

Balancing Fistula First With Catheters Last

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The success of Fistula First nationwide has been accompanied by an unplanned increase in hemodialysis catheters. Complications related to prolonged hemodialysis catheter use include increased morbidity, mortality, and cost. We hypothesize that the national focus on increasing fistulas may have inadvertently diverted attention away from initiatives to decrease dependence on hemodialysis catheters. Based on a synthesis of guidelines, reviews, published evidence, and the authors' opinions, we propose that the national vascular access initiative be revised to have a dual goal of Fistula First and "Catheters Last." These goals are not mutually exclusive, but rather complementary. We recommend a systematic refocus on interventions that not only increase fistulas, but help avoid extended catheter use. Clearly, the ideal practice for hemodialysis vascular access remains early placement of fistulas with enough maturation time such that they can be used for initiating long-term hemodialysis therapy when the need arises. To effect this change, a reimbursement policy covering the costs associated with permanent access placement before the need for dialysis is essential. Individualized patient management strategies may consider such innovative approaches as initiating patients on peritoneal dialysis therapy or using nonautogenous grafts as bridge accesses in lieu of catheters. For patients who are dialyzing using catheters, immediate active planning for permanent access placement and removal of the catheter is necessary. In the same vein as Fistula First, the renal community should once again be galvanized in working together toward controlling the catheter epidemic in our dialysis population.

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The National Kidney Foundation expert panels' recommendations for vascular access support the fistula as the access of choice.¹⁻³ The Centers for Medicare & Medicaid Services recognized an opportunity to galvanize all stakeholders into a coalition to support a Fistula First initiative, with a goal to promote fistulas for hemodialysis in most eligible patients.⁴ Fistula First reached the goal of 40% fistula prevalence in hemodialysis patients ahead of schedule, and the next milestone expected by the Centers for Medicare & Medicaid Services is a 66% fistula rate by 2009.⁵ However, increasing surgical placement of fistulas may have unintended consequences and is accompanied by new challenges that, if addressed, may further enhance the success of the program. This review provides an overview of these challenges and offers our recommendations for how to overcome them. More specifically, we draw attention to the very high rates of central vascular catheter (CVC) use in our hemodialysis population.

THREE MAJOR CHALLENGES OF FISTULA FIRST

1. Absent or Late Placement of the Fistula in Patients Initiating Dialysis

The 2005 Clinical Performance Measures Project reported that 74% of incident patients

initiated hemodialysis therapy using a CVC between January 1 and August 31, 2004, with 52% remaining on CVCs 90 days later.⁶ More importantly, these data reflect a combination of factors, including late referral of patients for nephrological care,⁷⁻⁹ patient anxiety and resistance to accepting and participating in plans for renal replacement therapy,¹⁰ lack of funding for patients with the opportunity to have a vascular access placed before the need for dialysis,¹¹ and challenges posed by the inability to precisely predict the occurrence and timing of imminent dialysis therapy.¹²

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2. Delay and/or Failure of Fistula Maturation

A second challenge comes from fistulas that fail to “mature.” Maturation refers to the expected vein enlargement in response to increased blood flow and shear stress,¹³ accompanied by increased vascular tissue mass, likely mediated by endothelial cells.¹⁴ In the United States, the Dialysis Outcomes and Practice Patterns Study found the median reported time for maturation at 98 days.¹⁵ In 1 program with aggressive fistula placement, the mean was 70 days.¹⁶ Conversely, maturation times as low as 15 to 28 days were reported in Japan.¹⁵ The differences in maturation time indicate room for improvement in the evaluation process for fistula development. Therefore, it is recommended that a new fistula be referred back to the surgeon within 4 to 6 weeks (~28 to 42 days) if it is still not usable.^{3,17-19}

Maturation is functionally defined by clinical criteria, mainly by physical examination to show sufficient vessel size and area available for cannulation, then tested for capacity to meet blood flow requirements for hemodialysis, commonly 300 mL/min or greater in the United States. With no established consensus on flow requirement or minimum frequency of successful use, the definition of maturation varies by local practice, dependent in part on the experience and cannulation skills of patient care staff.

Apart from the prolonged wait for fistula maturation, between 20% and 54% of fistulas fail to mature during the course of 1 year.²⁰⁻²⁴ Numerous characteristics, including whether this is the primary or secondary access (after ≥ 1 failed), blood vessel selection, and experience of the surgeon and patient care staff, may impact on the maturation rate.^{19,25,26} Feldman et al²² used models adjusted for age, previous access, cardiovascular disease, and mean arterial pressure and predicted that maturation rates can be improved to approximately 84% in their dialysis population when applying selected “best” surgical practices available in the United States. Currently, low fistula maturation rates result in extended exposure to CVCs, and in approximately 20% or more patients, the period of exposure becomes indefinite because of the combination of failure to mature and poor access follow-up care. Low success rates also may reflect the inclusion of patients who were considered “borderline”

candidates for surgical fistula placement in the past, but are now aggressively pursued. Patel et al¹⁶ reported that even with the use of duplex vessel mapping, as fistulas increased from 61% to 73% in prevalent patients and from 66% to 83% in incident patients, there was an appreciable decrease in fistula maturation rate from 73% to 53%.

