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PD First: Peritoneal Dialysis as the Default Transition to Dialysis Therapy

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ABSTRACT

Peritoneal dialysis (PD) and in-center hemodialysis (HD) are accepted as clinically equivalent dialysis modalities, yet in-center HD is the predominant renal replacement therapy (RRT) modality offered to new end-stage renal disease (ESRD) patients in the United States and most other industrialized nations. This predominance has little to do with clinical outcomes, patient choice, cost, or quality of life. It has been driven by ease of HD initiation, physician experience and training, inadequate pre-ESRD patient education, ample in-center HD capacity, and lack of adequate infrastructure for PD-related care. As compared with in-center HD, PD is a widely applicable, yet underutilized modality of RRT that provides comparable clinical outcomes, superior quality of life measures, significant cost savings, and many other unmeasured advantages. A "PD First" approach not only has advantages for patients but also physicians, healthcare systems, and society. In this review, we will summarize evidence demonstrating that PD should be the default modality when new ESRD patients are transitioning to dialysis therapy when preemptive transplantation is not an option and highlight the essential infrastructural requirements to allow for a "PD First" model.

Background

Although peritoneal dialysis (PD) has many compelling advantages as compared with in-center hemodialysis (HD), it remains underutilized as an initial modality in the majority of new end-stage renal disease (ESRD) patients in the United States. Currently, 93% of all incident dialysis patients start in-center HD, the majority with a central venous catheter (CVC) (1). However, there is no clinical, quality of life, cost benefit, or other acceptable reason for the discrepancy in utilization of HD versus PD. Although the reasons are not entirely clear, it appears the increased HD utilization has been driven by ease of HD initiation, physician experience and training, misinformation about contraindications to PD, inadequate pre-ESRD patient education, ample in-center HD capacity with prior financial incentives favoring HD, and lack of PD-related infrastructure to assure successful PD program utilization. With the changing healthcare marketplace with greater emphasis on cost-efficient delivery of patient-centered quality care, and increased incentives for home dialysis, there is great need to implement "PD First" as the model of dialysis care.

Clinical Outcomes

Multiple studies using national registries have attempted to compare short and long-term outcomes in PD and HD (2–9). Noting the limitations of these observational studies, adjusted aggregate data of the studies since the early 1990s demonstrate that PD has a survival advantage in the early years in the majority of patient populations (Table 1). This early survival advantage is independent of age or comorbidities such as diabetes or cardiovascular disease. More importantly, although there have been gains in survival in both HD and PD over the past 2 decades, gains in survival in PD have significantly outpaced gains in HD (7,8).

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TABLE 1. Short and long-term outcomes comparing peritoneal dialysis (PD) and in-center hemodialysis (HD)

Author	Cohort	Location	Sample size	Follow-up	Key results
Liem et al. (2)	1987–2002	Netherlands	16,643 (10,841 HD; 5,802 PD)	Up to 16 years	Lower mortality for PD in younger diabetics and nondiabetics up to 15 months; no difference thereafter Lower mortality for PD in older nondiabetics for 6 months; higher after 15 months Equal risk for older diabetics up to 15 months
Huang et al. (3)	1995–2002	Taiwan	48,629 (45,820 HD; 2,809 PD)	Up to 6 years	Similar 5-year mortality for PD and HD (56% vs 54%) Similar 10-year mortality for PD and HD (35% vs 34%)
Sanabria et al. (4)	2001–2003	Colombia	923 (437 HD; 486 PD)	Up to 5 years	No mortality difference between PD and HD overall PD favored in younger nondiabetics
McDonald et al. (5)	1991–2005	Australia & New Zealand	25,287 (14,733 HD; 10,554 PD)	Up to 5 years	11% lower risk of death for PD patients in first 12 months; HD favored thereafter No difference in long-term mortality in recent (2004) cohort
Weinhandl et al. (6)	2003	USA	98,875 (matched 6,337 HD:PD)	4 years	8% overall lower risk of death for PD patients Similar 4-year adjusted survival for PD & HD (47% vs 48%)
Mehrotra et al. (7)	1996–2004	USA	684,426 (620,020 HD; 64,406 PD) Cohorts (1996–1998, 1999–2001, 2002–2004)	Up to 5 years	No difference in the 5-year adjusted survival for PD & HD (33% vs 35%) in 2002–2004 cohort Attenuation of HD survival advantage with later cohorts as compared to earlier cohorts
Yeates et al. (8)	1991–2007	Canada	46,839 (35,531 HD; 14,308 PD) Cohorts (1991–1995, 1996–2000, 2001–2004)	Up to 5 years	Overall PD survival advantage in the first 18 months; HD favored after 36 months Overall mortality rates similar between PD and HD PD favored for 2 years in the 2001–2004 cohort; survival thereafter similar
Chang et al. (9)	1997–2006	Taiwan	Matched 4721 PD:HD Cohorts (1997–2000, 2001–2005)	Up to 5 years	HD survival favored in 1997 to 2001 cohort with HR of 1.33 No difference in survival for 2001–2005 cohort

