Home dialysis: conclusions from a Kidney Disease: Improving Global Outcomes (KDIGO) Controversies Conference

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Home dialysis modalities (home hemodialysis [HD] and peritoneal dialysis [PD]) are associated with greater patient autonomy and treatment satisfaction compared with in-center modalities, yet the level of home-dialysis use worldwide is low. Reasons for limited utilization are context-dependent, informed by local resources, dialysis costs, access to healthcare, health system policies, provider bias or preferences, cultural beliefs, individual lifestyle concerns, potential care-partner time, and financial burdens. In May 2021, KDIGO (Kidney Disease: Improving Global Outcomes) convened a controversies conference on home dialysis, focusing on how modality choice and distribution are determined and strategies to expand home-dialysis use. Participants recognized that expanding use of home dialysis within a given health system requires alignment of policy, fiscal resources, organizational structure, provider incentives, and accountability. Clinical outcomes across all dialysis modalities are largely similar, but for specific clinical measures, one modality may have advantages over another. Therefore, choice among available modalities is preference-sensitive, with consideration of quality of life, life goals, clinical characteristics, family or care-partner support, and living environment. Ideally, individuals, their care-partners, and their healthcare teams will employ shared decision-making in assessing initial and subsequent kidney failure treatment options. To meet this goal, iterative, high-quality education and support for healthcare professionals, patients, and care-partners are priorities. Everyone who faces dialysis should have access to home therapy. Facilitating universal access to home dialysis and expanding utilization requires alignment of policy considerations and resources at the dialysis-center level, with clear leadership from informed and motivated clinical teams.

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Home dialysis modalities, including home hemodialysis (HD) and peritoneal dialysis (PD), are associated with increased patient autonomy and treatment satisfaction and are sometimes less costly than in-center HD (ICHD).[1–7] Yet, despite mounting evidence regarding the benefits of home dialysis, its use worldwide remains low. The availability and use of home-based dialysis therapies remain variable, shaped by a complex interplay among national healthcare policies, systems for dialysis delivery, financial considerations, and culture. In many regions, including several high-income areas, individuals facing kidney failure have limited or no access to home HD. For PD, recent substantial growth in use among low- and middle-income regions has been accompanied by a concomitant decline in PD among many high-income regions.[8]

Globally, the net burden of untreated kidney disease is rising.[9] The population of individuals receiving dialysis therapy is projected to double from 2010 to 2030.[10] In response, increasing worldwide home dialysis utilization may be a means to improve universal access to kidney replacement therapy (KRT) in low- and middle-income

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regions by developing and implementing low-cost, self-managed dialysis.

In 2018, the first Kidney Disease: Improving Global Outcomes (KDIGO) dialysis controversies conference, entitled Dialysis Initiation, Modality Choice, Access, and Prescription, cemented the understanding that choice of dialysis modality plays a central role in a person-centered and goal-directed approach to KRT.[11] In 2019, the second KDIGO dialysis controversies conference addressed Blood Pressure and Volume Management in Dialysis, both of which are significantly and variably impacted by dialysis modality.[12] This third meeting of the KDIGO dialysis conference series focused on policy, facility, and patient factors affecting home dialysis utilization (Figure 1; Table 1), as well as considerations for expanding its use (Table 2).[13]

POLICY FACTORS AFFECTING MODALITY AVAILABILITY

Who pays for dialysis varies internationally and has significant implications for availability of care. Publicly funded treatment is free for patients in some regions, but in other regions, individuals must pay for some or all services.[14] Some models are hybrids in which modality access and coverage are influenced by whether the payer is public or private. For healthcare systems, providing access to dialysis and optimizing healthcare economics are often competing interests (Figure 2). The amount spent on healthcare is increasing annually for all Organisation for Economic Co-operation and Development nations.[15] Dialysis care is expensive, and for many, it is associated with poor quality of life.[16,17] For lower- and middle-income regions, costs of dialysis care are often too high to provide KRT to all patients with kidney failure.[18] A rationale for PD-first policies in publicly funded systems is that the lowered costs maximize dialysis availability to the largest possible population[19]; however, a consequence of PD-first policies may be constraint of individual choice of therapy.[20]

In addition to the considerable costs of dialysis therapy, its environmental impact is significant, and mitigation strategies should be prioritized.[21] Action is required on waste reduction, as well as efficiency of energy and water use, which apply equally to home- and center-based dialysis. A clear advantage of home therapies is the lower level of need for transportation and the decreased associated carbon footprint; however, more-frequent dialysis in the home can offset this benefit.[21]

