



A Korean perspective on the 2019 Kidney Disease Outcomes Quality Initiative guidelines for vascular access: what has changed and what should be changed in practice?

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The Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines are developed by the National Kidney Foundation in the United States; however, the guidelines have an impact on most international societies, including those in Korea. The KDOQI recently released the updated 2019 guidelines for vascular access based on numerous papers and controversies concerning vascular access since 2006, when the first guidelines were published. The new KDOQI guidelines have undergone significant changes compared to previous guidelines, including a change in the philosophy regarding a patient-centered approach using an end-stage kidney disease “Life-Plan.” In addition, there are newly developed or revised definitions and some key differences from previous guidelines. The process of adapting guidelines needs to be individualized to hemodialysis practice in each country, while agreeing with general principles and philosophy; therefore, we summarize changes in the updated guidelines and discuss the application and implementation of the new principles and concepts of the guidelines for vascular access care in Korea.

Keywords: Arteriovenous fistula, Guideline, Kidney Disease Outcomes Quality Initiative, Renal dialysis

Introduction

Hemodialysis (HD) continues to be the most common treatment modality for patients with end-stage kidney disease (ESKD) in Korea [1]. The longevity of HD patients is closely related to the quality of dialysis treatment and depends on reliable and durable vascular access (VA), which is often referred to as the lifeline of HD patients.

Furthermore, the medical cost of care for arteriovenous (AV) access continues to increase [2].

In addition to these medical and economic demands, the optimal care of VA based on new evidence from substantial research, technical improvements in devices, and changes in patient demographics has improved since the release of VA guidelines by the National Kidney Foundation (NKF) Kidney Disease Outcomes Quality Initiative (KDOQI)

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in 2006 [3]. The KDOQI guidelines for VA were updated and released in 2019 [4] and contain many changes from previous guidelines. These changes are not only based on new information but also include information regarding the recalibration of evidence on which the previous guidelines were based (Table 1).

The 2019 guidelines were developed according to the GRADE (Grade of Recommendations Assessment, Development, and Evaluation) Evidence to Decision (EtD) framework [5,6], which is a more advanced step of the GRADE approach used in the development process of the prior guidelines. In that process, a higher level of evidence review was required, and it was led by an independent evidence review team (ERT). This team pooled the evidence through strict criteria with high standards, leading to the recalibration of previous evidence, which had implications for the 2006 guidelines. Some evidence previously classified as high-level evidence was downgraded to moderate- or low-level evidence by the ERT. As a result, these guidelines have a more significant evidence base for their recommendations and suggestions. For example, when a statement indicates that “There is inadequate evidence for KDOQI to make a recommendation,” the Work Group cannot make any recommendation, suggestion, or other evidence-based guidance based on the very low, low, or inadequate quality of evidence amassed by the ERT. However, this should not be interpreted as “do not recommend” or “do not suggest.” This simply indicates that the level of evidence is not sufficient to be a guideline for the rating, but that it is an important topic that needs to be included, so further research is needed.

There is underreported data that revision of the evidence could not counter. For example, there is no literature regarding vessel preservation, so new guidelines qualify for expert opinion statements. When the guidelines state that “KDOQI considers it is reasonable” or “considered reasonable,” this indicates expert opinions. To avoid misunderstanding of the revised guidelines, it is necessary to understand the GRADE approach before evaluating specific statements.

For the past several years, the optimal care of VA has been of paramount concern in Korean societies. In particular, nephrologists who were interested in VA care formed the Korean Society of Diagnostic and Interventional Nephrology (KSDIN) in 2010, which is supported by the Korean Society of Nephrology (KSN). The KSDIN has tried to establish the

Table 1. Changes in the new guidelines compared to the previous guidelines

Concept	2019 KDOQI guidelines	
	2006 KDOQI guidelines	Patient first
Definition	Fistula first, catheter last AV access (AVF or AVG) dysfunction and complications Mature fistula is defined by satisfaction of rule of 6s Catheter dysfunction is defined as a failure to attain and maintain an extracorporeal blood flow of 300 mL/min or greater at a prepump arterial pressure more negative than -250 mmHg Diagnostic criteria of catheter-related bacteremia require blood draws from the peripheral vein	More patient-focused approach with development of an ESKD Life-Plan AV access dysfunction and complications are divided into three categories - Thrombotic flow-related - Nonthrombotic flow-related - Infectious Mature fistula is one that can provide prescribed dialysis consistently with two needles for >2/3 dialysis sessions within 4 consecutive weeks Catheter dysfunction is defined as a failure to maintain the prescribed extracorporeal blood flow required for adequate HD without lengthening the prescribed HD treatment The new definition does not require blood draws from the peripheral vein but allows blood draws from the HD circuit

