Kidney Medicine

Urgent Start Peritoneal Dialysis: A Population-Based Cohort Study

Neelam M. Bhalla, Neiha Arora, Jeanne A. Darbinian, and Sijie Zheng

Rationale & Objective: It is a common practice to start patients in urgent need of dialysis on hemodialysis via a central venous catheter. Because central venous catheter use is associated with increased risk of infections, hospitalizations, and mortality, urgent start peritoneal dialysis (PD) increasingly represents a viable alternative. This study aimed to examine clinical outcomes, complications, mortality, and modality retention in patients who initiated urgent start PD.

Study Design: Retrospective cohort study.

Setting and Participants: Eighty-four adult members of a large integrated health care system who initiated urgent start PD between January 1, 2011, and December 31, 2014.

Exposure: Urgent start PD.

Outcomes: Retention rates at 30, 90, and 365 days; time to the development of noninfectious and infectious complications, modality failure, and all-cause mortality.

Analytical Approach: Cumulative incidence of all-cause mortality was estimated using the Kaplan-Meier method. Retention rates for PD were computed using binomial proportions.

Results: Occurrence of major complications was less than 5%. Catheter malfunction occurred in 6% of cases; of those, catheter patency could be established in 80%. Infectious complications occurred in 20% of patients who initiated PD and included peritonitis and exit site infections. At 365 days after initiation, the cumulative incidence of all-cause mortality was 9.7% (95% CI, 4.7%-19.4%). PD retention rates were 98.8%, 91.3%, and 80.0% at 30 days, 90 days, and 1 year, respectively.

Limitations: Retrospective cohort design, a well-matched comparable group of urgent start hemodialysis patients could not be identified, small number of patients in a single integrated health care system, uncertain or limited generalizability of findings to other health care systems.

Conclusions: At 1 year after initiation, patients who initiated urgent start PD had high survival and modality retention rates. In unplanned initiation of dialysis, urgent start PD is a viable and sustainable option and should be considered in selected patients to optimize care.

Visual Abstract included

Complete author and article information provided before references.

Correspondence to S. Zheng (Sijie.X.Zheng@kp.org)

Kidney Med. 4(3):100414 Published online January 21, 2022.

doi: 10.1016/j.xkme.2022.100414

Approximately 600,000 patients in the United States have end-stage kidney disease, 460,000 of whom are receiving dialysis annually.[1] The overwhelming majority (92%) are started on in-center hemodialysis (HD), of which 80% do so via a central venous catheter (CVC).[1,2] Moreover, in patients with unplanned dialysis initiation, HD with a CVC is the default method. CVC use has been shown to be associated with increased infectious complications, hospitalizations, and mortality.[2-8]

In the last decade, peritoneal dialysis (PD) has been used in patients requiring urgent start of dialysis.[9-15] PD is a safe and effective home modality and has several advantages over HD.[16-22] In urgent start PD, the catheter is placed and can be used within 24 hours, rather than the traditional 2 weeks. The treatment is modified at initiation (low fill volumes, supine position, cycler use) and increased as tolerated. It can be started in the hospital and transitioned to an outpatient clinic, where it is done by a PD nurse several times per week. Training of PD is given concurrently at the outpatient PD unit.[11-14]

Urgent start PD has been shown to have a low incidence of complications, including peritonitis, leaks, catheter malfunction, hospitalizations, and modality failure, with favorable 90-day outcomes.[13,14,23-25] The objectives of this study were to examine the demographic and clinical characteristics in patients who were initiated on urgent start PD and to assess complications, survival rate, and modality failure at defined time intervals. We also followed the retention rate of urgent start PD and examined factors leading to a change in modality. We hypothesized that urgent start PD would have low complication rates and high retention rates and thus would be a viable alternative to urgent start HD via CVC.

METHODS

Study Design

This retrospective cohort study was conducted within the membership of Kaiser Permanente Northern California (KPNC), an integrated health care system with more than 4.5 million members. The membership is racially and ethnically diverse, with demographic characteristics similar to that of the underlying population, except at the extremes of income.[26]

Study Eligibility

From electronic hospitalization discharge records, we identified a preliminary cohort of adult KPNC members who underwent placement of a catheter for PD between January 1, 2011, and December 31, 2014. The ascertainment of relevant procedures was based on the *International*

PLAIN-LANGUAGE SUMMARY

The traditional practice of starting people in urgent need of dialysis on hemodialysis via central venous catheter is associated with increased risk of infection, mortality, and hospitalization. Increasingly, peritoneal dialysis (PD) is being used in patients requiring urgent start of dialysis. We studied patients who underwent urgent start PD in a large, integrated, racially and ethnically diverse health care system and assessed retention, complications, and mortality during the first year after the initiation of the modality. Our results showed that there was a high retention rate of the PD modality at the end of 1 year, as well as a high survival rate. These results help validate that PD is a safe and sustainable treatment option for patients requiring prompt and unplanned dialysis.

Classification of Diseases, Ninth Revision (ICD-9) and Current Procedural Terminology codes for the creation of cutaneoperitoneal fistula and insertion of tunneled intraperitoneal catheter for dialysis, performed surgically or laparoscopically. Qualifying procedures must have been linked to 1 or more supporting ICD-9 diagnosis codes for acute kidney injury, stage 5 chronic kidney disease, or both, made within 7 days before or after the procedure, hospital admission, or discharge. Tables S1 and S2 provide the complete list of diagnosis codes and Table S3 provides the complete list of procedure codes included in the initial ascertainment of eligible cases. In addition, the ICD-9 procedure code for the PD modality (54.98) was captured from the index hospital discharge records where available.

