The Future of Peritoneal Dialysis in the United States: Optimizing Its Use

John Burkart

Department of Nephrology, Wake Forest University Medical Center, Winston Salem, North Carolina, and Health Systems Management, Tifton, Georgia

Peritoneal dialysis (PD) has been used to treat patients with stage V chronic kidney disease since 1976. However, despite this long history, as of 2008 <8% of prevalent ESRD patients in the United States are treated with PD, a modality mix that is significantly different from what is seen in other developed countries. Data are reviewed that suggest that the reasons for this seem to be caused by non–medical-related issues such as subtle differences in practice patterns and unintended financial considerations. Medical outcome date would seem to favor more utilization of PD. For instance, data from the USRDS suggested that the relative risk of death for PD *versus* center hemodialysis has been improving, tending to favor those on PD for longer and longer periods of time. Infectious complications have also been markedly reduced. It is anticipated that changes in government reimbursement, such as the bundling of dialysis-related services, will stimulate a renewed interest in home therapies. Currently most home dialysis units are small, and some have minimal clinical experience with PD. If trends in reimbursement do favor a renewed interest in PD, for patient outcomes on PD to continue to improve, there will likely need to be further educational activities focused on PD, and perhaps, consolidation of PD programs may needed.

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Peritoneal dialysis (PD) has been used as a chronic treatment for patients with ESRD since 1976 (1). Although the first patient to be treated with chronic ambulatory PD (CAPD) lived in Austin, TX, as of 2008, <8% of prevalent patients with ESRD in the United States are on PD, which is markedly different from the experience in other developed countries such as Mexico, Canada, New Zealand, Australia, and Hong Kong (2). Why is this, and given the current modality mix in the United States, what is the future for PD in terms of patient outcomes, utilization, and technological advances? I became an attending nephrologist in 1984, and I have treated many patients with PD, some for >15 yr. We have a robust center hemodialysis (CHD) and a robust home dialysis unit (both PD and home hemodialysis [HHD]), our patients do well, and I am the medical director of that unit. It would be fair to say that I am biased toward home dialysis and toward PD in general. It is based on these experiences and my review of the literature that I feel that PD has a future; it is currently underused; and that, over time, patient outcomes on PD should improve even further.

Materials and Methods

As part of the "State of the art in ESRD" therapies conference, I was asked to prepare and present a talk that commented on the future of PD in the United States. Specifically, I was asked to be provocative and state what is the difference between what happens in the United States and other countries. I was asked to review published data and formulate opinions as to how PD use could grow if clinically appropriate. This paper is a summary of my presentation.

Correspondence: Dr. John Burkart, Professor of Medicine/Nephrology, Department of Nephrology, Wake Forest University Medical Center, Winston Salem, NC 27157. Phone: 336-716-3963; Fax: 336-716-4318; E-mail: jburkart@wfubmc.edu

Review of Medical Outcome Data

What Is the Evidence that PD Should Have a Brighter Future? The use of any treatment modality for a chronic disease state should be dependent on many factors that are both medical and nonmedical. Some of these medical-related factors should include clinical effectiveness in terms of prolonging life, risk benefit ratios, and complication rates. Some nonmedical issues such as quality of life, ease of use, ability for the patient to be rehabilitated, and finally cost to the patient and to society also need to be considered. Review of literature addressing each of these issues is very favorable for PD and will be presented below.

Relative Risk of Death. In general, to potentially optimize longevity and quality of life, a patient with stage V chronic kidney disease (formerly called ESRD) needs to either get a renal transplant or receive treatment with dialysis (center HD [CHD], HHD, or PD). As of 2008, <1% of the prevalent ESRD population was on HHD (2). About 8% of patients were on PD, whereas the majority of patients were on CHD. What are the reasons for this modality distribution? One might think that this is because there are data that would suggest that there is a lower death rate on CHD. Although in my opinion, a counterproductive study, the best way to see which modality (PD *versus* CHD) is the better for an individual patient would be to do a prospective randomized trial comparing the two therapies. This has been attempted three times. The first was a historical study where U.S. veterans were randomized to either three times a week HHD or 3 days a week on automated PD (a therapy where the dose of dialysis in terms of small solute clearance would be significantly lower than the currently recommended minimal target *Kt/V*) (3). In that study, patients randomized to the HHD arm had less hospitalizations and appeared to have a better maintained nutritional status. In my opinion, that was an interesting study but one that is not relevant to the current discussion. In the 1990s, Baxter Healthcare attempted a randomized trial of PD *versus* HD, but it