3. Failure to Maintain Long-Term Fistula Patency

A third challenge lies in enhancing the long-term patency rate of fistulas because they fail over time, albeit with a failure rate less than that for nonautogenous grafts or CVCs.¹⁻³ One-year fistula survival rates ranged from 47% to 75% across the country.^{21,27-31} A recent national study found that approximately 31% of patients dialyzing with a fistula will have a catheter placed within the succeeding 6 months.³² A combination of factors can influence the longevity of fistulas, inherent among them are patient comorbidity, initial surgical quality of the fistula, type and location of the fistula, and “salvage” skill of the interventionalist(s) or vascular surgeon(s). Prior catheter use also is associated with a 59% greater risk of fistula failure compared with fistulas placed as the primary access ($P < 0.03$).³³ We postulate that this association may be related to stenosis or narrowing of draining veins or the central vein as a complication of CVC use (including insertion and removal procedures), although it also is possible that at least some patients who initiate dialysis therapy with a CVC are inherently just poor candidates for a fistula. Importantly, the complication rate, patency rate, and survival of a mature fistula also are dependent on the quality of dialysis patient care staff.^{34,35} Therefore, current high nurse and patient care technician turnover rates that create gaps in education, experience, and training require focused attention. A direct comparison of 1-year fistula survival rates between the United States and Europe shows 63% (ie, abandonment of 37%) versus 83%, suggesting ample room for improvement.²⁷

THE OTHER PROBLEM: AN EPIDEMIC OF HEMODIALYSIS CATHETERS

The 3 challenges enumerated promote conditions whereby the success of increased fistula

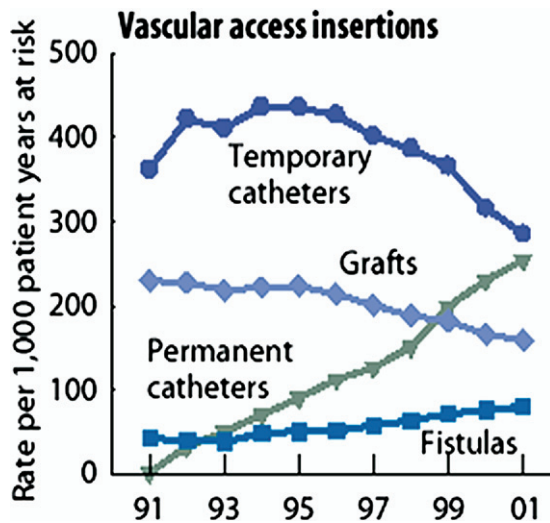


Figure 1. Graph from the US Renal Data System 2003 Annual Data Report³⁸ (Fig 5.19, p S93) shows trends of vascular access insertions (ie, creation/placement) in prevalent hemodialysis patients from 1991 to 2001.

compared with fistulas,³⁸ with a rate of increase more prominent from 1997 to 2001 after the release of the first National Kidney Foundation guidelines for vascular access (Fig 1).¹ The 2006 US Renal Data System annual report (data from 2004) documented a catheter placement rate of 477/1,000 patient-years as opposed to the much lower fistula placement rate of 96.8/1,000 patient-years.³⁹ Clearly, the problem not fully addressed by the Fistula First initiative concerns the rampant proliferation of CVCs for hemodialysis.

Some patients develop a preference for keeping a CVC as a permanent access because of aversion to being cannulated repeatedly by large-gauge needles. Education regarding the complications associated with CVC use for the patient (and/or family if applicable) is key to obtaining patient “buy-in” for establishing a permanent arteriovenous access. A summary of CVC complications is shown in Fig 2 and discussed in greater detail next.

placement is tempered by more catheters.³⁶⁻³⁸ Data from the US Renal Data System document the disproportionate increase in permanent CVCs

Complications of Catheter Use

A CVC is a foreign body that may incite chronic inflammation and thus malnutrition, ane-

