Dialysis Initiation, Modality Choice, Access, and Prescription: Conclusions from a Kidney Disease: Improving Global Outcomes (KDIGO) Controversies Conference

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Running title: Dialysis Initiation: A KDIGO conference report

Word count:

Keywords:

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ABSTRACT

Globally, the number of patients undergoing maintenance dialysis is increasing, yet throughout the world there is significant variability in the practice of initiating dialysis. Factors such as availability of resources, reasons for starting dialysis, timing of dialysis initiation, patient education and preparedness, dialysis modality and access, as well as varied “country-specific” factors significantly affect patient experiences and outcomes. As the burden of end-stage kidney disease (ESKD) has increased globally, there has also been a growing recognition of the importance of patient involvement in determining their goals of care and decisions regarding their treatment. These converging observations suggest that improving outcomes in kidney replacement therapy will require global leadership. To that end, in January of 2018, KDIGO (Kidney Disease: Improving Global Outcomes) convened a Controversies Conference focused on dialysis initiation, including modality choice, access, and prescription. Here we present a summary of the conference discussions, including consensus points, areas of controversy, identified knowledge gaps, and priorities for research. A major theme identified during the conference was the need to move away from a “one-size-fits-all” approach to dialysis and provide more individualized care that incorporates patient goals and preferences while still maintaining best practices for quality and safety. Identifying patient-centered goals that can be validated as quality indicators in the context of diverse healthcare systems to achieve equity of outcome will require alignment of goals and incentives between patients, providers, regulators, and payers that will vary across healthcare jurisdictions.

INTRODUCTION

During the past 3 decades, the number of patients undergoing maintenance dialysis globally has increased dramatically.[1] In 2010 it was estimated that the number of patients on dialysis was 2.05 million worldwide, and modeling data suggest this number will more than double by 2030.[2] Several factors have contributed to the increase: improved survival of the general population, reduction in mortality of dialysis patients, an increase in the incidence of chronic kidney disease (CKD), broadening of kidney replacement therapy acceptance criteria, and greater access to maintenance dialysis in low- and middle-income countries.[1, 3-5]

The circumstances in which maintenance dialysis is initiated and the choices regarding initial modality and access can significantly affect patient experiences and outcomes. Lack of patient preparedness and urgent starts to dialysis are associated with lower survival and higher morbidity.[6, 7] Home modalities such as home hemodialysis and peritoneal dialysis can improve patients' perception of autonomy.[8] Peritoneal catheters have been traditionally inserted by surgeons but can also be inserted by interventionalists or nephrologists using percutaneous techniques. The decisions about dialysis access at dialysis initiation must consider future kidney replacement modality and dialysis access options. Hemodialysis vascular access via an arteriovenous fistula (AVF) versus arteriovenous graft (AVG) or central venous catheter (CVC) is generally associated with lower mortality, medical complications, and costs.[4] However, in some circumstances—such as in elderly patients or those with poor arteriovenous access—an AVG or CVC may be the preferred method of dialysis access.

Historically, the evaluation of adequacy of dialysis has been based on small solute clearance. However, this limited focus excludes the multidimensional parameters involved in achieving optimal dialysis, leaving out necessary evaluations that reflect the many comorbidities present in the dialysis population and does not necessarily reflect how well or how satisfied the patient feels about their treatment. With the increasing recognition of the importance of patient preferences and satisfaction for shared decision-making and assessing outcomes,[8-16] it has become clear that a more multifaceted approach is needed for evaluating dialysis as a treatment modality.[17]

In January of 2018, KDIGO (Kidney Disease: Improving Global Outcomes) convened a controversies conference titled, *Dialysis Initiation, Modality Choice, Access, and Prescription*. Here we present a summary of the discussion, including consensus points, areas of controversy, identified knowledge gaps, and priorities for research. The conference agenda, discussion questions, and plenary session presentations are available on the KDIGO website: http://kdigo.org/conferences/controversies-conference-on-dialysis-initiation/.

DIALYSIS MODALITIES AND AVAILABILITY

Dialysis modalities include in-center; satellite and home hemodialysis; and continuous ambulatory and automated peritoneal dialysis. Prescription patterns can be categorized as conventional, incremental, intensive (short daily or nocturnal), trial-based, and palliative. Availability of modalities and prescription patterns usually depends upon local resources, reimbursement policies, and infrastructure more so than informed patient preferences. In some parts of the world in-center hemodialysis is the predominant modality, whereas a "peritoneal dialysis first" approach is taken in a number of jurisdictions with excellent outcomes. In industrialized countries, peritoneal dialysis is often more cost effective than hemodialysis, yet the opposite may be true for countries with no local manufacturing of peritoneal dialysis fluids or with tariffs on importing peritoneal dialysis supplies.[18-20] Factors independently associated with a lower likelihood of use of peritoneal dialysis are diabetes as the cause of ESKD, higher healthcare expenditure as a percent of gross domestic product, a larger number of private-for-profit hemodialysis facilities, and greater cost of peritoneal dialysis consumables relative to staffing.[19]

Early mortality (death within the first 90 days of starting dialysis) disproportionately affects patients starting in-center hemodialysis. This is likely because of selection bias, whereby patients with acute kidney injury complicating chronic kidney failure are more likely to initiate and remain on hemodialysis versus peritoneal dialysis.[21] Strategies to reduce early mortality are not well studied.

