

How To Build a Successful Urgent-Start Peritoneal Dialysis Program

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Abstract

In-center hemodialysis (HD) remains the predominant dialysis therapy in patients with ESKD. Many patients with ESKD present in late stage, requiring urgent dialysis initiation, and the majority start HD with central venous catheters (CVCs), which are associated with poor outcomes and high cost of care. Peritoneal dialysis (PD) catheters can be safely placed in such patients with late-presenting ESKD, obviating the need for CVCs. PD can begin almost immediately in the recumbent position, using low fill volumes. Such PD initiations, commencing within 2 weeks of the catheter placement, are termed urgent-start PD (USPD). Most patients with an intact peritoneal cavity and stable home situation are eligible for USPD. Although there is a small risk of PD catheter-related mechanical complications, most can be managed conservatively. Moreover, overall outcomes of USPD are comparable to those with planned PD initiations, in contrast to the high rate of catheter-related infections and bacteremia associated with urgent-start HD. The ongoing coronavirus disease 2019 pandemic has further exposed the vulnerability of patients with ESKD getting in-center HD. PD can mitigate the risk of infection by reducing environmental exposure to the virus. Thus, USPD is a safe and cost-effective option for unplanned dialysis initiation in patients with late-presenting ESKD. To develop a successful USPD program, a strong infrastructure with clear pathways is essential. Coordination of care between nephrologists, surgeons or interventionalists, and hospital and PD center staff is imperative so that patient education, home visits, PD catheter placements, and urgent PD initiations are accomplished expeditiously. Implementation of urgent-start PD will help to increase PD use, reduce cost, and improve patient outcomes, and will be a step forward in fostering the goal set by the Advancing American Kidney Health initiative.

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Introduction

With the increased global burden of ESKD, there is a need for optimal RRT (1). Although most cost effective, timely transplant is challenging due to logistics and scarcity of organs. Therefore, most patients with ESKD need dialysis to sustain their lives. Given the progressive upsurge of the ESKD population, equitable growth of various dialysis modalities is expected. However, the default RRT in ESKD remains in-center hemodialysis (HD) (2,3). In 2017, 87% of the US patients with incident ESKD began RRT with HD, and only 10% started with peritoneal dialysis (PD) (3).

Large numbers of patients do not get pre-ESKD education or access planning due to inadequate or lack of kidney care (4). For instance, 33% of patients with incident ESKD received little or no pre-ESKD nephrology care in 2017 (3). Consequently, such patients present to hospitals with advanced ESKD, requiring urgent dialysis initiation. In addition, some patients with advanced kidney disease and established nephrology care may develop unanticipated accelerated progression of kidney disease. The majority of such patients start HD with central venous catheters (CVCs), because most physicians and hospital staff are more comfortable with HD than PD initiation (2,5,6). In 2017, 80% of patients initiated HD with a CVC (3).

Most patients who begin dialysis in the inpatient setting stay on the same dialysis modality as outpatients (2).

Individuals initiating HD with CVCs have much higher mortality, morbidity, length of stay, and cost of care compared with those initiating PD or HD with appropriate vascular access (7–10). The reported 1-year risk of catheter-related bloodstream infections is quite variable, ranging from as low as 9% to as high as 79% (8). In an observational study of all Medicare facilities that provided outpatient HD in New England throughout 2015 and 2016, mean bloodstream infection rate per 100 patient-months was 2.15 ± 6.5 and 0.23 ± 0.8 for patients with and without catheters, respectively (11). Put differently, the mean catheter-associated bloodstream infection rate was 0.71 per 1000 catheter days. The relative risk of a bloodstream infection in patients with a catheter compared with those without a catheter was 7.5 (95% CI, 6.3 to 8.9) (11).

PD is more cost effective and provides similar or superior outcomes compared with HD (9,10). PD can commence almost immediately after PD catheter implantation. Thus, urgent-start PD avoids the need for temporary vascular access and a repeat vascular procedure to establish a permanent access. In addition, it allows for the better preservation of residual kidney

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function and offers the lifestyle benefits that can be achieved with a home-based therapy (12). Therefore, initiation of urgent-start PD is an attractive option in patients with late-presenting ESKD. This review will focus on strategies, logistics, challenges, and benefits to develop a successful urgent-start PD program.

Economic Cost of Dialysis Modalities

Although ESKD comprises 1% of the US Medicare population, it consumes >7% of the annual Medicare expenditure at \$35.9 billion (3). In the landscape of rising healthcare expenditure, cost of HD is 1.25–2.35 times higher than that of PD in most developed countries (13). Likewise, annual per patient cost of HD in the United States is \$13,000 higher than that of PD (3). This makes PD a more cost-effective dialysis modality than HD. In January 2011, in an attempt to control costs, the US Centers for Medicare and Medicaid Services (CMS) instituted a single, bundled, prospective payment system for all dialysis modalities, making PD financially more attractive (14). However, despite financial incentive from the CMS prospective payment system, the growth of PD has been modest so far (15). One reason for slow PD growth is low utilization of urgent-start PD in the United States. In reality, urgent-start PD should be a valuable option among patients requiring unplanned dialysis initiation. A recent study found the first 90-day cost of urgent-start PD to be \$3000 lower than that of urgent-start HD (16). Indeed, urgent-start PD can be a step toward

achieving the goal of 80% incident patients on dialysis initiating home dialysis by 2025, as stated in the Advancing American Kidney Health initiative (17).

Defining Urgent-Start PD

The major goal in the management of patients who crash in with advanced ESKD and needing urgent dialysis initiation is to avoid CVC placement and the associated complications. PD catheters can be safely placed in such patients, averting the need for CVCs. Typically, a 2-week break-in period is recommended after placement of the catheter to facilitate healing, prevent catheter complications, and allow patients and family members to get trained in the PD technique (18–20). However, if needed, PD can be initiated almost immediately using a modified protocol (21). By definition, all PD initiations that begin within 2 weeks of the catheter placement are considered urgent-start PD (20,22).