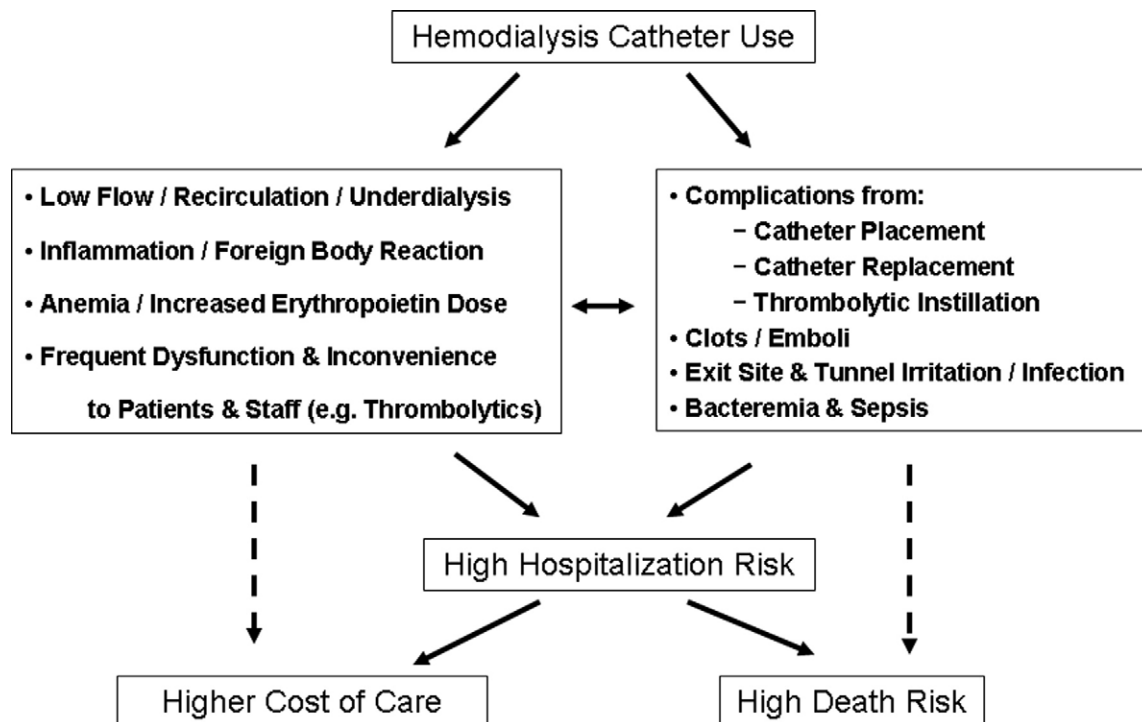


Figure 2. Complications associated with hemodialysis catheters.

mia, and cardiovascular disease.^{40,41} It may deliver lower than expected blood flows and inefficient dialysis from access recirculation and thereby predispose to underdialysis.^{42,43} Patients may find the preceding reasons esoteric, but they will appreciate the impact of frequent clotting and thrombosis, requiring 3.0 tissue-type plasminogen activator instillations and 1.1 catheter replacements/1,000 patient-days,³⁶ procedures that require additional time, risk, and effort on their part. Dysfunction and clotting occur, with temporary salvage rates of 43% to 98% varying by center, catheter brand, and thrombolytic agent.^{44,45} Thrombi may encroach into the right atrium and superior vena cava, infrequently causing pulmonary embolism or superior vena cava syndrome.⁴⁶⁻⁴⁹ These complications often require repeated interventions that may have such adverse consequences as bleeding, emboli, subclavian stenoses, or secondary infections. In some cases, damage to veins from subclavian catheterization or vascular procedures may jeopardize the future ability to support a well-functioning permanent arteriovenous access in the ipsilateral arm.⁵⁰⁻⁵² These risks are compounded with repeated procedures and CVC replacements because the primary failure rate is 52% to 91% per year.^{53,54}

However, the most concerning aspect of catheter use is a high infection rate, estimated at 2.5 to 5.5 cases/1,000 patient-days or 0.9 to 2.0 episodes/patient-year.⁵⁵ Current data systems count CVCs as temporary or permanent based on time in situ (>90 days), but carry no distinction between cuffed tunneled catheters and noncuffed nontunneled catheters despite a 40% greater infection risk with the latter.⁵⁶ Considering that CVCs in long-term hemodialysis patients are used for many weeks, there is no place for noncuffed nontunneled catheters in outpatient dialysis facilities.³

Despite “aseptic” catheter placement procedures, biofilm was shown to form along the CVC lumen as early as 24 to 72 hours after implantation.⁵⁷⁻⁵⁹ Intermittently, there is microbial seeding into the bloodstream such that the cumulative number of patients with CVCs developing bacteremia increases over time.^{59,60} For most patients, the question is not if but when, bacteremia will occur if catheters are maintained indefinitely. Once bacteria proliferate in the bloodstream, satellite foci of infec-

tion can occur through hematogenous spread,⁵⁹ predisposing patients to endocarditis,^{61,62} vertebral osteomyelitis,^{63,64} septic pulmonary emboli/abscesses,^{65,66} and meningitis.^{67,68} Underlying immune dysfunction predisposes to sepsis,⁶⁹⁻⁷² increasing death risk 5- to 9-fold.⁷³ Even if a hemodialysis patient were to recover, the lifelong death risk remains increased and never returns to the baseline mortality risk of patients without sepsis/bacteremia (Fig 3).⁷⁴

Although not necessarily causal, the relative risk of death associated with catheter use compared with fistulas is increased by 1.4- to 3.4-fold.⁷⁵⁻⁷⁹ Even in the face of potential confounding from patient characteristics or circumstances, findings of studies examining associations between access type and risk of death are consistent and compelling. Based on findings from patients enrolled in the Hemodialysis Study, the increased death risk from catheters is transferred to patients who had a prior fistula who switched to a catheter, resulting in a 2-fold increase compared with patients who had a fistula at the beginning and end of a 1-year follow-up interval (the baseline risk).⁷⁹ Similarly, data from the same cohort showed attenuation of death risk for patients using a catheter who subsequently switched to a fistula, but still down to 1.4-fold greater than baseline (whereas patients using solely a catheter during follow-up had a 3.4-fold greater risk).

Catheters are associated not only with greater hospitalization rates because of sepsis, but also with greater rates of all-cause hospitalization.⁸⁰⁻⁸³ The annual Medicare expenditures for patients with a CVC average approximately \$20,000 more than for patients with a fistula. A comparison of cost components, the largest of which is inpatient hospitalizations, is shown in Fig 4.^{84,85} For dialysis providers, frequent hospitalizations translate into missed in-center treatments, loss of revenue, and lower returns because of fixed costs (staff and facility). For physicians and nurses, patients with a CVC require increased attention, especially with the development of urgent and emergent complications. Therefore, decreasing CVC rates is favorable to patients, caregivers, providers, and payers, making it logical for these stakeholders to support a “Catheter Last” quality improvement initiative, as they did for Fistula First.