The only absolute contraindications for chronic hemodialysis are no possible vascular access or prohibitive cardiovascular instability. The only absolute contraindications for peritoneal dialysis are if the peritoneal cavity is obliterated, the membrane is not functional, or catheter access is not possible. Anuria is not a contra-indication for peritoneal dialysis. Every other health condition is a relative contra-indication, and therefore the selection of dialysis modality should reflect informed patient choice with decision support appropriate to the healthcare system. Patients/caregivers should be informed of the challenges, considerations, and trade-offs of the different dialysis modalities tailored to their health and social circumstances.

In multiple countries it has been reported that men more commonly receive dialysis than women.[2, 22, 23] Further evidence is needed to clarify whether and where disparities exist and the causes, which could result from biological differences or sociocultural bias.

Of note, conference participants recognized that preserving residual kidney function is important and should be a goal for all clinicians and dialysis patients. However, residual kidney function should not be the sole consideration in selecting the initial dialysis modality, because the quality of evidence comparing decline in residual kidney function across modalities is not strong enough to favor one modality over another. Similarly, there is insufficient evidence for widespread adoption of an incremental dialysis approach at initiation with the aim of trying to preserve residual kidney function.

Urgent Versus Non-Urgent, Planned Versus Unplanned Starts

Urgent starts are defined as those in which dialysis must be initiated in less than 48 hours upon presentation. Non-urgent starts are those in which dialysis initiation can be more than 48 hours after presentation. A planned approach is one in which the modality has been chosen prior to the need for dialysis and there is an access ready for use. An unplanned start is when access is not ready for use. Hemodialysis or peritoneal dialysis is possible in both planned or unplanned and urgent or non-urgent start situations (Figure 1). However, patients who require urgent dialysis in the setting of hyperkalemia, volume overload, or marked uremia are not good candidates for urgent-start peritoneal dialysis. The following are five key elements to a successful urgent start with peritoneal dialysis:[24]

1. Ability to place a peritoneal catheter within 48 hours
2. Staff education regarding use of catheter immediately after placement
3. Administrative support in inpatient and outpatient settings
4. Identification of appropriate candidates for urgent-start peritoneal dialysis
5. Utilization of protocols in every step of the urgent-start process (from patient selection until ready to discharge home with appropriate post-discharge follow-up)

The major barriers to an urgent-start peritoneal dialysis program are lack of surgeons or interventionists (radiologists or nephrologists) who can place a peritoneal dialysis catheter within the urgent start timeframe (e.g. 48 hours) and limited capacity of the healthcare facility to support urgent-start peritoneal dialysis and train patients on short notice. When critical illness, time, or capacity to offer hemodialysis and peritoneal dialysis limit the initial choice, patients should subsequently be provided with support to enable transition to their preferred modality when feasible.

PATIENT EDUCATION AND SUPPORT

Preparation for Dialysis

Education and decision aids are essential in helping patients to better understand kidney disease, weigh treatment options in relation to their circumstances, feel in control, and share information with family members and/or carers.[12] Additionally, early education is associated with lower mortality once on dialysis.[13]

The dialysis modality should be chosen with timely shared decision-making between the healthcare team, patients, and their carers and should include discussions about options and implications of various dialysis modalities (Figure 2). The approach for choosing modality should be person-centered, engaging the patient in choosing the dialysis modality in the context of local resources, costs for the patient, capacities of regional healthcare facilities, medical feasibility, and importantly, aligning with the patient's goals of care. The workgroup recommended that the goal should be to encourage and support patients to select a home-based therapy (peritoneal dialysis or home hemodialysis) or self-care dialysis and identify ways to overcome barriers to this goal (Table 1). However, the workgroup recognized that most patients in many parts of the world would still be treated with in-center hemodialysis, and the intention of the recommendation is to acknowledge that many more patients around the world could be dialyzing at home or undertaking self-care than are presently. Finally, in low- and middle-income countries, it may be appropriate to prefer one modality over another taking into account the relative cost to the society, the infrastructure for dialysis delivery, the cost of dialysis solutions, availability of water supply for hemodialysis and unlimited power supply for dialysis (PD cycler or hemodialysis). The preferred dialysis modality in these countries may be dictated by the unique circumstances of each jurisdiction. Patients do in fact perceive that home dialysis (peritoneal dialysis or hemodialysis) offers the opportunity to thrive; improves freedom, flexibility and well-being; and strengthens relationships.[8, 11] However, some voice anxiety and fear about performing dialysis treatments at home because of lack of confidence in their ability to master the technical aspects of dialysis, including self-cannulation for home hemodialysis, and because of isolation from medical and social support.[8, 11]

Effective education should be offered to patients as they approach stage G4 CKD.[25] The patient's family/carer should be involved early in the education process. Education materials may include tours or videos with interviews of patients on the different modalities. Comprehensive education should also be available in the in-patient setting and for those who did not have regular follow-up with a nephrologist or access to dialysis education prior to starting dialysis.

Supporting Patients During Dialysis

After a patient starts dialysis, the healthcare team should provide ongoing support to optimize the health benefits of the selected modality. More intensive support may be required in the early period immediately after initiation and may decrease over time. Early attrition from peritoneal dialysis may result from catheter or mechanical problems, infection, late referral to nephrologists, prior kidney replacement therapy, or management in a small center.[26] It is important to anticipate and prevent these modifiable factors or quickly address such issues.