(Continued to the next page)

Table 1. Continued

	2006 KDOQI guidelines	2019 KDOQI guidelines
Key differences in guidance		
Modality education	Patients with a GFR less than 30 mL/min/1.73m ² (CKD stage 4) should be educated on all modalities of kidney replacement therapy options	Adult and pediatric patients with an eGFR less than 30 mL/min/1.73 m ² (CKD G4) with progressive decline in kidney function (including failing transplant or PD) should be educated on all modalities of kidney replacement therapy options
Timeline for AV access creation	AVF should be placed at least 6 months before anticipated HD start	In nondialysis CKD patients, AVF should be created 6–9 months before anticipated HD start
Preoperative evaluation	Vascular mapping should be performed in all patients before placement of an access	Selective preoperative ultrasound in patients with high risk of AV access failure rather than routine vessel mapping in all patients
Postoperative care	None	Adjuvant far-infrared therapy is suggested to improve AVF primary patency be based on individual circumstances
AV access type & location	AVF are preferred; wrist > elbow > transposition	Create AVF or AVG consistent with patient Life-Plan and overall goals of access care
	Then, AVG; forearm loop > upper arm AVG > necklace or lower extremity AVG	Site dependent on patient's Life-Plan and anticipated duration of HD
	Avoid long-term catheter if possible	
Surveillance	Recommends organized monitoring/surveillance approach with regular assessment of clinical parameters of the AV access and HD adequacy	Does not suggest routine AVG surveillance by measuring access flow, pressure monitoring or imaging
		Inadequate evidence to support AVF surveillance beyond physical examination
AV access maintenance	Preemptive PTA may be indicated in certain cases of abnormal physical findings	Monitoring is primary, while surveillance findings are supplementary
	None	Does not recommend preemptive angioplasty of AV access with stenosis not associated with clinical indicators
Intraluminal agents to prevent CVC dysfunction or CRBSI		Suggests that the selective use of once weekly prophylactic CVC locking with a thrombolytic agent (recombinant TPA) can be considered in patients in need of long-term CVCs
		Suggests that the selective use of prophylactic antibiotic locks can be considered in patients in need of long-term CVC who are at high risk of CRBSI (e.g., multiple prior CRBSI)
New technologies	The efficacy of stent grafts for the salvage of AVGs has not been compared with other strategies, but may provide better long-term results	Stent-graft is suggested for treatment of clinically significant graft-vein anastomotic stenosis of AVG in preference to angioplasty alone when the stent-graft is used appropriately in view of patient ESKD Life-Plan and overall goals and targets
		Stent-graft is suggested to treat in-stent restenosis in AVG and AVF for overall better 6-month post-intervention outcomes
		Early cannulation graft is an option when a patient urgently starts HD without sufficient prior time to plan creation of AV access

AV, arteriovenous; AVF, arteriovenous fistula; AVG, arteriovenous graft; CKD, chronic kidney disease; CRBSI, catheter-related bloodstream infection; CVC, central venous catheter (tunneled hemodialysis catheter); eGFR, estimated glomerular filtration rate; ESKD, end-stage kidney disease; GFR, glomerular filtration rate; HD, hemodialysis; KDOQI, Kidney Disease Outcomes Quality Initiative; PD, peritoneal dialysis; PTA, percutaneous transluminal angioplasty; TPA, tissue plasminogen activator.

best care for patients based on the data and situation in Korea. In line with this, we summarize the new guidelines, focusing on what has changed, and discuss how Korean experts will adopt the new principles and philosophy of the guidelines and apply those to patients in Korea.

Change in concepts and definitions

Change in concepts (from ‘fistula first’ to ‘patient first’)

The updated guidelines present a new concept of VA care based on the fact that each patient’s lifetime experience with chronic kidney disease (CKD) is very different. Therefore, we need an individualized approach to meet their needs. The previous KDOQI guidelines promoted the concept of ‘fistula first’; however, many studies have raised serious questions regarding this one-size-fits-all approach to VA, finding substantial heterogeneity across patients in the benefit derived from the creation of an arteriovenous fistula (AVF) [7-9].

Therefore, the new guidelines have emphasized a more patient-centered approach, which considers the complications and solutions according to the needs and preferences of each patient, and recommends establishment of an ‘ESKD Life-Plan.’ The Life-Plan takes into account the next treatment modality for the individual patient along with dialysis access. While ‘fistula first’ is still important and should be supported when appropriate, ‘fistula first and catheters last’ is not the only message; getting the right access to the right patient at the right time for the right reasons is crucial.