Logistics and Infrastructure of Urgent-Start PD

Barriers to Urgent-Start PD

Numerous barriers, at multiple levels, impede the initiation of urgent-start PD (Table 1). Lack of awareness of home dialysis options among patients is a major barrier that can be surmounted with implementation of in-hospital educational interventions (2). Inadequate knowledge and experience and misperceptions about urgent-start PD is another

Table 1. Barriers to urgent-start peritoneal dialysis

Barriers	Interventions
Provider-related factors	
Lack of knowledge and experience among clinicians	Education of nephrologists and surgical trainees/interventionalists about PD catheter insertion techniques
Misconceptions or biases about PD	Visits to centers of excellence for fellows and nephrologists for hands-on experience
Timely PD catheter insertion	Identify dedicated surgeons, interventional radiologists, or nephrologists for PD catheter insertion for urgent starts Education of surgical trainees/interventionalists about PD catheter-insertion techniques Courses for surgeons and interventionalists to provide hands-on experience about catheter-implantation procedures
Infrastructure-related factors	
In hospital	
<i>Delay in PD catheter insertion</i>	Having structured protocol for urgent-start PD
<i>Lack of effective communication between hospital and outpatient PD center staff</i>	Identify dedicated personnel to streamline the process of education, and coordination of care between hospital and outpatient PD center
Outpatient PD unit	
<i>Unable to accommodate urgent initiation due to lack of individual rooms for training or trained staff</i>	Identify dedicated personnel to communicate with in-hospital team and for home visit Availability of adequate clinic rooms in the PD unit Ensuring adequate PD nurses and resources
Patient-related factors	
Lack of patient awareness about home modalities	Well-designed in-hospital patient education program
Patient refusal	Assess the cause of refusal
Physical	
<i>Reduced physical strength to lift PD bags</i>	Assistance by home care partner
<i>Reduced dexterity to make connections</i>	Assisted PD if available
<i>Reduced vision/hearing</i>	
Cognitive impairment such as dementia or learning disabilities	
PD, peritoneal dialysis.	

important barrier that limits clinicians' use of PD (23). Nearly 50% of US nephrologists feel uncomfortable in caring for patients on PD (5,24). Education of trainee nephrologists on all aspects of PD can help overcome this barrier (25). Similarly, the training of US surgeons in insertion of PD catheters is inadequate (26). Improvement in training and increasing availability of other operators (such as interventional radiologists and nephrologists) for PD catheter placement, and providing financial incentives to surgeons and other operators, may help improve utilization of urgent-start PD (27). The lack of infrastructure at hospitals or dialysis centers is yet another major barrier, because the inability to train and dialyze patients who need urgent-start dialysis may discourage physicians to consider home dialysis therapy for such patients (28). Developing sound infrastructure to overcome the aforesaid and additional barriers is the main goal for a successful urgent-start PD program, as discussed below.

Components of Successful Urgent-Start PD Programs

Only well-organized PD programs with a robust infrastructure are successful, safe, and feasible for unplanned PD initiations (20,21). Support from the hospital administration is essential to establish a successful urgent-PD program. Not only should the hospital ensure there is adequate surgical or interventional staff who are familiar in urgent placement of PD catheters, but also adequate space, PD equipment, and sufficient nursing staff (adequately trained in performing urgent PD) should be provided. A delay in PD catheter placement and PD initiation can increase the length of hospitalization, thereby increasing the cost of inpatient care. A structured urgent-start PD program can streamline an expeditious PD initiation process and can offer an efficient and cost-saving approach for dialysis initiation (16).

It is crucial that the selection process of dialysis modality should be taken jointly with patients, nephrologists, surgeons, and the dialysis center. Interdisciplinary coordination and efficiency of care are essential and include prompt

patient selection, expedited dialysis modality education and home evaluation, urgent PD catheter placement, and nursing and hospital administration support (Table 2). Furthermore, clear protocols should be developed and standardized for urgent-start PD to ensure smooth transition from hospital to outpatient PD center.

The key elements for a successful urgent-start PD include:

- (1) dialysis modality education,
- (2) patient selection process,
- (3) home evaluation,
- (4) urgent placement of PD catheters,
- (5) urgent initiation of PD in hospital, and
- (6) urgent-start PD and training in an outpatient PD center.

Dialysis-Modality Education

Most patients who crash in with advanced ESKD have not had formal predialysis education (2,3). In any case, the demands from an educational program in unplanned settings are different from those in predialysis settings, because the ability of many patients to comprehend and make quick decisions about dialysis modality may be impaired due to their sickness and uremic state. Nonetheless, expedited dialysis-modality education should be provided and, if possible, family members should be involved in the decision-making process. Providing dialysis education considerably increases the use of PD in unplanned dialysis initiation (2,29). In a retrospective study, patients starting urgent home dialysis increased from 13% to 35% after implementation of an in-hospital education program (2). Having a dedicated dialysis educator to offer individual guidance, and providing printed materials and educational videos, will immensely help patients and families in choosing the appropriate dialysis modality to fit their lifestyles (Table 3). Translators and, if feasible, printed materials in the patient's native language should be available for patients who are non-English speaking.

Table 2. Logistics and infrastructure requirements for urgent-start peritoneal dialysis program

Requirements
<p>Hospital support</p> <ul style="list-style-type: none"> Multidisciplinary patient selection approach Expedited patient education process Prompt communication with PD center to expedite home visit Easy availability of surgeons or interventionalists (radiology or nephrology) to urgently place PD catheter Provision of nursing staff trained in urgent-start PD Providing equipment and supplies to conduct PD Clear protocols to standardize urgent-start PD Coordination of care with outpatient PD center for seamless discharge process <p>Dialysis center support</p> <ul style="list-style-type: none"> Prompt conduction of home visit Ability to evaluate patient within 1–2 d after hospital discharge Provision of ample space and equipment to conduct urgent-start PD Availability of adequate nursing staff trained in urgent-start PD Providing education and training to the patient about urgent-start PD Administrative support for smooth transition of care from hospital to PD center
PD, peritoneal dialysis.