After excluding members aged <18 years on the date of the procedure, we identified 1,675 health plan members who met the initial procedural and diagnostic criteria for urgent start PD. The identification of eligible urgent start PD cases is depicted in Fig 1. We excluded 1,478 of the initial 1,675 cases for the reasons shown in Fig 1. Of the remaining 197 patients, 96 were deemed potentially eligible urgent start PD cases after preliminary medical record review. A subsequent review confirmed that 84 were eligible urgent start cases, and these comprised the final participants for the study.

The insertion of PD catheters was performed by surgeons (via laparoscopic placement) or interventional radiologists (by percutaneous placement), depending on the local expertise at the medical center where the patient was treated. Surgeons repaired hernias or performed omentopexy based on surgical findings. The 84 patients requiring urgent start PD received care at 16 different hospitals throughout the region.

Per current clinical practice, urgent start PD is initiated at low fill volumes (1.0-1.2 L) in the supine position and employing a cycler; volume is increased as tolerated. The initiation can occur in the hospital or at the outpatient clinic (PD unit), where it is performed by a PD nurse 3-5 times per week for 6-8 hours per day. Training of PD is done at the same time.[11-14]

The KPNC Institutional Review Board (IORG #00001045) approved this study with a waiver of informed consent due to the retrospective, data-only design of the study.

Data Collection

Data were obtained from electronic clinical and administrative databases and included hospital discharge records, outpatient clinical encounters, patient demographic and clinical characteristics, acute inpatient hospitalizations, and deaths during the study period. We calculated the Deyo version of the Charlson Comorbidity Index using a 1-year precatheter insertion capture of diagnosis and procedure codes linked to inpatient and outpatient encounters.[27,28] Prior kidney care was ascertained from the number of clinical encounters linked to nephrology clinics or providers between 1 and 6 months before the initiation of urgent start dialysis. Chart review was conducted by the study's investigators to confirm urgent start PD status. This was defined as the need to initiate dialysis urgently, secondary to late referral or unexpected deterioration in kidney function, in patients without a pre-existing arteriovenous fistula or arteriovenous graft. Patients who were initiated on PD within 2 weeks after the placement of the intraperitoneal catheter also met criteria for urgent start PD.

Study Outcomes and Definitions

For all valid urgent dialysis patients, the investigators collected data on complications and outcomes that occurred during the 1-year period after the initiation of dialysis using a structured data collection tool. Complications were broadly categorized as noninfectious or infectious. The noninfectious complications were classified further as major (hernia, hydrocele, and catheter injury) and minor (bleeding managed conservatively, pericatheter leak, and catheter malfunction). The infectious complications included peritonitis and exit site infection. The outcomes of interest were death (secondary to any cause), cessation of dialysis modality, kidney transplant, and recovery of kidney function.

Statistical Analysis

For the final cohort, the cumulative incidence of all-cause mortality at 12 months was estimated using the Kaplan-Meier method. Associated pointwise 95% confidence intervals for the survivor function were computed using a log-log transformation. Retention rates for PD at 1, 3, and 12 months were computed using binomial proportions with exact 95% confidence intervals.

The follow-up began at study entry (initiation of urgent start dialysis); for analyses that examined mortality risk, the follow-up ended with death, loss to follow-up because