Therefore, an approach that considers the next steps alongside the planning of the first VA has been emphasized. This planning provides many advantages, such as preserving the blood vessels necessary for the successful formation of dialysis vessels in the future and avoiding unnecessary procedures and complications. Therefore, the updated KDOQI focused on the P-L-A-N (Establish Patient Life-Plan, and then consider the corresponding Access Needs) approach for individual patients (Fig. 1). The “Patient Life-Plan” should be considered, including “Access Needs” for ‘What is next?’, such as a creation plan, contingency plan, and succession plan even before the initial VA is placed. The new KDOQI guidelines recommend an annual review and update of the patient’s individualized ESKD

Life-Plan as well as a minimum quarterly review of VA functionality, complications, risks, and access options, which is a nephrologist’s responsibility. Hence, more active participation of nephrologists will be required for planning VA, rather than leaving it in the hands of the vascular surgeon.

New and revised definitions of access use

The new or updated definitions align with more modern practices for our dialysis patients. The old KDOQI guidelines presented the ‘rule of 6s’, which we were familiar with for over a decade. The new guidelines, however, state that a mature fistula is one that can provide the prescribed dialysis consistently with two needles for over two-thirds of dialysis sessions within 4 consecutive weeks. In Korea, adequate HD efficacy was clinically obtained in many cases, even though the prescribed blood pump flow was somewhat lower than in the United States or Europe. Therefore, even if the VA did not reach the 6s threshold, it was still often used successfully for HD.

In the previous KDOQI guidelines, catheter dysfunction was defined as the failure to attain an extracorporeal blood flow of 300 mL/min or greater with a prepump arterial pressure more negative than 250 mmHg. However, the

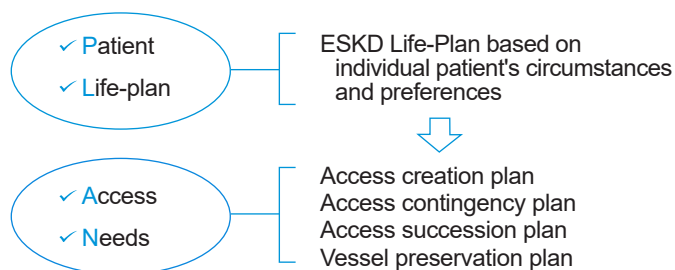


Fig. 1. Individualized P-L-A-N (Patient Life-Plan and their Access Needs). The 2019 Kidney Disease Outcomes Quality Initiative guidelines for vascular access suggest considering the patient first, followed by planning vascular access consistent with their individual ESKD Life-Plan, which is the anticipated continuum of kidney replacement treatments (peritoneal dialysis, hemodialysis, transplantation, or conservative care). “Access Needs” include three main components: an access creation plan, access contingency plan, and access succession plan. Concurrently, there must always be a vessel preservation plan, to ensure viability for future access. ESKD, end-stage kidney disease.

new guidelines define catheter dysfunction as a failure to maintain the prescribed extracorporeal blood flow required for adequate HD without lengthening the prescribed HD treatment. Prescribing HD treatment without prolonged HD time should be considered significant, and sometimes flow in the catheter at 250 to 270 mL/min is not regarded as a malfunction in Korea.

The definition of catheter-related infections incorporates the Centers for Disease Control and Prevention (CDC) [10] and Infectious Diseases Society of America (IDSA) [11] guidelines. It also considers the circumstances of the HD unit and patients, which made it more practical. Now, blood can be taken from dialysis circuits, which is an easier and faster way to make the diagnosis compared to venipuncture, which can further damage the native veins.

Access dysfunction is a very general term that is not specific with regard to the etiology of dysfunction. Therefore, the definitions of dysfunctions and complications have been divided more specifically and replaced with three terms; thrombotic flow-related, nonthrombotic flow-related, or infectious. This definition was also applied to complications. For example, stenosis or thrombosis is a thrombotic flow-related complication, and AV access aneurysm or steal syndrome is a nonthrombotic complication. The Work Group wanted to distinguish AV access dysfunction due to stenosis or thrombosis from other causes of dysfunction, such as aneurysm or steal syndrome.

Finally, infiltration injury was defined as vessel injury related to cannulation or the dialysis procedure and was categorized as minor, major, or severe cannulation injury according to the recovery period or the necessity for more active treatments, such as transfusion, hospitalization, and endovascular or surgical intervention. It is now recommended to report infiltration injury according to the classification in the new guidelines.

