



# Is It Time for Precision Dialysis?

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## Introduction

In 2015, President Obama announced funding for precision medicine to augment personalized medicine, which has been described as “the right treatment for the right patient in the right place at the right time.” Patients with ESKD experience high symptom burden and mortality, necessitating more precision-based therapies and tools. Precision medicine is evidence-based tailoring of prevention and treatment strategies according to individual characteristics, with goals to improve outcomes and reduce disease burden (1). We propose the application of precision-based principles to KRT and a model to achieve them. The framework for the precision-based approach to advanced CKD and ESKD includes the selection and prescribing of dialysis modality on the basis of lifestyle, environmental factors, patient-centric factors, and comorbidities. Another precision-based component is vascular access for those patients undergoing hemodialysis (HD), including arteriovenous fistula, arteriovenous graft, or central venous catheter. Arteriovenous fistula may be associated with fewer procedures, lower mortality, and lower cost; arteriovenous graft or central venous catheter may be preferred in the elderly (2).

## What Is Precision Dialysis?

Historically, the determination of dialysis modality has been driven by physician comfort, local resources, financial incentives, and public policies like “Peritoneal Dialysis (PD) First” (3), diverging from a patient-centered selection process. There is compelling evidence that prioritizing patient goals improves outcomes and perception of care (4). The precision-based choice of dialysis modality is timely, is individualized, and involves shared decision making assisted by members of the health care team (5). These goals are achievable by proactive education on KRT modalities of the patient and caregiver (if applicable), avoiding physician bias. Team members engage patients and family members in discussing the therapy’s effect on lifestyle, symptoms, burden of treatment, and financial considerations while offering alternative options. The options also include a time-limited trial or withholding dialysis if consistent with patient goals. With appropriate predialysis support and training, up to 50% of patients with ESKD can attain self-care dialysis (6). Predialysis education is mostly done in small patient groups by CKD nurse educators,

often in conjunction with dietitians and social workers. In the United States, limited financial and personnel resources are barriers to individual patient education sessions that offer more targeted guidance. Tele-education with simulation-based programs could fill this void. A national collaborative effort for developing, testing, and validating patient-centric CKD tele-education programs could better leverage these limited resources. This would provide an opportunity for more patients with CKD to receive the targeted guidance needed for informed decision making.

## Why Is Precision Dialysis Better for Patients?

Individual patient characteristics should drive the prescription of the devices, membranes, and fluids required for more physiologic KRT to improve outcomes. Significant intra- and postdialysis symptoms persist despite efforts by the nephrology team to optimize quality of patient care. Depression, anxiety, and pain are common symptoms that affect patient quality of life and outcomes. Addressing patient-related factors, including symptom burden, lifestyle, and care partner burnout, is increasingly accepted as a component of dialysis prescription. Elements of precision-based dialysis that directly affect dialysis prescription are small solute clearance, residual kidney function (RKF), electrolyte concentrations, extracellular fluid volume, and intra- and postdialytic symptoms. Identifying patient priorities and setting achievable goals on the basis of continuing discussions with the patient and family members should drive the prescription of precision-based dialysis. Patient and/or caregiver burnout can supervene due to the burden of performing dialysis, transportation to the center, and visiting other doctors for clinic appointments. Resources to address burnout are limited, especially if patients lack social support in home-based therapies. Assisted peritoneal dialysis, home HD, and self-care dialysis modalities may allow patients to overcome fear and reduce burnout. Funding and regulatory hurdles of paying caregivers are among the obstacles to an assisted program in the United States that have been overcome in other countries. Tax deduction for care partners or patients could engage caregivers and compensate for time off work. These efforts could help align incentives for payers, dialysis providers, and patients.

Small molecule (*i.e.*, urea) clearance has driven the dialysis prescription for decades. The target adequacy

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(Kt/Vurea) in HD is achieved by modifying dialysis prescription. Payers, such as Medicare, do not allow accounting of RKF in their quality metrics for in-center HD. The approach of modifying Kt/Vurea from dialysis to account for RKF is termed incremental dialysis. The homogenous approach of three times a week in-center HD is the antithesis of a precision-based model. Both home-based peritoneal dialysis and HD include RKF when measuring adequacy of the dialysis prescription. The intermittent nature of HD, rapid decline of kidney function, and patient resistance to increased dialysis duration later make the inclusion of RKF challenging. A review of incremental HD reports conflicting outcomes, although the quality of life benefits of two times per week dialysis is established (7). In keeping the intent of precision-based dialysis, shared decisions regarding the initial prescription and setting an expectation for future changes may overcome the patient's hesitation. The constant monitoring for signs and symptoms of inadequate dialysis while monitoring urine output may mitigate the fears of underprescription.