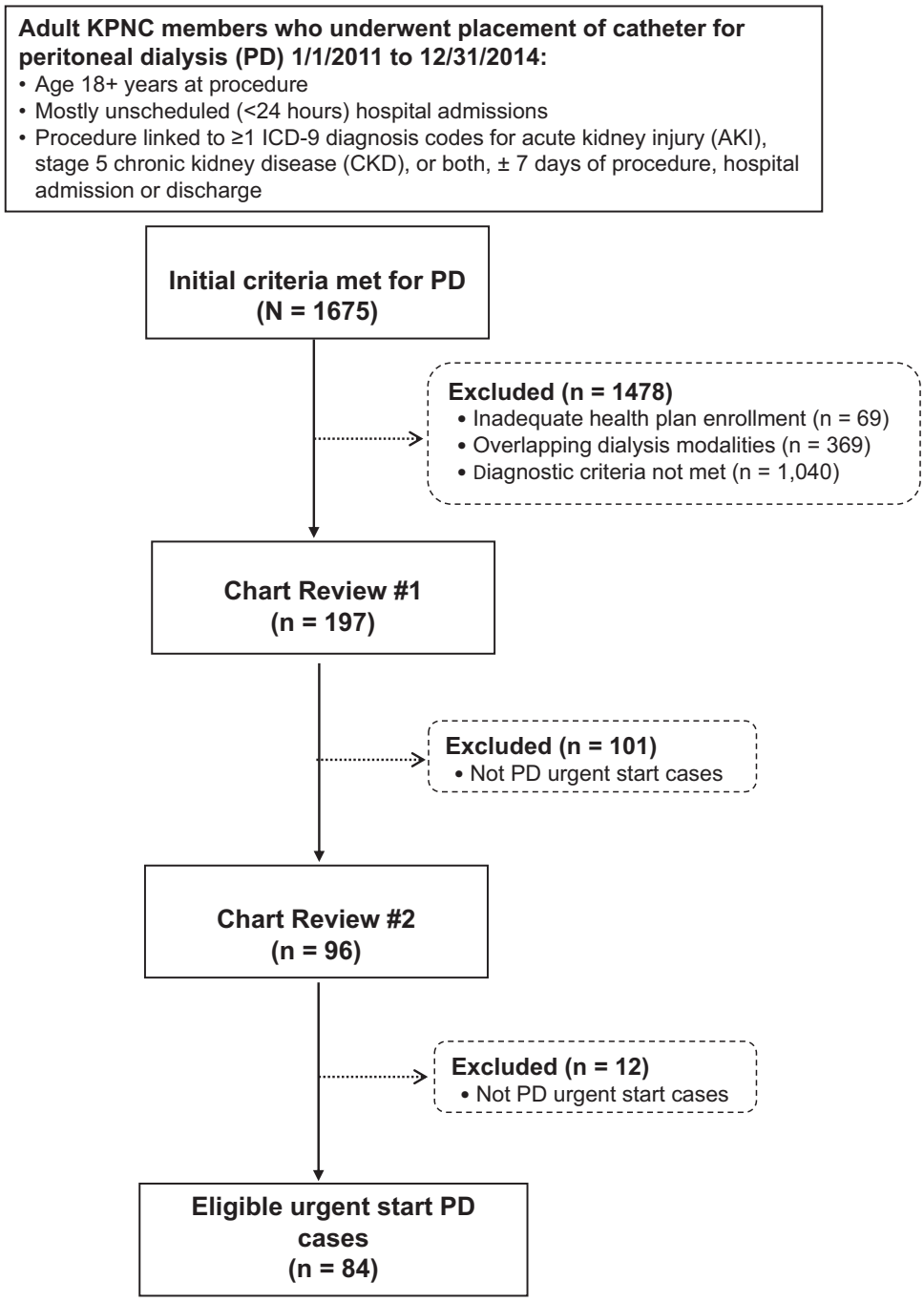


Figure 1. Identification of Urgent Start Peritoneal Dialysis Cases: 2011-2014.

of disenrollment from the health plan, or 1 year after study entry, whichever occurred first. To calculate PD retention rates, the follow-up ended with the first occurrence of initial dialysis modality cessation, death, kidney transplant, recovery of kidney function, loss to follow-up, or 1 year after study entry, whichever occurred first. At each time point examined, patients whose follow-up ended for reasons other than not tolerating PD (medical or psychosocial reasons) before the end point were excluded from the denominator. All analyses were performed using SAS version 9.3 (SAS Institute).

RESULTS

The final analytic cohort consisted of 84 urgent start PD cases. As presented in Table 1, 54 (64.3%) cases were men, and roughly one-third comprised each of the 3 groups shown for age at dialysis initiation. Asians/Pacific Islanders were the largest racial/ethnic group with 29 (34.5%) patients, followed by 20 (23.8%) non-Hispanic Whites, 16 (19.1%) African Americans, and 16 (19.1%) Hispanics. Progressive stage 5 chronic kidney disease was the major reason for the initiation of urgent start PD in 53

Table 1. Characteristics of the 84 Urgent Start Peritoneal Dialysis Cases

Characteristic[a]	n (%)
Sex	
Female	30 (35.7%)
Male	54 (64.3%)
Age (y), median (IQR)	58.5 (44.5, 69.5)
18-49	28 (33.3%)
50-64	27 (32.1%)
≥65	29 (34.5%)
Race/ethnicity	
Non-Hispanic White	20 (23.8%)
African American	16 (19.1%)
Asian/Pacific Islander	29 (34.5%)
Hispanic	16 (19.1%)
Other[b]	3 (3.6%)
BMI (kg/m^2), median (IQR)	26.6 (23.6, 31.4)
<25.0	30 (35.7%)
25.0-29.9	28 (33.3%)
≥30.0	26 (31.0%)
Charlson Comorbidity Index[c]	
Median (IQR)	4.0 (3.0, 5.0)
0-2	18 (21.4%)
3-4	29 (34.5%)
5+	37 (44.1%)
Prior renal care[d]	55 (65.5%)
Reason urgent start dialysis initiated	
AKI associated with infection	3 (3.6%)
AKI not associated with infection	28 (33.3%)
Progressive CKD5	53 (63.1%)
Backup HD	23 (27.4%)

Abbreviations: BMI, body mass index; HD, hemodialysis; IQR, interquartile range; AKI, acute kidney injury; CKD5, chronic kidney disease stage 5.
[a]n (%), unless otherwise specified.
[b]Includes multiracial, American Indian, and unknown race/ethnicity.
[c]Weighted score (Deyo method) based on 17 comorbid conditions ascertained from in- and outpatient clinical encounters in year before the initiation of urgent start dialysis. For the highest category (index score ≥5), the range was 5-9.
[d]n (%) with ≥1 visit to nephrology clinic 1-6 months before the initiation of urgent start dialysis. Encounter types included telephone (scheduled or otherwise), office visit (face-to-face), or secure messaging.

(63.1%) patients, and 55 (65.5%) patients had nephrology clinic encounters before the initiation of dialysis.