Key differences in the statements of 2019 guidelines

Preparation for dialysis access and education on ESKD modalities

When we talk about preparing our patients who are transitioning to dialysis either for peritoneal dialysis (PD) or a transplant, the old KDOQI guidelines support the idea that patients with a glomerular filtration rate (GFR) of <30

mL/min/1.73m² or with stage-4 CKD should be educated on all the modalities of kidney replacement therapy, including transplantation. However, the new guidelines state that adult and pediatric patients with GFRs of <30 mL/min/1.73m² and with progressive decline in kidney function, including kidney failure, transplant, or PD should be educated on all the modalities of kidney replacement therapy. This recommendation is derived from the fact that multiple papers support the idea that the patients who failed a transplant actually went back on catheter for multiple reasons. These included denial by the patient that their transplant was failing and the lack of preparation on the nephrologist's part for access care and referring the patient in a timely fashion for permanent access [12]. In addition, the old KDOQI guidelines state that AV fistulation should be placed at least 6 months before the anticipated start of dialysis, whereas the new guidelines recommend a slightly longer interval of 6 to 9 months before the anticipated dialysis. We all acknowledge that it is difficult to estimate when a patient initiates dialysis, but we have some framework to help us.

Preoperative evaluation

The previous KDOQI guidelines suggested that vascular mapping should be performed in all patients before placement of AV access. One of the major changes that the new KDOQI guidelines presented is that selective preoperative ultrasound should be performed in patients who are at a high risk of AV access failure, rather than routine vessel mapping in all patients. High-risk patients include those who are elderly, female, or who have a history of central venous catheters or peripherally inserted central catheter lines, cardiac rhythm devices, peripheral vessel damage due to venipuncture, or comorbidities such as peripheral vascular disease and coronary artery disease. It is reasonable to individualize the mapping for certain patients, but considering the increase in elderly CKD patients, most patients would be included in the high-risk group. In addition, there are no absolute criteria for minimal vessel diameter in planning the creation of an AV fistula in the new guidelines. We are familiar with the idea that 2.0 to 2.5 mm for the vein and 2 mm for the artery were the recommended diameters for fistula creation [13–15]. The KDOQI guidelines note that there is a lack of evidence to support those

recommendations; however, it is crucial to assess the vessel wall condition along with vessel distensibility and calcification before the creation of AV access. Thus, the new guidelines state that it is reasonable to evaluate multiple characteristics of vessel quality for AVF creation (size, distensibility, flow, etc.).

Order of preferences

According to the concept of ‘patient first,’ which promotes individualized decision-making regarding access placement, the arteriovenous graft (AVG) or long-term catheter can be the first access option in some circumstances with valid reasons. Korea has one of the fastest-growing populations of elderly HD patients in the world, and more than 90% of patients start renal replacement therapy with HD. Therefore, whether the “fistula first” approach should also be applied in elderly patients is a crucial issue in Korea. AVFs have fewer complications once they mature, but they take more time to mature and are associated with a competing risk of death until the patient begins to derive benefits. Therefore, patient life expectancy becomes a significant concern. The survival benefit of AVF decreases as patient age increases [16]; therefore, individualized VA selection that considers patient morbidity, short life expectancy, and personal preference are necessary.

We are used to the idea of “catheter last” and the avoidance of long-term catheters if possible. The new KDOQI guidelines state that the use of tunneled or nontunneled catheters is actually reasonable in valid circumstances, which requires a substantial change of mindset.

The preference of ‘distal, nondominant arm’ emphasized in the previous guidelines remains an important principle, but it depends on the ESKD Life-Plan, vascular condition, and preference of the individual patient. The new guidelines state that the type and location of AV access be considered depending on whether the patient’s life expectancy is more than one year and whether the situation is urgent or not.

Site recommendations are dependent on the Life-Plan and anticipated duration of dialysis. Thus, placement of a forearm AVF, forearm loop AVG or proximal forearm AVF could be a reasonable choice for patients anticipated to live more than a year, while a forearm loop AVG, brachiocephalic AVF, or upper arm AVG could be a reasonable choice for patients anticipated to live less than a year. This idea is

ideal, but the current tools for predicting estimates of the anticipated HD duration need more studies, so choosing access type and location should be based on the operator’s discretion and best clinical judgment in consideration of the patient’s ESKD Life-Plan. For urgent HD initiation, an early cannulation graft or catheter can be considered. Although the early cannulation graft is not available yet in Korea, we anticipate this will make significant changes in preparing for maintenance HD in the future.