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was stopped prematurely because of low recruitment rates. There were no data published on that study, so any recruitment, selection, or other issues pertinent to today's discussion are not known. Nephrologists in The Netherlands also attempted to conduct such a trial (4). The inclusion–exclusion criteria and patient selection for that trial are well presented. In that study, of the 738 patients who were eligible to participate, all were given an informed consent that described both CHD and PD. After informed consent, only 38 patients agreed to be randomized. No statistically significant outcome data could be derived from this trial (the number of enrolled patients was too small); however, two important outcomes can be drawn. First, in a society where one really has a free choice, the study will likely never be done; second, when informed of options, most patients want to make a choice (in this study, almost 50% chose PD). It is my understanding that, in China, where there are financial issues that prevent many patients from receiving optimal renal replacement therapy, a fourth prospective randomized trial is currently underway. There are no outcome data, and the methods have not been published. We await results if this trial is concluded, but again, given some of the differences in availability of dialysis and patient recruitment, the results may not be able to be generalized to western medical practices.

This leaves us with observational cohort studies to review. I recognize that there are limitations to these studies (*i.e.,* patients are not randomized, there are unrecognized patient selection biases, there may not have been equal access to PD or HD for all patients, there may be poor documentation of comorbidities or the severity of the comorbidity, there are center effects), and it is recognized that causality can not be established. In other words, just because a certain patient subgroup does better on PD than on HD in these observational studies, this does not unequivocally mean that a similar patient in your office would do better on PD. The best we can truthfully say is that these are hypothesis-generating observations. However, what do these suggest to me or us?

The U.S. Renal Data Systems (USRDS) is a robust national database that captures clinical data from day 90 on all treated patients with ESRD in the United States whose treatments are paid for by Medicare and Medicaid. Data from the 2008 report suggest that there was no difference in the 60-mo survival probability between PD and CHD for the population as a whole (5). Additionally, analysis of these data showed that relative risk of death PD *versus* CHD changes over time and how quickly this change happens is different depending on cause of ESRD, vintage (year patient started renal replacement therapy [RRT]), gender, country of treatment, and presence or absence of comorbidity (6,7). These USRDS observations suggest that patients who start their RRT on PD have a survival advantage over similar patients on CHD. This survival advantage changes over time and is not as robust if the primary case of ESRD is diabetes, the patient is elderly, or the patient has comorbidities. These observations are not confined to the United States. There are similar data from Canada (8), Northern Europe (9,10), and from Australia and New Zealand (ANZDATA) (11) (although the survival advantage for PD is not as robust in the ANZDATA as it is in other countries, a point I will come back to later in manuscript). Further analysis of the USRDS data suggests that clinical outcomes for PD are improving. In fact it is noted that, for patients who started PD during the years 1991–1995, for the population as a whole, the relative risk of death initially favored PD but started to favor CHD sometime after ~12 to 16 mo on therapy, whereas the survival advantage for PD over HD was maintained for ~36 mo for the vintage who started PD between 1996 and 2000 (12)! In my opinion, these observational cohort data that examined the patient survival risk for PD *versus* CHD would certainly suggest that PD has a future and that the use of PD therapies should be considered more often.