The complications incurred up to 1 year after the initiation of urgent start dialysis are summarized in Table 2. Major noninfectious complications were rare, occurring in 4 (4.8%) patients, and included right inguinal hernia, hydrocele, and catheter injury. Among minor noninfectious complications, catheter malfunction occurred in 5 (6.0%), bleeding that was managed conservatively occurred in 2 (2.4%), and pericatheter leaks occurred in 6 (7.1%). Catheter patency was re-established in 4 of the 5 (80%) occurrences of catheter malfunction. Infectious complications occurred in 17 (20%) patients and included peritonitis in 8 (9.5%), exit site infections in 6 (7.1%), and both complications in 3 (3.6%). We selected the cutoff point of 21 days (3 weeks) to attribute complications to the urgent start procedure versus other

Table 2. Complications That Occurred During the Follow-up for the 84 Urgent Start Peritoneal Dialysis Cases

Complication[a]	n (%)
Noninfectious	
Major[b]	4 (4.8%)
Minor	13 (15.5%)
Catheter malfunction[c]	5 (6.0%)
Bleeding (conservatively managed)	2 (2.4%)
Pericatheter leak	6 (7.1%)
Infectious	17 (20.2%)[d]

[a]Complications were not necessarily mutually exclusive, as participants could have incurred >1 complication during the follow-up.
[b]Right inguinal hernia, hydrocele, or catheter injury.
[c]First occurrence.
[d]Includes 8 with peritonitis, 6 with exit site infection, and 3 with both.

factors. Among the 17 patients with noninfectious complications, we observed that 1 had a major complication (right inguinal hernia) and 9 had minor complications (4 had catheter malfunctions, 3 pericatheter leaks, and 2 bleeding managed conservatively) that occurred less than 3 weeks after the initiation of urgent start PD and thus were potentially attributable to the procedure. For the remaining 7 patients with noninfectious complications, 3 had major: complications (right inguinal hernia, hydrocele, and catheter injury) and 4 minor (1 had a catheter malfunction and 3 pericatheter leaks) that occurred 3 or more weeks after the initiation of urgent start PD and were less likely to be attributed to the procedure itself. All 17 cases of infectious complications occurred more than 21 days after initiation of urgent start PD.

The PD retention rates were calculated at 3 end points: 30 days, 90 days, and 1 year after the initiation of urgent start dialysis (Fig 2). The retention rate was 98.8% at 30 days after study entry, with 83 patients remaining on PD; 1 patient switched to HD after 9 days for psychosocial reasons. By 90 days, the follow-up ended for 4 patients because of kidney transplant (n = 2), recovery of kidney function (n = 1), or death (n = 1). Among the remaining 80 patients, 73 still received PD (91.3% retention rate) and 7 stopped for medical (n = 3, 42.9%) or psychosocial (n = 4, 57.1%) reasons. Within 1 year after PD initiation, the follow-up ended for 14 patients secondary to kidney transplant (n = 4, 28.6%), death (n = 5, 35.7%), recovery of kidney function (n = 1, 7.1%), or health plan disenrollment (n = 4, 28.6%). The retention rate was 80% at 1 year, with 70 patients remaining under observation and, among these, 56 still receiving PD. Of the 14 patients no longer receiving PD, 12 (86%) switched to HD. The reasons for discontinuing PD were psychosocial for 6 (42.9%) patients, medical for 5 (35.7%) patients, peritonitis for 2 (14.3%) patients, and catheter malfunction for 1 (7.1%) patient.

Acute inpatient hospitalizations during follow-up are summarized in Table 3. In the first year after the initiation of dialysis, 43 (51.2%) patients who underwent urgent start PD were hospitalized; the median length of stay was 3.0 days. In total, there were 96 unique inpatient

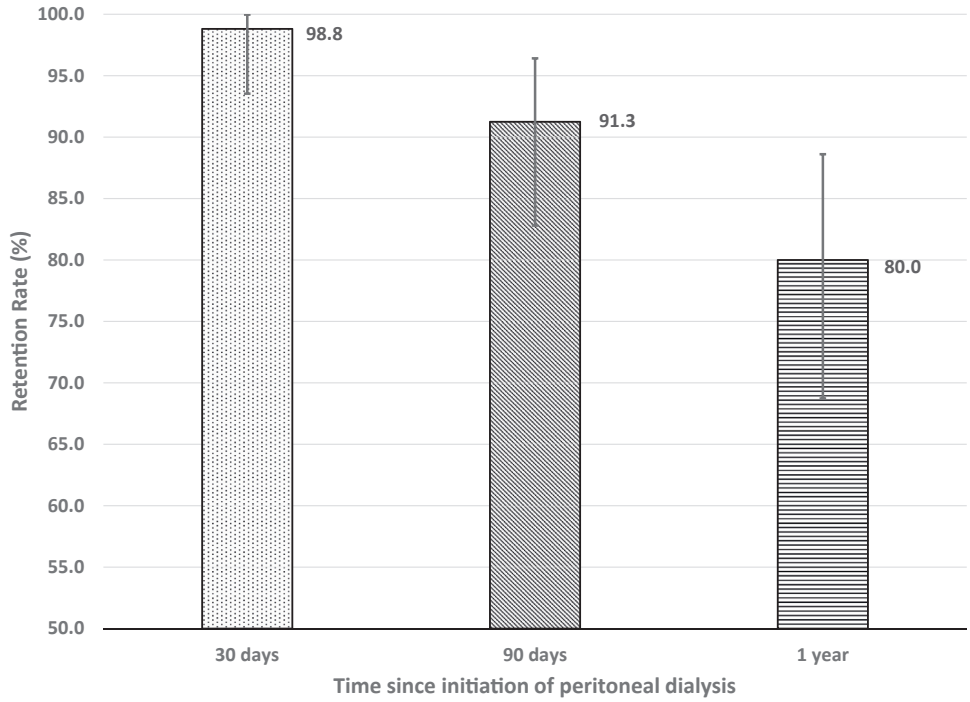


Figure 2. Urgent Start Peritoneal Dialysis Retention Rates at 30, 90, and 365 days. Percent retention and 95% confidence intervals are shown at each time point after the initiation of urgent start peritoneal dialysis.

