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Fistula First: Recent Progress and Ongoing Challenges

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The original Dialysis Outcomes Quality Initiative (DOQI) guidelines publicized in 1997 provided specific recommendations for management of hemodialysis patients to optimize dialysis adequacy, anemia, and vascular access outcomes. With frequent feedback from the dialysis networks, nephrologists rapidly succeeded in providing the vast majority of their hemodialysis patients with an adequate Kt/V and hemoglobin. In contrast, increasing arteriovenous fistula (AVF) use in hemodialysis patients proved to be much more challenging. Initially, a goal was set to have 40% AVF use in prevalent US hemodialysis patients. To accelerate the process, the Fistula First Breakthrough Initiative (www.fistulafirst.org) was established in 2003. With a combination of extensive educational activities and frequent feedback to nephrologists, surgeons, and dialysis facilities, this goal was met by 2005. The bar was subsequently raised to 66% AVF use in US hemodialysis patients, a level comparable to that achieved in several European countries.¹

In this issue of the *American Journal of Kidney Diseases*, Lynch et al² provide a wealth of information regarding progress in achieving the AVF goals in the United States between 2007 and 2010. Overall, AVF use increased from 45.3% to 55.5% among the prevalent hemodialysis population. It is gratifying that the proportion of catheter-dependent patients actually decreased concurrently from 28.2% to 24.0%. The proportion of dialysis facilities consistently achieving the 66% AVF goal increased from 6.4% to 19%. However, there were dramatic differences among dialysis networks. Thus, in 2010, the proportion of facilities achieving a 66% AVF rate ranged from a low of 9.4% in Network 6 to a high of 49.2% in Network 16. AVF use was lower in women, older patients, and those with peripheral vascular disease, but clinical and demographic factors explained only a small proportion (~20%) of the variation among networks. Unfortunately, the picture is far less encouraging among patients initiating hemodialysis (incident patients), where AVF use in 2010 was far lower, ranging between 8.0% in Network 18 and 18.4% in Network 16.

Why is it so difficult to achieve a high AVF rate in the United States? Optimizing dialysis adequacy and anemia is fairly straightforward. Meeting the target Kt/V is easily accomplished in most patients, provided hemodialysis is prescribed appropriately and the

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patient adheres to the prescription. Target hemoglobin levels can be achieved in most patients by appropriate prescription of erythropoietin and intravenous iron. In contrast, achieving optimal vascular access outcomes is extraordinarily complex. It requires close collaboration among multiple health care providers, including nephrologists, surgeons, radiologists, and dialysis staff. It requires intensive educational efforts to convince patients to undergo elective surgical procedures with the promise of long-term benefits. It requires vigilance to monitor AVF outcomes, identify nonmaturing AVFs, and refer patients for appropriate and timely percutaneous or surgical interventions to promote AVF maturation. This process is particularly challenging in patients who have not yet initiated dialysis, as they do not see a health care provider thrice weekly. Having a dedicated access coordinator may improve vascular access outcomes.^{3,4}

Lynch et al² highlight 2 important observations regarding vascular access management. First, the enormous variability in AVF use among dialysis networks, and within single networks, suggests major differences in practice patterns and is consistent with results from several prior publications. For example, the Dialysis Outcomes Practice Patterns Study (DOPPS) reported much lower AVF use in the United States than in Europe.¹ Similarly, Hirth et al in 1996 observed substantial differences in AVF use among US dialysis networks.⁵ Finally, a secondary analysis of the Hemodialysis (HEMO) Study illustrated dramatic differences in AVF use among individual dialysis units within single metropolitan areas.⁶

Second, there is a glaring discrepancy in AVF use between incident and prevalent patients. Predialysis medical care is much more fragmented in the United States than in West Europe, where universal health care coverage is commonly available. Many patients in the United States lack adequate medical insurance prior to initiation of dialysis, potentially limiting their ability to obtain routine medical follow-up or vascular access surgery. Possibly, AVF use in incident patients would be higher if lack of insurance were removed as a barrier. While the study by Lynch et al² excluded patients receiving dialysis in Veterans Administration (VA) facilities, a model of universal health care coverage in the United States, another recent study reported that AVF use among incident hemodialysis patients receiving their care in the VA system was significantly higher than that obtained in patients with standard Medicare coverage (21.4% vs 13.5%).⁷ Nevertheless, the incident AVF rate in hemodialysis patients in the VA system is still much lower than in Europe (~65%),¹ suggesting that additional factors are at play.