Table 3. Patient education about dialysis modalities

Patient Education
<p>Discuss dialysis options for treatment for ESKD In-center and home hemodialysis PD</p> <p>Discuss pros and cons of dialysis modalities</p> <p>Pros of PD</p> <ul style="list-style-type: none"> <i>Self-therapy: improves self-esteem</i> <i>Needleless</i> <i>Flexible schedules</i> <i>No frequent travel to the dialysis center</i> <i>Provides more even dialysis, with minimal fluctuation of BP</i> <i>Less fluid and dietary restrictions</i> <i>Greater freedom to travel</i> <i>Patient can remain in workforce while dialyzing at night</i> <i>Better quality of life compared with HD</i> <i>Lower morbidity and mortality compared with HD</i> <i>Better transplant outcomes compared with HD</i> <i>Lower cost</i> <p>Cons of PD</p> <ul style="list-style-type: none"> <i>Daily therapy</i> <i>Body image issues</i> <i>May cause abdominal pain and discomfort</i> <i>Risk of hernias</i> <i>Restriction on lifting weight</i> <i>Restriction on certain types of exercises</i> <i>Can be associated with infection of catheter if not careful</i> <p>Pros of in-center HD</p> <ul style="list-style-type: none"> <i>Therapy is only three times a week</i> <i>Treatment performed by trained staff</i> <i>No catheter placed in abdomen</i> <i>No restriction on lifting weight</i> <i>No restriction on exercises</i> <p>Cons of in-center HD</p> <ul style="list-style-type: none"> <i>Need to travel three times a week to dialysis center</i> <i>Two large needles placed on every treatment (unless patient has catheter)</i> <i>Fluctuation in BP during HD treatment</i> <i>Less freedom to travel (need to find a dialysis center when traveling)</i> <i>More dietary and fluid restrictions</i> <i>More expensive than PD</i> <i>Lower quality of life compared with HD</i> <p>Discuss home requirement for PD Require sufficient clean and enclosed space for treatment Indoor space for storage of supplies Water and electric supply</p>
PD, peritoneal dialysis; HD, hemodialysis.

Patients Selection

Selection of appropriate candidates is central in developing a thriving urgent-start PD program (30). The selection process should include evaluation of medical, psychosocial, and surgical barriers to PD. Screening questionnaires may help in facilitating patient selection and can be developed in collaboration with staff from hospitals, CKD clinics, and PD centers (21). Patient preferences and life goals should be reviewed, and home situation, living environment, and family and social support should be assessed. Visual acuity and manual dexterity should be examined, and the abdomen should be inspected for presence of extensive scars from previous abdominal surgeries or large hernias (Figure 1).

There are very few contraindications to urgent-start PD. Most patients with an intact peritoneal cavity, stable home situation, and desire to do PD are eligible for urgent-start

PD. Patients with recent abdominal surgery compromising the peritoneal membrane, acute bowel inflammation, colostomies, and uncorrected hernias are not candidates for urgent-start PD. Previous abdominal surgeries, however, should not be absolute contraindications for PD. Some patients do develop peritoneal adhesions after abdominal surgeries, but the extent of adhesions is difficult to predict without laparoscopic exploration (31–33). Direct visualization of the peritoneum and placement of the PD catheter by advanced laparoscopy has been very successful in most instances (34,35). Frailty, advanced age, poor vision, psychiatric or memory issues, and lack of motor skills are not contraindications to PD but mere barriers that can be overcome with assisted PD, either provided by the family members at home or by trained personnel at home or nursing facilities (36–40). Assisted PD programs have been successful in other countries such as Canada, Denmark, and France (38,41–43). The CMS does not fund assisted PD programs in the United States. Similarly, poor literacy should not be considered a barrier to PD. A vigorous, thorough, and simplified training process to accommodate patients with limited health literacy can lead to successful PD in such patients (44).

Some patients may present with severe hyperkalemia, metabolic acidosis, volume overload, or uremic pericarditis and need emergent dialysis. Such patients should not be excluded from urgent-start PD. They should be initially managed with emergent HD using a temporary CVC. Once stabilized, the patients should be reevaluated for urgent-start PD, as discussed above (Figure 1).

Home Visit

If possible, an expedited home visit, either virtual or in person, should be considered within 24–48 hours of patient selection (Table 4). Typically conducted by a licensed PD nurse, home evaluation entails an overall assessment to determine if home conditions are safe and supportive of PD (Table 4). The patient should have a clean and adequate, enclosed space to perform PD. In addition, a sufficiently temperature-controlled space should be available to store PD supplies. The home should have proper plumbing and supply of running water. Moreover, an appropriate electric supply, including grounded three-prong outlets, is needed, particularly for patients choosing automated PD (APD). Because APD is usually performed at night, the patient should have easy access to the toilet. During the visit, the nurse documents the number of households and pets living in the house, identifies any barriers, and recommends appropriate changes.

Urgent Placement of PD Catheters

A crucial step in the success of an urgent-start PD program is prompt and timely placement of the PD catheter. Currently, there are no evidence-based recommendations for preferred catheter design or optimal insertion technique for urgent-start PD. Catheters can be placed surgically by open-surgical or laparoscopic techniques. Alternatively, a percutaneous approach using peritoneoscopic (Y-Tec) or fluoroscopic guidance can be used (34,45). To minimize postoperative risk of pericatheter leaks, purse-string sutures can be placed around the deep cuff in the posterior rectus