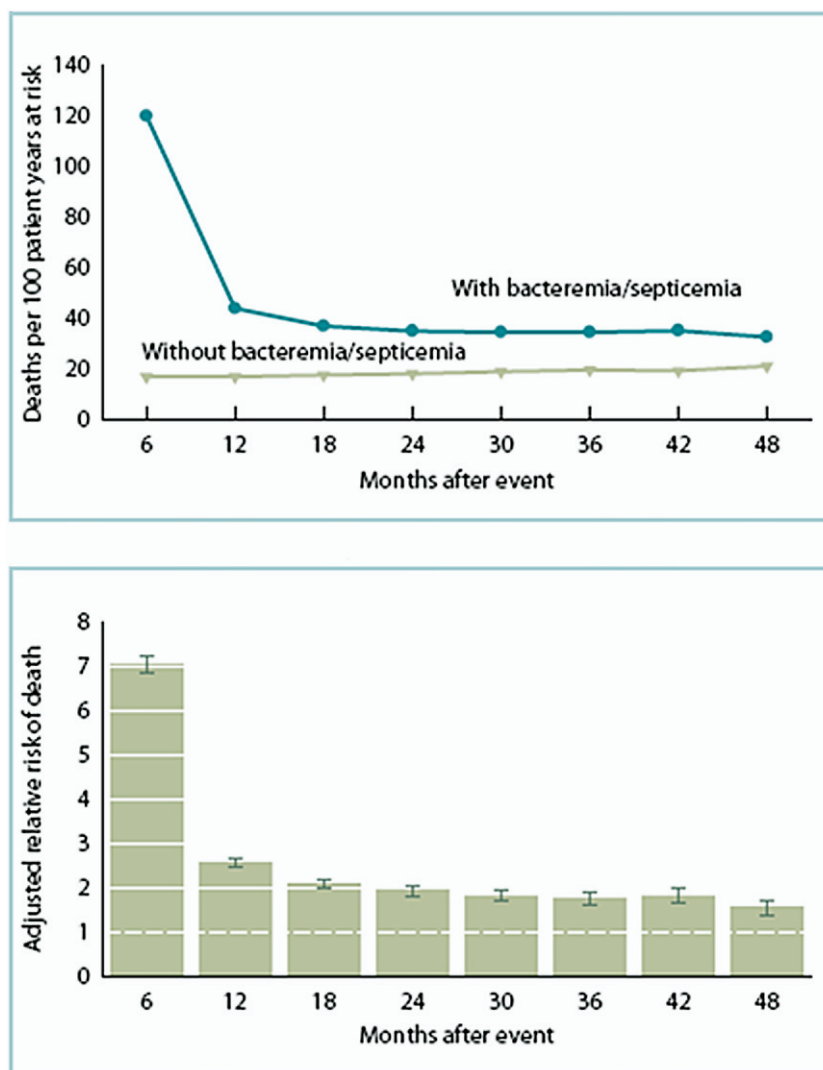


Figure 3. Graph from the US Renal Data System 2004 Annual Data Report⁷⁴ (Figs 6.39 and 6.40, p S128) shows the increased mortality rate associated with even a single episode of sepsis/bacteremia for incident hemodialysis patients from 1996 to 2000, excluding the first 90 days.

MOVING FORWARD: CATHETERS LAST

Many programs are mainly directed at improving fistula rates to keep pace with the rest of the country on the Fistula First dashboard. Catheter rates are not reported, although a Fistula First change concept states “AVF [arteriovenous fistula] placement in patients with catheters where indicated.”⁸⁶ We fully support Fistula First, but believe the renal community should establish a conscious and concerted effort to pursue Catheters Last with the same vigor. These 2 concepts are not mutually exclusive. The final section of this review provides some initiatives (listed in Table 1) conceptually categorized under 2 major areas, although the components clearly have a role in both: (1)

timely removal of incumbent catheters (actionable now), and (2) avoidance of catheter placement (ideal solution).

1. Timely Removal of Catheters From Eligible Patients

Optimize the Process for Vascular Access Evaluation

For the majority of patients initiating dialysis therapy with a temporary CVC, a concurrent plan for evaluation and placement of a permanent access with expedient removal of the catheter as soon as possible should be in place. The primary responsibility of initiating this process rests on the shoulders of nephrologists. However, once a patient with a CVC first enters the