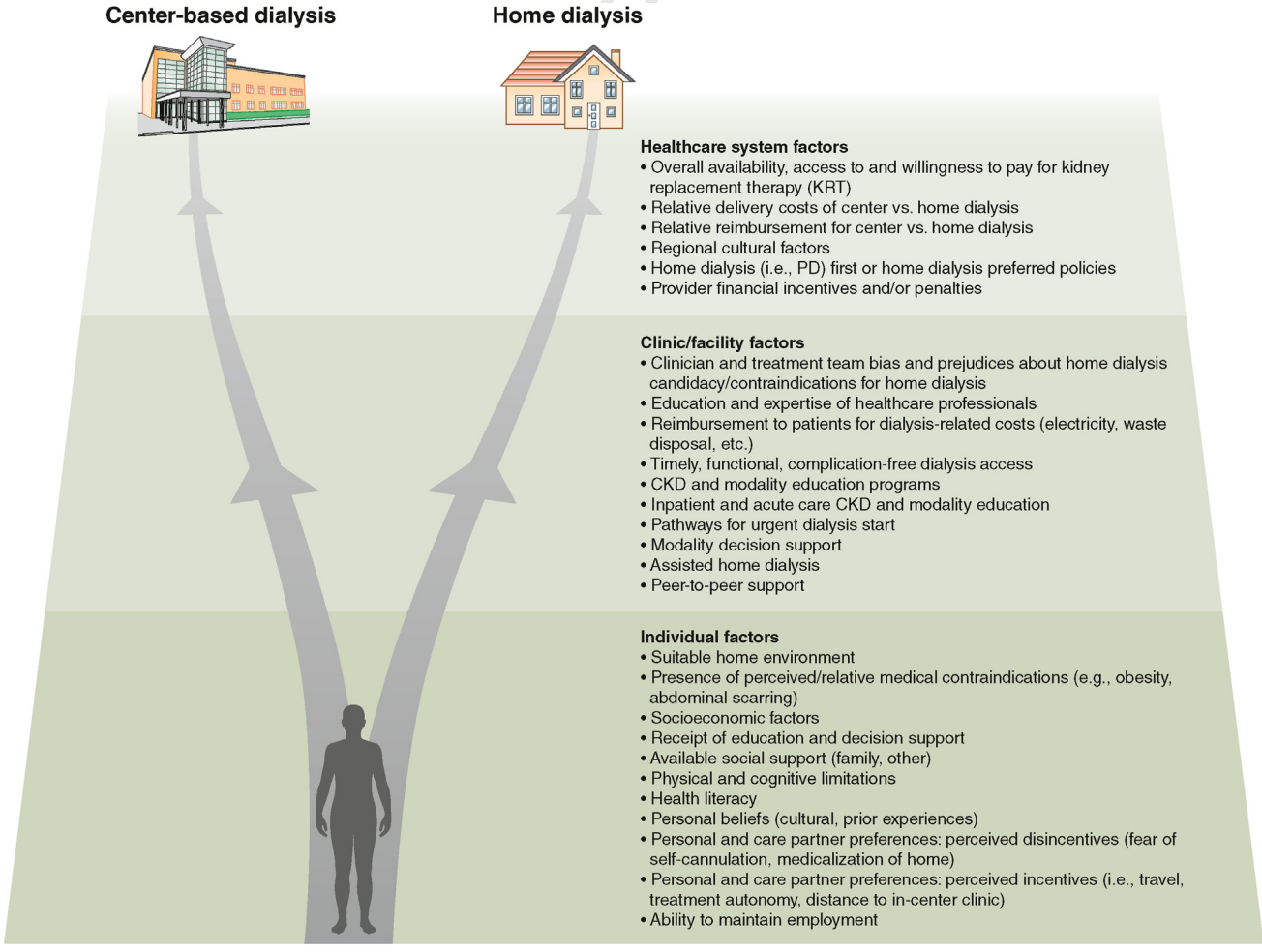

Figure 1 | Factors leading to either center-based or home-based dialysis. CKD, chronic kidney disease; PD, peritoneal dialysis.

Table 1 | Summary of consensus points and residual controversies

Consensus points
• Economic and local policies have a strong role in dialysis modality distribution within a region.
• Clinical outcomes are comparable among existing dialysis modalities, although patient quality of life may be better with home dialysis across certain domains.
• All individuals in need of maintenance dialysis should have home dialysis as a potential treatment option.
• Individualized care, patient choice, education, and shared decision-making are central to modality selection in environments where multiple dialysis treatment options are available.
• The choice of dialysis modality should be directed by the anticipated benefits to quality of life as perceived by the patient and care-partners.
• High-quality education and clinical experience for healthcare professionals around home dialysis therapies are priorities.
Residual controversies and questions
• Is a stronger evidence base needed to support interventions purported to increase the use of home dialysis?
• Is it advisable or feasible to initiate further randomized clinical trials of dialysis modality comparisons given prior efforts and the importance of patient choice?
• How do we measure the success of home dialysis growth as use expands to individuals previously considered ineligible?
• In what contexts or circumstances could PD-first policies be considered and endorsed?
• How do we measure and cross-compare home dialysis utilization in the context of differential rates of transplantation and conservative nondialytic care?

PD, peritoneal dialysis.

Whether home dialysis can result in cost savings from the perspective of the payer is context-dependent. In general, PD costs are lower than ICHD costs, but this tends to be truer in high-income regions, largely due to staffing costs. In several countries, the cost of PD is greater than that of ICHD, often because of the high costs of consumables.[22] Large-scale use of PD can lead to cost reductions, and local manufacturing of PD fluid reduces shipping and tariffs.

Modifying the frequency or amount of assistance with home dialysis also influences costs. Having trained personnel provide assistance to PD patients in their homes increases expense and may reduce realized cost savings relative to ICHD. For home HD, the first year of treatment has high costs associated with installation of equipment and initial patient training, but in subsequent years, costs become lower than those with ICHD.[22] For patients who do not continue long enough on home HD to recoup training and set-up costs, savings may not be realized. High rates of transition, such as for kidney transplantation or a return to ICHD, may increase costs of home, relative to center-based, therapies.[23]

Regardless of region, home dialysis often results in at least some cost burden being shifted to patients or their care-partners. To offset these costs, some countries, including Canada, Australia, the United Kingdom, and New Zealand, have local reimbursement policies to individuals for power, water, and waste disposal. Whether such reimbursements influence choice of modality is unclear.

Expansion of use of home dialysis within a given health-care system is complex and requires alignment of policy, fiscal resources, organizational structure, and provider incentives or accountability (Table 3). Financial and policy levers for influencing the use of home dialysis need to be contextualized to the population of interest, existing culture, healthcare infrastructure and resources, and health priorities and challenges. Policy makers, health economists, clinicians, patients, and their care-partners all have varying priorities that need to be balanced. The most appropriate financial model and healthcare policy toward home dialysis should be determined by each jurisdiction, after considering the accessibility to dialysis, healthcare economics, sustainability, and local outcomes.

Historically, many successful PD initiatives have been operationalized at the payer and dialysis-provider level. Figure 3 documents countries in which high utilization of home dialysis can be attributed partly to such initiatives.[24–29] In many regions, ICHD is the default and therefore predominant modality, and financial pressures to keep all stations in HD centers full may be present. In reimbursement models, the 4 key stakeholders are the payer, the dialysis provider, the nephrologist, and the patient (Figure 4). Actions by the payer and provider are likely to have the greatest impact. Payer interventions can take several forms, such as direct fiscal incentives or penalties, coverage for a particular modality type(s), capacity limits, or a combination of these. Incentives to providers should reach the team of professionals supporting home dialysis, including nurses, surgeons, and radiologists.[30] However, financial incentives alone are unlikely to increase use of home dialysis, as they are only one piece in a complex system.[31,32]

EVALUATING AND COMPARING MODALITY OUTCOMES

Comparisons of clinical outcomes between home and ICHD are largely limited to observational studies, and the results can be challenging to interpret in the context of selection bias and confounding. Very few studies include robust measures of residual kidney function, frailty, or social determinants of health, limiting analysis of key subgroups. Most studies are from higher-income regions, limiting their global applicability.

Clinical outcomes

Peritoneal dialysis versus hemodialysis. Although the evidence has major limitations, it suggests that age,[33–38] gender,[37,39,40] race,[37,41,42] region, diabetes status, vascular

Table 2 | Research priorities for home dialysis outcomes and implementation

Standardized reporting and outcomes
• Define and identify core outcomes of critical importance and relevance to all home dialysis stakeholders. • Use metrics to evaluate, report, and benchmark performance of dialysis modalities. • Develop and test strategies for capturing, reporting, and disseminating key outcomes (e.g., worksheets, toolkits, scorecards).
Policy and economics
• Evaluate the role of setting regional targets for home dialysis utilization on usage rates • In regions with limited dialysis availability, explore the role of home dialysis and its delivery as a sustainable, low-cost approach. • Develop policies that enable and improve access to technological innovation for home dialysis. • Examine initiatives that reduce the ecological impact of dialysis. • Evaluate and compare implementation of health economic models for dialysis delivery and their impact on home dialysis use. • Evaluate whether the outcomes of PD-first policies are modified by differing local and regional circumstances. • Evaluate whether physician reimbursement impacts rates of home dialysis utilization. • Evaluate the cost-effectiveness of different models of assisted home dialysis.
Facility and organizational culture
• Develop and test mechanisms that build a culture of confidence around home therapies for healthcare professionals, patients, and care-partners. • Understand the best approaches to share expertise among networked facilities. • Develop and test tools that assess and address physician and healthcare team bias in modality selection. • Develop and test tools to assess home dialysis unit organizational culture.
Modality education and decision-making
• Evaluate approaches to enhance shared decision-making and assess and measure shared decision-making uptake and effectiveness. • Develop unbiased, commercial-free educational programs for staff, patients, care-partners, and family members. • Evaluate and compare models of training, including the following: virtual and personalized training; online education (providers and patients); hybrid individual training and group training; remote and home training; integrated in-center and teaching-specific facilities that focus on self-care dialysis skills; transitional care facilities and standard dialysis facilities; and subspecialty home dialysis facilities and mixed facilities. • Measure the impact of patient motivation and ability, for example, using patient activation measures and their role in home dialysis utilization. • Use virtual platforms and leverage existing technology to develop novel methods (i.e., simulations) for education and training (especially for cannulation). • Evaluate best models for peer support (live and video) from experienced units and assess their impact on patient-reported outcomes and home dialysis utilization.
Technology, monitoring, and support
• Evaluate effectiveness of eHealth interventions and their integration into home management. • Enhance communication and cooperation between dialysis providers and primary care providers. • Evaluate the role of telehealth, remote monitoring, and virtual patient encounters on home dialysis utilization. • Assess the prevalence of care-partner burnout and how it impacts home dialysis utilization.
Modality transition
• Analyze data from population-based registries on transitions between dialysis modalities and identify areas for improvement. • Analyze perspectives of patients, care-partners, and health professionals on the process of transitioning. • Identify predictive factors of switching from in-center to home HD/PD and predictive factors of switching among home modalities. • Assess outcomes of patients who switch modalities, moving from in-center to home dialysis or among home modalities; map the recruitment pathway to facilitate this transition; and identify optimal transition pathways from PD to home HD.
Assisted home dialysis
• Standardize definitions and data collection (clinical and economic) on assisted home dialysis. • Initiate cost-effectiveness analyses of assisted home dialysis compared to unassisted home dialysis across a broad range of models of care delivery and regions. • Compare paid versus unpaid assistance and type of assistance (professional vs. family). • Design studies inclusive of patient-centered outcomes and family-member outcomes (burden of care, physical and emotional fatigue, etc.) and consider comparator groups of nondialytic conservative care and alternate dialysis modalities.