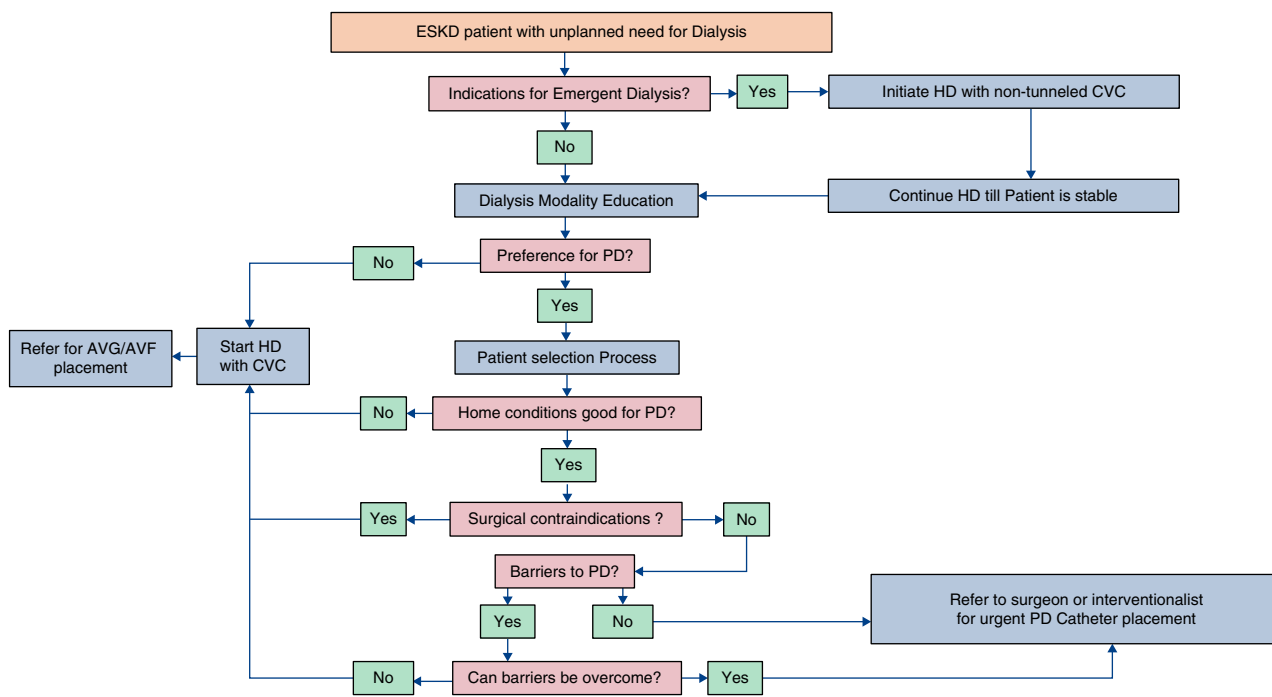


Figure 1. | An algorithm describing steps involved in evaluation and selection of late presenting ESKD patients for urgent-start PD. AVG, arteriovenous graft; AVF, arteriovenous fistula; CVC, central venous catheter; HD, hemodialysis; PD, peritoneal dialysis.

sheath to obtain a watertight seal (38,46–50). The advantages and disadvantages of various techniques are outlined in Table 5. Successful placement of PD catheters by laparoscopic, open-surgical, and percutaneous approaches has been accomplished in various urgent-start PD programs (Table 6) (41,46,50–56).

There are no studies comparing outcomes of various operative techniques in urgent-start PD. Conversely, investigators have observed comparable outcomes from various PD catheter-implantation methods in planned PD (PPD) settings (51–57). However, a recent meta-analysis comparing open dissection, basic laparoscopic, and advanced laparoscopic procedures demonstrated significantly superior outcomes for advanced laparoscopy over the other two approaches (58). It is quite likely that the advanced laparoscopic technique allows for adjunctive procedures such as

lysis of adhesions, omentopexy, and identification and repair of previously unsuspected hernias, which can further improve catheter outcomes (32,59).

Although current guidelines do not recommend a specific procedure for catheter placement, the choice of operator (surgeon, nephrologist, or interventional radiologist) and the technique (open surgical, laparoscopic, or percutaneous) should be dictated by the local experience and resources at the individual site. Hospitals should encourage training of interventional radiologists and nephrologists in urgent-PD catheter placement. Although many interventionalists are not familiar with PD catheter-placement techniques, workshops and training courses to obtain necessary skills are readily available (information available at www.ispd.org). One advantage of interventionalists placing the urgent-PD catheter is eliminating the need for general anesthesia and scheduling an operating room. This can expedite the entire process of urgent-start PD. Some patients, such as those with prior major abdominal surgeries or obesity, may not be suitable for percutaneous techniques and should instead have laparoscopic or open-surgical implantation (32,54).

Table 4. Home evaluation for PD candidacy	
Home Evaluation	
Environment	Proper plumbing and running water Cleanliness Electricity supply with grounded three-prong outlets Temperature-controlled storage place Enclosed space for PD Easy access to toilet
Other occupants	Pets House members
PD, peritoneal dialysis.	

Urgent Initiation of PD in Hospital

Hospital stay should be minimized after PD catheter placement. Unless there are medical reasons for continued hospitalization, the patient may be discharged on the same day of the PD catheter surgery, and should follow up at the outpatient PD center in 1–2 days. However, if the patient remains admitted in hospital, PD can commence in an inpatient setting, if needed.

Initially, with the patient in the recumbent position, a rapid manual exchange with low fill volume (FV) of 500 ml should be performed to evaluate the patency of the

Table 5. Advantages and disadvantages of PD catheter-placement techniques

Technique	Operator	Advantages	Disadvantages
Open surgical	Surgeons	Can be done under local anesthesia Preferred in patient with prior abdominal surgeries but high risk for general anesthesia	Requires operating room facilities and staff
Laparoscopic	Surgeons	Catheter inserted under direct vision Preferred in patients with prior abdominal surgeries because it allows visualization of the peritoneal cavity Allows adjunctive procedures to be done simultaneously ^a	Needs general anesthesia Higher cost Requires operating-room facilities and staff
Peritoneoscopic	Nephrologist	Performed under local sedation Less invasive Allows immediate use of the catheter	Break-in period preferred Does not allow for adjunctive procedures Risk of bowel perforation
Percutaneous-needle guidewire technique	Interventional radiologist	Less invasive Performed under local anesthesia Can be done at bedside or procedure room Allows immediate use of the catheter	Blind insertion Risk of bowel perforation ^b Not preferred in those with prior abdominal surgeries Does not allow for adjunctive procedures

PD, peritoneal dialysis.
^aOmentopexy, identification and repair of previously unsuspected abdominal wall hernias, adhesiolysis.
^bCan be minimized using real-time ultrasound guidance.

catheter and the presence of any pericatheter leak (Figure 2). If successful, further exchanges of low FV (500–750 ml) in the supine position can be performed, either manually or by APD with a cycler, if available (Figure 3). APD may reduce the burden of frequent manual exchanges on the staff and facilitate accurate delivery of the prescribed FV. The number of exchanges and the tonicity of the dialysate is determined by the extent of uremic symptoms and volume status, respectively, as discussed in more details in the next section. Unlike an outpatient center, the inpatient setting gives more flexibility in terms of time to perform exchanges. Therefore, if needed, frequent exchanges over a longer time period can be performed, as dictated by the clinical status of the patient.

Urgent-Start PD and Training in an Outpatient PD Center

Upon discharge, the patient should be seen in the PD center within 24–48 hours. Initial evaluation includes assessment of volume status and uremic symptoms to determine the urgency of initiating PD (Figure 4). If there is no immediate need to start PD, the patient can wait a few days to promote healing and reduce the risks of catheter complications (19). However, if needed, PD can be initiated immediately after admission (19,38,60,61). Successful initiations of PD within 2–6 days have been reported in many studies (47,48,50,62–65). As discussed in the above section, PD catheter patency and presence of any leaks should be assessed upon admission (Figure 2).