It is important to point out that these clinical observations from the United States have occurred before widespread use of alternative PD solutions and also are representative of the way PD has been practiced until now in the United States. During that time, most home dialysis units had a median of 8 to 10 patients, which is certainly not enough to support a robust home infrastructure for nurses and doctors to refine their skills or conduct optimal continuous quality improvement programs that may improve patient outcomes (13). Many believe that potential changes in practice patterns discussed below would likely result in even further improvements in PD patient outcomes.

PD-Related Complication Rates Are Decreasing. PD therapies were historically associated with a high rate of peritonitis and transfer to CHD as a result. I think that, in the 1980s, this may have been a medical reason to justify limited use of PD. However, changes in clinical practice such as but not limited to innovations in connection technologies, catheter design (14), and the use of prophylactic antibiotics (15) have resulted in marked overall improvement in catheter function and peritonitis and exit site infection rates (16). As a result, recent vintages of PD cohorts have shown a reduction in the percent of patients who transfer to CHD because of infectious-related complications (17). I believe that these data on PD infection-related complication rates would suggest that we should consider offering PD more often. PD infections seldom result in bacteremia (a common association with HD-tunneled catheter-related infections) with its associated high mortality risk and they occur less often than infections in patients with tunneled HD catheters. Note that, if one was to look at reported clinical practice differences between the United States, Canada, and Australia/New Zealand, one might find one possible hypothesis for why the relative risk of death PD *versus* HD was not as robust in the ANZDATA. Those investigators reported a high incidence of deaths caused by fungal peritonitis and high infection-related complication rates (18). Furthermore, they stated that use of standardized infection policies such as the use of prophylactic antibiotics was not common in 70% of the units. Although this observation does not conclusively establish reasons for less robust advantage for PD over CHD in the ANZDATA, it would suggest that we consider implementation of standards and practice patterns that include aggressive peritonitis prevention protocols and standardized treatment protocols for peritonitis. I believe that small home dialysis units that are lacking in infrastructure may not be able to adequately address these complications of the therapy.

Transplant-Related Issues. Many would argue that a functioning renal transplant is the best form of renal replacement therapy. Of course, not all patients are a candidate for a transplant. However, of those who are, is there a difference in their outcome if patients are transplanted from PD or HD? Multiple retrospective cohort observational studies suggested that, if transplanted from PD, one was less likely to have delayed graft function and therefore would be likely to have longer graft survival. A more recent study from the United States suggested that patients transplanted from PD (or if at least 50% of their pretransplant RRT time was on PD) had a 6% lower risk of death and a 3% lower risk of graft failure than those transplanted from CHD (19). Given our goal to improve transplant rates and the transition from dialysis (PD or HD) to transplant, this would suggest that the future of PD is bright, and PD should be considered more often.

Quality of Life–Related Issues. Health-related quality of life has now been recognized as an important predictor of outcome and is acknowledged as an import consideration in choosing a medical therapy for any illness. Current data do not show a consistent difference between studies in SF 36 ratings between PD and HD overtime. However, there is a consistent trend that favors PD in how patients rate their satisfaction with their therapy and the impact it has on their day to day lives. PD patients tend to be more satisfied with their therapy than CHD patients are. In one study, they were 1.5 times more likely to be

satisfied with their therapy and tended to rate their care for many specific areas more highly than the CHD patients did (20).