Patients' confidence in handling the home dialysis equipment should be assessed prior to the start of dialysis and subsequent to initiation.

Frailty can impact the dialysis and overall patient experience as well as prognosis. Because frailty can occur at any age, it should be assessed on a regular basis so that any reversible issues are identified and used to inform decision-making about treatment and support for the patient.

TIMING AND PREPARATION FOR DIALYSIS INITIATION

Risk equations can be helpful in predicting a timeframe for when kidney replacement therapy may be necessary (Table 2), although the optimal timing for starting dialysis is unclear, and in clinical practice the reasons for initiating dialysis are varied. In a prospective analysis from Europe, 23 different primary reasons for initiating dialysis were identified.[27] Additionally, registry data indicate mean predialysis eGFR varies between countries (approximately 5 $mL/min/1.73m^2$ in Taiwan; average 8.5 in the United Kingdom, 7.3 in Australia, 6.4 in New Zealand, 9-10 in Canada and France; and 11 in the United States).[28-31] A specific eGFR value for initiating dialysis in the absence of symptomatic kidney failure has not been established. Generally, current guidelines do not support preemptive dialysis initiation,[32-34] although an exception is the 2011 European guidelines.[35]

Initiation of dialysis should be considered when one or more of the following are present: symptoms or signs attributable to kidney failure (for example neurological sequelae attributable to uremia, serositis, anorexia, medically resistant acid-base or electrolyte abnormalities, intractable pruritus or bleeding); inability to control volume status or blood pressure; or a progressive deterioration in nutritional status refractory to interventions.[32] Depending on the patient's preferences and circumstances, an aggressive trial of medical non-dialytic management of advanced CKD symptoms may be warranted before initiating maintenance dialysis.

In adults over 60 years, in the absence of acute kidney injury and where low levels of albuminuria exist, declines in eGFR may be relatively slow, <3 mL/min/1.73m^2/year,[30] and therefore the risk of dying before the need to initiate dialysis is higher than in other populations. Indeed, 20%-35% of Stage 4-5 elderly CKD patients die per year before reaching dialysis.[36] Additionally, elderly patients have a lower likelihood of survival in the 90 days after initiating dialysis.[37] If patients have no other indications for starting dialysis, the decision may be made to delay initiation of dialysis in older patients until eGFR falls < 6 mL/min/1.73m^2. In patients with late-stage CKD, it is important to discuss options for both medical and dialytic management in the event that acute kidney injury or additional significant illness occurs. Decision-making, including advanced care planning can be aided using predictive models, such as those developed by Couchourd et al,[38] Bansal et al,[39] and Ivory et al,[40] and should include having individualized discussions regarding clinical course, goals of therapy, and patient preferences. Patients should also be made aware of the options of medical management without dialysis, such as supportive care and/or comfort measures/hospice care, when appropriate.

Predialysis Assessments

For patient-reported outcome measures, available assessments pertain to symptoms, objective markers of nutrition, functional capacity, and markers of kidney function. Available clinical reported outcomes are muscle strength, gait speed, body mass index, and biomarkers such as eGFR, serum albumin, etc. There is considerable variation in physician reliance on biochemical and hematologic variables such as creatinine, eGFR, urea, bicarbonate, potassium and phosphate levels, and hemoglobin levels among patients at the start of dialysis.[27] Indices that measure frailty in CKD may be useful for informing patient decision-making,[41] but further research is needed regarding the effectiveness of this approach Table 3.

The timing of predialysis assessments depends on the absolute level and rate of decline in kidney function, symptom load, and associated metabolic, hematologic and clinical comorbidities but will generally fall within the range of monthly to every 3 months. There was general consensus that symptoms such as anorexia, nausea, and fatigue should be improved or resolved within 1 month after starting dialysis therapy, although it was recognized that there is a lack of data to inform interpretation of symptom changes after initiation of kidney replacement therapy.

Predialysis Care and Referrals

Predialysis care has been associated with improvement in measurable outcomes such as delayed initiation of dialysis, cardiovascular complications, and mortality.[42] Optimal multidisciplinary predialysis care includes not only timely referral but also frequent visits where patients can access different members of the care team (Figure 3).[43] Registry data report wide variation in the transition period from CKD5 to CKD5D. A minimum 90-day transition period aligns with AKI recovery, registries, and early mortality on dialysis; however, the effects of interventions on lifestyle and risk factor modification may require years to take effect. Realistically, some patients may always have barriers to empowered decision-making and self-management. The predialysis CKD care timeframe should be long enough to encompass, but not be limited to the 90-day transition period.

Recommendations for “timely referral” to a nephrologist, particularly for access creation, are mostly based on time to dialysis, for example 6 months before the need to start of dialysis. Although the timing to start dialysis can be difficult to accurately predict, evidence-based kidney failure risk equations could be used to create a more standardized approach.[44] However, this must be combined with, rather than, replace clinical judgement. Strategies to avoid late referral are listed in Table 4.