Because higher FV and an upright position raise the intraperitoneal pressure along with the associated risks of mechanical complications, urgent-start PD should be initiated using low FV with the patient in the supine position

(66,67). There is no consensus on the initial FV. FVs of 0.5–1 L, based on patient weight, were used in 17 patients who were initiated on a cycler in one study (68). In a randomized controlled trial, patients started PD with a larger FV of 1 L, which was rapidly up-titrated to 2 L by 5 days (19). In contrast, a recent study from Brazil started with a high FV (30 ml/kg) right from the outset (69). More individualized prescription based upon body surface area has been used by other groups (21). In general, the FV should be determined based on the size and comfort of the patient. A typical starting volume is 500–750 ml. The FV should be slowly increased every 3–4 days, as tolerated, while monitoring for catheter leaks and overfill, until the patient reaches a maximum FV of 1.5–3 L, typically in 2–4 weeks.

The tonicity of the dialysate and the number and frequency of PD exchanges are determined by the extent of symptoms and volume status. Depending on clinical judgment, three to five exchanges over 4–8 hours a day are performed by the PD nurse, three to five times a week. The PD prescription should be evaluated and adjusted frequently, depending on the clinical status of the patient. PD fluid should be completely drained when breaks in treatment are needed.

In addition to PD exchanges, diuretics should be prescribed in patients with good residual kidney function. A bowel regimen should be included to avoid constipation. Heparin (500 U/L) is usually added to dialysate as long as the effluent is bloody (Table 7).

The PD center requires a specific setup to support urgent-start PD. The clinic should have two or more rooms. The training room should be large enough to lodge the reclining

Table 6. Clinical outcomes in some urgent-start PD studies

Author	Year	Number of Patients and Additional Details	Study	Insertion Technique/ Operator	Time of PD Initiation	Leak (%)	Catheter Migration (%)	Exit-Site Infection	Peritonitis Rate	Technique Survival (%)
Song <i>et al.</i> (48)	2000	21; gradual increase in fill volume 38; full exchange volume (2 L)	Prospective randomized	Percutaneous	Day 0	10 ^a	10	10%	24%	86 (1 yr)
					Day 0	11 ^a	8	5%	16%	84 (1 yr)
Banli <i>et al.</i> (73)	2005	41	Prospective observational	Open surgical	Day 6	5 ^b	2	—	2%	—
Jo <i>et al.</i> (54)	2007	51	Prospective observational	Percutaneous (nephrologist)	Day 0	2 ^a	6	4%	4%	—
Casaretto <i>et al.</i> (74)	2012	11		Laparoscopy	0–2 d	0	9	—	0 ^a	—
Alkatheeri <i>et al.</i> (72)	2016	30	Prospective	Percutaneous (nephrologist) or laparoscopy (surgeon)	0–13 d (median 6 d)	10 ^c	20	7%	3%	93 (3 mo)
Javaid <i>et al.</i> (68)	2016	17		82% percutaneous (nephrologist) or laparoscopy (surgeon)	1–3 d	0 ^d	11	—	—	88 (6 mo)
Dias <i>et al.</i> ^e (80)	2017	51	Prospective	Percutaneous (nephrology)	0–3 d (median 2 d)	8	16	17%	0.5 ^f	86 (6 mo)
Ye <i>et al.</i> (70)	2019	2059	Retrospective	Percutaneous (nephrologist)	Day 0	0.9 ^a	4	0.3%	1%	97 (1 yr)
Povlsen <i>et al.</i> (75)	2006	52; acute start 88; planned start	Retrospective, unmatched control	Open surgical	Day 0	8 ^g 0 ^g	15 15	4% 6%	15% 6%	87 (3 mo) 90 (3 mo)
Yang <i>et al.</i> (50)	2011	226; incremental PD 84; late start	Retrospective	Open surgical	Day 1 41–43 d	2 ^d 2 ^d	3 2	1% 0%	4% 2%	36 (823 d) 68 (522 d)
Ghaffari (21)	2012	18; acute start	Quality improvement project	Percutaneous (interventional radiology)	—	33 ^d	11	1/55 ^h	1/110 ^h	—
Liu <i>et al.</i> (71)	2014	9; planned start 344 (<7 d) 137 (8–14 d) 176 (>14 d)	Retrospective	Percutaneous (nephrologist)		11 ^d	22	1/42 ^h	1/42 ^h	—
						2	4	—	10%	94 (6 mo)
						2	0.7	—	10%	99
Ranganathan <i>et al.</i> (19)	2017	39 (1 wk) 42 (2 wk) 41 (4 wk)	Randomized control trial	Surgical		0	1	—	9%	98
						28 ⁱ	—	—	—	97 (6 mo)
						10 ⁱ	—	—	—	95
						2 ⁱ	—	—	—	80

PD, peritoneal dialysis.

^a1 mo.^b<2 wk.^c<1 wk.^d6 mo.^eUsed high-volume PD.^fEpisode/patient-year.^g3 mo.^hPer patient-month.ⁱ60 d.