Monitoring and surveillance

The updated guidelines do not suggest routine AVG surveillance and note that there is insufficient evidence supporting fistula surveillance beyond physical examination [17–21]. From the available data, the Work Group found that it is inadequate to make a recommendation for routine AVF surveillance through the assessment of access blood flow, pressure monitoring, or imaging for stenosis in addition to routine clinical monitoring to improve access patency. The new guidelines place a greater emphasis on monitoring and training regarding its application than on surveillance. The 2006 KDOQI guidelines recommended AV access imaging, as well as preemptive correction of stenotic lesions with more than 50% stenosis when critical AV access flow (Qa) values were present in addition to clinical findings. However, the 2019 KDOQI guidelines cast doubts on the diagnostic value and validated diagnostic thresholds of surveillance that are able to accurately predict stenosis leading to future thrombosis, and emphasize that monitoring should be the primary tool and surveillance should be used in a supportive role. Hence, nephrologists and dialysis staff responsible for HD treatment and VA care need to be properly trained in physical examination of AV access to monitor and recognize clinical indicators of AV access dysfunction (Table 2) [4]. However, there is ongoing debate regarding the role of surveillance; thus, this is one of the controversial changes in the new KDOQI guidelines. It is reasonable to believe that an effective surveillance method or validated threshold has yet to be found, rather than assuming that surveillance itself is ineffective or useless. Therefore, further research is mandatory to identify more reliable and reproducible surveillance techniques or indicators.

Table 2. Clinical indicators (signs and symptoms) suggesting underlying clinically significant lesions during access monitoring

Procedure	Clinical indicator
Physical examination or check	Ipsilateral extremity edema
	Alterations in the pulse, with a weak or resistant pulse, difficult to compress, in the area of stenosis
	Abnormal thrill (weak and/or discontinuous) with only a systolic component in the region of stenosis
	Abnormal bruit (high pitched with a systolic component) in the area of stenosis
	Failure of the fistula to collapse when the arm is elevated (outflow stenosis) and lack of pulse augmentation (inflow stenosis)
Dialysis	Excessive collapse of the venous segment upon arm elevation
	New difficulty with cannulation when previously not a problem
	Aspiration of clots
	Inability to achieve the target dialysis blood flow
	Prolonged bleeding beyond usual for that patient from the needle puncture sites for three consecutive dialysis sessions
	Unexplained (>0.2 units) decrease in the delivered dialysis dose (Kt/V) on a constant dialysis prescription without prolongation of dialysis duration

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Indications for preemptive intervention

In the updated KDOQI guidelines, preemptive angioplasty of AV access (AVF or AVG) is not recommended for stenosis not associated with clinical indicators. Together with the statements on surveillance, this is the most notable change in the new guidelines which could impact the clinical practice of access care in South Korea, where percutaneous transluminal angioplasty (PTA) for the preventive purpose is still commonly implemented [2].

The 2006 KDOQI Work Group previously recommended AV access surveillance with preemptive angioplasty of stenosis for improving AV access outcomes. However, detection of stenosis in isolation is not clinically meaningful without inspecting the effect of intervention on clinically important outcomes, such as AV access thrombosis, patency, and intervention rates. Some studies on the outcomes of preemptive angioplasty that were rated as high quality in the 2006 guidelines were found to be underpowered in the updated 2019 guidelines, which contributed to the change in the recommendations for AV access surveillance and preemptive angioplasty. More clinical studies are necessary as the current data is not solid enough to show improved outcomes such as AV access patency after a prophylactic intervention on stenosis without clinical indicators. For AVF, the data were unclear, and for AVG, the data did not demonstrate improved patency with surveillance and subsequent preemptive intervention on graft with no clinical indicators when compared to routine clinical examinations

[22,23]. Because the controversy of preemptive angioplasty is in part caused by an ambiguous definition, the new KDOQI guidelines attempt to clarify this by discussing prophylactic correction by focusing on its implementation for the stenosis with or without a clinical indicator [24]. Thus, it is emphasized in the topic as ‘do not intervene’ on a stenotic lesion if the stenosis is detected via surveillance in the absence of clinical indicators. In terms of AV access maintenance, the new KDOQI guidelines provide room for preemptive angioplasty, which is reasonable for patients with consistently persistent clinical indicators and underlying AV access stenosis to undergo preemptive angioplasty of their AV access to reduce the risk of thrombosis and loss of AV access. If not, preemptive correction of AV access should only be performed if it is associated with clinical indicators.

Clinically, it is important to refer patients timely for intervention through early recognition of clinical indicators from significant stenosis as well as to refrain from regular PTA scheduled regardless of clinical indicators. In Korea, therefore, it is crucial to educate health practitioners related to HD treatment on the application of monitoring to clinical indicators of AV access in addition to convincing physicians involved in PTA to intervene only if the clinical indicators meet the recommendations in the new guidelines.

Pharmacological primary and secondary prevention of arteriovenous-access flow dysfunction

The former guidelines did not discuss pharmacological

primary and secondary prevention of AV access flow dysfunction, but the 2019 KDOQI guidelines included new information.