Tailoring Timing and Support for Certain Subgroups of Patients

Initiation of dialysis in the setting of a failing graft or moving between dialysis modalities. Patients with a failing kidney transplant may not be adequately prepared for approaching ESKD because the focus of care may be to maintain graft function rather than prepare for dialysis. CVCs are used in nearly two thirds of patients with failed kidney transplant grafts,[45] and the relatively low prevalence of arteriovenous fistulae or grafts in this group at initiation of dialysis needs to be investigated more thoroughly.[45] Collaboration with CKD programs may be beneficial, especially as eGFR declines below 20-30 mL/min/1.73m^2. Education and review of patient preferences and life goals are important, as is the preparation for possible next steps such as hemodialysis, peritoneal dialysis, another kidney transplant, or supportive care, as a part of the patients ESKD Life-Plan.[46] Studies based on global kidney transplant registries will be needed to track specific issues in managing patients with failing kidney grafts.

Data from the United States indicate that peritoneal dialysis patients under nephrologist supervision have a very low rate of arteriovenous access upon transition to hemodialysis.[47] Predictive models are needed to identify peritoneal dialysis patients that require transition preparation such as education and vascular access creation,[48, 49] particularly to support home hemodialysis when appropriate.

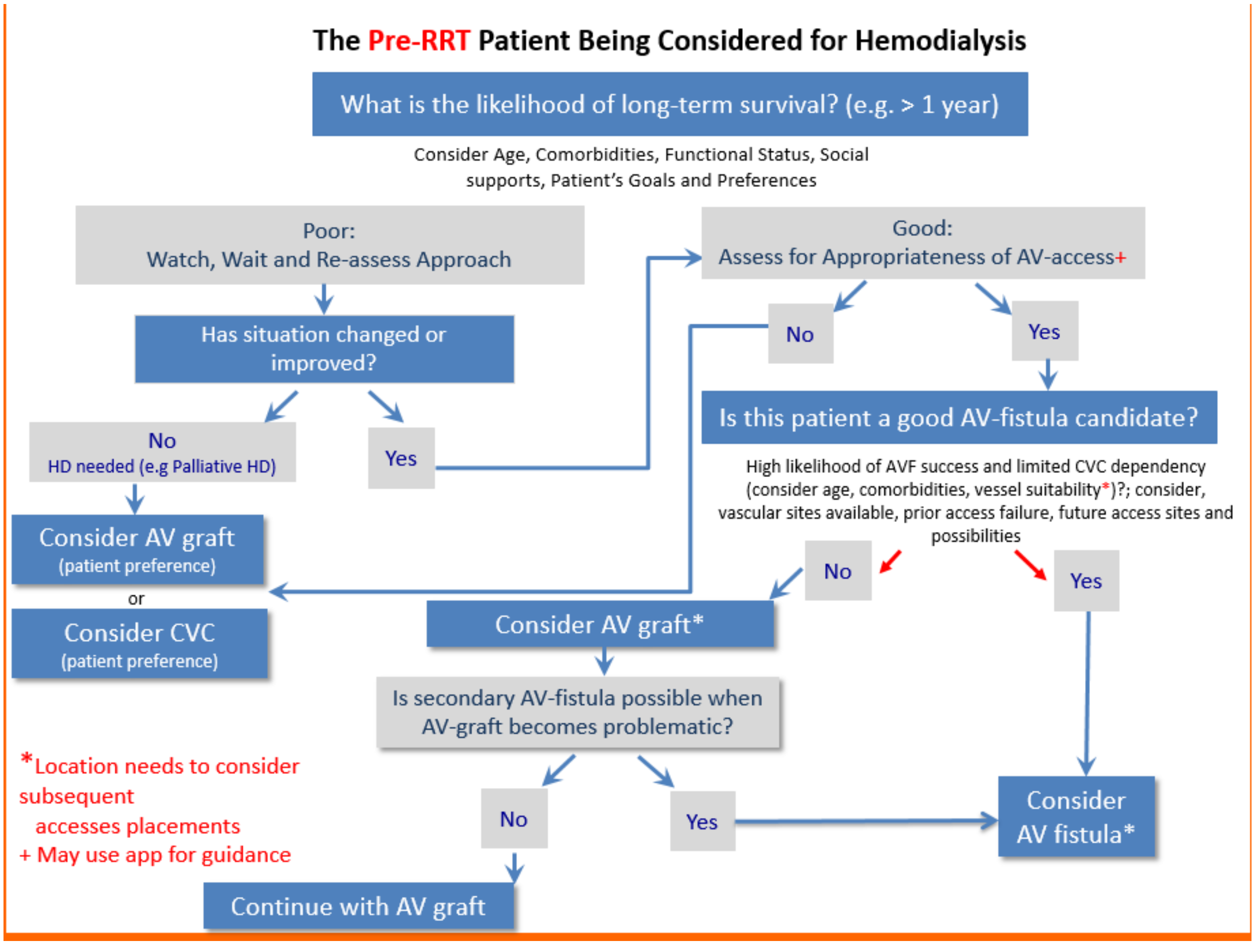
Pediatric initiation of dialysis. Unlike in adults, in the pediatric population, CKD is more likely to lead to end-stage kidney disease versus death, and therefore, validated prediction models for referral to preemptive transplant/dialysis are especially important. In a retrospective cohort study of 603 children with eGFR less than 60 mL/min/1.73m^2, kidney failure risk equations provided excellent discrimination of the risk of developing ESKD in 1 or 2 years in those with a kidney failure risk equation (KFRE) score of at least 13.2% compared to those with a score less than 13.2%.[50] In children, the unique aspects of growth, nutrition, and cognitive as well as emotional maturation increase the complexity of diagnosis, treatment, and decision-making, and therefore having a multidisciplinary team to address these issues is especially important. Children will have different needs as they age, and it is important to recognize that young adulthood and the transition to independent living can be a time when patients need a lot of support. A pediatric global initiative to determine the impact of early versus late initiation of preemptive transplant/dialysis could be conducted as a pragmatic randomized controlled trial, with a similar approach to that of the IDEAL study in adults[51] but with outcomes concentrated on growth, cognitive development, and nutritional status.