Of note, in the first year of dialysis, while there has been a significant decrease in mortality of patients on PD since the 1990s, there has been no significant improvement in mortality among HD patients.

With regard to longer term outcomes, older studies had suggested PD to be inferior compared with HD. However, given the improvements in PD outcomes with time, when considering contemporary cohorts from multiple different countries, there is no demonstrable difference in survival in patients who started PD as compared with HD out to 5 years in the majority of patients irrespective of comorbidities (7,8).

Quality of Life

"*We should place the highest value not on living, but on living well.*" Socrates

Given the similar survival data between HD and PD, quality of life (QoL) ("*living well*") has become increasingly important in patients' choice of dialysis modality. Patients that choose PD often favor PD due to flexibility of schedule, ability to perform dialysis at home, and ability to dialyze while sleeping (10). Yet, objectively measuring QoL while comparing patients on each dialysis modality is exceedingly difficult.

Studies have attempted to use health assessment questionnaires such as the Medical Outcomes Survey Short Form 36 (SF-36), the Kidney Disease Quality of Life Surveys (KDQOL), and the EuroQol to assess QoL differences between dialysis modalities. The inherent limitation in interpreting these studies is the different case-mix characteristics among patients on HD versus PD (11). In addition, clinicians and patients often differ when defining QoL, bringing the utility of the generic questionnaires into question. Multiple systematic reviews have demonstrated that while there is not a definitive QoL measure that is favored by modality, patients choosing PD mostly rate their QoL higher than patients on in-center HD (12,13). Even in the

elderly, in a multicenter cross-sectional study, Brown et al. demonstrated equivalent to better QoL measures for those on PD relative to HD (14).

Given the limitation of QoL studies utilizing generic questionnaires, certain studies have concentrated on identifying factors that patients deem important to QoL. In a cross-sectional study of new ESRD patients, a dialysis patient focus group was utilized to create a 23-item questionnaire, which prioritized factors patients perceived as important to their QoL. The questionnaire was administered to 736 new ESRD patients (256 PD; 480 HD) on average 7 weeks after dialysis initiation (15). The results of the study revealed that patients on PD were much more likely to give excellent ratings of dialysis care overall (85% versus 56%) as well as specific aspects of care. Adjustment for multiple factors including age, race, marital status, employment status, distance from center, and time on dialysis did not reduce the differences between HD and PD.

An additional QoL measure that patients identify as important includes the ability to maintain employment (16). Although approximately half of new dialysis patients are of employment age, many patients with a new diagnosis of ESRD leave their jobs after starting dialysis. Overall, 18.9% of prevalent patients, ages 18–54 on dialysis in the United States, are employed (17); yet, a majority of individuals who are unemployed have indicated that they would like to return to work either part or full-time (18).

A cohort of patients who had been employed in the year prior to initiating dialysis were surveyed soon after dialysis start to ascertain what factors influence employment status while on dialysis (19). Among the patients that remained employed, those who were are on PD were significantly more likely to remain employed after dialysis initiation. In the Choices for Healthy Outcomes in Caring for ESRD (CHOICE) study, patients choosing PD were three times more likely to be employed (27% versus 8.6%) (20). Although it remains unclear as to whether it is the dialysis modality or other factors that influence employment status, PD makes employment more feasible given the flexibility of schedule it affords to the patients (21).

Cost

Until recently, the cost of healthcare in the United States had outpaced inflation to the point that it consumed 17.4% of the gross domestic product (22). Patients with ESRD, while only accounting for 1.3% of the patients with Medicare, consume 8.1% of the Medicare budget (1). Therefore, in the healthcare reform process, cost-effective care of patients on dialysis is of utmost importance to assure ongoing health coverage for this and other populations, while maintaining a sustainable economy.

