Precision Medicine in the Transition to Dialysis and Personalized Renal Replacement Therapy

Connie M. Rhee, MD, MSc,[*] Yoshitsugu Obi, MD, PhD,[*] Anna T. Mathew, MD, MPH,[†] and Kamyar Kalantar-Zadeh, MD, MPH, PhD[,‡,§]*

Summary: Launched in 2016, the overarching goal of the Precision Medicine Initiative is to promote a personalized approach to disease management that takes into account an individual's unique underlying biology and genetics, lifestyle, and environment, in lieu of a one-size-fits-all model. The concept of precision medicine is pervasive across many areas of nephrology and has been particularly relevant to the care of advanced chronic kidney disease patients transitioning to end-stage kidney disease (ESKD). Given many uncertainties surrounding the optimal transition of incident ESKD patients to dialysis and transplantation, as well as the high mortality rates observed during this delicate transition period, there is a pressing urgency for implementing precision medicine in the management of this population. Although the traditional paradigm has been to commence incident hemodialysis patients on a 3 times/week treatment regimen, largely driven by adequacy targets, there has been growing recognition that alternative treatment regimens (ie, incremental hemodialysis) may be preferred among certain subpopulations when taking into consideration factors such as patients' residual kidney function, volume status fluctuations, symptoms, and preferences. In this review, we examine the origins of current practices in how dialysis is initiated among incident ESKD patients; incremental dialysis therapy as a dynamic and patient-centric approach that is tailored to patients' unique characteristics; recent data on the incremental hemodialysis regimen and outcomes; and future research directions using a precision nephrology approach to ESKD management with the potential to develop novel approaches, tools, and collaborative efforts to improve the health, well-being, and survival of this population.
Semin Nephrol 38:325−335
Keywords: Incremental dialysis, twice-weekly hemodialysis, residual kidney function, individualized dialysis

In 2016, the Precision Medicine Initiative was launched by the Office of the US President, National Institutes of Health, Food and Drug Administration, Office of the National Coordinator for Health Information Technology, and other stakeholders as a revolutionary approach that takes into account individuals' variability in their underlying biology and genetics, lifestyle, and environment in the treatment and prevention of disease.[1−4] In lieu of a one-size-fits-all model developed for the average person, the overarching goal of precision medicine is to pursue a personalized approach that identifies interventions that are most effective for patients according to their unique characteristics.

Although the Initiative is in its early stages, the concept of precision medicine has been pervasive in nephrology for many years, and is particularly relevant to the care of advanced chronic kidney disease patients transitioning to end-stage kidney disease (ESKD). Indeed, using a personalized approach that comprehensively considers a patient's medical history, lifestyle factors (eg, diet, physical activity, health behaviors), environment (eg, geographic location, social support), and personal beliefs and preferences is essential in determining which treatment strategy (eg, hemodialysis versus peritoneal dialysis, kidney transplantation, conservative management) is most ideal for the individual (Fig. 1).

The framework used in the transition of patients to ESKD is a prime example of how a personalized approach is used to guide clinical practice in nephrology (Fig. 2). However, there is further need for a more expanded role of precision medicine in the management of incident ESKD patients who are transitioning to dialysis. For example, the traditional paradigm has been to commence incident hemodialysis patients on a 3 times/week treatment regimen, which largely has been driven by adequacy targets.[5−7] However, there has been growing recognition that alternative treatment regimens (ie, more-frequent, less-frequent treatment schedules)

**Harold Simmons Center for Kidney Disease Research and Epidemiology, Division of Nephrology and Hypertension, University of California Irvine, School of Medicine, Orange, CA.*
†Division of Nephrology, McMaster University, Hamilton, Ontario, Canada.
‡Tibor Rubin Veterans Affairs Medical Center, Long Beach, CA.
§Los Angeles Biomedical Research Institute, Harbor−University of California Los Angeles, Torrance, CA.
Financial support: Supported by research grants from the National Institutes of Health/National Institute of Diabetes and Digestive and Kidney Diseases K23-DK102903 (C.M.R.), K24-DK091419 (K.K.-Z.), R01-DK096920 (K.K.-Z.), U01-DK102163 (K.K.-Z.); National Kidney Foundation (C.M.R.); American Thyroid Association (C.M.R.); and philanthropist grants from Mr. Harold Simmons (K.K.-Z.), Mr. Louis Chang (K.K.-Z.), and Dr. Joseph Lee (C.M.R, K.K.-Z.).

Conflict of interest statement: none.

Address reprint requests to: Connie M. Rhee, MD, MSc, Harold Simmons Center for Kidney Disease Research and Epidemiology, Division of Nephrology and Hypertension, University of California Irvine School of Medicine, 101 The City Drive South, City Tower, Orange, California 92868-3217. E-mail: crhee1@uci.edu
0270-9295/ - see front matter