### Precision Dialysis and Health Care Policy

The accessibility, scope, and characteristics of ESKD care are directly linked to the wealth of a country and the proportion of resources spent on health care. Various public policies and payment models are adopted to provide high-quality care and cost efficiency (8). In the United States, the Advancing American Kidney Health Initiative (AAKHI) directs the Centers for Medicare and Medicaid Services to develop and test payment models to prevent and slow the progression of CKD, to increase home dialysis and pre-emptive transplant, and to improve

available organs for transplantation. Redesigning dialysis delivery can improve patients' morbidity and mortality, improve lifestyle and satisfaction, and reduce the cost of care. The current payment model choices in the AAKHI enable nephrology practices to select the model that best fits their resources, which is a welcome shift from the monolithic approach represented by the ESKD quality incentive payment to dialysis facilities (9). The current state of regulatory policies, infrastructure, and health care personnel is not well equipped to achieve the goals of the AAKHI (10). Funding policies subsidizing creative, individualized approaches to care rather than penalties that adversely affect providers' ability to address vulnerable patients' needs are needed. The proposed ESKD Treatment Choice model is expected to reduce Medicare spending to dialysis facilities and clinicians by \$185 million over 6.5 years (11). These cost savings should be reinvested in programs that identify and validate patient-centric initiatives and expand the infrastructure to incorporate them into clinical care. The AAKHI provides a high-level strategy for improving the care of patients with advanced CKD and kidney failure, but it comes up short in advancing the implementation of precision medicine for this population. Box 1 summarizes recommendations to achieve these goals.

The coronavirus disease 2019 pandemic is likely to accelerate achievement of many precision dialysis goals. In-center HD has become more expensive with social distancing in dialysis facilities and transportation, patient cohorting, and infection testing. Home dialysis modalities may become more attractive to patients who fear infection exposure, but this should remain an informed choice with appropriate education of all advantages and disadvantages of each modality as they apply to the individual patient. The transition to web-based patient education will be hastened

Box 1. Suggestions for delivering precision-based dialysis	
Domain	Recommendations
CKD progression	<ul style="list-style-type: none"> <li>• Appropriate diagnosis of CKD</li> <li>• Utilization of technology for risk factor modification (e.g., diet, BP, activity, weight, comorbidities, prognosis)</li> <li>• Accessibility to genetic testing</li> </ul>
Initiation of KRT	<ul style="list-style-type: none"> <li>• Improving health literacy</li> <li>• Accessibility to tele-education</li> <li>• Shared and informed decision making</li> <li>• Establishing conservative approach as treatment choice for modality</li> <li>• Inclusion of environmental and lifestyle factors in modality choice</li> <li>• Dialysis access placement according to patient characteristics</li> <li>• Team-based approach for KRT education</li> <li>• Providing emotional support</li> <li>• Incremental dialysis</li> </ul>
Developing the workforce	<ul style="list-style-type: none"> <li>• Training the workforce in home dialysis</li> <li>• Expertise in dialysis access placement</li> <li>• Competency-based educator programs</li> </ul>
Health system initiative	<ul style="list-style-type: none"> <li>• Patient clinical and social characteristics in payment model</li> <li>• Kidney residual function in adequacy metric</li> <li>• Developing patient-centered quality metrics, including QOL, anxiety, depression, pain, and dialysis-related symptoms</li> <li>• Financial incentives for home care partners/patients, including tax credits for electricity bills and home remodeling</li> <li>• Funding programs providing supportive and palliative care</li> <li>• Subsidizing efforts for urgent start PD, transitional care dialysis units</li> </ul>
QOL, quality of life; PD, peritoneal dialysis.	

by social distancing considerations and will allow for more individualized patient guidance than can be achieved with in-person patient group sessions.

### Conclusion

In summary, precision dialysis advocates an evidence-based approach identifying genetic, environmental, and lifestyle factors to individualize KRT modality selection and prescription, including choice of vascular access and use of incremental dialysis if appropriate. There is accelerating research on molecular markers, devices, and medication choice/dosing that drive additional precision-based therapies in kidney disease. Integrating precision medicine research results into value-based models of care will be a challenging task. It is hoped that careful consideration of the construction of health care delivery models, including adjustments for patient-centric characteristics and subsidies for infrastructure improvements, will accomplish these goals.

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