Dialysis Patient-Centeredness and Precision Medicine: Focus on Incremental Home Hemodialysis and Preserving Residual Kidney Function

Nieltje Gedney,[*] and Kamyar Kalantar-Zadeh, MD, MPH, PhD[†,‡,§,¶]

Summary: An exponential interest in incremental transition to dialysis recently has emerged in lieu of outright three times/wk hemodialysis initiation as the standard of care. Incremental dialysis is consistent with precision medicine, given individualized dialysis dose adjustment based on patient's dynamic needs, leading to reduced patient suffering from longer or more frequent dialysis treatments and improved health-related quality of life. It includes twice-weekly or less frequent hemodialysis treatments with or without a low-protein diet on nondialysis days, or a shorter (<3 h) hemodialysis treatment three times per week or more frequent treatments, a useful approach for home hemodialysis initiation. Peritoneal dialysis also can be initiated incrementally with a shorter dwell time, less daily solution volume, or therapy for fewer than 7 days per week. Subsequent transition to more frequent or more intense dialysis therapy within several months or longer will counter worsening fluid retention and uremia, for example, whenever residual urea clearance decreases to less than 2 mL/min or if urine volume reaches less than 500 mL/d, especially if loss of nocturia ensues. There are many advantages to using precision medicine tools to institute incremental dialysis protocols including preservation of residual kidney function, adhering to patient preference, and allowing for a greater patient-centeredness. Incremental dialysis may become the treatment of choice in End-stage renal disease Seamless Care Organizations (ESCO). This article also features a home hemodialysis patient's experience as a real-world scenario of how individualization of dialysis therapy based on unique patient characteristics and adjustment and shortening of hemodialysis treatment time and frequency led to improved patient experience, compliance with treatment regimen, and increased urine output, and the role of future ESCOs.

Semin Nephrol 38:426–432

Keywords: Chronic kidney disease (CKD), transition of care, hemodialysis, peritoneal dialysis, incremental dialysis, residual kidney function, patient-centeredness

*Home Dialyzors United, Kearneysville, WV.
†Harold Simmons Center for Kidney Disease Research and Epidemiology, Division of Nephrology and Hypertension, University of California Irvine Medical Center, Orange, CA.
‡Tibor Rubin Veterans Affairs Long Beach Healthcare System, Long Beach, CA.
§Department of Epidemiology, University of California Los Angeles Fielding School of Public Health, Los Angeles, CA.
¶Los Angeles Biomedical Research Institute, Harbor–University of California Los Angeles, Torrance, CA.

Financial support: Supported by a National Institutes of Health/National Institute of Diabetes and Digestive and Kidney Disease midcareer award K24-DK091419 (K.K.Z.).

Conflict of interest statement: Kamyar Kalantar-Zadeh has received honoraria and/or support from Abbott, AbbVie, Alexion, Amgen, American Society of Nephrology, Astra-Zeneca, AVEO Oncology, Chugai, DaVita, Fresenius, Genentech, Haymarket Media, Hofstra Medical School, International Federation of Kidney Foundations, International Society of Hemodialysis, International Society of Renal Nutrition and Metabolism, Japanese Society of Dialysis Therapy, Hospira, Kabi, Keryx, Novartis, National Institutes of Health, National Kidney Foundation, Pfizer, Relypsa, Resverlogix, Sandoz, Sanofi, Shire, Vifor, UpToDate, and ZS-Pharma. Nieltje Gidney is affiliated with Home Dialyzors.

Address reprint requests to Kamyar Kalantar-Zadeh, MD, MPH, PhD, Harold Simmons Center for Kidney Disease Research and Epidemiology, Division of Nephrology and Hypertension, University of California Irvine, School of Medicine, 101 City Dr S, City Tower, Orange, CA 92868-3217. E-mail: kkz@uci.edu

0270-9295/ - see front matter

https://doi.org/10.1016/j.semnephrol.2018.05.012

Since 2014, the topic of transition of care in chronic kidney disease has received focused attention, highlighted by a US Renal Data System special study center that is dedicated to focused examination of this emerging topic.[1,2] In the United States and many other countries and regions of the world, an outright three times/wk hemodialysis initiation is the norm. Until recently, twice-weekly hemodialysis frequency or shorter dialysis treatment time (eg, <3.5 to 4 hours per hemodialysis session) was considered suboptimal and against the standard of care. However, in recent years, an unprecedented interest in, as well as heated debate about, the reinvigoration of less frequent hemodialysis treatment upon transitioning to maintenance dialysis therapy has emerged.[3-6] This so-called *incremental dialysis* is based on the premise that in many patients who initiate dialysis therapy for the first time, substantial residual kidney function still exists, represented by a native kidney urea clearance of more than 3 mL/min or a daily urine output of 600 mL or more.[3,7] In these patients, usually the majority of incident dialysis patients, a less frequent (<3 times/wk) hemodialysis, or less than a full dose of peritoneal dialysis, during the first months of dialysis therapy is not only adequate, but it also may lead to longer preservation of the residual kidney function.