encounters; the reasons for hospitalization (based on principal discharge ICD-9 diagnosis codes) were cardiovascular complications for 35 (36.5%) encounters, dialysis related for 4 (4.2%), kidney, excluding dialysis, for 2 (2.1%), infection for 23 (24.0%), and other for 32 (33.3%).

The outcomes by 1 year after the initiation of urgent start PD are shown in Table 4. Seven of the 84 patients died during the follow-up period; the cumulative incidence of all-cause mortality was 9.7% (95% CI, 4.7%-19.4%). For the survival analysis, the mean (± standard deviation) follow-up time was 302 ± 155 days and ranged from 9-365 days. The underlying cause of death (ascertained from the patient's state death certificate record) included complications related to cardiovascular disease in 1 (14.3%), diabetes-related complications in 3 (42.9%), infection in 1 (14.3%), malignancy in 1 (14.3%), and kidney disease in 1 (14.3%).

Table 3. Acute Inpatient Hospitalizations During the Follow-up for the 84 Urgent Start Peritoneal Dialysis Cases

Characteristic	
Acute inpatient hospitalizations	n (%)
0	41 (48.8%)
1	17 (20.2%)
2+	26 (31.0%)
Median (IQR)[a]	1.0 (0.0, 2.0)
Length of stay (d), median (IQR)[b]	3.0 (1.0, 5.0)

Abbreviation: IQR, interquartile range.
[a]Range: 0-10.
[b]Length of stay (days) for subset of cases with ≥1 hospital encounter where admission was after the initiation of urgent start dialysis modality. Range: 1-32.

DISCUSSION

Within a large integrated health care system comprised of a diverse population, we have observed that urgent start PD is a feasible and sustainable modality, with high retention and low catheter malfunction rates and an overall survival rate of 90.3% at 1 year after initiation. This study demonstrates that urgent start PD is a viable alternative to traditional urgent start HD with a CVC.

Based on historical precedent, the default treatment of patients with acute kidney injury is in-center HD via CVC.[1-5,7] A recent position paper from the Renal Physicians Association has called for the reassessment of this paradigm.[2,9] Patients starting dialysis with a CVC have higher rates of infection, hospitalization, and mortality

Table 4. Outcomes for the 84 Urgent Start Peritoneal Dialysis Cases

Outcome	n (%)
Modality failure[a]	14 (16.7)
Kidney transplant	4 (4.8)
Recovery of kidney function	1 (1.2)
Death[b]	7 (8.3)

[a]Reasons for failure: catheter malfunction (n = 1); peritonitis (n = 2); medical (n = 5, including hydrothorax, hydrocele, calciphylaxis, and malignancy); psychosocial (n = 6).
[b]Deaths occurred >30 days after the initiation of urgent start dialysis modality (by design).

compared with patients starting HD with a mature arteriovenous fistula or arteriovenous graft.[2-7] PD is greatly underutilized, despite patients starting PD having lower mortality in the first 2 years than patients starting HD.[1,16-19] After the 2011 Medicare prospective payment system reform, PD prevalence only increased from 9.4% to 12.6%.[30] The reasons for this are multifactorial and include less emphasis on PD education in nephrology training programs.[31] Even fewer programs offer urgent start PD in the United States.

KPNC provides health care to 4.5 million members in the region, and The Permanente Medical Group is the largest multispecialty group therein, encompassing 21 medical centers. KPNC and The Permanente Medical Group have increased PD incidence from 15% to 33% over the past 10 years through a multidisciplinary system-wide approach.[32]

In this study, complications incurred by PD urgent starts, including infectious complications, were not associated with increased morbidity or mortality, in contrast to bacteremia often seen with CVC in HD urgent starts. The longer-term outcome of urgent start PD was excellent, with a notably high retention rate. There were 14 events of modality failure among urgent start PD cases (16.7%) attributable to the following: psychosocial reasons in 6 (42.9%); catheter malfunction in 1 (7.1%); peritonitis in 2 (14.2%); medical causes in 5 (35.7%: 2 calciphylaxis; 1 malignancy; 1 hydrothorax; 1 hydrocele). Most of these occurred after 90 days.