https://doi.org/10.1016/j.semnephrol.2018.05.003

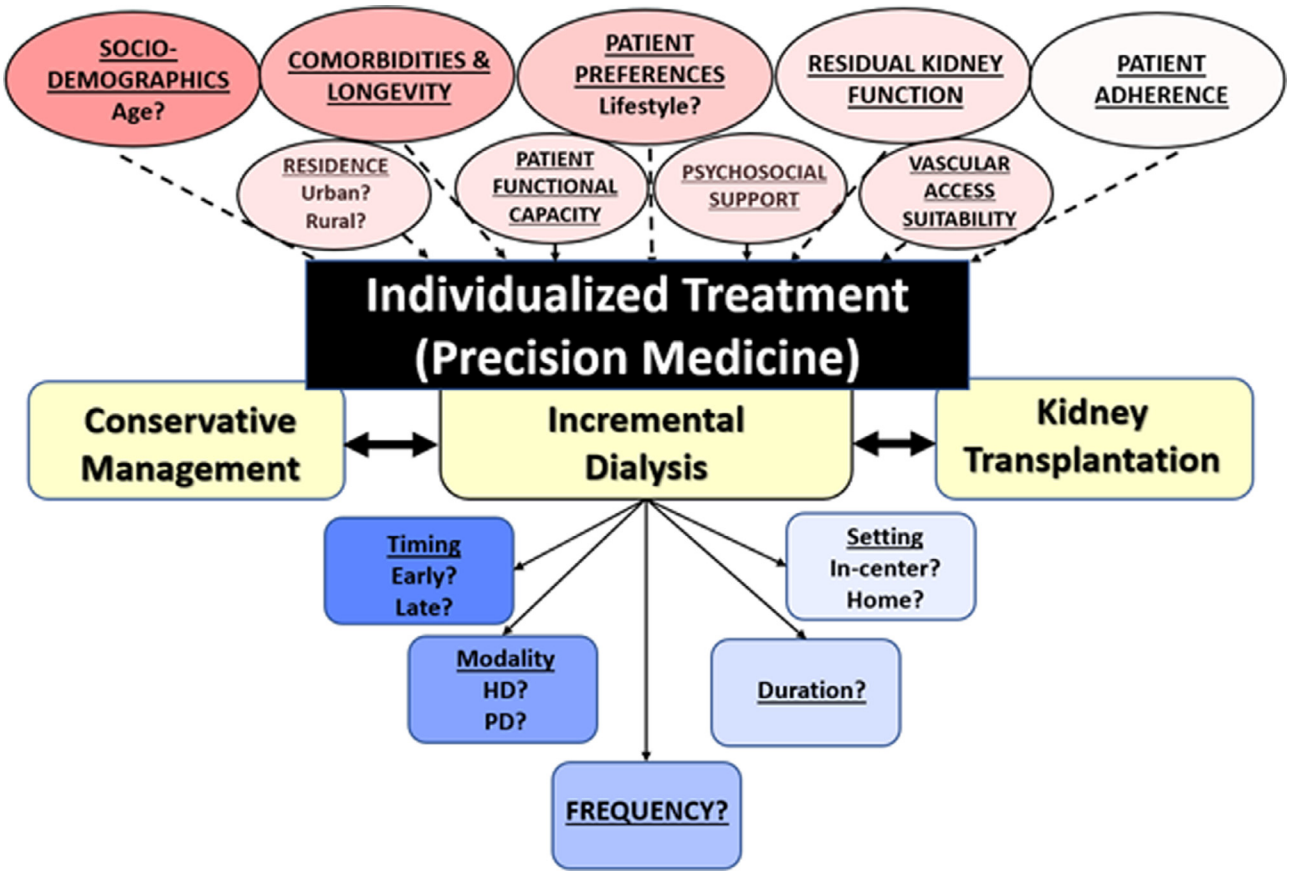

Figure 1. Personalized approach in the transition to renal replacement therapy.

may be preferred among certain subpopulations when taking into consideration additional factors such as patients' residual kidney function, volume status fluctuations, symptoms, and preferences. Indeed, the optimal regimen in the first few months after dialysis initiation is not known,[5–8] and adding further complexity to this uncertainty is the heightened mortality risk of this early transition period.[9–11] In this article, we examine current

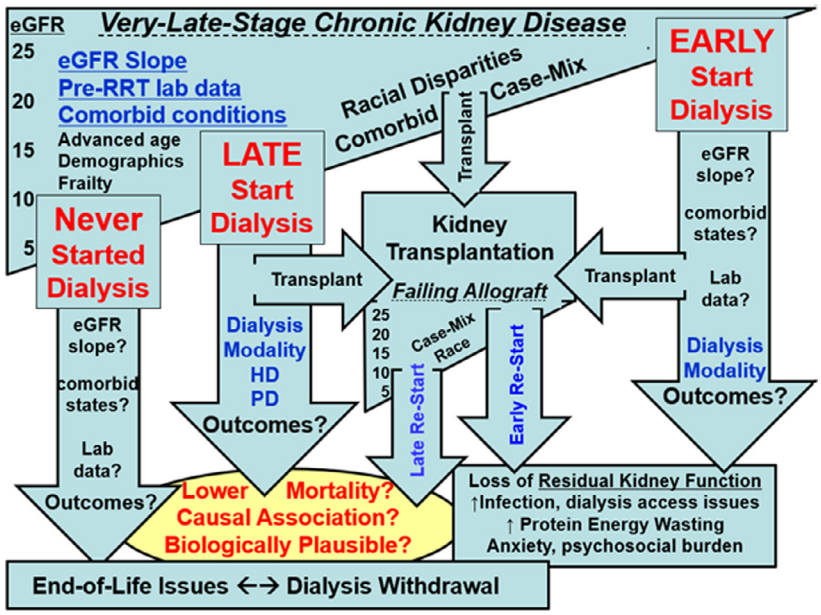

Figure 2. Framework used in the transition of patients to end-stage kidney disease. eGFR, estimated GFR; RRT, renal replacement therapy.