Pregnancy and initiation of dialysis. The definitive method for determining pregnancy in the setting of kidney failure is ultrasound, because levels of β-hCG can be increased during kidney failure, leading to false-positive pregnancy tests.[52] Conception pre-dialysis results in higher infant survival and lower likelihood of prematurity than conception after starting dialysis.[53] Cohort data have indicated that dialysis intensity affects outcomes, with longer durations resulting in a higher live birth rate, longer gestational age, and greater infant birth weight.[54] In pregnant women undergoing dialysis, an intensive prescription should be considered. During pregnancy, women on dialysis should be monitored for low potassium, phosphate, and folate, as well as high glucose, especially for patients undergoing tidal peritoneal dialysis. It is also important to evaluate for anemia and assess nutrition and magnesium levels. Previously the timing of initiation of dialysis in pregnancy was based on high urea levels (BUN>100 mg/dL [36 mmol/L], goal to decrease <50 mg/dL). The goal currently is to initiate at BUN<50 mg/dL,[55] also recognizing anecdotally the importance of fluid, electrolyte and acid-base disturbance. A possible strategy for research is evaluating registry data to determine the impact of early versus late initiation of dialysis in pregnancy, along the lines of the IDEAL study in adults[51] but with outcomes concentrated on live birth rate, pregnancy survival, gestational age, and birth weight.

DIALYSIS ACCESS AND PREPARATION

It is widely accepted that preemptively establishing dialysis access leads to better patient outcomes; however, there are significant challenges and barriers within healthcare systems and among payers and patients to establish dialysis access that is matured and functional for dialysis initiation (Table 5).[56-62] According to most guidelines, peritoneal dialysis access should be prepared whenever possible at least 2 weeks before starting kidney replacement therapy.[63, 64] In patients referred late, this recommendation might determine a temporary or definitive shift of patients to hemodialysis. However, recent evidence has demonstrated that urgent-start peritoneal dialysis is possible and safe, if properly conducted.[65] Although meeting participants acknowledged the benefits of fistulas,[66] they recognized the "fistula-first" approach is not appropriate for all patients destined for hemodialysis. Established paradigms for dialysis access should be reconsidered in the framework of the patient's ESKD Life-Plan,[46] taking into account individual patient and vessel characteristics, life goals and preferences. Age, comorbidities, likelihood of long-term survival, treatment goals, and timing of dialysis initiation are all factors that could affect the choice for access, which should be individualized for each patient.[46, 67] Ideally, peritoneal dialysis and hemodialysis access should be viewed within an integrated ESKD

Life-Plan program,[46] with the goal of always keeping in mind the subsequent best treatment modality and access for the individual patient (Figure x or Table x).



Selection and Management of Access as Related to Funding Policies

Selection and management of access that is tightly linked to funding policies may have serious implications for patient health. In resource-limited environments, if surgery is less expensive than endovascular procedures, it can put patients at risk for early exhaustion of vascular access sites. Economic constraints leading to prolonged use of non-tunneled CVCs can increase the risk of infection for patients. Conversely, in resource-rich environments, well-reimbursed endovascular procedures can lead to over-intervention, vessel damage, and premature loss of vascular access. Ideally, financial incentives should be aligned with best care practices.

Unfortunately, there is no consensus, evidence base, or outcome measures for best practices at the individual patient level that can be measured on a population basis. Specific outcomes used as a measure of best practice at the population level do not always apply at the patient level. To provide individualized patient care, it may be necessary to adopt "process" versus outcomes measures of best practice, such as percent of patients referred to and evaluated for vascular access before dialysis initiation. Targeting process best practices (e.g referral for vascular access) may lead to better best practice outcomes (e.g. more functional AV-accesses). Priorities for research and education are described in Table 6.

Access "Exit Strategies"

Important in the decision-making process for choosing initial dialysis access is the consideration of what options are available if the initial access fails. As expected, because of the unique dialysis modality and access needs of each patient, such access contingency and succession plans must be individualized (re: KDOQI 2018); there is no published evidence to inform back-up. At best, evidence for lack of planning—as discussed above for failing transplants and PD patients—highlights the need for access contingency and succession planning (ref: KDOQI 2018).

Research is needed to evaluate the optimal order of exit strategies in access for hemodialysis—for example, if a right radiocephalic AVF access fails, should the next access be a right upper arm AVF or left radiocephalic AVF? While this should be individualized according to the patient's access at dialysis initiation and their subsequent ESKD Life-Plan, it highlights that access decision making in preparation for dialysis initiation has implications for future access options,

OPTIMAL DIALYSIS ADEQUACY AND SYMPTOM CONTROL

For decades, dialysis adequacy has been defined by small solute clearance (Kt/V and urea reduction ratio in hemodialysis; Kt/V and creatinine clearance in peritoneal dialysis). Measuring small solute clearance has been emphasized in clinical practice guidelines, used as the basis for clinical performance measures and/or payment, and treated by many clinicians as dogma. However, evidence for relationships between small solute clearance, plasma levels of these solutes, and clinical outcomes and/or symptomatology is at best weak. It is increasingly recognized that small solute clearance measures only one of many aspects of dialysis care that are likely to affect outcomes.[14, 17, 68] Therefore, all solute kinetic goals should be interpreted and implemented in the context of the patient's overall goals and clinical status.