Our study results are consistent with other reports from the literature. Masseur et al[14] followed 81 patients who started PD urgently and had a 92.6% retention rate at 90 days. Lobbedez et al[23] compared outcomes between 34 PD urgent starts and 26 HD urgent starts with a CVC. They reported similar survival, unaffected by dialysis modality. The actuarial technique survival was 90% at 6 months and 88% at 1 year in the patients who underwent urgent start PD.[23]

Koch et al[25] noted no difference in survival between HD and PD groups at 6 months in their study. Patients who underwent HD had a higher overall and infectious mortality risk.[25] Similarly, Ivarsen and Povlsen[10] reported 3-month technique survival of 75% in 52 patients who underwent urgent start PD. Xu et al[24] investigated the prevalence of mechanical complications related to the PD catheter and abdominal wall in 922 patients started on urgent PD. Abdominal wall complications developed in 4.8% (hernia 55%; hydrothorax 25%; hydrocele 14%; leak 7%), whereas catheter complications were seen in 9.5%. The overall technique survival was 92%, and peritonitis rate was low.[24]

Urgent start PD has been shown to be more cost effective than urgent start HD via CVC. Liu et al[33] assessed the costs associated with urgent start PD, urgent start HD, or dual approach over the first 90 days. The estimated per patient cost was $16,398 for urgent PD, $19,352 for urgent HD, and $19,400 for HD and PD.[33] Given the small number of patients in this study, we did not perform cost analysis.

Ideally, all patients with chronic kidney disease should start dialysis optimally, that is, either on HD with a mature access or on PD as a planned elective start. However, many patients continue to be started in an unplanned way on HD using a CVC, despite the associated increased risk of complications and reduced survival. Urgent start PD has the potential to reduce the use of CVC and increase the utilization of PD.

The Advance America Kidney Health initiative has provided an impetus to increase home dialysis and preemptive transplant, with a goal of reaching an 80% incidence of either or both by 2025. To achieve this goal, the nephrology community must take bold steps to change the current approach of providing suboptimal kidney replacement therapy for incident dialysis patients. This study demonstrates that urgent start PD is safe and feasible and can increase home dialysis in accordance with the Advance America Kidney Health initiative.

Since the COVID-19 pandemic began, preliminary data have shown that patients receiving PD have lower risk of infection for COVID-19 than those receiving in-center HD,[34] underscoring the need to provide the option of urgent start PD. During the pandemic, many medical centers have considered arteriovenous fistula/arteriovenous graft placement surgery as nonurgent, leading to delayed access creation. In our experience, patients delayed laboratory surveillance of kidney function because of the fear of coming to medical facilities, with resultant acute kidney injury or occult chronic kidney disease progression in some, necessitating urgent dialysis. Urgent start PD is a good alternative in this setting.

A major strength of our study is that it derived from a large, contemporary, diverse population in an integrated health care system in Northern California.[26] Furthermore, we had a wealth of electronic clinical data that supported our analysis. Our study did have limitations. We were unable to identify a comparable (well-matched) group of patients requiring urgent start HD; thus, our study was limited to reporting outcomes and complications among patients requiring urgent start PD only. Furthermore, our cohort comprised a small number of patients within a single integrated health care system, in which health care delivery is well coordinated. It is unclear whether our results are generalizable to other health care systems, where the delivery of care historically has been more fragmented. Ideally, a prospective, multicenter randomized study should be conducted to confirm the results.

In conclusion, within an integrated health care system, urgent start PD was shown to be a safe, viable, and sustainable treatment option. Given the recent executive order for increasing home dialysis incidence, urgent start PD should be more widely used for patients needing prompt and unplanned dialysis initiation.

SUPPLEMENTARY MATERIAL

Supplementary File 1 (PDF)

Table S1: ICD-9 Diagnosis Codes for Chronic Kidney Disease (CKD)

Table S2: ICD-9 Diagnosis Codes for Acute Kidney Injury (AKI) and Acute Kidney Failure (AKF)

Table S3: ICD-9 and CPT-4 Procedure codes for Peritoneal Dialysis (PD) Access

ARTICLE INFORMATION

Authors' Full Names and Academic Degrees: Neelam M. Bhalla, MD, Neiha Arora, MD, Jeanne A. Darbinian, MS, MPH, and Sijie Zheng, MD, PhD

Authors' Affiliations: Division of Nephrology, Kaiser Permanente Medical Center, Hayward, CA (NMB); Division of Nephrology, Kaiser Permanente Medical Center, Fremont, CA (NA); Division of Research, Kaiser Permanente Northern California, Oakland, CA (JAD); and Division of Nephrology, Kaiser Permanente Medical Center, Oakland, CA (SZ).

Address for Correspondence: Sijie Zheng, MD, PhD, Division of Nephrology, Kaiser Permanente Medical Center, 3600 Broadway, Oakland, CA 94611-5730. Email: Sijie.X.Zheng@kp.org

Authors' Contributions: Research idea and study design: NMB, SZ, JAD; data acquisition: JAD, NMB, NA, SZ; data analysis/interpretation: NMB, NA, JAD, SZ; statistical analysis: JAD; supervision or mentorship: NMB, SZ. Each author contributed important intellectual content during manuscript drafting or revision and accepts accountability for the overall work by ensuring that questions pertaining to the accuracy or integrity of any portion of the work are appropriately investigated and resolved.

Support: This work was supported by Kaiser Permanente Northern California Community Health (RNG200435). The funders of this work had no role in study design; collection, analysis, and interpretation of the data; writing the report; or the decision to submit the report for publication.

Financial Disclosure: The authors declare that they have no relevant financial interests.