HD, hemodialysis; PD, peritoneal dialysis.

access type,[43] and body mass index[43] affect relative survival with PD or ICHD. Two prospective randomized controlled trials explored whether outcomes for those starting ICHD differ from outcomes for those starting PD. The first study ended prematurely, due to low enrollment,[44] and the second study had a substantial number of patients who declined randomization to modality.[45] These studies underscore the important role of patient choice in dialysis modality selection and illustrate logistical challenges that limit feasibility of controlled trials to compare home versus in-center dialysis.[45]

Hemodialysis at home versus in-center. Several observational studies have compared home HD with ICHD. Although interpretation of these studies needs to be taken in the context of the various home HD prescriptions evaluated, findings have generally suggested that home HD is associated with lower rates of hospitalization, decreased mortality, and

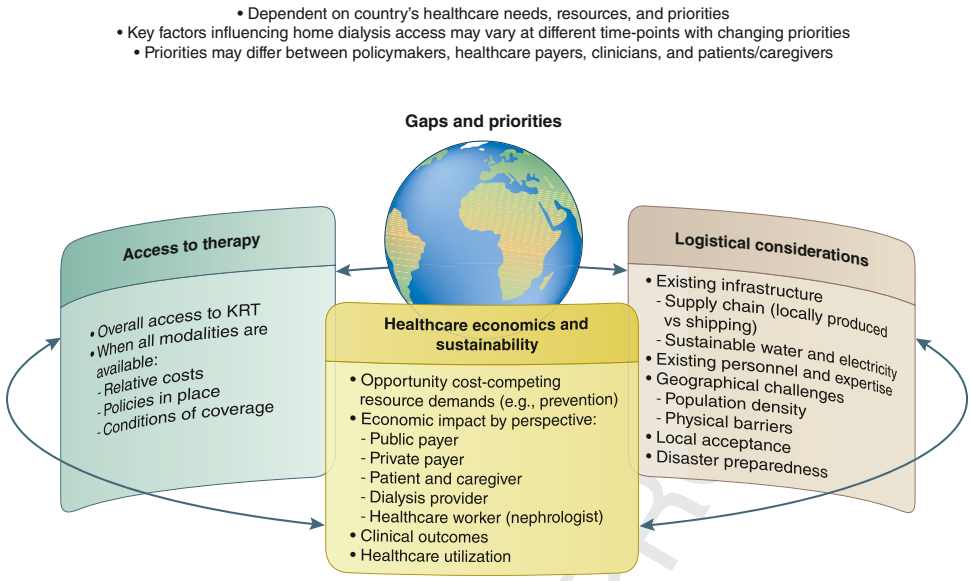

Figure 2 | Global perspectives on access to home-based dialysis. KRT, kidney replacement therapy.

fewer adverse non-access events.[46–51] Limited randomized controlled trial data suggest that intensive HD improves blood pressure control, regresses left ventricular hypertrophy, and normalizes phosphate levels without dietary restrictions, but adverse vascular access events may be increased.[4,52] Given inherent biases in observational data and limited published subgroup data, still unclear is whether clinically important outcomes differ by modality, and, if so, which populations are most likely to derive substantial benefits from home dialysis versus ICHD.

Quality of life

Home versus in-center dialysis. Health-related quality of life is highly valued by patients and their families. Data from randomized controlled trials and observational studies[53–55] comparing PD with ICHD have found only small differences in health-related quality of life by modality, with a marginally better physical component score among PD patients.[7,53] In categorical analyses, 23% to 39% of ICHD patients, and 14% to 24% of PD patients, had the highest burden range (burden score <25), and 8% to 25% of ICHD patients, and 10% to 37% of PD patients, had the lowest reported burden.[13] A study from the United Kingdom of frail, older patients highlighted similar quality of life with assisted PD and ICHD,[54–56] although, an important finding is that older patients report being more satisfied with PD.[54,57]

Table 3 | Factors required for expanding use of home dialysis within a healthcare system

- Healthcare policy (e.g., home dialysis–first policies)
- Fiscal resources
- Organizational structure
- Provider incentives and accountability
- Measurement of impact and ongoing feedback

Quality and performance metrics for evaluating home dialysis programs

As home dialysis programs expand, identification of the most-appropriate metrics to use for assessing and enabling improvement of care is key. Data from the Standardized Outcomes in Nephrology (SONG) initiative indicate that life participation and fatigue are 2 key patient concerns in the dialysis community,[58,59] yet these outcomes are challenging to measure and are therefore infrequently incorporated into quality-assessment programs. Additionally, very few of the quality practice indicators used to assess dialysis practice, such as vascular access type, blood stream infections, and calcium and phosphorus levels, directly address home dialysis. Others, including measures of small solute clearance (e.g., Kt/V), have limited evidence to support their use in individuals on home dialysis and, when implemented, may disadvantage facilities in quality-assessment programs.[60]

Although efforts are in progress,[61] standardization of metrics across countries or regions is lacking. A home-dialysis–specific (home HD and PD) patient experience measure has been developed for use in the US,[62] although comparison of PROMs (patient-reported outcome measures) and PREMs (patient-reported experience measures) among sites of care and among patients can be difficult.

Quality metrics need to be feasible to implement (not limited by economic status or healthcare setting), standardized to reduce heterogeneity nationally and internationally, and meaningful to all end-users (Table 4[63]). Tools to define quality can include measures of structure, process, and outcomes, with the first 2 items serving as surrogates for the third.[64] Patient-, center-, and policy-level components should be balanced to measure the feasibility and outcomes of home dialysis expansion, keeping the patient's perspective central while integrating facility-level and national-level metrics.