Meeting participants favored a holistic view of end-stage kidney disease care, in which a more comprehensive concept replaces what is currently referred to as "dialysis adequacy." Multiple measures and goals should be considered when assessing adequacy of dialysis, including small solute clearance, residual kidney function, volume status, biochemical measures, nutritional status, cardiovascular function, symptoms, and the patient's experiences and goals. While many meeting participants felt that a rigid emphasis on solute clearance does not serve the interests of all patients, there was general agreement that clinicians should continue to recognize accepted minimums for small solute removal during dialysis. Research is needed to investigate the role and importance of middle and large solutes, protein-bound and carbamylated molecules, and metabolic products of intestinal bacteria (Table 7).

It should be recognized that patients may interpret "adequacy" differently than clinicians, and therefore goals for treatment should be individualized and reassessed over time. To this end, many—but not all—meeting participants propose that the term "adequate dialysis" be changed to "goal-directed dialysis," which specifically refers to using shared decision-making between the patient and care team to establish realistic care goals to allow the patient to meet his or her own life goals and allow the clinician to provide individualized, high-quality dialytic care.

The components of goal-directed dialysis can be thought of as those directly affected by the dialysis procedure, such as small solute levels, electrolyte concentrations, volume status, and intra-dialytic symptoms as well as those that are indirectly affected by the dialysis procedure, such as symptom burden, nutritional status, activity level, work capacity, and social engagement. (Figure 4). Priorities should be individualized and consistent with achievable goals of the patient. Priorities may change between the initial months of dialysis and thereafter; therefore, prioritization requires ongoing discussions between patients and clinicians about realistic expectations and prognosis. Discussion may need to be tailored depending on the patient's cognitive function, health literacy, numeracy, socioeconomic status, and initial dialysis experiences.

Implementing Goal-Directed Dialysis

Implementing goal-based care is challenging and will require buy-in from patients, providers, regulators, and payers, whose motivations can sometimes be in conflict (Figure 5). Communication tools can be helpful in establishing goals with patients. In healthcare systems, incentives between providers and payers need to be aligned, and symptom assessment and other patient-reported outcomes will need to be validated and then incorporated into routine care (possibly through technology). This is a significant shift from current international practice and one that will require joint investment from regulators, policy makers, industry, clinicians and, importantly, patients and their carers.

CONCLUSION

A major theme identified during the conference was the need to move away from a "one-size-fits-all" approach to dialysis and provide more individualized or personalized care. Identifying and achieving patient-centered goals is now recognized as an important component of dialysis care, and these will require provider tools, patient tools, and alignment of goals and incentives among patients, caregivers, healthcare providers, regulators, and payers. Meeting participants acknowledge that any suggestion for moving toward patient-centered, goal-directed dialysis assumes that whatever systems are in place for delivering dialysis are modifiable. Admittedly, in some regions around the world, ability to change existing structures may be limited, with different drivers for inertia being present in the developed and developing world. To that end, the approaches outlined here are meant to serve as strategies that may be implemented via a variety of tactics depending on the local environment.

This conference is first of a series of dialysis controversies meetings to help provide a blueprint for delivery of optimal contemporary kidney replacement therapy. Subsequent topics in this conference series will address management of dialysis complications, innovations in kidney replacement therapy, and diagnosis of hypertension and blood pressure management in end-stage kidney disease.

ACKNOWLEDGMENTS

Jennifer King, PhD, assisted with medical writing and manuscript preparation.

DISCLOSURES [to be compiled later]

The conference was sponsored by KDIGO and supported in part by unrestricted educational grants from

Table 1. Patient and Healthcare System Barriers to Home-Based or Self-Care Dialysis and Potential Solutions

Barriers	Potential Solutions
Patient/carer specific	*Patient & carer support*
Lack of awareness	Education and training; flexible group and individualized training programmes
Physical and cognitive barriers	Carer programs; increased support and peer education Home visits, assisted home dialysis, remote monitoring
Social considerations	Government policy and incentive programs
Carer burden	Transparent information regarding burden of dialysis Respite care for carers
Out-of-pocket costs	Reimbursement of out of pocket costs
Physical space at home	Independent community homes; development in technology
Perceptions and fears of dialyzing at home (needle phobia, body image)	Education and counseling; psychosocial therapy
Healthcare system specific	*Public advocacy*
Accessibility	
By patient location	Independent community houses
Distance to home program	Home training programs
Extended care facilities	Flexible and individualized programs
Lack of infrastructure	
Delivery models	Innovations: hub & spoke, supportive networks, centers of excellence
Economic	Incentive payments
Within healthcare variability	
Healthcare team bias	Healthcare team training

Table 2. Risk Equations for Predicting Timeframe to Needing Kidney Replacement Therapy

Patient Group	Risk Predicted	Reference
Stage 3 or 4 CKD	5-year kidney replacement therapy	Schroeder et al[69]
Elderly CKD	5-year mortality	Bansal et al[39]
>75 years old, within 3 months of dialysis	Mortality	Couchoud et al[38]
>15 years old, initiating dialysis	6-month mortality	Ivory et al[40]