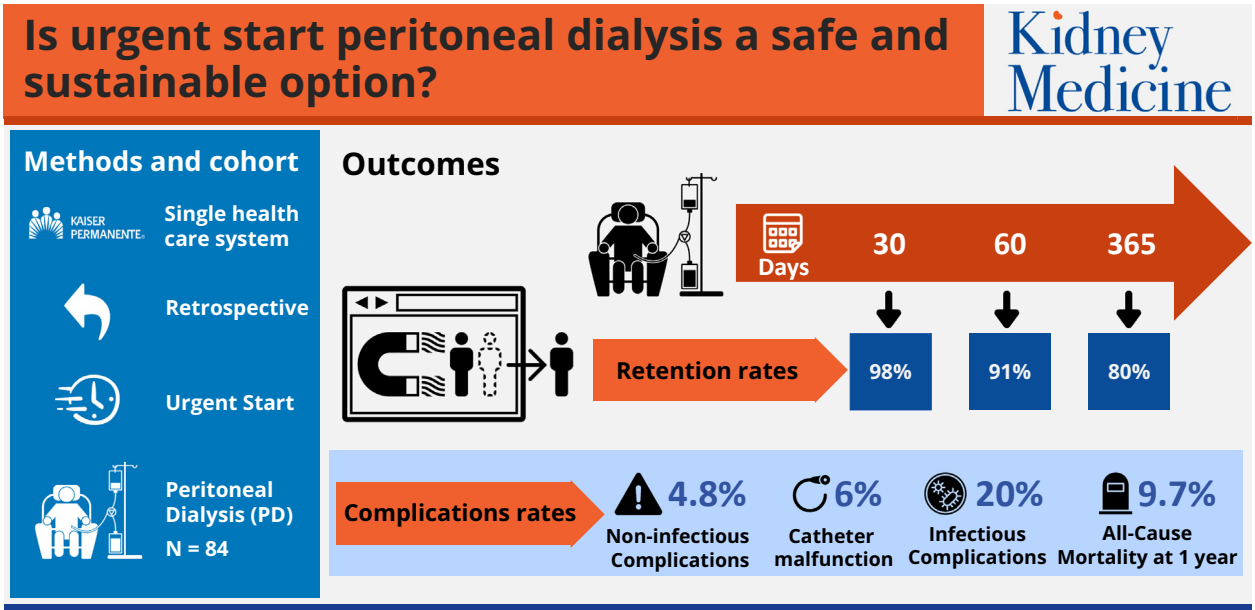
Acknowledgements: The authors would like to thank Alan Go, MD, for his thoughtful and insightful review of the manuscript and suggested revisions.

Peer Review: Received July 14, 2021. Evaluated by 2 external peer reviewers, with direct editorial input by a Statistical Editor and the Editor-in-Chief. Accepted in revised form November 28, 2021.

REFERENCES

1. 2013 USRDS annual data report: atlas of chronic kidney disease and end-stage renal disease in the United States. United States Renal Data System. National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases. Accessed February 5, 2022. https://render.usrds.org/atlas.aspx
2. Xue H, Ix JH, Wang W, et al. Hemodialysis access usage patterns in the incident dialysis year and associated catheter-related complications. *Am J Kidney Dis*. 2013;61(1):123-130.
3. Perl J, Wald R, McFarlane P, et al. Hemodialysis vascular access modifies the association between dialysis modality and survival. *J Am Soc Nephrol*. 2011;22(6):1113-1121.
4. Bradbury BD, Fissell RB, Albert JM, et al. Predictors of early mortality among incident US hemodialysis patients in the Dialysis Outcomes and Practice Patterns Study (DOPPS). *Clin J Am Soc Nephrol*. 2007;2(1):89-99.
5. Collins AJ, Foley RN, Gilbertson DT, Chen SC. The state of chronic kidney disease, ESRD, and morbidity and mortality in the first year of dialysis. *Clin J Am Soc Nephrol*. 2009;4(suppl 1):S5-S11.
6. Allon M. Dialysis catheter-related bacteremia: treatment and prophylaxis. *Am J Kidney Dis*. 2004;44(5):779-791.
7. Lee T, Barker J, Allon M. Tunneled catheters in hemodialysis patients: reasons and subsequent outcomes. *Am J Kidney Dis*. 2005;46(3):501-508.
8. Moist LM, Trpeski L, Na Y, Lok CE. Increased hemodialysis catheter use in Canada and associated mortality risk: data from the Canadian Organ Replacement Registry 2001-2004. *Clin J Am Soc Nephrol*. 2008;3(6):1726-1732.
9. Neumann ME. Urgent-start PD: moving the therapy forward. *Nephrol News Issues*. 2014;28(7):20-22.
10. Ivarsen P, Povlsen JV. Can peritoneal dialysis be applied for unplanned initiation of chronic dialysis? *Nephrol Dial Transplant*. 2014;29(12):2201-2206.
11. Ghaffari A. Urgent-start peritoneal dialysis: a quality improvement report. *Am J Kidney Dis*. 2012;59(3):400-408.
12. Casaretto A, Rosario R, Kotzker WR, Pagan-Rosario Y, Groenhoff C, Guest S. Urgent-start peritoneal dialysis: report from a U.S. private nephrology practice. *Adv Perit Dial*. 2012;28:102-105.
13. Mahnensmith RL. Urgent-start peritoneal dialysis: what are the problems and their solutions? *Semin Dial*. 2014;27(3):291-294.
14. Masseur A, Guest S, Kumar V. Early technique success after initiation of treatment with urgent-start peritoneal dialysis. *Adv Perit Dial*. 2014;30:36-39.
15. Arramreddy R, Zheng S, Saxena AB, Liebman SE, Wong L. Urgent-start peritoneal dialysis: a chance for a new beginning. *Am J Kidney Dis*. 2014;63(3):390-395.
16. Ghaffari A, Kalantar-Zadeh K, Lee J, Maddux F, Moran J, Nissenson A. PD First: peritoneal dialysis as the default transition to dialysis therapy. *Semin Dial*. 2013;26(6):706-713.
17. Chaudhary K, Sangha H, Khanna R. Peritoneal dialysis first: rationale. *Clin J Am Soc Nephrol*. 2011;6(2):447-456.
18. Sinnakirouchenan R, Holley JL. Peritoneal dialysis versus hemodialysis: risks, benefits, and access issues. *Adv Chronic Kidney Dis*. 2011;18(6):428-432.
19. Vonesh EF, Snyder JJ, Foley RN, Collins AJ. Mortality studies comparing peritoneal dialysis and hemodialysis: what do they tell us? *Kidney Int Suppl*. 2006;(103):S3-S11.
20. Cross J, Davenport A. Changing the paradigm from contraction of peritoneal dialysis programs to increasing prevalent peritoneal dialysis numbers. *Adv Perit Dial*. 2013;29:50-54.
21. Kao TW, Chang YY, Chen PC, et al. Lifetime costs for peritoneal dialysis and hemodialysis in patients in Taiwan. *Perit Dial Int*. 2013;33(6):671-678.
22. Marants R, Qirjazi E, Grant CJ, Lee TY, McIntyre CW. Renal perfusion during hemodialysis: intradialytic blood flow decline and effects of dialysate cooling. *J Am Soc Nephrol*. 2019;30(6):1086-1095.
23. Lobbedez T, Lecouf A, Ficheux M, Henri P, Hurault de Ligny B, Ryckelynck JP. Is rapid initiation of peritoneal dialysis feasible in unplanned dialysis patients? A single-centre experience. *Nephrol Dial Transplant*. 2008;23(10):3290-3294.
24. Xu D, Liu T, Dong J. Urgent-start peritoneal dialysis complications: prevalence and risk factors. *Am J Kidney Dis*. 2017;70(1):102-110.