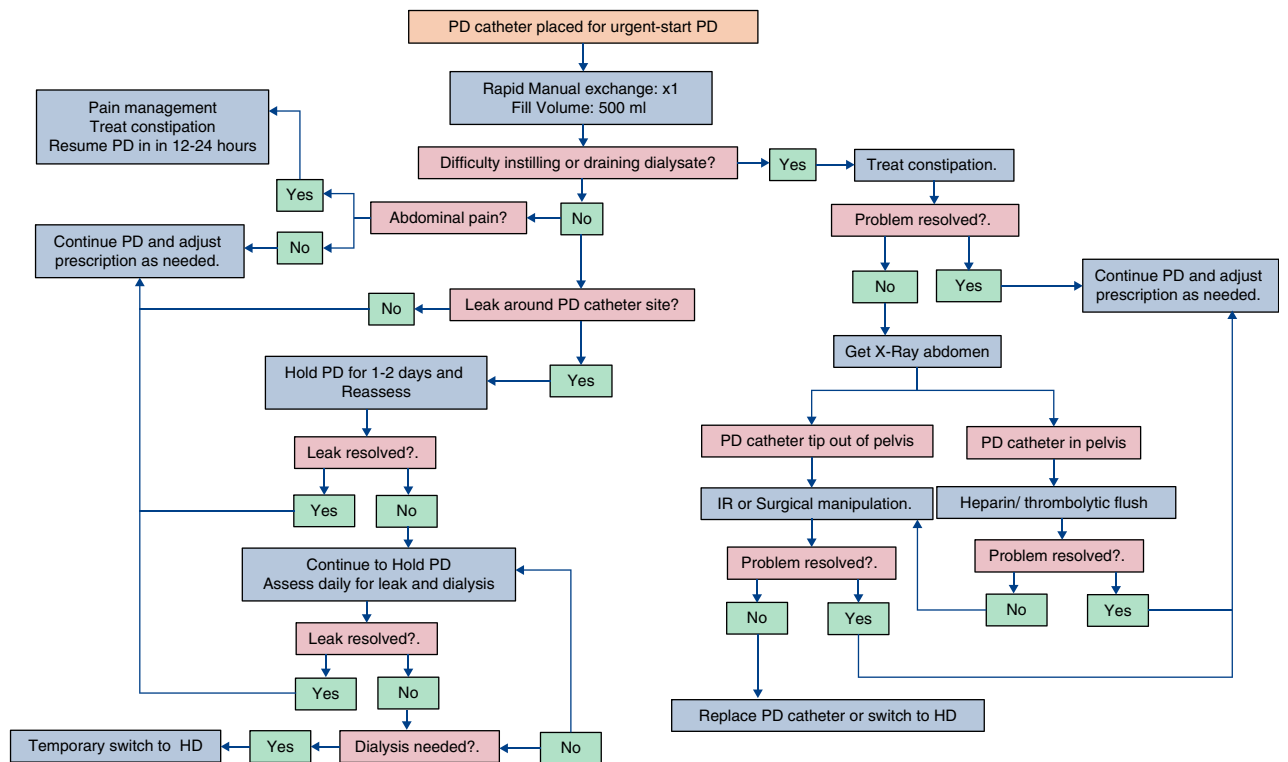


Figure 2. | Evaluation and management of PD catheter-associated mechanical complications in urgent-start PD. The first step in the urgent-start PD initiation process is to assess the patency of the PD catheter and evaluate for the presence of any leak around the catheter or surgical sites. This is done by instilling 500 ml of dialysate, with the patient in the recumbent position. If there is a problem with instilling or drainage of PD fluid, the patient should be given a stool softener or laxatives to ensure they do not have constipation. If the problem with poor catheter flow persists, an x-ray of the abdomen should be done to evaluate migration or malposition of the PD catheter. If the catheter tip is outside the pelvis, the catheter will need repositioning, either by a radiologist under fluoroscopic guidance or by a laparoscopic surgical procedure. If the catheter has not migrated and the tip is still in place, forceful flushing of the catheter with heparinized saline, or instilling the catheter with a thrombolytic agent such as tissue plasminogen activator (1 mg/ml for a period of 1–2 hours) (34), may be attempted. If unsuccessful, the catheter will need radiologic or surgical manipulation. If the catheter is patent, but the patient experiences abdominal pain or discomfort, the fluid should be drained out, constipation (if any) should be treated, and pain control measures should be taken. Reevaluate the patient in the next 12–24 hours, depending on inpatient or outpatient settings, and reattempt PD with low fill volumes (500–750 ml). If abdominal leaks are observed, PD should be held for 1–2 days. If the leak persists after 1–2 days, further management depends on the volume status, uremic state, and overall clinical status of the patient. If the patient can wait for a few more days, PD can be reattempted at that time. However, if the clinical condition does not permit more waiting, or if the leak persists even after waiting for several days, the patient should be temporarily switched to HD, and PD can be initiated again after waiting for the leak to stop. IR, interventional radiology.

chair and equipment and supplies for dialysis. PD centers with more than one nurse are more suitable for urgent-start PD so that, while one nurse is busy with the urgent-start PD, the other can address issues of the established patients. Although one/one nursing is not required for the entire treatment, the patient should have a call light or bell to obtain assistance from a nurse when required.

The time spent in the center during urgent-start PD provides an opportunity to commence training for the patient and the family members. Depending on the uremic state of the patient, the training process can start right away or after a gap of 1–2 weeks. PD training should preferably involve printed materials, videos, verbal instructions, and several days of hands-on training. Initially, patients get a basic understanding of PD by observing the PD nurse on the basic technique and concept of PD. The training is then advanced, at a pace determined by the comprehension of the patient and the family members involved in patient care, until the training is complete and the patient is ready to be discharged home, usually by 2–4 weeks.

Outcomes of Urgent-Start PD

Urgent-start PD may be associated with an increase in catheter-associated mechanical complications as compared with PPD.

In a large, retrospective, single-center study enrolling 2059 patients on urgent-start PD, 4% of patients developed catheter malfunction and 2% of patients experienced abdominal wall complications, including hernia, hydrothorax, hydrocele, and leakage, within the first month after catheter insertion. The rates of early peritonitis and exit-site infections were 0.28 and 0.08 per patient-year, respectively (70). However, the study did not compare patients on urgent-start PD and PPD. In the only randomized controlled trial comparing urgent-start PD with PPD, in 122 patients, a significantly higher rate of pericatheter leaks was observed in patients who initiated PD at 1 week compared with those who commenced at 2 weeks or 4 weeks after surgical catheter implantation (19). The risks of infection were similar in the three groups. Most leaks were conservatively managed without surgical intervention, yet a significantly