The KDOQI guidelines do not suggest the use of fish oil or aspirin for preventing AVF flow dysfunction. There was also inadequate evidence for making a recommendation on the use of oral simvastatin and ezetimibe for reducing AVF interventions or thrombosis. However, KDOQI evaluated the potential of the use of adjuvant far-infrared therapy for improving AVF primary patency and suggested its use according to individual circumstances, feasibility, and the clinician's best judgment and expertise. Currently, adjuvant far-infrared therapy has been introduced limitedly in a small number of centers in Korea [25], but it is expected that more centers will implement adjuvant far-infrared therapy based on individual circumstances in the future.

New technology

While early cannulation graft, which is a new recommendation

related to new technologies, is not yet available in Korea, a stent-graft (Covera Vascular Covered Stent; Bard Peripheral Vascular Inc., Tempe, AZ, USA) has recently become available. However, the stent-graft can be covered by insurance only in the usage for vessel rupture during endovascular treatment in Korea, while it is recommended for stenosis in the graft-venous anastomosis of AVG in the new KDOQI guidelines. We cannot predict insurance coverage for the application of stent-graft in the stenotic lesions in Korea, but we look forward to the use of stent-graft in the venous anastomosis of AVGs to reflect the new guidelines in the near future. In addition, the early cannulation graft should be introduced in Korea as it can help patients to avoid central venous catheter placement or reduce its duration.

Korean perspective on the 2019 NKF-KDOQI guidelines for vascular access

From a Korean nephrologist's viewpoint, the patient-centered ESKD Life-Plan strategy is unfamiliar, the role of the

Table 3. Korean perspective on the updated KDOQI guidelines for vascular access

Subjects	Key issues relevant to the clinical practice of Korean Nephrologists
Access planning	An expansion of understanding the multidisciplinary approach for establishing an ESKD Life-Plan is necessary. More active involvement of nephrologists in the establishing the ESKD Life-Plan, planning VA, and enhancing interdepartmental cooperation is important for improving access care in Korea.
Preoperative evaluation	The population of elderly incident HD patients has increased in Korea, and most incident HD patients who need planning of VA creation may have one of the risk factors. In addition, Doppler US examination for access mapping is covered by national insurance in Korea, hence preoperative US mapping is anticipated to be performed in general.
Postoperative care	Currently, adjuvant far-infrared therapy is implemented in a limited fashion in a small number of centers in Korea, but it is expected that more centers will try adjuvant far-infrared therapy based on individual circumstances in the future.
Monitoring and surveillance	Dialysis staff should be trained in monitoring techniques, including physical examination, to detect clinical indicators. Currently, it is mandatory to measure the static venous pressure every month by the regular national assessment for dialysis adequacy in Korean hospitals, but this will need to be reconsidered in the future according to the new guidelines. In Korea, surveillance using UDT and Doppler US is covered by reimbursements from the national health insurance system, so it is increasingly being implemented. However, monitoring is primary, and surveillance should be applied as a supplementary method.
AV access maintenance	AV access stenosis is suggested to fall under two categories: stenosis associated with a clinical indicator or stenosis not associated with a clinical indicator. PTA should be considered only for stenosis accompanied by clinical indicators. It is not recommended except for patients with consistently persistent clinical indicators to undergo preemptive angioplasty, and timely surgical correction could be considered to comply with the goals and targets of VA care. There should be <3 interventions to maintain AV access use per year. Regular scheduled PTAs, regardless of the presence of clinical indicators, are not suggested.
New technologies	Stent grafts for AV access became available in Korea recently, but these are reimbursed by the national insurance system only for the treatment of ruptured stenotic segments of AV access. Currently, early cannulation grafts are not available in Korea.
Future research	Currently, clinical trials for drug-coated balloons (KCT0003654) and plastic cannulation (KCT0003745) are underway in Korea, and are anticipated to report results in the next year.

AV, arteriovenous; ESKD, end-stage kidney disease; HD, hemodialysis; KDOQI, Kidney Disease Outcomes Quality Initiative; PTA, percutaneous transluminal angioplasty; UDT, ultrasound dilution technique; US, ultrasound; VA, vascular access.

nephrologist in the multidisciplinary team remains vague, and some of the statements or new technologies in the updated guidelines are currently not available (Table 3). To apply this new strategy in Korea and to develop a multidisciplinary approach, Korean nephrologists, who are directly involved in dialysis treatment and responsible for ESKD patients, should have an updated insight on the optimal care of VA considering their patient's Life-Plan. Despite recognizing the importance of healthy VA for patients, clinical decisions on access care largely depend upon interventional radiologists or surgeons; therefore, VA management by nephrologists has been fragmented and limited in Korea. However, in 2010 with the support of the KSN, the KSDIN was established so that nephrologists could have a more active role in access care through different activities, including hands-on training with Doppler ultrasound for AV access, educating on the standards of dialysis access care suitable in Korea, developing academic programs for interventional nephrology fellowship, promoting research capabilities and building a registry cohort of VA procedures, and collaborating with national and international scientific communities. To broaden the understanding of the updated guidelines for health practitioners involved in dialysis access care, the KSDIN translated the 2019 KDOQI guidelines for vascular access into Korean and distributed it publicly.