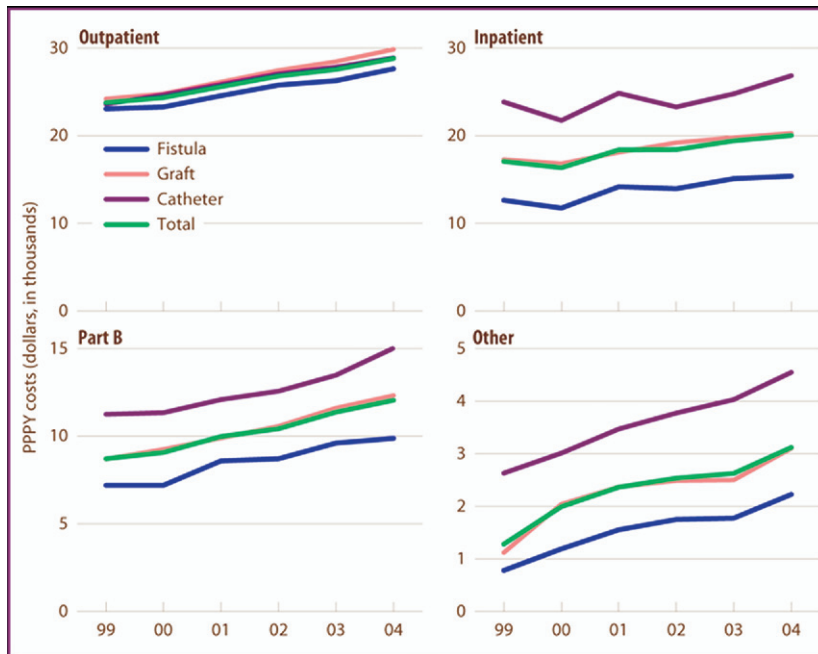


Figure 4. Graph from the US Renal Data System 2006 Annual Data Report⁸⁵ (Fig 11.46, p S219) shows the increased Medicare expenditures associated with various types of vascular access.

dialysis unit, it is incumbent upon the staff to promptly communicate with nephrologists to establish the plan for permanent access placement as part of “short-term” patient plans required by regulatory agencies. Such a plan should include a timeline for establishment of the permanent access (preferably a fistula): the sooner, the better for the eligible patient.

A hypothetical timeline that shows stages that lead to a mature arteriovenous fistula is shown in Fig 5. Shortening the time lag between placement of a catheter and referral for permanent access is immediately actionable and within the control of nephrologists, with assistance from dialysis facility staff. This initial stage includes developing an action plan with patient buy-in through education from nephrologists, facility caregivers, and, ideally, access surgeons. The second (patient evaluation for access placement) and third stages (surgical placement of an arteriovenous access) are multifactorial. Patient-related factors and behaviors may impact on obtaining surgical appointments, whereas surgeon- and hospital-related factors will determine whether access placement is performed as scheduled or at all.^{36,87} Nephrologists can control the referral pattern and should channel patients to surgeons who agree to be an active part of the access team.^{86,88} The last stage, during which an access

is already in place and maturing, is impacted on by many factors, as previously discussed and reviewed elsewhere.^{19,25,26} Reevaluation of a nonmaturing fistula by 4 to 6 weeks allows for such early interventions as ligation of accessory veins, dilatation of stenoses, or surgical maneuvers to bring the arterializing vein closer to the skin to ease cannulation difficulties.^{17,25,89,90}

Formalize the Process Within a Multidisciplinary Vascular Access Team

The need for a team approach becomes evident once the process is reviewed. A frequent complaint from many nephrologists and staff hinges on the availability and/or responsiveness of surgeons. Surgeons are the major consideration in determining the success of any vascular access program.^{87,91} Therefore, the leadership skills of the nephrologist are important in resolving barriers and convincing surgical colleagues to become active participants.^{25,92-94} Surgeons respond to feedback, learn new techniques, and become champions of fistula placement.⁹⁵⁻⁹⁷ Rewarding surgical practices that support such initiatives with increased referrals provide incentive toward continued cooperation and teamwork.⁸⁸ In this context, the renal community needs to continue to advocate for support from other stakeholders (eg, payers, surgical societies, agencies responsible for hospital accreditation, and

Table 1. Barriers and Potential Solutions for Both Fistula First and Catheter Last

Goals	Barriers/Problems	Recommendations
Timely catheter removal		
The CVC problem	Acceptance of catheters Patient refusal to plan/ remove CVC	Adopt Catheters Last program Standardized education and vigorous nephrologist advocacy
Define the process	No champion Poor follow-up	Nephrologist must lead 1. Track process/outcomes (eg, time to referral, AVF placement, CVC removal) 2. Establish algorithms (standing orders) with routine CQI reviews 3. Surgeon or hospital-employed vascular access coordinator
	“Poor” candidates for permanent access AVF failure to mature	Vessel mapping and referral protocol 1. Surgical reevaluation within 4-6 wk if not usable (without tolerating further delays) 2. Consider duplex ultrasound or radiological study
Multidisciplinary team	Poor communication	1. Engage surgeon/staff for “buy-in” to process/ goals 2. Discuss concerns/preferences 3. Engage & discuss the role of the radiologist or interventionalist
	Disagreements	1. Standardize education 2. Review evidence/literature 3. Consider best practices
Avoiding catheters		
Early permanent access placement (preferably but not exclusively AVF)	Late referrals	1. Education for PCP & patients for early referral to nephrologist 2. GFR-based referral protocols 3. Consider PD or synthetic grafts as bridge therapy
	Access planning with early referrals	1. Modality selection education 2. Access planning in stage 3 and placement by stage 4 CKD (no later than GFR of 20 mL/min)
	Imprecise prediction of need for dialysis	1. Use decrease in GFR 2. Need further research to improve precision of predictions
	Policy limitations	1. Catheters Last dashboard 2. Medicare payment for access placement in new patients with ESRD without coverage before 90 d 3. Payment reform and incentives for AVF placement before the need for dialysis in CKD
Maintain existing accesses	Fistula failures	1. Improve staff cannulation training and protocols 2. Monitoring and surveillance

Note: To convert GFR in mL/min to mL/s, multiply by 0.01667.