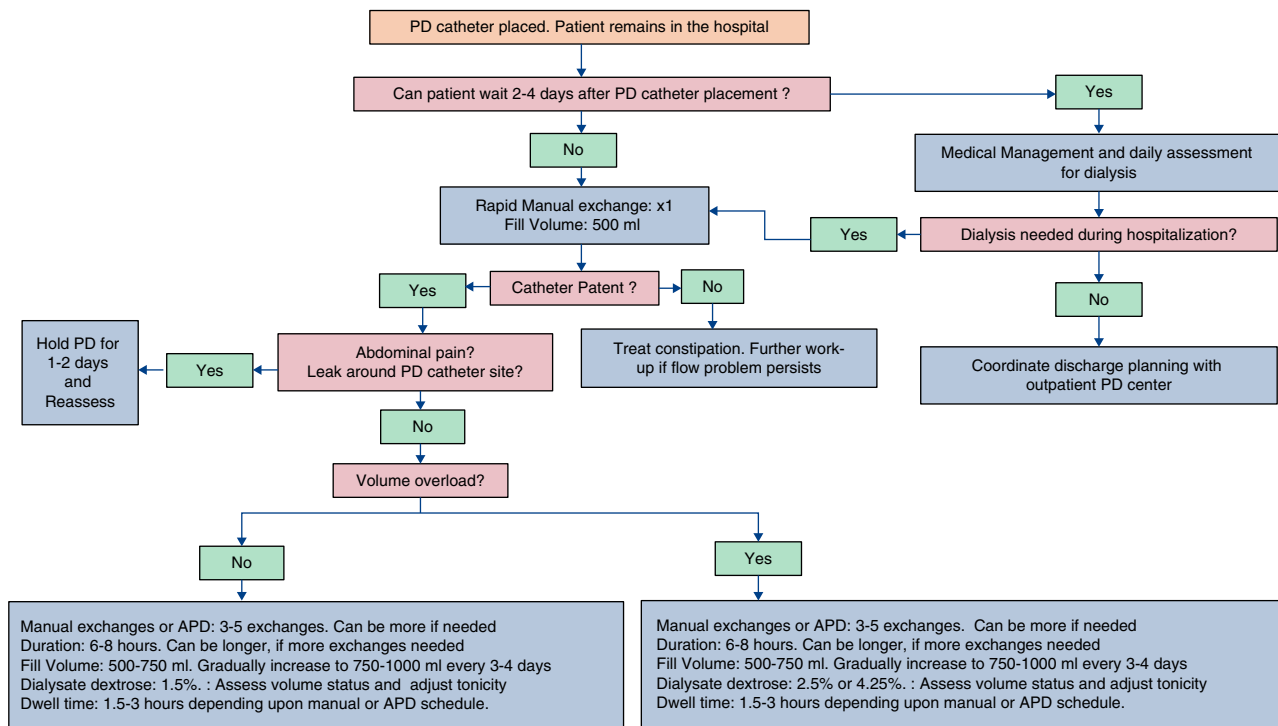


Figure 3. | A stepwise approach to initiate urgent-start PD in hospital settings. If possible, the patient should be promptly discharged from the hospital after placement of the PD catheter. However, if the patient needs to stay in the hospital and requires dialysis, PD can be initiated in hospital. Low fill volumes of 500–750 ml should be used to begin with. Patient should be in a recumbent position throughout the exchanges. PD exchanges can be performed either manually or by automated PD (APD) with a cyclor. APD is preferred over manual exchanges, because using a cyclor reduces the burden of frequent manual exchanges on the staff and facilitates accurate delivery of the prescribed fill volume, thus minimizing errors. The number of exchanges and the tonicity of the dialysate are determined by the extent of uremic symptoms and volume status, respectively. Inpatient settings provide more flexibility with time and number of exchanges performed compared with the outpatient settings. More exchanges over a longer period of time, including nighttime PD, can be performed in hospital.

higher number of patients in the 1-week group required temporary HD than in the other two groups (19). Similar results have been observed in several observational and retrospective studies. In a single-center, matched, case-control study of 104 patients, patients on urgent-start PD experienced more frequent mechanical complications, but similar technique survival or peritonitis episodes, compared with subjects on PPD (61). In a large, retrospective study from China, patients initiating PD within 7 days more frequently experienced mechanical complications than those commencing PD between 8 and ≥ 14 days after open-surgical PD catheter insertion (71). Outcomes and complications associated with urgent-start PD are summarized in Table 6 (21,48,50,54,68–75). Altogether, the studies report higher catheter-related mechanical complications with urgent-start PD, but no significant differences in risk of infection, PD-technique survival, hospitalizations, or mortality between urgent-start PD and PPD (20,21,50,61,76,77). Importantly, most catheter-related complications can be managed conservatively, without the need for catheter removal or change in dialysis modality (61,72).

Data comparing complications associated with urgent-start PD and unplanned HD (UHD) are limited and shown in Table 8. A retrospective, observational study in 176 patients from China observed a significantly higher rate of bacteremia and all-cause infectious complications in

patients receiving UHD than in those initiating urgent-start PD (78). Similarly, a significant increase in catheter-related bacteremia in the first 6 months was observed in patients on UHD compared with those receiving urgent-start PD in an observational cohort study of 123 patients from Germany (63). In another retrospective study from China involving 94 patients, the incidence of composite infectious and noninfectious dialysis-related complications during the first 30 days was significantly lower in patients on urgent-start PD compared with those on UHD (79). In contrast, a recent, nonrandomized, prospective study from Brazil showed no significant difference in bacteremia but a significantly higher rate of catheter exit-site infections in patients on UHD than in those on urgent-start PD (80). Despite higher dialysis-related complications associated with UHD, no difference in overall mortality between the two groups has been reported (20,63,78–80). A systemic review comparing outcomes between UHD and urgent-start PD was recently concluded (81). The preliminary results suggest a lower risk of bacteremia and catheter malfunction, but no difference in mortality among patients on urgent-start PD compared with those on UHD (82).

In nutshell, based upon available evidence, the risks of higher morbidity associated with initiating urgent-start HD with a CVC are far higher than the perceived risks of early