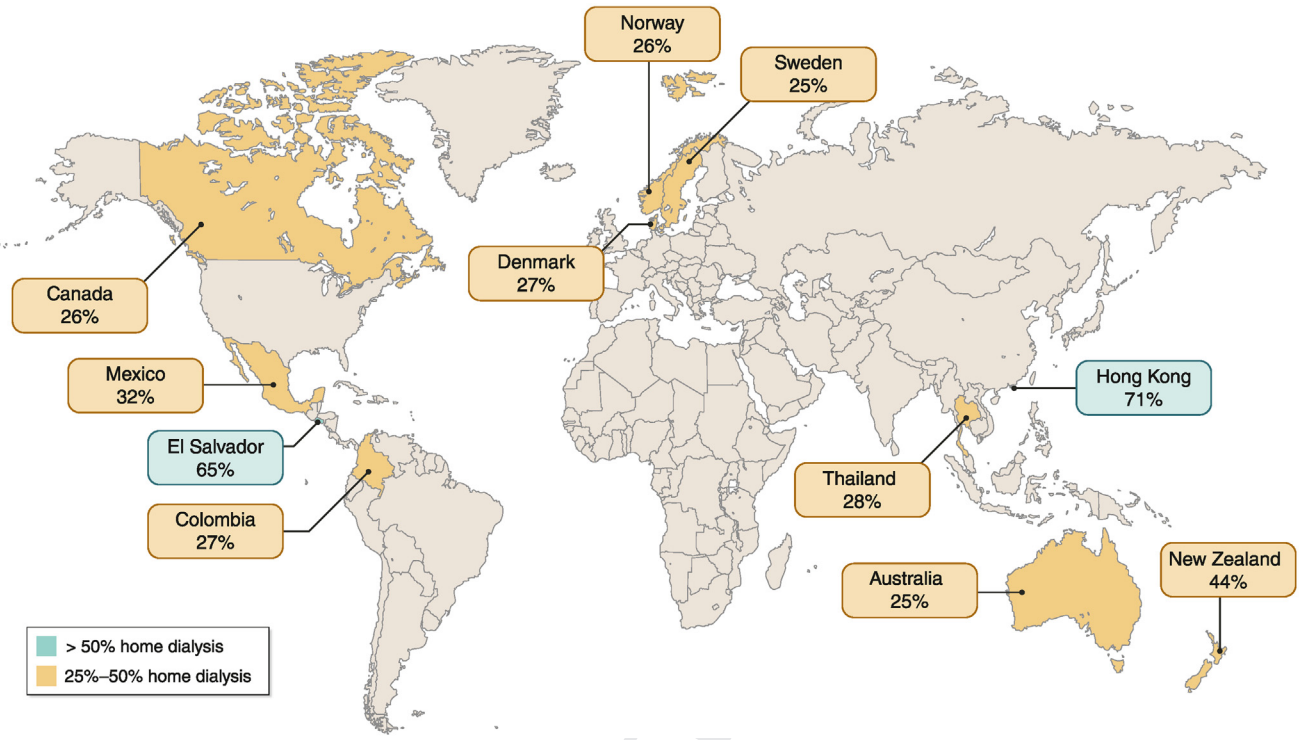

Figure 3 | Representation of countries with high utilization of home-based dialysis in prevalent patients with kidney failure. Countries with high utilization of home dialysis have implemented home dialysis–first or –preferred policies. Home dialysis–first policies have largely centered around peritoneal dialysis (as in Hong Kong,[24] Thailand,[25] Mexico,[26] and Colombia[27]), although in some countries, home dialysis–preferred policies have included home-based hemodialysis (as in Canada, Australia, New Zealand, and multiple Scandinavian countries). Home dialysis–preferred policies may be implemented regionally within a given country and vary by the degree of financial incentives. Figures obtained from US Renal Data System 2020 Annual Data Report,[28] except for Thailand,[25] and Australia and New Zealand.[29]

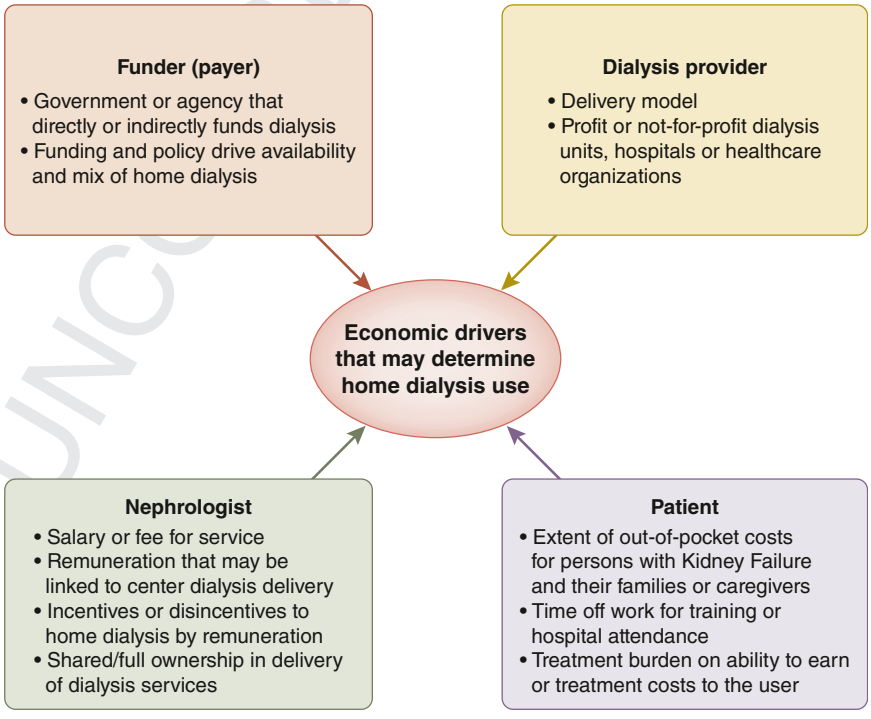

Figure 4 | Economic drivers influencing use of home-based dialysis.

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Table 4 | Potential quality metrics in home dialysis

	Challenges in applying a standardized definition	PD	Home HD
Patient survival	• Heavily dependent on comorbidities and frailty • Whether to classify and capture cause of death • Whether to include dialysis withdrawal as a death event • How to account for deaths after transition to center-based therapy (these may be premorbid events underestimating home dialysis–related mortality).	X	X
Technique survival	• Most experience relates to PD, but has a role in the understanding of home HD • What constitutes technique failure? o Classify temporary transition (whether to include specific time intervals) and the particular value of death-censored technique failure • Work is underway to standardize causes	X	X
Patient-reported experience and outcomes measures	• Selection of kidney-specific versus generic measures • Impact of repeated assessments and floor/ceiling effects • Response bias including disparities among responders versus non-responders[63] • Heterogeneity of domains • Uncertainty regarding goal—specifically, whether the focus should be on modifiable outcomes or identification of key issues • Cultural and health literacy generalizability • Separate tools potentially needed for care-partners	X	X
Hospitalization	• Uncertainty regarding whether time in hospital (e.g., length of stay) versus frequency of hospitalization is paramount (e.g., rate) • Attribution to a home versus in-center modality for recent modality change • Differentiating "good" hospitalizations (transplant, elective procedures) from "avoidable" hospitalizations • Emphasis on readmission versus initial admission	X	X
PD infections and peritonitis	• Heterogeneity of data capture • Some subjectivity in the definition of a PD-related infection • Work underway to standardize metric focusing on episodes per patient-year as defined by the ISPD	X	
Residual kidney function	• Uncertain numerator and denominator • Heterogeneity of causes of residual kidney function loss, with some etiologies potentially avoidable and other loss nonmodifiable • Variability in assessment with some relying on volume and others on measures of solute clearance • High patient burden with collection, and frequent inaccuracy	X	X
Biochemical markers of small solute clearance	• Limited data supporting a specific target threshold for small-molecule clearance • Focus on numbers rather than overall well-being to make treatment decisions • Lack of universal data standards, including determining inputs into Kt/V calculations	X	X
Noninfectious catheter loss	• Many causes not modifiable • Regional factors influence access to advanced surgical techniques (such as laparoscopy) • Standardized definitions (work underway) • Registries often do NOT capture access loss prior to PD commencement, missing a high number of individuals with early mechanical complications	X	
Vascular access infection	• Balancing patient preference versus risk, particularly with buttonhole cannulation • May disincentivize more frequent hemodialysis, as the more an access is used, the higher the risk of infection • May disincentivize home hemodialysis among those with fears of using arteriovenous access by disincentivizing use of central venous catheters		X
Noninfectious vascular access loss	• Relatively low numbers of accesses lost • Instruments under development		X
Adverse procedure-related events	• Relatively rare events • Dependent on patient self-report, resulting in limited and inconsistent ascertainment	X	X
Water quality	• Likely topped out for use as a metric • Clear link between standards and outcomes is missing	X	