Reimbursement Issues that Would Favor Increased Use of PD. As the number of patients with ESRD continues to grow, labor costs have increased, and as our RRT technologies and medications have evolved, the costs for caring for a patient with ESRD and total costs of an ESRD program for society have skyrocketed. According to the 2005 USRDS report, in 2001, a typical PD patient cost to CMS was approximately $13,900 less than for a typical CHD patient, and the corresponding savings for PD *versus* CHD in 2002 and 2003 were approximately $15,600 and $17,200/patient/yr, respectively (21). Although the cost per patient per year for both PD and CHD has continued to grow, the difference in cost between the two modalities has also continued to increase, so that in 2006, the USRDS reported that the average cost for a CHD patient was $71,889, whereas for a typical PD patient, it was $53,327. As noted above, the reasons for these differences in reported costs of the therapies are multifactorial. It is important to note that, in the United States, dialysis providers are reimbursed by the Centers for Medicare and Medicaid Services (CMS) for dialysis-related services in two ways. Payment by CMS is currently on an as treated basis: there is a fixed "composite rate" for dialysis-related services and an additional payment for "injectable" medications on an "as used" basis. This "composite rate" has changed very little since 1974 and is currently about $143.00/treatment on average, almost the same in actual dollars reimbursed as it was in the 1970s. However, this would represent a tremendous decrease in the relative amount paid, representing only about $15.50 in 1974 dollars. Historically, this fixed "composite rate" was for but not limited to such things as personal costs; dialysis supplies; overhead for the facility; and routine dialysis-related laboratory testing. These costs and what should be included in the "composite rate" are reviewed annually. Most providers would state that depending on patient mix and copayments that this payment is barely sufficient to cover the costs of providing dialysis services. In most geographic locations in the United States, dialysis units whose payer mix is 100% Medicare would lose money if the composite rate was their only means of reimbursement (22).

However, in addition to the "composite rate," providers are also reimbursed for "injectable" medications (such as erythrocyte-stimulating agents, intravenous iron, and vitamin D) on an "as used" basis. Data from the USRDS have suggested that, from 1992 to 2004, use of and therefore the cost to CMS of these medications has tended to steadily increase (23). An unintended consequence of this approach is that the potential profit margin for a dialysis provider is heavily reliant on the difference between the purchase cost and reimbursed amount for each of these injectable drugs. It turns out that, on average a, PD patient tends to use less intravenous medications (and therefore potentially has a lower profit margin from "injectables") than a CHD patient. In 2005, the Medicare Modernization Act readjusted the relative amounts of these payments adding some of the monies typically paid for "injectables" to the composite rate with a case mix adjustment for the acuity of patient care. It is anticipated that CMS will complete the transition from an "as used" payment system to a "bundled" payment (such as 95% of current composite rate plus injectable costs) for the overall delivery of dialysis related care starting in 2011 (Congressional bill HR 6331).

Health care officials in other countries have taken different approaches. For instance, as a result of observed differences in medical outcome data and financial cost, Hong Kong has initiated a PD first policy (24). As of 2007, 80% of patients were on PD and 20% on CHD. PD costs were 40% those of CHD ($13,000 *versus* $30,000 US $/yr). Using this approach, the reported technique survival for PD in Hong Kong at that time was 75% at 8 yr! Based on these financial data, I think PD should be used more often and that the future for PD is bright. One analysis of potential cost savings in the United States suggested the following: if PD use was to decrease from the current rate of 8% to only 5%, Medicare spending for dialysis would increase by an additional $401 million over the next 5 yr, whereas if PD utilization would increase from 8% to 15%, Medicare costs may decrease as much as $1.1 billion over 5 yr (25).

What Is Unique About the U.S. Renal Replacement Community?

Financial Considerations. As I mentioned above, there may be subtle financial incentives that are unique to the United States that may influence modality use. In the current pay for what is used system, providers may be able to make a bigger margin/patient when more "injectables" are used. If there is an excess of HD capacity, there is less of an incremental cost for the provider to put the next patient on CHD (the nurse, building, dialysis chair, central water system, *etc.* are already there) where the disposable supplies are less than what the daily supplies are for a PD patient. Furthermore, the current reimbursement for "training" the patient to go home (on HD or PD) does not adequately cover the actual costs of that training. A home dialysis unit must therefore make a much larger upfront investment in a home patient than in a CHD patient. If the patient does not stay on the home modality for very long, the unit may never be able to recoup that upfront investment. When considering staffing for a home dialysis unit, it is often suggested that the typical nurse to patient ratio is about one nurse to every to 20 or 25 patients. A recent review of the relationship between ownership patterns and clinical outcomes and PD utilization for PD patients in the United States suggested that the typical U.S. dialysis unit had ~10 to 15 patients (26). This number has many possible implications such as, but not limited to, inability to train a new patient in a timely manner; inability to do quality improvement; lack of nursing/center experience; and lack of a robust infrastructure to support patients and physicians as far as protocols and individualization of care. It has been shown that there is a strong association between center size and outcomes in PD patients (27,28). These and other subtle variables may influence how robustly home therapies are offered at an individual dialysis center.