As of 2010, when comparing ESRD patients who have insurance coverage for dialysis therapy through Medicare, in-center HD has an annual average cost of $82,285 as compared with $61,588 for PD (1).

Given the higher PD technique failure rate, some have suggested that there is a significant cost associated with patients that switch from PD to HD. However, in a 3-year mean adjusted cumulative cost analysis, compared with patients who received only HD, those on PD only and those who transitioned from HD to PD had significantly lower healthcare costs at 1 and 3 years. More importantly, patients who transitioned from PD to HD had costs similar to HD only patients at 3 years (23), supporting the notion of PD as the default modality for dialysis therapy.

Aside from the above-mentioned cost analyses, modality cost comparisons fail to take into account certain opportunity costs and modality-specific cost savings. As outlined elsewhere in this article, PD is much more conducive to maintaining employment given the flexibility of schedule and ability to dialyze at home. The ability to maintain employment while on a PD is an opportunity cost savings that is usually unaccounted for. The transportation cost savings associated with decreased travel to and from the dialysis unit for patients on PD as compared with in-center HD is another potential unaccounted cost savings.

PD patients also require less erythropoietin-stimulating agents (ESA) than HD patients. In a large contemporary cohort (10,527 PD, 139,103 HD) of dialysis patients between 2001 and 2006 at a single large dialysis organization, HD patients at the same level of hemoglobin used three to four times the ESA doses, irrespective of case-mix adjustment (24). The cause(s) of this difference in ESA requirement between HD and PD remains unclear. Postulated reasons for the difference include: (i) increased blood loss during HD treatments and blood draws; (ii) difference in ESA responsiveness based on mode of ESA administration; (iii) increased inflammation in HD patients resulting in more protein-energy wasting evidenced by higher C-reactive protein levels; (iv) increased endogenous erythropoietin production in PD patients, presumably due to longer duration of preserved residual kidney function (RKF). Aside from the cost implication, lower ESA dose requirements have also been associated with lower cardiovascular mortality.

Additional Benefits of Peritoneal Dialysis First

Patients starting dialysis for the first time often have significant RKF. Maintenance of RKF has been associated with improved survival in several studies (25,26). Although it is not entirely clear how RKF contributes to mortality, studies have suggested a link between RKF and cardiovascular outcomes (27). As compared with HD, patients on PD have a slower decline of their RKF.

The re-evaluation of the CANUSA study demonstrated that it is RKF, not the overall clearance, which affects survival on PD (28).

If PD is the initial modality of dialysis, it affords patients' longer duration with RKF. Preservation of RKF decreases the total volume of PD exchanges required and therefore less dextrose exposure, which helps minimize weight gain and increases lifespan of the peritoneal membrane. Given that patients on PD have optimal outcomes when preserving their RKF, starting patients on PD may optimize patient survival. Once the RKF is lost, patients having difficulty achieving adequate ultrafiltration or metabolic clearance can be more easily transferred to HD (either in-center or at home HD) in an elective manner with a planned fistula. On the other hand, when longstanding patients on HD transition to PD, the transfer is often difficult as most are anuric, have not electively committed to self-care, and may have developed disabilities, which impact ability to perform PD.

Another important consideration for PD as the default initial dialysis modality involves the understanding that outcomes on HD are critically tied to having a fistula as the access of choice. This is evidenced by one study that demonstrated that first-year outcomes on PD and HD are equivalent when comparing incident PD patients to patients on HD who dialyzed via a fistula. However, PD was significantly favored in the first year when compared with HD patients who start with a CVC (29). With the vast majority of patients starting HD with a CVC, a 20% primary fistula failure rate, and many vascular accesses requiring revision over their lifespan, many longstanding HD patients "burn out" their accesses and become dependent on CVCs and resultant CVC-related complications. PD as an initial modality not only allows for preservation of vascular accesses for future HD but also allows for the longest possible lifespan on some modality of renal replacement therapy (RRT).

Barriers to PD

The US ESRD marketplace has traditionally been better suited to support in-center HD. With reimbursement for dialysis services previously favoring HD, the dialysis organizations, policy makers, and other stakeholders have created the infrastructure to support in-center HD with less of a focus on home modalities.