Abbreviations: AVF, arteriovenous fistula; CKD, chronic kidney disease; CQI, continuous quality improvement; CVC, central venous catheter; ESRD, end-stage renal disease; GFR, glomerular filtration rate; PCP, primary care physician; PD, peritoneal dialysis.

quality improvement organizations) to set expectations for both the hospital and surgeon in terms of timeliness of operating room availability, access choices, and surgical success rates.

To facilitate patient evaluation, appropriate (bilateral) vessel mapping is essential as part of the approach. Duplex ultrasound appears to be the

most prevalent method and can provide not only vessel sizes along the entire length of the extremities, but also may provide an estimate of depth, not available by using angiography (alternative choice).^{3,25,98} Some surgeons have strong preferences that require consensus with referring nephrologists.⁹⁵ Vessel mapping may identify patients

nature of some procedures can be communicated easily from the dialysis unit to the nephrologists to the surgeon, and the hospital or operating room and care can be coordinated in the same way. Within the setting of a multidisciplinary team-approved process with a reliable communication channel in place, the surgical vascular access coordinator provides careful tracking of vascular access placements, procedures, outcomes, and complications. For their part, dialysis providers can invest in an electronic medical record/informatics system integrated into the workflow environment, providing data management support.

2. Avoiding Catheters

Campaign for Early Referral of Patients With Chronic Kidney Disease

The ideal (yet most difficult) solution for improving the fistula rate while simultaneously avoiding catheters is having a mature fistula in place for eligible patients before the need for long-term hemodialysis therapy. Currently, there is no Medicare coverage for the cost of permanent access placement before the need for dialysis, and it will take an act of Congress to have such coverage in place. However, for eligible patients, private insurers may pay for vascular access procedures in patients with chronic kidney disease (CKD). Of Medicare patients older than 67 years, only 40% of hemodialysis patients had an access placed before the first day of dialysis therapy, and a quarter of the accesses were catheters.¹⁰⁷ However, in 1 report, approximately 27% of patients seen early by a nephrologist still initiated dialysis therapy with a CVC.⁹⁴

A paradigm is available for early nephrology referral that prepares the patient for renal replacement therapy, recommending permanent vascular access placement at CKD stage 4.¹⁰⁸ It is imperative that this message be delivered to primary care physicians, patients with CKD, and their families. Nephrologists should disseminate this message within their local area hospitals. Unfortunately, the date of first treatment is difficult to predict, and the timing of dialysis therapy initiation often does not follow a predictable course. Only 1 in 5 patients with CKD stage 4 may make it to end-stage renal disease (>2 in 5 patients die), and the others would have undergone an unnecessary procedure with fistula place-

ment.¹⁰⁹ Perhaps this is predominantly true for older patients because younger patients are more likely to survive to end-stage renal disease.¹² However, clinical events (eg, a viral or bacterial infection or cardiovascular event) often precipitate the need for dialysis therapy. In addition, the time required to convince a patient and/or family about the need for dialysis¹¹ supports discussion of fistula placement earlier, even at CKD stage 3. A more precise estimate for the need and timing of initiating dialysis therapy is an area of interest for future studies.

Nevertheless, in our opinion, all eligible patients with CKD stage 4, a glomerular filtration rate less than 30 mL/min (<0.5 mL/s), should be exhorted with great conviction by the nephrologist to have a fistula placed. Below this threshold, the rate of progression is often unpredictable, consequences of having to use a CVC are gruesome, and the risk-reward ratio for an unused properly constructed fistula in the appropriate surgical candidate is minimal.

Bridging the Gap: Peritoneal Dialysis

Inevitably, novel strategies will need to be explored, including the use of peritoneal dialysis (PD) as “bridge” therapy. Inadequate patient education regarding dialysis options contribute to underuse of such alternative renal therapies as PD.¹¹⁰ Exposure to structured education programs leads to more patients opting for therapies other than in-center hemodialysis, even late into predialysis stage 4.¹¹¹⁻¹¹³

The imminence of dialysis therapy should not preclude the use of PD as bridge therapy. European programs that use PD as first-line therapy have been initiating PD within 24 hours of catheter placement by using small-volume exchanges without the need for a prolonged peritoneal catheter maturation time.^{114,115} If placed at the time of or soon after PD catheter insertion, a fistula can be allowed to mature without exposure to a CVC and its complications. In some instances, patients may decide to remain on PD therapy permanently, which is not surprising considering patients who began dialysis on PD therapy expressed greater satisfaction from their therapy than patients initiated on hemodialysis therapy.¹¹⁶ Furthermore, patients on PD therapy experienced greater improvement in factors related to quality of life within the first year of therapy.¹¹⁷

Table 2. Annual Relative Risk for Outcomes Associated With Hemodialysis Vascular Access