25. Koch M, Kohnle M, Trapp R, Haastert B, Rump LC, Aker S. Comparable outcome of acute unplanned peritoneal dialysis and haemodialysis. *Nephrol Dial Transplant*. 2012;27(1):375-380.
26. Gordon NP. Similarity of the adult Kaiser Permanente membership in Northern California to the insured and general population in Northern California: statistics from the 2011-12 California Health Interview Survey. Kaiser Permanente Division of Research. Accessed November 11, 2021. https://divisionofresearch.kaiserpermanente.org/projects/memberhealthsurvey/SiteCollectionDocuments/chis_non_kp_2011.pdf
27. Charlson M, Szatrowski TP, Peterson J, Gold J. Validation of a combined comorbidity index. *J Clin Epidemiol*. 1994;47(11):1245-1251.
28. Deyo RA, Cherkin DC, Ciol MA. Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. *J Clin Epidemiol*. 1992;45(6):613-619.
29. RPA position paper on peritoneal urgent starts. Renal Physicians Association. Accessed August 19, 2020. https://www.renalmd.org/store/viewproduct.aspx?id=16022862
30. Sloan CE, Coffman CJ, Sanders LL, et al. Trends in peritoneal dialysis use in the United States after Medicare Payment Reform. *Clin J Am Soc Nephrol*. 2019;14(12):1763-1772.
31. Rope RW, Pivert KA, Parker MG, Sozio SM, Merell SB. Education in nephrology fellowship: a survey-based needs assessment. *J Am Soc Nephrol*. 2017;28(7):1983-1990.
32. Pravoverov LV, Zheng S, Parikh R, et al. Trends associated with large-scale expansion of peritoneal dialysis within an integrated care delivery model. *JAMA Intern Med*. 2019;179(11):1537-1542.
33. Liu FX, Ghaffari A, Dhatt H, et al. Economic evaluation of urgent-start peritoneal dialysis versus urgent-start hemodialysis in the United States. *Medicine (Baltimore)*. 2014;93(28):e293.
34. Cozzolino M, Conte F, Zappulo F, Ciceri P, Galassi A, Capelli I, et al. COVID-19 pandemic era: is it time to promote home dialysis and peritoneal dialysis? *Clin Kidney J*. 2021;14(Suppl1):i6-i13.


Is urgent start peritoneal dialysis a safe and sustainable option?
Kidney Medicine
Methods and cohort
KAISER PERMANENTE
Single health care system
Retrospective
Urgent Start
Peritoneal Dialysis (PD)
N = 84
Outcomes
Days
30
60
365
Retention rates
98%
91%
80%
Complications rates
4.8%
Non-infectious Complications
6%
Catheter malfunction
20%
Infectious Complications
9.7%
All-Cause Mortality at 1 year
Conclusion: At one year, urgent start PD patients had high survival and modality retention rates. Unplanned urgent start PD is a viable and sustainable option for patients with ESKD.
Reference: Bhalla N, Arora N, Darbinian JA, et al. Urgent start peritoneal dialysis: a population-based cohort study. Kidney Medicine, 2022.
Visual Abstract by Hector M. Madariaga, MD
@HecMagsMD