HD, hemodialysis; ISPD, International Society for Peritoneal Dialysis; PD, peritoneal dialysis.

When developing and implementing home dialysis quality measures, potential items to evaluate include the proportion of people that select a modality who ultimately receive that modality, as well as the rate of transfer from the home modality to ICHD. The reasons for discontinuing a modality and whether these reasons are modifiable are important to track.

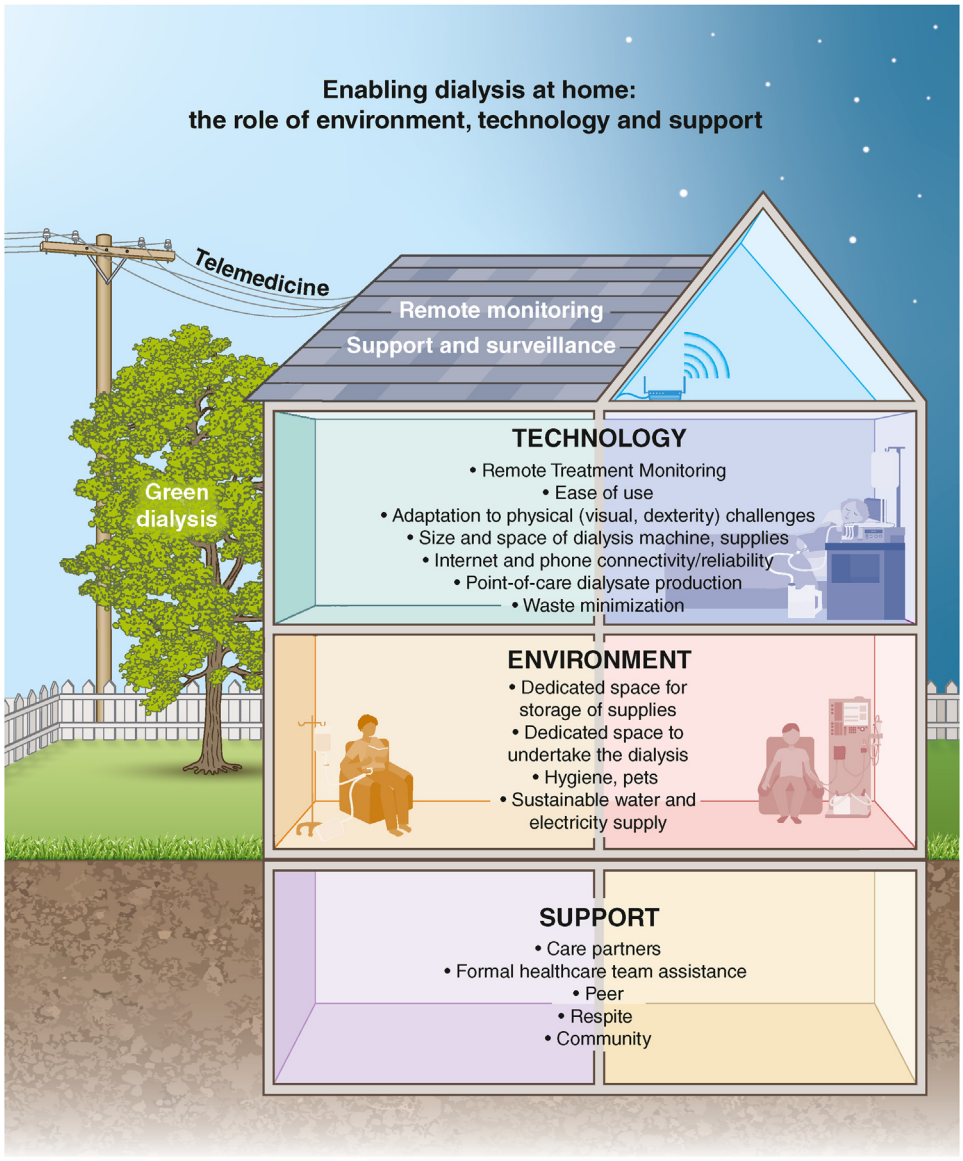

Figure 5 | Enabling dialysis at home.

These data need to be conceptualized within the context of conservative care and kidney transplantation utilization, both of which vary widely across jurisdictions, impacting measures of home dialysis utilization. Additional metrics and domains are discussed in Table 4. Ideally, any list of measures would be parsimonious, would be updated frequently to maintain relevance and immediacy to clinical care, and would help alleviate rather than reinforce disparities in home dialysis utilization.[65]

CHOOSING HOME DIALYSIS

Given evidence suggesting only small differences in outcomes between home and in-center dialysis, modality choice should be preference-sensitive, informed, and individualized based on perceived quality of life, life goals, and symptom burden. Ideally, individuals, their care-partners, and their healthcare teams will decide together on the most appropriate initial modality, using shared decision-making.[66] Choices may be more widely available in higher-income regions, where KRT options are less likely to be constrained by economic factors.

Clinician bias and approach have a strong influence on patient decision-making.[67] Incumbent upon clinicians is presentation of both dialysis and dialysis modality as choices, emphasizing that several treatment options exist and that many individuals with kidney failure will require, over time, several different kidney failure treatment modalities. Currently, the number of dedicated educators on dialysis modalities is insufficient, especially those who can