Studies	Fistulas	Grafts	Central Venous Catheters*
Bacteremia/septicemia			
Powe et al ⁷³ (first 6 mo only)	1.00	1.63 (0.79-3.38)	2.38 (0.997-5.66)
Ishani et al ¹¹⁹	1.00	1.05 (0.82-1.35)	1.95 (1.47-2.57)
Hoehn et al ¹²⁴	1.00	1.29 (0.50-3.34)	7.64 (3.73-15.67)
Taylor et al ¹²⁵	1.00	1.37 (0.36-5.96)	8.49 (3.03-23.78)
Death			
Astor et al ¹²⁶	1.00	1.21 (0.82-1.78)	1.47 (1.01-2.17)
Polkinghorne et al ⁷⁸	1.00	1.73 (0.76-3.96)	2.74 (1.48-5.10)
Xue et al ⁷⁷	1.00	1.16 (<i>P</i> > 0.09)	1.70 (<i>P</i> < 0.0001)
Pastan et al ⁷⁶	1.0	1.1 (0.9-1.4)	1.4 (1.1-1.9)
Pastan et al ⁷⁶ (+DM)	1.0	1.2 (0.8-1.9)	1.7 (1.0-2.8)
Dhingra et al ⁷⁵ (+DM)*	1.00	1.41 (1.13-1.77)	1.54 (1.17-2.02)
Dhingra et al ⁷⁵ (No DM)	1.00	1.08 (0.92-1.26)	1.70 (1.41-2.05)

Note: Statistically significant risks with 95% confidence intervals that do not cross 1 are in bold. Numbers in parentheses indicate confidence intervals when provided. Relative risks from the adjusted models are presented below.

Abbreviations: +DM, subset of patients with diabetes mellitus only; No DM, subset of patients without diabetes mellitus only.

*Cuffed, tunneled, and/or "permanent" central venous catheters.

Outcome comparisons between PD and hemodialysis patients have inevitable selection bias. However, despite the presence of a catheter in the peritoneal cavity, the risk of developing sepsis in hemodialysis patients (in total, not limited to patients with CVCs) is more than double that for PD patients.¹¹⁸ In a national study, the associated risk of developing sepsis in patients with fistulas (reference) was similar to that of PD catheters (0.96; 95% confidence limits, 0.75 to 1.23), whereas that of a permanent CVC was double that of PD (1.95; 95% confidence limits, 1.47 to 2.57).¹¹⁹ In addition, hospitalization and total Medicare costs are lower for PD than hemodialysis.^{120,121} These costs savings extend to patients initially on PD therapy who later switch to hemodialysis therapy compared with concurrent patients on solely hemodialysis therapy.¹²¹

As a corollary, although somewhat controversial, we believe an improvement opportunity also exists for placing fistulas in most patients who are currently on PD therapy because a significant portion of them will switch to hemodialysis therapy either temporarily or permanently over time.^{122,123}

Bridging the Gap: Arteriovenous Grafts

Vessel mapping has identified candidates for potential fistula placement who previously were characterized as having "exhausted all vessels for fistula."^{24-26,95,98,99} In some instances, when

vessels are not suitable for fistula placement based on 2 independent opinions, they may be evaluated for placement of synthetic grafts. In our opinion, grafts are acceptable for hemodialysis and, based on associated clinical outcomes, are still preferred over long-term CVCs.³ Emphasis on the fistula may have created a misimpression that grafts and CVCs are equally disadvantageous, but the associated infection and mortality risks of grafts are more similar to fistulas than catheters (Table 2).^{73,75-78,119,124-126} In studies in which grafts were compared directly with catheters, increased hazard ratios for death in patients with CVCs were 1.46 (95% confidence interval, 1.41 to 1.52) to 1.8 (95% confidence interval, 1.5 to 2.2).^{76,77} In some patients, when dialysis is imminent and a fistula is not a viable option, a graft remains an acceptable access in lieu of a CVC and is often ready for use much earlier than a fistula, thus potentially avoiding the CVC altogether.

Future conversion of grafts to fistulas is not a new concept, akin to conversion of old "shunts" to fistulas.¹²⁷⁻¹²⁹ This elective conversion is facilitated by the observed maturation of the vein immediately distal to the venous end of the graft. Similar to a developing autogenous fistula,¹³ grafts transfer increased flow and shear stress to the anastomotic venous drainage, causing thickening of the in-

tima.^{130,131} This phenomenon often is blamed for the excessive intimal proliferation directly at the anastomotic site of the graft, thus predisposing to outflow stenosis.¹³² In 1 center, mature veins distal to 17 failing grafts had a mean diameter of 4.8 ± 1.1 mm (by means of Doppler and/or physical examination), and all 17 were successfully converted to fistulas within 3 years.¹³³ After thorough evaluation, Beathard¹³⁴ estimated that 74% of patients with forearm loop grafts had veins that were suitable candidates for conversion into fistulas. Therefore, it is plausible that patients started with a graft may have suitable veins for conversion to fistulas in as early as 6 to 8 weeks, similar to that of conventional fistula maturation. In the future, grafts from improved biomaterials may be used soon after surgical placement, similar to CVCs.^{135,136}

Short-term patency rates of grafts are similar to fistulas.¹³⁷ Therefore, infection risk is the greater challenge for the strategy of using grafts as the bridge. The prevalence of graft infections based on recent single-center reports may be between 3.5% and 8.2%.^{138,139} Graft infections occurred within the first month in 15% of patients and within the first year in 59% of patients.¹³⁹ In other cohorts, median time to infection was reported at approximately 7 months after catheter placement.^{140,141} However, the absolute baseline graft infection risk remains low compared with that of catheters, quantified at 0.08 infections/graft-year as opposed to 2.0 infections/catheter-year, a significant 25-fold difference in risk.¹³⁹