Therefore, more nephrologists have become interested in diagnostic and therapeutic procedures for VA; as a result, Doppler ultrasound examinations, tunneled HD catheter placements, and endovascular procedures by nephrologists have steadily increased in Korea [26]. In line with an increasing concern of nephrologists and along with the rapid growth of patients requiring HD in Korea, the new guidelines are expected to have a significant impact on patient care for VA, patient education, and training programs. Although the updated guidelines are based on limited clinical data from Korea and include a number of statements that cannot be currently practiced, the patient-centered approach based on the ESKD Life-Plan strategy will be introduced into our clinical practice through our strenuous effort for best practice of access care.

Summary

The new KDOQI guidelines outline the best-individualized care through a standardized process by review of the latest evidence and recalibrating previous data through the advanced GRADE-EtD format with high-quality standards. Although some controversies remain, the Work Group makes room for new evidence and provides suggestions for future research in the updated guidelines.

Table 4. Goals^a and targets

ESKD Patient on HD Life-Plan Target	
1	All ESKD patients on HD Life-Plan goal: Establish and Document the Patient's P-L-A-N, to be reviewed and updated annually. Component: a) Patient Life-Plan: 1–2 year (short term) and 5-year plan (long term) b) Access Needs: i) creation plan, ii) contingency plan, iii) succession plan
AV Access (Fistula or Graft) Target	
2	All AV access (Fistula or Graft) Intervention goal = "1-2-3" intervention as follows; 1. For each 1 AV access creation 2. There should be ≤2 interventions to facilitate AV access use 3. There should be ≤3 interventions to maintain AV access use per year Access use refers to successful use of AV access with two-needle cannulation to achieve prescribed dialysis.
Central Venous Catheter Target	
3	All CVC, regardless if the CVC is cuffed or not, tunneled or not, or the "final CVC" or not; Infection goal = catheter-related bloodstream infection rate of <1.5/1,000 catheter days

AV, arteriovenous; CVC, central venous catheter; ESKD, end-stage kidney disease; HD, hemodialysis.

^aOverarching goal: to achieve reliable, functioning, complication-free dialysis access to provide prescribed dialysis while preserving future dialysis access site options as required by the individual patient's ESKD Life-Plan.

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The new guidelines are less prescriptive than the previous 2006 guidelines in targeting the fine details in each area due to differences in practice patterns, thereby leaving more to the clinician's discretion, but the guidelines also emphasize the importance of high-quality standards with defined targets for achieving the overarching goal of VA care (Table 4).

An emphasis is made across the entire document that all clinicians should be aware of the patient's unique circumstances and needs, and apply a patient-centered approach for access care. Therefore, nephrologists in Korea should be actively involved in the planning and maintaining of VA based on the best clinical judgment, with careful application of the guidelines in order to achieve optimal patient outcomes.

The 2019 KDOQI guidelines for vascular access request that nephrologists have extensive experience and insight in coordinating and integrating multidisciplinary VA teams based on the patient's ESKD Life-Plan. This will help us to attain the "right access, in the right patient, at the right time, for the right reasons," providing new challenges and opportunities for the nephrology society in Korea.

Conflicts of interest

All authors have no conflicts of interest to declare.

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Authors' contributions

Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Visualization: HSL, SGK
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References

