients with ESRD have a high prevalence of sleep disorders, and it has been proposed that this may reflect suboptimal dialysis and may impact on quality of life as well as cardiovascular mortality [65]. The greatest effects of NHD on sleep disorders have been seen in patients with sleep apnea. Significant reductions in the apnea-hypopnea index have been shown in patients converted from CHD to NHD [66,67]. Mechanistically, this improvement may be due to two effects of NHD: (1) improvements in ventilatory instability associated with ESRD that leads to increased ventilatory sensitivity to hypercapnia and (2) improvements in pharyngeal cross-sectional area that may be due to improved fluid balance and decreased neck edema.

Fertility

Patients with ESRD undergoing CHD have reduced rates of fertility and a high rate of fetal complications [68]. More intensive hemodialysis is recommended for those pregnant females on CHD based on several observational studies showing better outcomes with longer treatment times [69-71].

Quality of Life

Patients on CHD typically report relatively poor quality of life and the majority do not work. Several studies have examined the changes in quality of life when patients make the switch from CHD to more intensive therapy [36,50,72-74]. Despite receiving more dialysis with its attendant time and labor demands, the majority of studies have reported improved cognition, improved psychomotor efficiency, and improved quality of life parameters using several different survey instruments (such as the Beck Depression Index, SF-36, and Sickness Impact Profile) [36,50,72]. These studies may be influenced by modality-selection bias as healthier patients with better baseline quality of life may opt for NHD at a higher rate than CHD [75].

Hospitalization Rates

In one study, high-comorbidity patients with ESRD who were converted from CHD to SDHD while maintaining the same total weekly dialysis time were studied prospectively over 72 months. SDHD was associated with a significant 34% decrease in hospitalization days with, notably, no increase in vascular access hospitalizations [52].

In another study, 32 NHD patients were studied 1 year before and 2 years after conversion to NHD and compared to 42 CHD patients (matched for age, dialysis vintage and controlled for comorbidities) during the same time period [74]. While hospitalization rates were stable for the CHD group, the group that was converted to NHD experienced a fall in dialysis or
cardiovascular admission rates from 0.50 +/- 0.15 to 0.17 +/- 0.06 admissions per patient year (p = 0.04).

Survival

Abundant observational data spanning over three decades of investigation consistently shows associations between longer treatments times and improved outcomes, when compared to thrice-weekly HD for 3-4 hours [1,2,3]. The challenge in interpreting this data has always been the potential for selection bias, as it is usually the healthier, more functional patients that can dialyze multiple times a week, or do their own, more frequent dialysis at home [75]. It must also be noted that selection bias is but one of multiple potential biases that might be present in both observational and sometimes randomized controlled trial data. Great care must be taken in interpreting the results of these studies. Cohort studies, case controls and propensity scoring help in interpretation, but do not remove the multiple biases that surely can and do affect outcomes such as survival.

To reduce selection bias, as well as other sources of bias, the FHN trial randomized patients to hemodialysis six times per week (frequent HD, 125 patients) or three times a week (conventional HD, 120 patients) and followed them for one year [6]. The pre-determined outcomes for the FHN trial were (a) death, and for survivors, change in LVM, and (b) death, and for survivors, change in Physical Health Composite of the RAND 36 scale. The Daily FHN study did show a significant effect of daily dialysis on both of these - and thus satisfied a positive result on these pre-determined primary outcomes. It is notable that in this randomized, controlled trial, frequent HD was associated with a statistically significant reduction in LVH, as well as improvements in hypertension and phosphorus control. These findings are consistent with another previous, smaller randomized controlled trial, in which 52 patients were randomized to receive either nocturnal HD 6 times weekly, or conventional HD 3 times weekly [36]. In this study, frequent HD was also associated with a statistically significant reduction in LV mass, and with a reduction in the need for blood pressure and oral phosphate binder medications. Finally, the nocturnal arm of the FHN trial compared outcomes in 45 patients who received nocturnal home hemodialysis six times a week to outcomes in 42 patients who received conventional thrice weekly HD [76] and showed improved control of hyperphosphatemia and hypertension in patients in the nocturnal arm.

The number of vascular access interventions was higher in the frequent dialysis group, but there were no significant differences in failure rates of vascular access between the frequent and standard dialysis groups. It must also be noted that in the Nocturnal FHN study, patients treated with frequent hemodialysis had a significantly higher and faster rate of endogenous kidney function loss. It is not clear whether this association was causal, or what the implications might be for patients.

Patient Selection for Intensive Hemodialysis

Given benefits such as reducing extremes of solute fluctuations, decreased ultrafiltration rate, increase in dialysis dose and consistent improvements in clinical parameters, there are sub-groups of patients with ESRD who may be particularly good candidates for more intensive hemodialysis. These include:
- Patients with poor quality of life on current renal replacement modalities
- Patients who want to work or go to school during the daytime
- Patients who would benefit from a liberalized diet
- Patients who have disabling intra- or inter-dialytic complications
  - Unstable blood pressure during dialysis
  - Severe cramping during dialysis
  - Uncontrollable hypertension
  - Impaired left ventricular function or congestive heart failure
  - Persistent hyperphosphatemia
  - Calciphylaxis
- Patients with sleep apnea
- Patients who would benefit from and wish to stay with a home therapy after transition from peritoneal dialysis
- Patients who may not be candidates for kidney transplantation
- Patients who have difficulty in controlling uremic symptoms
- Obese patients
- Patients with an arteriovenous fistula that can consistently deliver blood flows of at least 250ml/min as needed for longer, slower treatments such as nocturnal HD, but not 350ml/min as needed for CHD. It must be noted that for patients with an access that cannot supply higher blood flows, a shorter therapy such as SDHD, that requires BFRs of 500ml/min, would not be a good option.