Dialysis Unit Ownership Patterns. From 1996 to 2004, the number of dialysis units in the United States increased by 51% (26). This was largely because of a growth in large dialysis organizations (LDOs) with minimal growth in the small dialysis organizations. This was associated with a parallel growth in the number (and percent of all ESRD patients) dialyzing in LDOs. During that 9-yr period, PD use was significantly less in LDOs than in non-LDO units (odds ratio, 0.77; 95% confidence interval, 0.76 to 0.79). LDOs tend to be for-profit, publicly traded companies. I believe there are a lot of good things about LDOs and that, in general, the care of an ESRD patient in these LDOs is wonderful. However, a "for profit" dialysis organization may be influenced by the financial considerations mentioned above differently than not-for-profit organizations. It was noted that PD use was significantly lower in for-profit units (odds ratio, 0.86; 95% confidence interval, 0.84 to 0.87) compared with not-for-profit units (26). By mid-2009, the number of patients treated in the 10 largest LDOs had more than tripled since 1995 (from 75,678 to 289,729), with the 10 largest LDOs providing dialysis care to the ~78% of the dialysis population, whereas the two largest providers (Fresenius Medical Care and DaVita, Inc.) alone provided care for 237,863 patients or 64% of the total ESRD population (29). During this period, the LDO HD population increased from 66,424 to 269,039, whereas the PD numbers went from 11,954 to 20,690. This may or may not be appropriate given the medical outcome data reviewed above. However, it is important to point out that this represents a

prevalent PD population of ~7% of LDO patients, which is much less than what is noted in other developed countries. Furthermore, the range in the percentage of patients on PD within these LDOs ranged from 6.25% to 20.43%, suggesting that nonmedical factors such as practice patterns, ease of use, infrastructure, and the renal replacement "culture" in the organization may have been influencing modality selection. In mid-2009 at the Wake Forest University Outpatient Dialysis Centers, 14% of prevalent dialysis patients were on home therapies, and of these, 97% were on PD. Our patients were not born PD patients. We educated them to become PD patients. I believe increased PD use is medically justified, and it can be done given the right infrastructure, real patient choice, and an unbiased approach to education and patient modality selection.

Fellowship Training and Mentoring Issues. As teachers we tend to teach what we know. We tend to promote what we are comfortable with. Most of us can remember a particular attending or mentor we respect and looked up to who influenced how we practice nephrology. Proponents of HD tended to be more prevalent at academic institutions than PD proponents. The NIH has funded two large multicenter HD trials: The Hemodialysis Trial (30) and the Frequent Hemodialysis Trials (31). There have been none in PD. Two surveys of nephrology fellows have suggested that their training is suboptimal (32,33). When asked, only 32% of fellows stated that they had attended an outpatient PD clinic; 52% stated that their PD rotation was <4 wk in duration; 53% attended between 0- and 10.5-d PD clinics; 24% of fellows had never initiated PD in a patient; 57% initiated PD on less than five patients; and 38% felt training was inadequate. The American Society of Nephrology, the National Kidney Foundation, and the International Society for Peritoneal Dialysis have all recognized this and have attempted to facilitate learning in PD both during fellowship and at national meetings. As a result, Wake Forest University and the International Society for Peritoneal Dialysis have been presenting a 3-d course on PD (The Peritoneal Dialysis University) to facilitate fellow training. These are fully attended, and there tends to be a yearly waiting list for attendance. Fellows consistently state that they have not received much of the information presented during the course in their fellowship and, in fact, 12/15 pretest questions are typically answered correctly in <75% of attendees. During the ASN-sponsored Board Review Course and Update held during late August 2009, a survey of fellows attending in preparation for initial certification was conducted. One of the questions asked was as follows: in what area of nephrology do you feel your fellowship was most deficient? 30% stated it was most deficient in PD. Another 21% stated PD was the second most deficient area of training. These data suggest that academia has failed PD. I believe fellowship programs need to do a better job representing PD truthfully, providing opportunities for patient care, and encouraging research in PD.