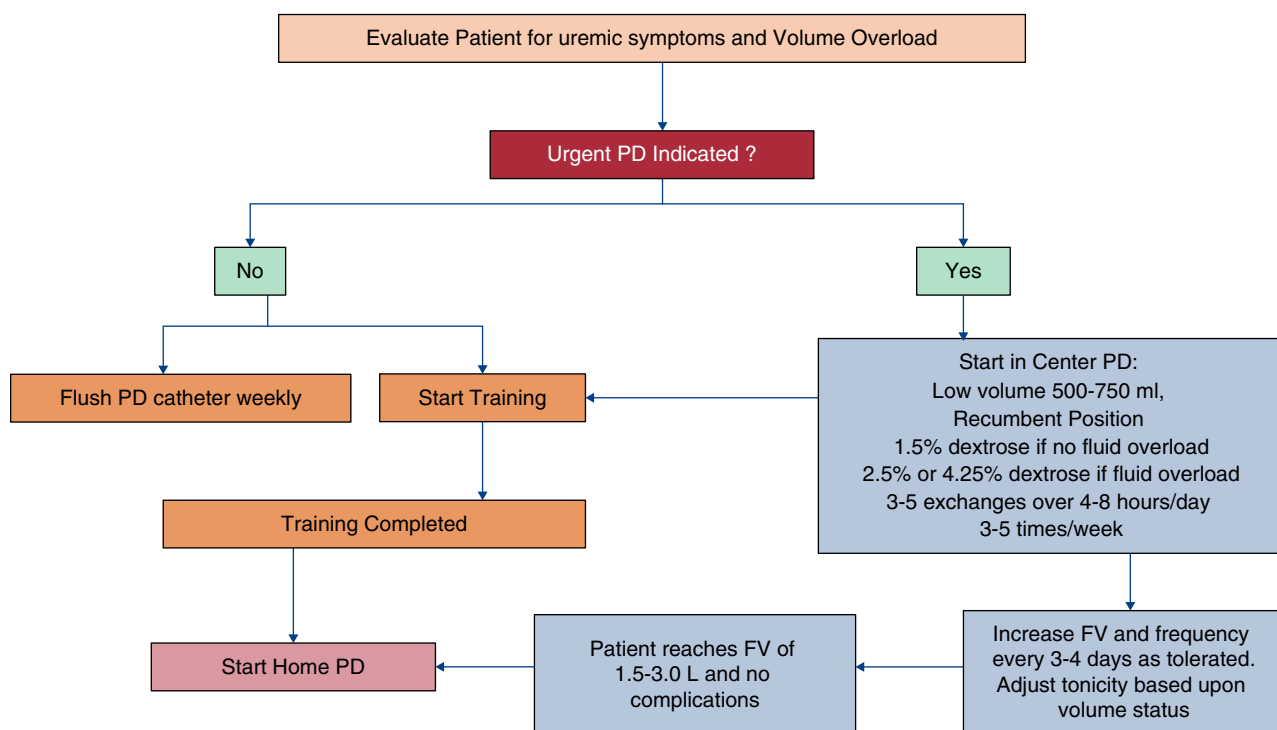


Figure 4. | A stepwise approach to initiate urgent-start PD in the out-patient PD center. Upon discharge from hospital, the patient is evaluated at the PD center in 1–2 days. Depending on the urgency of the need for dialysis, in-center PD may be initiated within 14 days of the catheter placement, using low fill volumes in a recumbent position. PD prescription is adjusted as tolerated. While getting in-center PD, the education process begins at a pace determined by the learning ability of the patient and the family. Once the education is complete, and target fill volumes are achieved, the patient is ready to be discharged home. FV, fill volume.

mechanical complications, making a strong case for initiating PD in patients with late-presenting ESKD.

Urgent-Start PD in the Midst of the Coronavirus Disease 2019 Pandemic

The ongoing coronavirus disease 2019 (COVID-19) pandemic, caused by the highly infectious severe acute respiratory syndrome coronavirus 2, has a mortality rate of 1%–4%, mainly due to life-threatening respiratory infections (83–87). Patients with chronic medical illnesses, including

CKD, are at increased risk of serious complications from COVID-19 (88). In fact, the first US COVID-19-related death was reported in a patient with ESKD on HD (89). COVID-19 infection is associated with fatality rates of 24%–31% among patients with ESKD (90,91). In the midst of the pandemic, ESKD poses unique challenges in management, both in in-hospital and outpatient settings. Patients on HD, who are visiting dialysis centers three times a week, are highly susceptible to environmental exposures that greatly increase the risk of transmission of infection to themselves, other patients, staff, family members, and other individuals who would be exposed during transit. Patients with ESKD who are suspected of having COVID-19 are commonly sent to the hospital, stretching emergency rooms and hospitals to their limits. With an increasing burden of hospitalized patients requiring RRT, hospitals are experiencing acute shortages of supplies and staff to perform dialysis procedures, and are rationing HD and continuous RRT for patients with ESKD and AKI (92,93). In this unprecedented, resource-constrained crisis, urgent-start PD in patients acutely ill with ESKD and AKI can be an invaluable option (94–97). Not only can urgent-start PD help to conserve resources and supplies, but it will also mitigate the risk of COVID-19 transmission by reducing the exposure of staff and other individuals, both in hospital and at dialysis centers. Such an observation was made during the 2009 influenza H1N1 pandemic, when a much lower incidence of viral infection was noted among patients on PD compared with those on HD (98).

Table 7. Considerations for urgent-start peritoneal dialysis prescription

Considerations
Initiate peritoneal dialysis in recumbent position
Use of low fill volumes (500–750 ml) upon initiation
Slowly increase the fill volume, as tolerated, every 3–4 d
Adjust dextrose concentration based on ultrafiltration requirement
1.5% dextrose dialysate if no evidence of volume overload
2.5% dextrose dialysate if mild-to-moderate volume overload
4.25% dextrose dialysate if severe volume overload
Bowel preparation to avoid constipation before and after surgery
Cough suppressants if needed
Add heparin to the dialysate bag; 500 U/L of solution
High-dose diuretics to aid with volume management when appropriate

Table 8. Studies comparing unplanned peritoneal dialysis and hemodialysis in patients with ESKD

Author	Year	Number of Patients	Follow-Up	Mortality (%)	Bacteremia	Peritonitis
Lobbedez <i>et al.</i> (20)	2008	34 PD 26 HD	12 mo	Actuarial patient survival at 1 yr: 83 for PD 79 for HD	—	—
Koch <i>et al.</i> (63)	2011	66 PD 57 HD	6 mo	30 42	3% 21% ^a	2% 2%
Jin <i>et al.</i> (79)	2016	96 PD 82 HD	1 mo	92 93	3 (3%) 11 (13%) ^b	2% 0%
Dias <i>et al.</i> (80)	2020	93 PD 91 HD	6 mo–2 yr		0.11 episodes/patient per yr 0.58 episodes/patient per yr	0.36 episodes/patient per yr Not reported

PD, peritoneal dialysis; HD, hemodialysis.
^a $P < 0.01$.
^b $P = 0.011$.

Summary

Urgent-start PD is a safe and cost-effective option for unplanned dialysis initiation in patients with late-presenting ESKD. A robust infrastructure with clear pathways is paramount in developing a successful urgent-start PD program. The ongoing COVID-19 pandemic has exposed the fragility of patients with ESKD, particularly those undergoing in-center HD, and underscores the need for urgent-start PD in this highly vulnerable population. Implementation of urgent-start PD will help to increase PD utilization, reduce cost, and improve patient outcomes, bolstering the goal set by the Advancing American Kidney Health initiative.

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Author Contributions

G. Pirwani, N. Rajora, and S. Shastri wrote the original draft; and R. Saxena conceptualized the study and edited and reviewed the manuscript.

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