For these patients, the ability to tailor a hemodialysis therapy to specific patient needs is critically important to ensure good outcomes and optimize quality of life.

Cost Effectiveness of More Intensive Hemodialysis

As noted, RPA believes that the current system where savings accrued to Medicare Part A have no relationship to the activities of Part B providers confounds the ability to accurately assess the cost-effectiveness of medical innovations such as advancements in more intensive hemodialysis. Accordingly, RPA believes that analysis of the cost-effectiveness of more intensive or alternate dialysis schedules must include the cost-savings from decreased hospitalizations, reduction in medications such as anti-hypertensives and phosphate binders, reduced need for transportation to and from a dialysis unit for those patients doing home dialysis, and the ability of the dialysis patient to work and provide child or elder care.

The London Daily/Nocturnal Hemodialysis Study compared the economics of short daily HD (n = 10), long nocturnal HD (n = 12), and conventional thrice-weekly HD (n = 22) in patients over 18 months [77]. A retrospective analysis of patients' conventional HD costs during the 12 months before study entry was conducted to measure the change in cost after switching to quotidian HD. Because of the increase in number of treatments, treatment supply costs per patient for the daily HD and nocturnal HD study groups were approximately twice those for conventional HD patients. However, average costs for consults, hospitalization days, emergency room visits, and laboratory tests for quotidian HD patients tended to decline after study entry. The major cost saving in home quotidian HD derived from the reduction in direct nursing time, excluding patient training. Total annualized cost per quality-adjusted life-
year for the daily HD and nocturnal HD groups were 85,442 Can dollars (2003) and 120,903 Can dollars, which represented a marginal change of - 15,090 Can dollars and - 21,651 Can dollars, respectively, as compared to conventional thrice-weekly HD. Overall, the authors conclude that their economic analysis points toward both improved quality of life and reduced costs for quotidian HD patients.

Another cost analysis study from Canada revealed that NHD was associated with a net 20% decrease in weekly mean total health care cost [78]. Cost categories found to be less expensive for NHD included: staffing, overhead, hospital admissions and procedures, and medications. Cost categories that were more expensive for NHD included hemodialysis materials and other capital costs and laboratory tests.

An economic evaluation comparing short daily or nocturnal hemodialysis with thrice-weekly conventional in-center dialysis was performed in the United States [79]. In this study, costs are sensitive to assumptions about the effect of daily dialysis on hospital days. Reductions of at least 8% in hospital days are required for these more intensive modalities to be cost saving.

It is important to understand that cost analyses such as these presume that patient outcomes with a new intervention are as good or better than those outcomes achieved with conventional care. If the emerging data on the benefits of more intensive hemodialysis are integrated into this analysis, then more intensive dialysis may be considered a “dominant” therapy in that it is both less expensive and more effective than conventional in-center hemodialysis.

Summary

Over one hundred abstracts and peer-reviewed journal articles have demonstrated clear and consistent clinical benefits of longer and/or more frequent HD treatments. This is the case whether the therapy is performed as SDHD or as NHD. Reported benefits include improvements in cardiovascular outcomes, bone and mineral metabolism, nutrition, sleep, fertility, and quality of life. Furthermore, observational data consistently shows associations between lower hospitalization rates and better survival. The benefits may be particularly robust in patients with comorbidities that are improved with consistent, gentle, and overall greater fluid removal, such as congestive heart failure, hypertension, and obstructive sleep apnea. In addition to many clinical benefits, quality of life can be optimized for some patients with a schedule that allows them to do their treatments at night, leaving their days free for school, work, or caring for family.

Individualized therapy is key to providing patient-centered care and provision of more frequent and/or intensive dialysis exemplifies this approach for patients with dialysis-dependent ESRD. Moving this from conversation to standard of care will require active changes in delivery of care structures, reimbursement models and payment policies of CMS and other third-party payors to support therapies other than the dominant in-center, thrice-weekly, 3-4 hours treatment paradigm. The is the essence of patient-centered care for people with ESRD.
Recommendations

1. Longer and more frequent dialysis should be an option available to all patients for whom there is potential for clinical and quality of life benefits.

2. Nephrologists should assess their patient population for those patients who might benefit from more intensive hemodialysis and offer them that option.

3. Medicare, Medicaid, and commercial health insurers should adopt payment policies that increase the availability of more intensive dialysis therapies (either SDHD or NHD) to patients as prescribed by the patient’s nephrologist.

4. Funding both in the form of Medicare reimbursement for dialysis through the ESRD Prospective Payment System (PPS) and research funding to NIH should be provided to advance technologies that promote the practice of more intensive hemodialysis, whether at home or in-center, for its convenience and cost effectiveness, but mostly for the clinical benefits it provides to patients.

5. Continued study of the benefits of more frequent dialysis is appropriate but should not preempt the provision of the best care possible based on current evidence.
References


# Glossary

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<td>LVH</td>
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<td>LVMi</td>
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