Patient Education—Modality Choice. It is accepted that patients should be given a choice and a voice in their modality selection. In general, data suggest that patients who are empowered and engaged in their therapy have better clinical outcomes. The pertinent question is—does modality education happen and, if so, does it happen effectively? The USRDS wave II data (34) and more recent publications (35) suggest that, historically, patient modality education was inadequate. Many patients state that they had not received PD education. As noted earlier in this manuscript, there was a recent attempt to randomize patients to either CHD or PD to determine whether either therapy was better in terms of some measurable clinical parameters (4). That study, conducted in The Netherlands, was terminated early because only 38 of 735 eligible patients (patients who had no medical contraindication to either PD or HD and agreed in principal to consider participation in the study) agreed to randomization. In turned out that part of the randomization process required obtaining informed consent and that process included an unbiased education about PD and HD. After receiving education, the majority of patients stated they wanted to make a choice, and ~50% of them choose PD! Similar data about patient choice after modality education exist from the United States. Again, ~50% of patients preferred PD and many more than the national average actually started on PD (36). It is possible that if we the educators are not comfortable with the therapy, or do not have the infrastructure to offer it appropriately, we do not honestly present both therapies as equal options for our patients.

Burden of Therapy. When one considers the burden of a therapy, one needs to consider not only the burden of care on the patient but also on the physician and the renal replacement community. Typical CHD units have a very robust infrastructure to administer medications, follow protocols, and care for dialysis-related issues. If a typical PD unit has 10 patients, these "infrastructure" components are not as likely to be as robust as those in a typical CHD unit. This could make it more difficult for a doctor to individualize a patient's prescription or to deal with the day-to-day dialysis-related problems. This may have a subtle impact on modality selection. Prior guidelines such as the National Kidney Foundation-Dialysis Outcomes Quality Initiative (NKF-KDOQI) guidelines may have made delivery of PD care relatively more onerous for providers (when one considered frequency or peritoneal equilibration testing for membrane function and frequency of checking total solute clearance). These tests were time consuming, were expensive, and perhaps were not adequately reimbursed in the "composite rate." So, again, if the patient numbers at a unit did not support more than one nurse, these procedures may have consumed the single nurse's time doing administrative/monitoring chores instead of patient improvement or care activities. The newest revision of these NKF-KDOQI guidelines may have made delivery of care for the PD patient less burdensome for patients and providers (37). Unfortunately, these newer guidelines may not have been entirely embraced by all providers—specifically the minimal total solute clearance goals. Newer data suggested that these minimal targets could be lowered. This would in general make prescriptions easier for the patients. However, in some cases, because of a competition between providers and publication of the average laboratory values for patient populations cared for by the provider, which uses numerical laboratory values to judge which provider is the best, the average delivered dose of dialysis may have been maintained at higher than needed doses. If this type of culture exists within a dialysis organization, it may add to the burden of the therapy, making it more difficult to care for a PD patient and at times causing unnecessary transfer to CHD because the "adequacy target" within that organization was not met, despite the delivered dose being higher than that recommended and the patient being asymptomatic.

Regulatory Issues. The FDA treats PD solutions as a "drug," and HD solutions as a "device." As a result, it is difficult to get new PD solutions approved in the United States unless a specific indication or "superiority" to standard glucose-containing fluids can be identified. As of 2009, there are only two types of dialysis solutions available in the United States: standard glucose-containing solutions and solutions containing icodextrin as an alternative osmotic agent. Other countries have other choices. These fluids have theoretical benefits on long-term clinical outcomes, which may even further prolong the survival advantage associated with doing PD. Further studies are needed to document what benefit, if any, these solutions may have on certain clinical outcomes. I think the FDA needs to form a review committee that takes another look at what is needed to get a PD fluid approved for use and consider suggesting some changes to that process.