Table 3. Dialysis Modality and Initiation Timing: Research Needs and Proposals

	Challenge and Approach for Investigation
Dialysis initiation	
Whether to initiate	• Can a CKD Frailty Index be used to inform patient decision-making? What would constitute the index—could it be based on the IPOS-Renal index? • Could a CKD Frailty Index be combined with traditional and novel biomarkers and clinical scoring systems (serial assessments of fluid status, nutritional status/body composition) to guide initiation of dialysis? • To what extent do uremic symptoms change after initiation of dialysis? • Could a CKD Frailty Index be used to identify clinically important changes over time in individuals before dialysis and after initiation of dialysis? Are the changes different with HD versus PD? • Is it possible to predict which patients improve and which get worse? (applicable to many outcomes)
When to initiate	• With aggressive medical management, can the initiation of dialysis be delayed safely? • Can an integrated care model improve quality and decrease costs for patients with kidney disease as they transition from CKD 5 to 5D? (https://innovation.cms.gov/initiatives/comprehensive-esrd-care/)
Timing of referrals and unplanned starts	• How can the number of crash or unplanned starts be reduced? • How can referral and optimal management of patients with advanced CKD be improved? • How can CKD patients at highest risk of acute kidney injury or heart failure exacerbations be identified? • Do tablet holidays from drugs such as diuretics, ACE inhibitors, metformin, and NSAIDs prevent exacerbations? • How can outcomes for post acute kidney injury patients be improved? • What measures can promote kidney recovery among acute kidney injury patients (in inpatient and outpatient settings)? • Should dialysis be different for 5 to 5D versus CKD to acute kidney injury? • What is the real-world effectiveness and cost effectiveness of universal screening for CKD in high-risk populations? • How effective are public health surveillance systems (public health lab and provider prompts) for CKD screening and risk prediction? • Can multidisciplinary care during transition periods improve the patient outcomes such as survival, hospitalization, cost-effectiveness, and quality of life? • For patients choosing PD with a late referral, how do

	the outcomes of those who start PD first versus compare with those who start with a short period of HD? • What are the outcomes of urgent start PD versus urgent and long-term HD as evaluated in large-scale studies?
Choice of modality	
	• What is the preferred timing for educating patients regarding dialysis modalities? Does the optimal time vary based on patient characteristics? • What is the optimal content and format for educating patients regarding advantages and disadvantage of each modality? How do we check the understanding? • What are the outcomes of various dialysis modalities in sub-groups of patients? • What are the characteristics and commonalities of “unexpected” deaths within the first 90 days of initiating dialysis, particularly in those with low burden of coexisting illnesses? • What are the barriers to equal gender access to therapies, and how do these vary by country? • Is respite care effective in retaining patients on home dialysis? • What is the effectiveness of telemedicine and/or remote monitoring compared to conventional care in patients undergoing home dialysis to increase time on therapy and reduce complications?
Dialysis prescription	
	• What is the threshold of kidney function or related symptoms at which to consider incremental dialysis? • As evaluated by randomized controlled trials, how do outcomes such as residual kidney function and patient-reported outcomes compare with incremental dialysis versus conventional, full-dose initiation (HD or PD)?
Monitoring	
	• How does telemedicine and/or remote monitoring compare to conventional care in patients undergoing home dialysis?

CKD, chronic kidney disease; HD, hemodialysis; PD, peritoneal dialysis; RCT, randomized controlled trial.

Table 4. Strategies to Avoid Late Referral for Specialized Nephrology Care

Provider	Strategy
Primary care	• Education on which at risk groups and how (eGFR, uACR, risk prediction) to screen, preventive treatment, and timely referrals
Laboratory	• Improved availability of eGFR reporting and uACR testing • Automated risk reporting and prompts for referral • Decision support integrated into EMR • Predefined multi-component CKD screen test
Public health	• Regional reporting of geographic and demographic trends in CKD screening and diagnosis • Designation of CKD as a reportable disease when risk threshold reached • Early notification surveillance systems for patients and primary care providers • EMR notification system of need for screening • Evaluation of cost-benefit of mass screening • Public awareness campaign

CKD, chronic kidney disease; eGFR, estimated glomerular filtration rate; uACR, urine albumin-to-creatinine ratio.

Table 5. Barriers to Choosing Dialysis Access[56-62]

Healthcare systems and providers
Difficulty customizing dialysis access care in various systems and environments
Difficulty accessing tertiary care
Lack of resources or access to procedures or specialists required for dialysis access (e.g. inability to choose PD due to limited access to operator for PD catheter insertion or long wait times for vascular access consult and creation)
Lack of dialysis access coordination
Lack of formal processes or policies for education, surgical or interventionalist referral and review, and access creation and follow-up
Limits in skill or experience of healthcare staff
Lack of longitudinal patient-level vascular access data
Inability or poor timing in educating patients
Patient ineligibility for starting dialysis (for example, undocumented immigrants in the U.S.)
Patients
Lack of knowledge of dialysis access
Fear of or denial for the need for dialysis, often manifested by avoiding dialysis access
Anxiety based on misinformation or related experiences from other patients
Cultural or language barriers
Payers
Inability to switch modality or access because of financial constraints
Lack of readily accessible and culturally appropriate patient education materials
Failure to endorse routine measurement of laboratory values
Failure to reimburse multiple access-related procedures during the same hospitalization
System-specific variability in reimbursement for access related procedures

Table 6. Research Questions and Priorities for Education in Dialysis Access

Peritoneal dialysis catheters

- In clinical practice, what are the optimal techniques for PD catheter insertion (and conducted by whom)? Do different anesthetic methods impact outcomes e.g local or regional blocks versus general anesthesia for catheter insertion?
- For peritoneal dialysis access, are low start volumes needed? How high are volumes needed to avoid CVC and hemodialysis in emergent and urgent starts?