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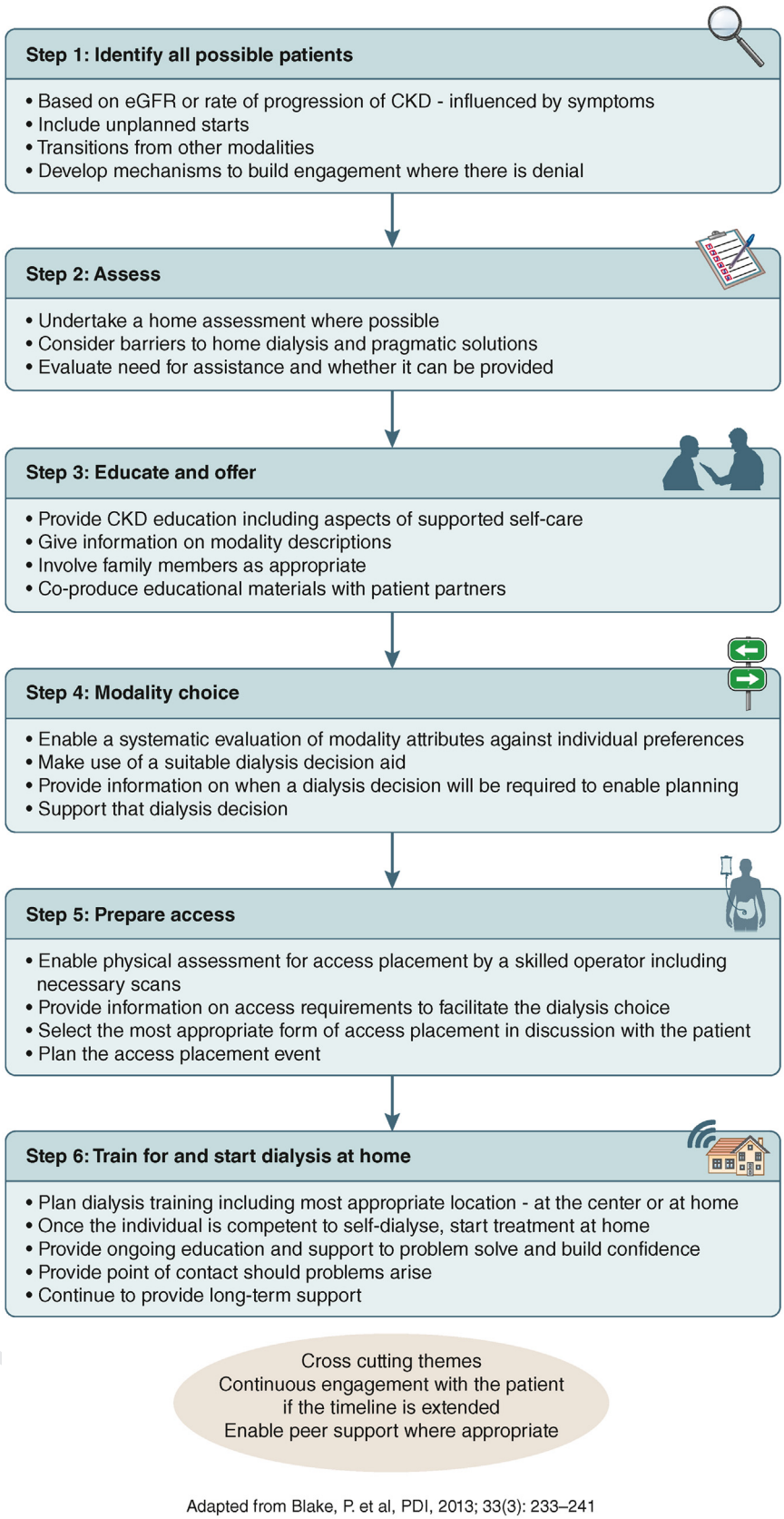

Figure 6| The chronic kidney disease (CKD) home therapies evaluation and assessment pathway. Based on Blake *et al.*, 2013.[72] eGFR, estimated glomerular filtration rate.

provide an unbiased, comprehensive view of the spectrum of kidney failure treatment options, including PD, home HD, in-center hemodialysis, transplant, and nondialysis conservative care.[68]

Patient considerations

Factors that have been associated with lower uptake of home dialysis are male sex, minority ethnicity, older age, greater comorbid burden, late referral to kidney care, lower socioeconomic status, obesity, and close proximity to dialysis centers.[69,70] Patient subgroups, including indigenous populations, minority ethnicities, certain religious groups, displaced persons, lower socioeconomic groups, and those with language barriers, lower health literacy, or cognitive impairment may have more barriers to engaging in decision-making and/or to being offered alternative modalities. These individuals require responsive strategies. Community and cultural experiences can influence individual choice; individuals may feel shame about being ill or that discussions about illness are taboo.

Pragmatically, multiple resources are needed for successful home dialysis, including a safe and clean environment, access to technology, and in many cases, support from family or community (Figure 5). Those who require physical support in performing dialysis may not have a care-partner or access to home support or paid care. Certain programs may discourage or may not support home dialysis for persons who live alone. Patients and families may be concerned about assuming responsibility for therapy, risk of infections, or a perceived lack of support, or they may believe that home therapy represents suboptimal or substandard care. Individuals may worry about imposing treatment on family/household members, and indeed, patients and their families can become fatigued, especially with long-term home care. Space in the home may be limited for materials and equipment, and some individuals may want to separate their home life from dialysis treatments. Waste management and environmental hygiene can also impact decision-making.

That stated, home dialysis has few absolute contraindications. Unstable or insufficient housing may be a barrier to both home HD and PD. Lack of a viable peritoneum, such as when the peritoneum has been damaged through surgery or inflammation, is an absolute contraindication for PD. Lack of vascular access is an absolute contraindications to home HD. Critically, a contraindication to one home modality, such as no remaining HD vascular access sites, may be a firm indication for a different home modality, such as PD. Relative contraindications to home dialysis exist on a spectrum (for example, mental health and cognitive impairment disorders) and potentially may be overcome with environmental modifications, technology adaptation, and assistance from care-partners or professionals.

Dialysis at home should not be limited to patients with high levels of activation and involvement in self-care. No threshold of these characteristics should determine candidacy; these can be developed with appropriate education and support.[71] For individuals who are reviewed in chronic kidney disease clinics, recurrent evaluation and iterative education and preparedness planning, governed by principles of shared decision-making, are important (Figure 6).[72] Emotional preparedness, and therefore support, is as important as educational preparedness and may require input from trained mental health professionals. Informing those who start ICHD urgently that changing modality after clinical improvement is a possibility is important.

PATIENT TRAINING

The association between patient-targeted education interventions and the subsequent choice and receipt of PD is strong.[73] Uptake of home HD can be increased through stepwise efforts to support and train individuals to participate in specific tasks related to their HD treatment.[71,74] Educational strategies and formats for training and evaluation vary,[73,75,76] and they exist for many aspects of dialysis care,[77] peer support, and peer education.[78,79]

Above all, education should be iterative, culturally sensitive, and consistent when provided by different team members. For individuals without predialysis care, education that occurs early in the dialysis tenure is imperative. For those who have unplanned starts, a pathway designed for early education that includes home opportunities should be established in each program. Having a dedicated team for new-start patients after discharge from hospital can facilitate education for individuals who may not have received predialysis education or made their modality decision.[80,81] Education can be provided in groups or one-to-one with healthcare teams, videos (internet, virtual, or video-based), written materials, and peer support. Using a variety of education methods is important, to accommodate learning styles. Educators must have a clear grasp of both home and in-center modalities. Training for healthcare professionals, critical to successful home dialysis programs, is discussed below. Improving clinician education and providing support to small centers are critical for increasing home dialysis utilization.

Qualitative studies evaluating barriers to home HD uptake indicate that self-cannulation is a significant source of fear and anxiety. Resources are needed to help overcome these fears and instill patient confidence.[82–84] In some cases, use of a central venous catheter rather than arteriovenous access may be a practical, although controversial, solution. Shared center-based HD care, whereby individuals are provided with support and given the choice to learn and perform tasks relating to their own care, may instill important principles of self-management, enabling more people to consider home dialysis.[71] This requires that all dialysis nurses and care professionals receive specific training, so that patient education becomes part of the routine delivery of care.