Careful Use of Existing Fistulas

A conservative approach to avoidance of hemodialysis catheters is to develop processes and techniques that will help maintain existing fistulas, such as careful needle placement and adequate training for cannulation technique.^{34,142} We recommend that experienced nurses or primary care technicians with a good cannulation track record initially cannulate newly mature fistulas because of intricacies associated with fistula cannulation compared with grafts.³⁴ Depending on the size, area of cannulation, measured flow, and clinical evaluation, nephrologists may opt to use a new fistula initially only to draw blood for the arterial dialysis tubing and then direct the venous return through the patient's

other vascular access (eg, graft or CVC). This technique exposes the new fistula to lower access pressure initially, decreasing blood leakage that leads to hematomas. Our recommended technique for cannulation of new fistulas relies on the use of smaller needles (17 G), a highly placed tourniquet to engorge the fistula (then removed after cannulation is completed), low angle of needle entry to avoid nicking, and careful taping of needles. Initially prescribing lower blood flows (with longer dialysis time) may accommodate the smaller needles. We suggest frequent inspection of the fistula, with instructions to stop the dialysis at the first sign of infiltration, to limit the size of the hematoma.

When selecting cannulation sites, we recommend separating the needle tips by approximately 2 inches (~5 cm) when possible to decrease recirculation. The predominant method used by most facilities is referred to as the "rotating sites" or "rope-ladder" technique, whereby both the arterial and venous needle sites are moved "up" along the fistula (ie, proximally, toward the central veins) in approximately 2-mm increments after each treatment while keeping the distance between needle tips constant. This technique is designed to avoid aneurysm formation associated with repeated cannulation around a very small area.¹⁴³ An alternative is the "buttonhole" technique, which uses the same site for each cannulation needle until a tract forms.¹⁴⁴ Once the tract is well formed, blunt needles (that pose a lower risk for nicking) can be used for cannulation through the tract every treatment, after removal of the scab. The buttonhole technique may be advantageous for patients with only a small area for fistula cannulation. However, the challenge is in ensuring that the exact same tract is used every time (requiring the same angle of entry); otherwise, it may weaken the fistula wall and predispose to aneurysm formation.¹⁴³ One setting in which the same cannulator can use the "buttonhole" is if the patient agrees to be trained in self-cannulation,¹⁴⁵ either in self-care units or for home hemodialysis. However, with a nursing shortage and increased staff turnover,¹⁴⁶ this technique may not be applied properly in most outpatient dialysis units (and in the hospital, as well). We recommend initially obtaining the surgeon's approval when consider-

ing the buttonhole technique for patients with new fistulas.

Monitoring and Surveillance for Continuous Fistula Use

Clinical practice guidelines recommend routine monitoring and surveillance for fistulas.³ Monitoring refers to periodic physical examination, whereas surveillance refers to periodic use of an adjunctive instrument, both designed to detect access dysfunction. Physical examination by experienced hands may detect impending access failure.^{18,147} More objective data can be obtained by using equipment, such as those designed to measure intra-access blood flow, and may detect access dysfunction with more lead time before failure.¹⁴⁸ Together, it is the hope that monitoring and surveillance will lead to early referrals that can preemptively address potential causes of access thrombosis, thus prolonging the life of the fistula.³ Currently, reports regarding the utility of an access flow surveillance program for the prevention of thrombosis and prolongation of fistula patency have not provided consistently favorable results.¹⁴⁹⁻¹⁵³ Clearly, apart from early detection of functional impairment, the ability to prolong the life of a dysfunctional access may be related to the variable effectiveness of salvage interventions.^{33,154-156} However, an added value of a surveillance program may be as an indicator for when to initiate the planning and placement of another fistula before the existing access is abandoned, thus buying time for the next fistula to mature and obviating the need for a catheter bridge.

CONCLUSION

The success of Fistula First has been accompanied by increasing CVC use because of a number of factors, many of which are "actionable" with a concerted effort. Complications related to prolonged dependence on CVCs lead to increased morbidity, mortality, and cost. It is possible that the national focus on increasing fistulas has inadvertently diverted attention away from decreasing catheters. We propose that the national vascular access initiative be revised to have a dual goal of Fistula First and Catheters Last. Our proposed goals and interventions are designed to meet both objectives and are not mutually exclusive, but rather complementary. Most are already embedded in vascular access clinical practice guidelines and Fistula First change concepts, but we

clearly need a systematic refocus on interventions that not only increase fistulas, but also avoid CVC use.

Emphasis should be placed on establishing a process within a multidisciplinary team for converting CVCs into fistulas expeditiously. Measures that improve cannulation techniques and physical examination, as well as judicious use of surveillance, should be used to assist in the maintenance of existing fistulas. The strategy of initiating patients on PD therapy or using grafts as bridge access in lieu of CVCs should be explored and perhaps tested in a rigorous clinical trial. However, the best practice for hemodialysis vascular access remains early placement of fistulas with enough maturation time such that it can be used for initiating long-term hemodialysis treatments when the need arises. Under Fistula First and Catheters Last, a national effort to persuade Congress to legislate Medicare coverage for permanent access placement for patients with CKD may eliminate a significant systemic barrier, facilitating both more arteriovenous fistulas and less CVCs for the initial hemodialysis of patients with end-stage renal disease. Local nephrologist-led education campaigns directed toward patients, primary care physicians, surgeons, hospitals, and payers are necessary to align interests and modify behaviors and clinical practice.

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