The ESRD Population. It is true that the "burden of therapy" is related to the procedure, the device, the frequency of use, *etc.* However, how the burden is overcome is related to ease of use, center tolerance,

and patient characteristics. The ESRD population in the United States and other countries is becoming more aged, more likely to have diabetes, and more likely to have comorbidities. All of these factors tend to make the observed survival advantage associated with PD less robust. Certainly, if a patient is in a nursing home, it may be impossible to do home dialysis unless the renal replacement community finds a clinically appropriate way to make a nursing home a safe and financially feasible place to do "home" dialysis. I believe that this can be done. However, we also need to better address why a patient with comorbidities (*i.e.,* diabetes or heart failure) may not do as well on PD as one without them. Prescriptions that minimize glucose exposure may be helpful. Better attention to volume control and attaining euvolemia may be helpful.

The Future for PD Starts Today. The survival data from observational cohort studies reviewed above are encouraging and, as mentioned, suggest that, for medical reasons, PD is underused and should have a bright future. It should be noted that in the most recent USRDS report, it is suggested that first-year survival on HD has been flat, whereas it has been improving yearly for patients on PD, so that compared with patients who started RRT in 1991 to 1995 when relative risk that favored PD at the start of dialysis began to favor CHD after 12 to 16 mo, in patients starting RRT between 1996 and 2000, the survival advantage for the group now favors PD for over 3 yr! (38) This improvement occurred before the widespread use of alternative dialysis solutions that may minimize side effects from the glucose in the dialysate and allow for potentially better control of BP and volume status. Furthermore, this overall improvement in clinical outcomes on PD has occurred despite the growth of LDOs and the observation that the largest LDOs had consistently lower PD use and patients treated in LDOs with the lowest PD use had the greatest risk of death (26).

The most common reasons for transfer to HD continue to be related to catheter problems and infectious complications. In reports from centers where there is a dedicated PD implantation team, catheter-related problems are minimal and seldom a reason for transfer (39). Unfortunately, this expertise is not available at all centers. Multiple studies have shown that there is a reduction in both exit site infections and peritonitis when prophylactic topical antibiotics are applied to the exit site when the patient is doing their daily exit site care (15,40), which is a practice that is not followed everywhere. In data from Australia and New Zealand, relative risk of death trends are similar to that in the United States and Canada, but the survival advantage offered by PD is not as robust (11). The reasons for this are unclear but may be related to practice patterns such as the approach to the prevention and treatment of peritonitis. In that database, there is a relatively higher risk of infectious death, especially from fungal peritonitis, than what is usually seen in other databases (18). It is also noted that, despite published data that suggest that with use of prophylactic antibiotics one can markedly reduce peritonitis, >70% of centers did not report using standardized antibiotic treatment or antibiotic prophylaxis protocols. These are interventions we can do now.

It is known that relative risk between PD and HD changes over time. One possible reason for this change is that, over time, if the PD patients' prescription is not changed to compensate for the loss of residual kidney function (and the associated water and sodium losses along with other things), the survival advantage offered by PD may become less robust. One prescription does not fit all (41). The potential ultrafiltration volume per dwell varies based on dwell time, transport type, instilled volume, and osmotic agent used in that instilled dialysis fluid. Optimization of drain volume and the sodium content in that drain volume is dependent on the physician being aware of these factors and adjusting the prescription to be able to accomplish these patient-specific goals (42). If the prescribing physician is not offered free access to all available options, his or her ability to optimize BP control while at the same time minimizing glucose exposure and optimizing patient quality-of-life issues may be suboptimal. If true, this would represent another "subtle" but real impediment to being able to prescribe PD in a "user friendly" environment for both the patient and the doctor. This is an intervention we could potentially do now.