1. ESRD Registry Committee. Current renal replacement therapy in Korea: Insan Memorial Dialysis Registry, 2018 [Internet]. Seoul: ESRD Registry Committee, 2018 [cited 2020 Jun 1]. Available from: http://www.ksn.or.kr/rang_board/list.html?code=sinchart_eng.
2. Lee HS, Ju YS, Song YR, et al. Current treatment status and medical costs for hemodialysis vascular access based on analysis of the Korean Health Insurance Database. *Korean J Intern Med* 2018;33:1160–1168.
3. Vascular Access 2006 Work Group. Clinical practice guidelines for vascular access. *Am J Kidney Dis* 2006;48 Suppl 1:S176–S247.
4. Lok CE, Huber TS, Lee T, et al. KDOQI clinical practice guideline for vascular access: 2019 update. *Am J Kidney Dis* 2020;75:S1–S164.
5. Alonso-Coello P, Oxman AD, Moberg J, et al. GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 2: Clinical practice guidelines. *BMJ* 2016;353:i2089.
6. Alonso-Coello P, Schünemann HJ, Moberg J, et al. GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 1: Introduction. *BMJ* 2016;353:i2016.
7. Xue H, Lacson E Jr, Wang W, Curhan GC, Brunelli SM. Choice of vascular access among incident hemodialysis patients: a decision and cost-utility analysis. *Clin J Am Soc Nephrol* 2010; 5:2289–2296.
8. Drew DA, Lok CE, Cohen JT, Wagner M, Tangri N, Weiner DE. Vascular access choice in incident hemodialysis patients: a decision analysis. *J Am Soc Nephrol* 2015;26:183–191.
9. Hiremath S, Knoll G, Weinstein MC. Should the arteriovenous fistula be created before starting dialysis?: a decision analytic approach. *PLoS One* 2011;6:e28453.
10. O'Grady NP, Alexander M, Burns LA, et al. Summary of recommendations: guidelines for the prevention of intravascular catheter-related infections. *Clin Infect Dis* 2011;52:1087–1099.
11. Mermel LA, Allon M, Bouza E, et al. Clinical practice guidelines for the diagnosis and management of intravascular catheter-related infection: 2009 Update by the Infectious Diseases Society of America. *Clin Infect Dis* 2009;49:1–45.
12. Al-Jaishi AA, Jain AK, Garg AX, Zhang JC, Moist LM. Hemodialysis vascular access creation in patients switching from peritoneal dialysis to hemodialysis: a population-based retrospective cohort.

- Am J Kidney Dis* 2016;67:813–816.
13. Silva MB Jr, Hobson RW 2nd, Pappas PJ, et al. A strategy for increasing use of autogenous hemodialysis access procedures: impact of preoperative noninvasive evaluation. *J Vasc Surg* 1998;27:302–307.
 14. Mendes RR, Farber MA, Marston WA, Dinwiddie LC, Keagy BA, Burnham SJ. Prediction of wrist arteriovenous fistula maturation with preoperative vein mapping with ultrasonography. *J Vasc Surg* 2002;36:460–463.
 15. Feldman HI, Joffe M, Rosas SE, Burns JE, Knauss J, Brayman K. Predictors of successful arteriovenous fistula maturation. *Am J Kidney Dis* 2003;42:1000–1012.
 16. Lee HS, Song YR, Kim JK, et al. Outcomes of vascular access in hemodialysis patients: Analysis based on the Korean National Health Insurance Database from 2008 to 2016. *Kidney Res Clin Pract* 2019;38:391–398.
 17. Asif A, Leon C, Orozco-Vargas LC, et al. Accuracy of physical examination in the detection of arteriovenous fistula stenosis. *Clin J Am Soc Nephrol* 2007;2:1191–1194.
 18. Paulson WD, Moist L, Lok CE. Vascular access surveillance: an ongoing controversy. *Kidney Int* 2012;81:132–142.
 19. Campos RP, Chula DC, Perreto S, Riella MC, do Nascimento MM. Accuracy of physical examination and intra-access pressure in the detection of stenosis in hemodialysis arteriovenous fistula. *Semin Dial* 2008;21:269–273.
 20. Beathard GA, Settle SM, Shields MW. Salvage of the nonfunctioning arteriovenous fistula. *Am J Kidney Dis* 1999;33:910–916.
 21. Coentrão L, Faria B, Pestana M. Physical examination of dysfunctional arteriovenous fistulae by non-interventionalists: a skill worth teaching. *Nephrol Dial Transplant* 2012;27:1993–1996.
 22. Ravani P, Quinn RR, Oliver MJ, et al. Preemptive correction of arteriovenous access stenosis: a systematic review and meta-analysis of randomized controlled trials. *Am J Kidney Dis* 2016; 67:446–460.
 23. Lok CE, Huber TS, Lee T, et al. KDOQI clinical practice guideline for vascular access: 2019 update. *Am J Kidney Dis* 2020;75(4 Suppl 2):S1–S164.
 24. Moist L, Lok CE. Con: vascular access surveillance in mature fistulas: is it worthwhile? *Nephrol Dial Transplant* 2019;34:1106–1111.
 25. Choi SJ, Cho EH, Jo HM, et al. Clinical utility of far-infrared therapy for improvement of vascular access blood flow and pain control in hemodialysis patients. *Kidney Res Clin Pract* 2016;35:35–41.
 26. Kim YS, Kim Y, Shin SJ, et al. Current state of dialysis access management in Korea. *J Vasc Access* 2019;20:15–19.