Availability of a range of PD catheter-insertion techniques, including percutaneous and surgical, allows use of the most appropriate approach given the individual patient characteristics. The percutaneous technique utilized by expert operators can often enable PD to be started in a timely manner for

Table 5 | Different models of assisted peritoneal dialysis delivery

Country	Healthcare system funded	Model of care	Comments
France[95]	Community nurses	Mostly CAPD 3–4 visits; some APD 2 visits	51% incident patients with assisted PD: 82% nurse assisted and 18% family assisted
Denmark[96,97]	Community nurses or nursing home staff	Predominantly APD with 2 visits	Assisted program also used to support urgent start of PD
Ontario, Canada[98,99]	Community nurses	APD 1–2 visits/d	Family assistance also required for some tasks; many also have access to integrated geriatric care
British Columbia, Canada[100]	Community non-healthcare professionals with PD training	APD 1 visit/d	Family assistance also required for some tasks
United Kingdom[56]	Non-healthcare professionals with PD training	Predominantly APD 1 visit/d; 2 visits/d APD, or CAPD supported in some centers	Assistants predominantly from healthcare agency organized by commercial supplier of PD fluid; some units employ own assistants; healthcare system reimburses 1 visit.
Brazil[101]	Nurse assistant	APD 1–2 visits/d	Single-center experience; PD funded by renal center, as not reimbursed by public healthcare system
China[102,103]	Family, home care assistant, younger PD patients	CAPD	Funded by family/patient; some centers train younger PD patients to assist older ones
Saudi Arabia[104]	Family, home care assistant	CAPD, APD	Funded by family/patient; single-center report

APD, ambulatory peritoneal dialysis; CAPD, continuous APD; PD, peritoneal dialysis.

suitable individuals, whereas advanced laparoscopic surgical approaches may be preferred in complex patients and those with intra-abdominal considerations.[85,86]

Peer support should be facilitated by dialysis programs because it provides vital and unique insights for new patients who are considering home therapies. Dialysis programs can work with local patient kidney organizations; in the United Kingdom, the National Kidney Foundation has initiated such a program (https://www.kidney.org.uk/peer-support).[79] Webinars or seminars targeted to patients and families can address myths relating to home dialysis and can ease individual concerns by providing open-question periods. Patient and care-partner input into the development of these programs is crucial (including prevalent home-dialysis patients and those who did not choose home dialysis). Studies of whether peer support groups increase home dialysis utilization are needed. Home visits support individual and family confidence in the home. Managing patient expectations and specifying that a change of modalities may be necessary in the future are important. Anxiety is common with early in-home practice, and provision of details regarding support contacts is essential, for reassurance and to enable problem solving. Reassurance should be provided that nursing or medical and technical support will continue when patients are at home.

Although no clear evidence indicates that decision aids impact usage of home dialysis, they can improve patient clarity and autonomy in decision-making and increase perception of control.[87] Example decision aids are the Yorkshire Dialysis decision aid,[87] the SHERPA decision aid, the National Patient Decision Aid for Established Renal Failure, the My Kidneys My Choice aid, and the Decision Aid for Renal Therapy.[88] They should be employed as part of, and not as a replacement for, standard in-person education. A 3-talk model of shared decision-making comprises a series of sessions for dialysis education, exploration of potential benefits and drawbacks for each modality, and a decision talk in which the patient decision is made and evaluated.[89,90]

Patients report having a positive feeling toward remote consultation and monitoring, but they feel that neither should replace face-to-face clinical contact.[91–93] Remote monitoring may be embraced by clinicians as a means of assessing whether patients are safely using home dialysis. Despite the high interest in using remote monitoring, good-quality evidence of effectiveness is needed before its widespread use in home dialysis is implemented.[94]

Assisted home dialysis

Assisted home dialysis refers to the provision of assistance to individuals receiving home dialysis by care-partners (i.e., family or friends), or hired staff (i.e., professionally trained dialysis nurses, personal support workers, community health workers, or other skilled aides) (Table 5[95–104]). Assistance can be nontechnical (for example, carrying dialysate bags into patient rooms), technical (machine setup, dialysis-related operations), clinical (evaluation of exit site, fluid-volume assessment), partial or complete, temporary or permanent, and paid or unpaid.

Family assistance for PD is ubiquitous, as reflected by evidence that the presence of social support is associated with greater uptake of PD.[105] Healthcare-provided assistance is more limited. France has the longest experience of assisted PD, predominantly as assisted continuous ambulatory PD using community nurses.[95] In the United

Kingdom, assisted PD provided by healthcare assistants has been shown to increase the rate of PD initiation, particularly in older patients.[106] Funded assisted PD, however, is not available in the majority of European countries.[107] Data from Canada indicates that nurse-assisted PD is associated with better technique survival, compared with that of family or self-care PD.[108]

Unpaid care-partner assistance occurs commonly. The majority of assisted PD in Asia and the Middle East is performed by domestic helpers, often as an additional workload.[109,110] In Malaysia, full or partial assistance by care-partners is defined in a renal registry, and no community nurse assistance is available. In the US, access to assistance is limited; some individuals have unpaid care-partners or hire private assistants. Notably, a recent feasibility study showed that appropriately trained nonregistered nurse assistants can successfully support patients on PD within the US healthcare system, at least on a temporary basis.[111]

For assisted home dialysis, relative program evaluations are difficult. A recent systematic review and jurisdictional scan evaluating the role of assisted PD across 34 studies, 46,597 patients, and 20 jurisdictions could not demonstrate clear clinical and economic benefits of PD assistance.[112] This failure to find benefit was likely due to the heterogeneity of study quality, outcomes, and models and types of assistances. Cost effectiveness and clinical outcomes evaluations of assisted home dialysis can be considered against both center-based dialysis and conservative, nondialysis care.

Strategies to decrease care burden without substantially increasing costs could include the following: adjusting the prescription for residual kidney function (fewer exchanges per day or incorporating days off dialysis, referred to as incremental dialysis); early and frequent education and monitoring for burnout; time-limited staff-assisted home dialysis during periods in which technique failure or complication rates are high (e.g., after falls or fractures); public-private partnerships (cost-sharing between government and dialysis organizations); and nominal incentives to care-partners (monetary or otherwise).

Care-partners require specific support; data suggest that their quality of life is poorer than that of the general population.[113] The optimal methods for educating and supporting care-partners of dialysis patients are not clear. Care-partners may benefit from some "time out" or "respite" that is scheduled proactively; this time is an important part of home dialysis programs (provided resources are adequate to support this approach). This respite can be provided as assistance or ICHD for distinct time periods or limited days, such as 1–3 days per week. Routine evaluation for burnout and proactive referrals are essential.