The future of PD starts now, and these are some examples of how potential changes in current practice as a result of better education and increased ability to use standard products and follow standard procedures may optimize our patient outcomes.

New Therapies or Approaches to Patient Care

I acknowledge that we really should not be having a debate as to which therapy (PD or HD) is the best. In fact, data suggest that for most patients outcomes are similar on either therapy. I also acknowledge that not all patients are candidates for PD. What we should be comfortable in doing is offering patients a choice. Futhermore, there is nothing that states a patient must be on either HD or PD. What is wrong with a combination of both? After all, there are advantages to both therapies. We need to be as comfortable with transitions from PD to HD or *vice versa* as we are with transitions from normal kidney function to transplant or from dialysis to transplant or from transplant to dialysis. This transition is not necessarily a "failure." It is something we should plan for or count on. As my colleague Dr Martin Schreiber states, "We should sit down and develop an ESRD Life Plan with each patient" that may or may not involve use of all therapies over time. There are limited retrospective observational data reporting outcomes of patients who have been treated with this approach, and the results are favorable (43,44). In my opinion, the fact that the patient has to have two accesses is not an issue. In general, PD catheters are a complication-free access. When a patient is going to transition from PD to HD (CHD or HHD), one could combine therapies. The PD catheter is already there. One can travel with PD, if the HD access clots, there is a PD catheter already there. The major problem is reimbursement. Given the current U.S. reimbursment system, how would one easily do this? If only one or two exchanges are done per day, I think simply being able to justify a fourth HD equivalent treatment per week would pay for the PD supplies.

Let us now consider frequent HD. Observational cohort data from studies that have reviewed clinical data from patients treated with frequent hemodialysis regimens (short daily, nocturnal, etc.) suggest that there are clinical benefits to doing more frequent HD (45). If randomized trials confirm a benefit, the million dollar question is—is the benefit related to frequency, timing of dialysis (day or night) small solute removal, middle molecule removal, etc? Let's say it is a positive result. How do we offer more to the patients who can not do HHD? One could conceivably do CHD three or four times a week and then have the patient leave the dialysis center with a PD dwell so that there is augmented solute (small and middle molecular weight) removal and more salt and water removal in between HD treatments (depending on solution used for that dwell). If the solution is icodextrin, the dwell can be drained every 12 to 24 h. Studies are needed. Finally, what about patients with decompensated congestive heart failure? Two studies have suggested that the use of PD ultrafiltration as a supplemental treatment to standard care may be helpful (46,47).

Conclusions and Recommendations. In summary, I believe that there are data to suggest that PD is underused in the United States. This is based on the medical outcome data I have outlined above. I also believe that we should not be debating which therapy is better but rather accepting the fact that we should individualize the patients' treatment and, if the patient is interested in doing home therapy, it is probably reasonable that we allow them to try. The average patient will do well on either therapy, and it is up to the renal replacement com-

munity to guide them and adjust the patient's therapy as indicated. I believe that there are some subtle and some real nonmedical reasons for PD underutilization, some of which are financially based. Anticipated changes in reimbursement such as bundling of payments for ESRD therapies should stimulate a trend toward increased PD use. However, if the increased utilization is not associated with increased support and further education of the renal replacement community in the practice of PD, the patients may not do as well as they could. Therefore, we should consider consolidation of small PD units into larger specialized PD centers. This will allow for a more robust infrastructure in our PD units, which is important for training (quality of and timing of), retraining, problem solving, ease of use for patients and doctors, development and implementation of peritonitis treatment protocols, and allowance for more time for education. I also believe that Academia should get more involved in PD so that we are able to keep up efforts to educate nephrologists with the ultimate goal that PD education happens at each academic medical center, not only on a national level. The government may need to reconsider what is needed for approval of alternative PD fluids. Finally, we should continue to work with payers and other government bodies so that reimbursement issues do not unintentionally prevent freedom of modality choice by patients and physicians.

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