However, some of the infrastructural limitations impeding the growth of PD in the United States are starting to be addressed. In March 2012, top leaders in the nephrology community came together at the first National Summit on Home Dialysis policy (30,31). Fifteen distinct recommendations to optimize home dialysis use were identified (Table 2). Subsequently, the Alliance for Home Dialysis was formed with the goal of promoting activities and policies that will improve modality choice while identifying and addressing systematic barriers that limit access to home dialysis therapies. In the rest of this article, we will review what we consider to be barriers to a PD First policy and suggest interventions to address such barriers.

CKD and Modality Education

Structured multidisciplinary predialysis education programs have consistently demonstrated improved patient outcomes, decreased hospitalizations, decreased need for urgent initiation of dialysis, and increased utilization of home modalities (32). In a prospective randomized study, investigators compared a multidisciplinary predialysis education group with a control group with the primary endpoint of mortality. The intervention group received multidisciplinary chronic kidney disease (CKD) care (case manager, social worker, dietitian, HD and PD patient volunteers, and nephrologists) from the onset of CKD stage 3. Education was provided with standardized lectures, interactive educational sessions, and reminders for timely follow-up. The control group received usual CKD care under the guidance of their nephrologist, without the support of a multidisciplinary team. Control patients were given written educational materials and nursing staff assisted with explaining the differences in PD and HD to the patients once CKD stage 4 was reached. As compared with the control group, the multidisciplinary intervention group had significantly lower mortality at 12 months, (1.7% versus 10.1%), an increased proportion of the study group chose PD (35% versus 20.5%), and a lower proportion required use of a CVC (25% versus 50.4%) (33).

In a similar study, predialysis education resulted in decreased hospitalizations, decreased need for urgent dialysis, and urgent vascular access while 53% of patients receiving predialysis education chose PD (34). In the National Pre-ESRD Education Initiative Survey, among patients who received dialysis modality education, 45% chose to be on dialysis at home (35).

However, several studies suggest that patients starting RRT have limited knowledge about their kidney disease and dialysis options (36). Many have not received education due to lack of pre-ESRD nephrology care while others receive inadequate CKD and modality options education despite having regular nephrology visits (37). Even when patients do not participate in a formal early multidisciplinary education program, home modality utilization can still be increased by an in-hospital education program for patients that acutely present to dialysis. In a retrospective study, patients acutely started on HD were given in-hospital CKD education prior to discharge. Of the 203 patients that acutely started HD (that survived to

TABLE 2. National summit on home dialysis policy: summary of delegate Recommendations (31)

Accessibility
Expand Medicare's CKD education program to include patients with CKD stage 5
Support mentoring programs, using existing patients as mentors
Develop competency measures for PD and HHD within physician training programs
Explore regionalization and partnership opportunities to bring economies of scale to home dialysis clinician training and patient services
Accountability
Enforce existing CMS Conditions for Coverage recommendation to provide education on all modalities in a way that patients can understand
Develop and adopt appropriate quality measures for home dialysis, including patient satisfaction measures specific to home patients
Reimbursement
Maintain reimbursement parity for home and in-center dialysis in the ESRD Prospective Payment System
Increase home dialysis training adjustment payment
Update tracking and reimbursement codes for home dialysis
Support more frequent home hemodialysis payment under Medicare
Evaluate payment across the care continuum (primary care, surgeons, hospitals, nephrologists) to ensure that incentives are properly aligned for home dialysis
Advance demonstration programs for alternative payment methods for home dialysis
Regulatory
Align federal and state regulatory requirements for home therapies, such as revising Conditions for Coverage, to reflect differences in home and in-center dialysis
Innovation
Provide clarity on regulatory requirements to support nocturnal hemodialysis
Fund innovation in home dialysis, including those focused on more frequent and extended dialysis therapies

CKD, chronic kidney disease; PD, peritoneal dialysis; HHD, home hemodialysis; CMS, Centers for Medicare and Medicaid Services; ESRD, end-stage renal disease.

discharge) and received in-hospital CKD education, 71 (35%) chose a home modality (49 PD, 22 home HD) (38).