Among the contributing factors that have led to the increasing enthusiasm about incremental dialysis is the patient-centeredness of the approach, including recent

and old data about the advantages of longer preservation of the residual kidney function.[8,9] This can be achieved by a variety of effective means, including and in particular via less frequent dialysis therapy and/or shorter dialysis treatment time.[8] The emerging incremental dialysis protocols appear to be more patient friendly and may lead to less suffering and better health-related quality of life. Although in the United States incremental dialysis often is coined with twice-weekly hemodialysis initiation in the first months of dialysis therapy, also known as the University of California Irvine incremental dialysis protocol,[10,11] there are different types of incremental dialysis transition prescriptions including even less than twice-weekly hemodialysis at the start (eg, once weekly or less), combined with a low-protein diet on nondialysis days.[12] Shorter hemodialysis treatment times, such as 2 to 3 hours per hemodialysis session, with three or more frequent treatments per week, also may be a useful approach for home hemodialysis initiation and maintenance (Table 1). This may appear in sharp contradistinction to the current expectations of longer hemodialysis time, 4 hours or more per session, to achieve a certain dialysis adequacy threshold (single pool Kt/V >1.2), which sadly often does not account for the residual kidney function given the perceived pressure by the so-called Quality Incentive Program of the Center of Medicare and Medicaid Services (CMS) to achieve these targets. Peritoneal dialysis also can be initiated incrementally,[13] including with shorter dwell time or less daily dialysate solution volume, or by undergoing therapy fewer than 7 days a week, such as with every-other-day protocols. Less frequent peritoneal dialysis may be combined with sporadic hemodialysis treatments, although there are little data about the benefits and challenges of such approaches. Therefore, an individual patient's dialysis prescription can be devised based on important characteristics unique to each patient including residual urine output, lifestyle and environmental factors (ie, dietary habits, access to treatment), as well as patient preference. Hence, incremental dialysis initiation via use of precision medicine concepts including offering individualized dialysis dose adjustment based on a patient's dynamic needs not only can enhance both in-center and home dialysis patient experience, but also lead to improved patient longevity, including for in-home dialysis patients.[14]

In all types of incremental dialysis, a patient's residual kidney function needs to be monitored judiciously because transition to more frequent or more intense dialysis therapy often is needed at some point in time, usually, but not always, within a few months or 2 to 3 years at maximum, whenever the residual urea clearance decreases to less than 2 mL/min or if urine volume is less than 600 mL/d, especially if nocturia ceases to exists.[3] According to a recent consensus report, in addition to a decrease in residual kidney function, there are 8 to 10 other criteria for maintaining less frequent dialysis versus transitioning to more frequent or more intense dialysis therapy to avoid volume overload or worsening uremia.[3]

Patient perspectives on incremental dialysis generally are positive given the less severe impact on lifestyle and suffering upon transitioning to dialysis therapy. In addition, more effective preservation of residual kidney function (ie, the ability to make urine for longer time while on dialysis), enhances patient preference for incremental dialysis protocols and its synergy with the recent Precision Medicine initiatives in the United States and other nations. As shown in Table 2, different types of incremental dialysis approaches highlight different aspects of

Table 1. Types of Incremental Dialysis Protocols

Type of Incremental Dialysis Protocol	Assumption	Suitability
HD		
Type A: less frequent HD (<3 times/wk)*	Maintaining at least 3 to 4 hours of HD treatment time per session	May be more suitable for in-center HD patients
Type B: shorter HD treatment time (<3 h)	Maintaining at least 3 times/wk HD frequency	Suitable for both in-center and home HD
Type C: any combination of the earlier-described protocols	N/A	Suitable for both in-center and home HD
PD		
Type D: shorter total PD dwell time or fluid volume/d	Maintaining daily (7 d/wk) PD	Home dialysis
Type E: <7 d/wk of PD therapy*	Maintaining standard dwell time and volume	Home dialysis
Type F: any combination of the earlier-described PD protocols	N/A	Home dialysis
Type G: any combination of PD with sporadic HD sessions	N/A	Combination of home and in-center dialysis

HD, hemodialysis; PD, peritoneal dialysis.
Note that in all protocols, residual kidney function needs to be monitored judiciously (monthly to quarterly).
*A low-protein diet (eg, 0.6 to 0.8 g/kg/d) can be used on nondialysis days.