Several critical events must occur for an AVF to be used in incident hemodialysis patients: (1) the patient must be under the care of a nephrologist and undergo AVF surgery prior to initiating dialysis, (2) the AVF must mature, and (3) the dialysis staff must be able to cannulate the AVF successfully (Table 1).^{8,9} Failure of any of these steps results in a patient initiating hemodialysis with a catheter. At present, nearly 80% of US patients initiate hemodialysis with a catheter,¹⁰ which means that only 20% achieve all the necessary steps. The DOPPS provides a fascinating comparison of achieving the different benchmarks among the United States, West Europe, and Japan. Although the proportion of patients with >4 months of nephrology follow-up prior to initiation of hemodialysis was quite similar, with rates of 68% in the United States, 65% in Japan, and 65%–82% in several West

European countries,¹¹ the time between referral to the surgeon and creation of the access varied substantially, with times of <4 weeks in 78% of US centers, 96% in Japan, and 78%–95% in several West European centers, but only 40% in the United Kingdom.¹¹ The median time to first cannulation of a new AVF ranged from a high of 98 days in the United States to a low of 25 days in Japan.¹¹ Finally, the median prescribed dialysis blood flow at initiation of hemodialysis was 300 mL/min in the United States, 250 mL/min in the United Kingdom, 200 mL/min in Germany, and just 160 mL/min in Japan.¹¹ Although difficult to quantify, it is likely that surgical expertise and experience also impact AVF success rates.^{12–14}

Certainly, all these variables affect the likelihood of initiating hemodialysis with an AVF. Not surprisingly, patients with longer predialysis nephrology care are more likely to initiate hemodialysis with an AVF.^{15,16} It is also notable that AVF failure is nearly 2-fold higher among patients with a prior dialysis catheter than in those without a prior catheter.¹¹ Despite routine preoperative mapping to select optimal vessels, most new AVFs require 1 or more percutaneous or surgical interventions to achieve suitability for dialysis. Clinical evaluation is helpful in assessing AVF maturation. In addition, postoperative ultrasound obtained 4–6 weeks after AVF creation may provide objective measurements of AVF diameter and blood flow useful in predicting suitability for dialysis. In particular, AVFs with a diameter ≥4 mm and blood flow >500 mL/min are associated with >90% suitability for dialysis.^{17,18} In sonographically immature AVFs, the ultrasound often reveals anatomic abnormalities, such as perianastomotic stenosis, large accessory veins, or excessive depth of the AVF.¹⁸ Interventions targeted at correcting these abnormalities frequently can convert an immature AVF to one that is suitable for hemodialysis.^{18–24}

Patient adherence to physician recommendations varies greatly among countries. Patients in the United States are less likely to follow their dialysis prescription,^{25,26} adhere to their medical regimen,²⁷ or comply with their dietary restrictions.²⁵ These behavioral patterns are prominent in large urban dialysis centers, often persist despite aggressive educational efforts, and can adversely impact efforts to optimize vascular access outcomes. Thus, for example, a single-center study from Birmingham, Alabama reported that 60% of patients missed 1 scheduled access appointment or appointments,²⁸ while a study from Miami, Florida noted that 37% of catheter-dependent patients declined to have access surgery despite substantial efforts to educate them about the risks of dialysis catheters.²⁴ These phenomena may be related to low educational levels, low income, or distrust of the health care system, and are not easily modified. It is unknown whether socioeconomic variables contribute to the large variability in AVF use among and within US dialysis networks, as these factors were not specifically analyzed by Lynch et al.²

Hemodialysis staffing differences likely also contribute to vascular access outcomes. European hemodialysis units are staffed exclusively by registered nurses (RNs), with a typical ratio of 1 RN to 3 or 4 patients. The staffing is far less favorable in the United States, where 1 RN cares for 10–12 hemodialysis patients, assisted by less-skilled patient care technicians. Moreover, the RN's attention is often diverted from patients with AVFs, as there are more catheter-dependent patients, and in many states only RNs may connect and disconnect catheter-dependent patients. Needle infiltration of AVFs is frequent in patients with new AVFs (<6 months in age) and in older patients. It can result in early AVF

thrombosis or prolonged catheter dependence.^{29,30} Patients with a shorter usable AVF length of cannulation (<7 cm) have longer catheter dependence.³⁰ The buttonhole cannulation technique may be helpful in such patients, although it may lead to bacteremia if not performed appropriately.³¹

In summary, maximizing AVF use in hemodialysis patients is extraordinarily complex, requiring intensive and ongoing multidisciplinary efforts to streamline the process. Nephrologists must assess the strengths and weaknesses of their local center and tailor a strategy that works best in that environment.

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Table 1**Barriers to Increasing Arteriovenous Fistulas and Potential Solutions**

Barriers to Achieving Arteriovenous Fistula	Potential Solutions
Late referral to nephrologist	Publicize referral criteria to primary care physicians and endocrinologists
Inadequate patient education	Chronic kidney disease clinics
Inadequate communication among nephrologists, surgeons, radiologists, and dialysis staff	Dedicated vascular access coordinator
Selection of appropriate vessels	Routine preoperative mapping
Inadequately trained surgeons	Limit referrals to surgeons with interest and experience; adequate oversight of trainees
Arteriovenous fistula nonmaturation	Train nephrologists and surgeons on clinical postoperative arteriovenous fistula assessment; postoperative ultrasound at 4–6 weeks; percutaneous or surgical salvage of immature arteriovenous fistulas
Difficulty in arteriovenous fistula cannulation	Training of dialysis staff; buttonhole technique; ultrasound assessment; consider percutaneous or surgical revision