To address the educational deficits among patients with CKD and ESRD, since 2009, the Centers for Medicare & Medicaid Services (CMS), under Conditions for Coverage, mandates presentation of RRT options to all patients starting dialysis. CMS additionally supports predialysis education with a series of six educational sessions, which are reimbursable for patients with CKD stage 4. Despite these efforts, the education provided to patients remains insufficient, inadequate, and often too late. Many nephrologists are failing to use the reimbursable educational sessions in CKD stage 4 to educate their patients. The CMS initiative is a good start, but until CKD educational centers are created to allow for referral of patients, the education of patients will remain fragmented and unstructured.

Governmental Policy and PD Infrastructure

Aside from the United States, HD utilization is higher and increasing in most industrialized countries such as Great Britain and Canada where HD capacity and infrastructure are readily available and a PD First policy does not exist. In comparison, in certain nations where the government supports or mandates a PD First model, PD utilization has been expanding. In the Far East, Latin America, Turkey, and Iran where there is lack of significant outpatient HD capacity, PD utilization has been increasing rapidly over the past 2 decades (39). Certain countries that have a PD First policy, such as Hong Kong and Mexico, have more than 80% of their ESRD patients on PD with patient outcomes similar to countries without such a policy, at a fraction of the cost (40–43). In addition, in Hong Kong and Thailand, if PD is chosen as the initial dialysis modality, the government will underwrite the cost of the therapy (40,43).

Aside from governmental and healthcare system support, the key infrastructural features that allow for successful PD programs include adequate pre-ESRD CKD education (discussed above), adequate physician knowledge, nurse training in PD, adequate support staff, adequate size of program, and continuous quality monitoring programs (39).

Many of these infrastructural needs are interrelated. In the United States where multiple smaller PD programs exist, the small number of patients at each center does not allow for adequate nurse experience and training, minimizing the ability to have adequate support staff to develop a successful PD program and compromising nephrology trainee exposure. By comparison, large PD centers in China, Hong Kong, and Taiwan often have more than 300 patients and tend to have outstanding clinical outcomes (42).

An important consideration to optimize the PD infrastructure in the United States is to consolidate smaller PD programs to larger ones to parallel successful programs from other countries. "PD Referral Centers" can be created to allow for training and management of PD-related issues in patients whose nephrologist prefer to defer PD-related management to more experienced, resourceful centers, while maintaining the role of primary nephrologist. Economies of scale can be developed to further push down costs. Larger centers also allow for increased clinical research to further enhance patient outcomes.

Provider Education

Many fellowship training programs do not have adequate numbers of PD patients to allow for trainees to become comfortable with the management of PD patients. In a survey of nephrology fellowship graduates, more than 44% did not feel well trained and able to provide care to PD patients (44). Recently, the American Society of Nephrology (ASN), which partly controls educational content for nephrology trainees, is standardizing the teaching and exposure of fellows to PD during fellowship to address this issue.

Although the majority of nephrologists in practice care for PD patients, many have limited exposure to PD, and with time, lose the skills necessary to optimally manage these patients. A component of a PD First model will need to include ongoing PD educational programs for practicing physicians not only to optimize patient outcomes but also to make practicing physicians comfortable with PD, so that more patients are offered the modality.

Educational programs should also be expanded to include primary care physicians, access surgeons, and other specialists, as many patients are misinformed about PD by physicians other than their nephrologist.

Aside from physician education, nursing education is critical to a PD First policy. Nursing schools have little-to-no formal education about PD. With limited number of patients on PD, most hospital-based nurses have little exposure to PD and thus are uncomfortable in handling hospitalized PD patients resulting in many patients being transitioned to HD while hospitalized. Given that nurses are critical to the education of patients, their own comfort and understanding of the modality is imperative to the success and growth of PD.

Lastly, social workers, case managers, and dialysis educators need to be included in the PD educational process. With much of the educational process about RRT options now deferred to these providers, education of multidisciplinary team members is another important factor in the promotion of PD. Their effort will help guide patients and families with better understanding of the modality prior to enrollment in PD, thus avoiding risk of failure in inappropriate PD candidates.

"Relative" Contraindications to PD

Physician and patient perceptions of contraindications to PD serve as additional barriers to PD. Due to lack of knowledge or comfort with PD, fear of technique failure or fear that a patient will make the "wrong choice" leads many physicians never to offer PD as an option in any patient who is deemed not an "ideal candidate".