Hemodialysis catheters

- ~~What is the best practice to limit bleeding after CVC insertion? How does cost of medication affect practice?~~
- ~~Can antibiotic impregnated catheters reduce early CVC-related bacteremia? If so, does this make them cost effective?~~

Arteriovenous access

- Evaluate different strategies of starting hemodialysis access (e.g. different CVC types and locations, early cannulation grafts) with the goal of preserving central veins and ultimately allow AV- access creation.
- Use of radial versus femoral arteries for cardiology interventions: need to balance reduced cardiovascular procedure complications with radial approach versus long-term consequences for CKD patients who will need hemodialysis via an AV-access.
- Explore the use of noninvasive cardiac devices (e.g. leadless pacemakers) and assess the actual need of ICDs in dialysis patients, in order to preserve central veins for better outcomes in hemodialysis access.
- Why is AVF maturation success and cannulation time markedly different between countries? Could there be agreement on when and how cannulation can be attempted and dialysis delivered (e.g. initial needle sizes and blood pump speed to facilitate AVF protection and development)? Should there be a dedicated cannulation team or expert cannulators to assist?

Palliative dialysis

- What is the most appropriate access?

Education for practitioners

- Educate and train all clinicians re: appropriate individualized dialysis access and that the concept of a "one-size fits all" fistula first-catheter last approach is not always applicable to all patients
- Educate and train surgeons that using brachial vein transposition in AVF creation may be unnecessary and may create delays that have negative consequences, such as continued use of a CVC or patient refusal of the second stage.
- Test and validate tools created for AVF use by Fistula First.

Education for patients

- Develop evidence-based tools to inform patients regarding hemodialysis and peritoneal dialysis access complications (CVC infections, AV access steal, thrombosis, PD catheter malfunction, multiple maintenance interventions, etc.). This will give patients better informed consent.

AVF, arteriovenous fistula; CVC, central venous catheter; CKD, chronic kidney disease.

Table 7. Research Needs for Implementing Goal-Directed Dialysis

Biomarkers	
Middle and large molecular-weight solutes, protein-bound uremic toxins, and intestinally-derived substances	• Measurement • Role in patient symptomatology and outcomes • Interventions
Prescription	
HD dialysate composition, biocompatible PD solutions	
HD frequency and duration	
Management	
Volume status	• Assessment and management
Patient-centered outcomes	• Development and implementation strategies
Symptoms	• Assessment, prevention, and management

HD, hemodialysis; PD, peritoneal dialysis

Figure Legends

Figure 1. Planned and Unplanned Dialysis Starts.

Figure 2. Choice of Dialysis Modality. The choice of dialysis modality should be personalized, involving a shared decision-making approach between physicians and patients who have received dialysis education.

Figure 3. Areas of Consideration During the Transition From CKD5 to 5D.

Figure 4. Components of Goal-Directed Dialysis.

Figure 5. Stakeholder Tension in Implementing Goal-Directed Dialysis.

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TABLE

The Integrated ESKD Life-Plan Approach for Dialysis Access Implementation*

- Options for Dialysis Access According to ESKD Life-Plan:
    - Conservative treatment (no dialysis, no access)
    - Pre-emptive transplant (no dialysis access; consider in future as needed)
    - Peritoneal dialysis (PD catheter, no AV-access; consider in future as needed)
    - Hemodialysis (AVF, AVG, CVC: access planning)
- Hemodialysis access planning
    - Consider likelihood of long-term survival (> 1 year)
        - **Poor**: Keep on conservative care and periodically reassess for changes. These patients are more likely candidates for AVG or CVC
        - **Good**: Assess quality of vessels for AV-access
            - AV-access not feasible → CVC
            - AV-access feasible → consider AVF likelihood of usability success; decision on the preferred access is to achieve complication-free access while preserving vessels for future sites per individualized ESKD Life-Plan: e.g. in an optimal scenario where all vessels available: forearm AVF, upper arm AVF, AV graft
    - Once HD access is established, consider improvements of care:
        - Timely shift to kidney transplant or PD, whenever feasible and appropriate
        - Shift from CVC to AVF or AVG, as soon as possible when feasible and appropriate
        - Secondary shift from AVG to AVF, when AVG is failing; when feasible and appropriate
    - When planning a dialysis access procedure, always keep in mind next possible access(es) for the individual patient, in order to attain the longest and most feasible access life-plan for the individual patient, based on their ESKD Life-Plan and goals of care

AVF, arteriovenous fistula; AVG, arteriovenous graft; CVC, central venous catheter; ESKD, end stage kidney disease.

** Modified in accordance to the KDOQI VA guidelines 2018, presented at NKF SCM 2018, Austin, TX (April 2018)*