HOME DIALYSIS PROGRAM DEVELOPMENT AND PROVIDER EDUCATION

Home dialysis programs engage multiple stakeholders to serve the local community.[114] Although each program is unique, development of a home dialysis program is underpinned by certain key principles, including the following: equity of access; patient, care-partner, and/or other stakeholder involvement; the addressing of population needs within the local healthcare system; clinical leadership; shared decision-making; and a quality-improvement culture.[115] Successful PD and home HD access programs are vital parts of all dialysis programs, with home dialysis integrated with existing ICHD and transplantation, such that each modality is viewed as complementary, not competitive. An organized, standardized approach is needed to identify new dialysis starts, assess home dialysis eligibility, and provide modality education and support while enabling individuals to make an informed decision regarding a treatment strategy.[116] Complex, multisystem, evidence-based systematic clinic-based interventions (i.e., education, feedback, and audits) have not always demonstrated benefit of increased utilization of home dialysis. This finding underscores the importance of stakeholder accountability (i.e., incentives/penalties) and feedback from patients' care-partners and providers for the success of any intervention. The development and implementation of local quality-improvement initiatives may be more successful for increasing home dialysis utilization than top-down approaches.[117]

A roadmap for developing home dialysis programs includes local assessment of needs; mentorship/support by local/regional expertise; a realistic plan for growth, underpinned by adequate resources and staff requirements, with competencies, safety training, and retention support; and standardization of processes and procedures (e.g., patient education, access creation, and treatment of common complications). Facility culture is key for maintaining a successful program.[118]

The most appropriate working arrangements for care teams will be influenced by the patient population and the number of available staff across disciplines. A meta-analysis of 10 studies of PD found a mortality benefit with larger centers,[119] although this could be due in part to newer centers having a smaller number of patients. These findings also suggest that smaller centers may need additional support over time.

Training health professionals

All healthcare professionals involved in caring for persons with kidney disease should receive early and comprehensive core training in all KRT options, including home dialysis.[120] This training should include contact during fellowship training that involves treating patients with home dialysis; such training is important both for building physician confidence in home dialysis care and limiting physician bias regarding home dialysis eligibility among certain individuals or patient groups.[121] Continuous maintenance training is necessary for nephrologists and nurses. Training should be underpinned by a system of competencies and responsibilities that will differ based upon local resources and healthcare

systems. The full multidisciplinary team contributing to staff education in home dialysis gives a unified message that builds individual confidence.

Home dialysis experts and educators

Home dialysis specialists have a specific skill set that requires recognition—it includes modality expertise combined with complex case management in the home setting. Rotating/mixing these specialists with other subspecialty experts risks diluting this expertise but may be necessary in smaller or resource-limited settings where individuals have multiple responsibilities. Specific home-dialysis educators and navigation specialists are professionals essential to the increased uptake of home therapies, as they can provide patient education that supports modality choice.

Modality transitions

Modality transitions are common and result from complications such as mechanical problems or infections, changes in social circumstances, or the development of additional comorbid conditions.[122] They can occur among any of the dialysis modalities, are often complex for centers to manage, and can be distressing and frightening for patients. When possible, transitions should be anticipated and planned for,[123] with a focus on improving patient quality of life as well as facilitating access to patient-centered HD regimes (e.g., adjustments to the intensity of HD therapy).[11,124] Successful transition is underpinned by protocols that require the following: comprehensive patient-centered education; support of a multidisciplinary healthcare team; well-defined care models delivered by dedicated staff skilled in patient training, monitoring, and support; and adequate infrastructure and organization.[11,77,115,123,125,126] Strategies to increase home-to-home dialysis transitions may need to focus on integrating home dialysis (home HD and PD) care whereby equal experience and comfort exists across all home dialysis modalities[127–129]; addressing unique patient barriers to home HD; and promoting technologic advances that simplify performing either PD or home HD.

Insights from the coronavirus disease 2019 (COVID-19) pandemic

The COVID-19 pandemic demonstrated the need to build system resilience for all possible disaster types and dialysis modalities. It illustrated difficulties in surgical dialysis access prioritization, provision supply chain problems, and vulnerability to staffing shortages.[130] The pandemic also highlighted the benefits of being able to dialyze at home amidst widespread challenges in obtaining and providing healthcare. Indeed, home dialysis can be advantageous in terms of flexibility and safety,[131] but it relies on the availability of supplies and consistent access to electricity and clean water.[132] Across some jurisdictions, the use of PD increased during the pandemic, but across many regions, training of new patients and reduction in access to PD catheter insertion may have restricted home dialysis growth.[133,134] Important lessons learned from the pandemic to improve home dialysis care and provision include prioritizing strategies and healthcare policies that maximize successful and timely PD access placement, exploring the role of and improving access to telemedicine, building redundancies in facility staffing and home dialysis training resources, and enhancing support so that patients can continue to receive treatment at home.[135]

CONCLUSION

Our consensus conference reaffirmed the need for advocacy and efforts to ensure equitable access to home dialysis to all individuals in need of KRT globally. Multiple research needs exist, and a systematic prioritization would aid implementation, although this undertaking was outside the scope of this conference. The importance of context, choice, and education in facilitating successful home dialysis is clear. There is no one-size-fits-all model for promoting and delivering home dialysis at any level, from patient to facility to healthcare system. Effective approaches are multipronged, engage multiple stakeholders, and take account of local circumstances. Clinical studies comparing modalities are limited in their generalizability; however, existing evidence suggests in-center dialysis, PD, and home HD are sufficiently similar in clinical outcomes to support personalized and individual choice among these options.

The conference agenda, scope of work, and plenary presentations can be found at https://kdigo.org/conferences/hd/.

APPENDIX

Other Conference Participants: Alferso C. Abrahams, Netherlands; Samaya J. Anumudu, USA; Joanne M. Bargman, Canada; Geraldine Biddle Moore, USA; Peter G. Blake, Canada; Natalie Borman, United Kingdom [UK]; Elaine Bowes, UK; James O. Burton, UK; Agnes Caillette-Beaudoin, France; Yeoungjee Cho, Australia; Brett Cullis, South Africa; Yael Einbinder, Israel; Osama el Shamy, USA; Kevin F. Erickson, USA; Ana E. Figueiredo, Brazil; Fred Finkelstein, USA; Richard Fluck, UK; Jennifer E. Flythe, USA; James Fotheringham, UK; Masafumi Fukagawa, Japan; Eric Goffin, Belgium; Thomas A. Golper, USA; Rafael Gómez, Colombia; Vivekanand Jha, India; David W. Johnson, Australia; Talerngsak Kanjanabuch, Thailand; Yong-Lim Kim, South Korea; Mark Lambie, UK; Edgar V. Lerma, USA; Robert S. Lockridge, USA; Fiona Loud, UK; Ikuto Masakane, Japan; Nicola Matthews, Canada; Will McKane, UK; David C. Mendelssohn, Canada; Thomas Mettang, Germany; Sandip Mitra, UK; Thyago Proença de Moraes, Brazil; Rachael Morton, Australia; Lily Mushahar, Malaysia; Annie-Claire Nadeau-Fredette, Canada; KS Nayak, India; Joanna L. Neumann, USA; Grace Ngaruiya, Kenya; Ikechi Okpechi, South Africa; Robert R. Quinn, Canada; Janani Rangaswami, USA; Yuvaram N.V. Reddy, USA; Brigitte Schiller, USA; Jenny I. Shen, USA; Rukshana Shroff, UK; Maria Fernanda Slon Roblero, Spain; Laura Solá, Uruguay; Henning Søndergaard, Denmark; Isaac Teitelbaum, USA; Karthik Tennankore, Canada; Floris Van Ommeslaeghe, Belgium; Rachael C. Walker, New Zealand; Robert J. Walker, New Zealand; Angela Yee-Moon Wang, Hong Kong; Bradley A. Warady, USA; Suzanne Watnick, USA; Eric D. Weinhandl, USA; Caroline M. Wilkie, USA; and Jennifer Williams, UK.

DISCLOSURE

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