There are studies that have demonstrated PD success in a multitude of populations, including patients with polycystic kidney disease, cirrhosis, obesity, diabetes, congestive heart failure, elderly, blind, physically disabled, and many others. Moreover, in a study comparing outcomes when patients are given autonomy to choose their dialysis modality (either PD or HD) as compared with when physician chooses the modality, patients who chose had significantly higher survival (45).

Although not all patients are candidates for self therapy, the experience of countries with a PD First model where more than 80% of patients are on PD suggests that with the appropriate infrastructure and experience, the vast majority of new ESRD patients can be successfully initiated on PD. Moreover, in two large studies that have objectively evaluated medical contraindications to PD in incident ESRD patients, PD eligibility was 78% and 83%, respectively (46,47).

Timely PD Catheter Insertion

A significant number of patients with CKD who choose PD as their future dialysis modality fail to be initiated on PD as their initial dialysis modality due to unexpected rapid progression of kidney disease. Given that many of these individuals become acutely ill requiring hospitalization, the necessity of urgent dialysis will often default the patient to HD with the use of a CVC.

Utilization of embedded PD catheters is one mechanism to avoid such complication and shortfall. Burying the free end of the PD catheter subcutaneously, ideally for several weeks prior to dialysis initiation, allows the external catheter cuff time to heal in a sterile environment. Analogous to having a mature fistula in anticipation of future HD initiation, embedded PD catheters placed 4–6 weeks prior to PD initiation allows elective start of PD with a "mature" PD access when a patient who has previously chosen PD needs to start dialysis. This will obviate guessing about timing of catheter placement relative to the need to start RRT and the catheter can be used on the day of the exteriorization of the external limb (48,49).

Urgent-Start Peritoneal Dialysis

It is understood that optimal initiation of any RRT modality requires planning, education, and advanced preparation. Yet, advanced planning is not achievable in patients who present with kidney failure requiring urgent dialysis. Up to 60% of patients present to ESRD without an established dialysis access and plan for RRT (1).

Traditionally, when patients presented late and unplanned subsequently requiring urgent or emergent dialysis, HD has been started after placement of a CVC. However, such patients have a much

higher morbidity and mortality, mainly due to bacteremia and other complications associated with CVCs (50–52).

More recently, several reports have demonstrated the safety and feasibility of urgently starting patients on PD who need urgent dialysis, but have no established access (53–58). This model of urgent-start PD affords unplanned patients the choice of PD who, otherwise, would have been relegated to in-center HD. This model also decreases the need for CVCs and minimizes early CVC-related complications. Urgent-start PD serves as another important mechanism to eliminate the perceived contraindication that patients who present unplanned are not PD candidates. Moreover, the described protocols of urgent-start PD have demonstrated that it can be accomplished with no increased risk to patients with short-term outcomes similar to, if not better than urgent in-center HD.

Conclusion

"*There is no greater evil once can suffer than to hate reasonable discourse*." Socrates

Over the past 2 decades, advances in PD have led to improvements in the therapy that clinically make outcomes indistinguishable from in-center HD in the short and long term. In addition, from a patient perspective, PD is favored as a modality that better preserves QoL. As compared with in-center HD, PD costs approximately 25% less per year per patient not accounting for other factors such as ability to work, decreased transportation cost, and decreased need for injectable drugs. Yet, the predominant dialysis modality in the United States remains in-center HD.

Making PD the default transition to dialysis therapy will require a cultural shift in the US dialysis marketplace; yet, it is time to make this shift. Until recently, the dialysis marketplace has allowed in-center HD to be the easy choice that is offered to the majority of our patients. However, as we move to a healthcare environment with increasing focus on "patient-centered" cost-efficient delivery of care, our focus should change to emphasize educating our patients to select the therapy that best suits their lifestyles and needs.

Conflict of Interest

A.G. has declared associations with DaVita Healthcare Partners, Inc. and Baxter Inc. K.K.Z. has declared associations with Amgen, Abbott, Baxter, DaVita, Fresenius/Kabi, Keryx, Genzyme, Otsuka, and Shire. J.L. has declared associations with DaVita Healthcare Partners, Inc. and Fresenius Medical Care. F.M. is an employee of Fresenius. J.M. and A.R.N. are employees of DaVita Healthcare Partners, Inc.

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