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Adjunctive Taurolidine-Citrate-Urokinase Lock Treatment for Peritoneal Dialysis-Associated Peritonitis: A Case Series of 13 Episodes

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Abstract

Background and objective: Evidence for adjunctive taurolidine-based catheter locks in peritoneal dialysis (PD) remains limited. We describe 13 previously unreported PD-associated peritonitis episodes, focusing on treatment feasibility, catheter retention, subsequent infection, PD continuity, and peritoneal equilibration test (PET) findings.

Methods: This retrospective single-center series included all 13 PD-associated peritonitis episodes recorded in the unit between July 2025 and July 2026, involving 13 patients, with episode onset between July 9, 2025, and July 23, 2026. The administrative cutoff was September 1, 2026. Patients received intraperitoneal antibiotics in all dialysis exchanges for 21 days and three hospital-administered taurolidine-citrate-urokinase lock instillations at approximately 5-7-day intervals, with antibiotic-containing dialysate remaining in the abdomen. Surveillance included weekly effluent leukocyte counts and cultures for four weeks after antibiotic completion. Analyses were descriptive; the four-week endpoint included only episodes with complete observation by the cutoff.

Results: Cultures were positive in 11 (84.6%) and negative in two (15.4%) episodes. All 13 (100.0%) completed the lock schedule and had recorded clinical resolution with catheter retention during active infection; the exact 95% confidence interval for retention was 75.3%-100.0%. No relapsing or recurrent peritonitis was recorded among the 12 evaluable episodes at the cutoff; the upper limit of the two-sided exact 95% confidence interval was 26.5%. The remaining patient subsequently completed four-week surveillance without further peritonitis; this post-cutoff update was reported separately. Mild transient discomfort occurred in seven (53.8%) patients. Median observed follow-up in the original analysis was 241 days (interquartile range, 147-293; range, 40-419). Post-peritonitis PET was available at the cutoff for 12 patients, all of whom had an unchanged transport category. At the cutoff, 11 (84.6%) remained on PD, one had discontinued because of caregiver unavailability, and one had died from a stroke reported as unrelated to peritonitis.

Conclusions: This series adds feasibility and follow-up observations on adjunctive lock treatment. Concurrent antibiotics, retrospective outcome assessment, and the absence of a comparator prevent attribution of benefit to the lock. The organism mix included infections that commonly respond to appropriate antibiotics alone. Intraluminal drug residence was not measured, and categorical PET stability does not establish membrane safety. Prospective comparative evaluation is needed, and this off-label approach must not delay guideline-indicated catheter removal.

Categories: Therapeutics, Nephrology, Infectious Disease
Keywords: biofilm, catheter lock, catheter salvage, peritoneal dialysis, peritonitis, taurolidine, urokinase

Introduction

Peritoneal dialysis (PD)-associated peritonitis can interrupt home treatment, cause catheter loss, and require transfer to hemodialysis. The International Society for Peritoneal Dialysis (ISPD) recommends standardized episode definitions and reporting of clinical outcomes [1]. Long-term observational experience also documents the continuing burden of peritonitis despite antimicrobial treatment [2]. Catheter preservation is therefore clinically relevant when it can be pursued without compromising infection control.

A potential obstacle to treatment is an intraluminal microbial reservoir. An electron-microscopy study detected biofilm on 20 (71.4%) of 28 removed PD catheters [3]. Such observations support a biological rationale for catheter-directed treatment, but they do not establish biofilm in every culture-positive or culture-negative episode.

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Taurolidine-based locks have been investigated in hemodialysis catheters, including formulations containing urokinase [4,5]. The LOCK IT-100 randomized trial evaluated taurolidine/heparin for prevention of bloodstream infection in vascular catheters [6]; this setting differs from treatment of established PD peritonitis. Experimental work demonstrated reduced *Pseudomonas aeruginosa* biofilm burden on PD-catheter material without complete device sterilization [7]. Recent susceptibility testing against bloodstream isolates offers additional indirect microbiological evidence [8]. Small PD series and case reports have described taurolidine-assisted salvage [9-11], while other investigators have studied antibiotic locks [12]. A recent report also described prolonged follow-up after taurolidine-citrate treatment [13].

The present study describes 13 additional, previously unreported treatment episodes, comprising all PD-associated peritonitis episodes recorded at our center between July 2025 and July 2026. All received taurolidine-citrate-urokinase catheter-lock treatment as an adjunct to intraperitoneal antibiotics following clinical assessment by the treating team. Clinical reasons for adding the lock included culture-negative peritonitis and infection with organisms recognized as having biofilm-forming potential, particularly when antimicrobial resistance was a concern. The principal descriptive objectives were to assess catheter retention during active infection and relapsing or recurrent peritonitis within four weeks after antibiotic completion. Additional objectives were to characterize completion of the three-lock schedule, tolerability, subsequent peritonitis during available follow-up, PD continuity, and routine peritoneal equilibration test (PET) findings. The analysis is restricted to the current episodes and is intended to inform further clinical evaluation rather than establish comparative efficacy.

Materials And Methods

Study design and population

This retrospective case series was conducted in the Nephrology and Dialysis Unit of Ospedale del Mare, ASL Napoli 1 Centro, Naples, Italy. The analytic cohort comprised 13 episodes of PD-associated peritonitis occurring from July 9, 2025, to July 23, 2026, in 13 patients, with one episode per patient in the current dataset. The administrative follow-up cutoff for the primary analysis was September 1, 2026. Data were assembled retrospectively from microbiological documentation and clinical follow-up records. All study investigators contributed to data collection and verification against the available source records. Episode identifiers E01-E13 are used throughout.

Adults receiving continuous ambulatory peritoneal dialysis (CAPD) or automated peritoneal dialysis (APD) received adjunctive catheter-lock treatment when the treating team considered catheter preservation clinically appropriate. The local treatment approach was used during both the first episodes of peritonitis and episodes occurring in patients with previous peritonitis. Clinical reasons for its use included infection with organisms recognized as having biofilm-forming potential, particularly when antimicrobial resistance was a concern, and culture-negative peritonitis. These considerations provided a clinical rationale for treatment and did not establish the presence of catheter biofilm in individual episodes. The adjunctive procedure was not restricted to relapsing or refractory peritonitis.

Between July 2025 and July 2026, the unit recorded 13 PD-associated peritonitis episodes, all of which received adjunctive lock treatment and were included in this analysis. No catheter was removed for peritonitis during this period. Completion of the three-lock schedule and catheter retention were not eligibility criteria, and no treated episode was excluded on the basis of either outcome. Concomitant exit-site or tunnel infection, fungal peritonitis, and clinical deterioration requiring urgent catheter removal were considered reasons to exclude or reconsider catheter preservation; no episode was excluded for these reasons. Thus, the analysis includes all peritonitis episodes recorded in the unit during the specified period, although the decision to administer the adjunctive treatment remained clinician-directed. There was no contemporaneous group treated with antibiotics alone.

Antibiotic and lock administration

All 13 episodes were treated with intraperitoneal antibiotics for 21 days (median, 21 days; range, 21-21 days), using continuous administration with antibiotics added to all dialysis exchanges. Vancomycin was administered at a loading dose of 20-25 mg/kg, followed by a maintenance concentration of 25 mg/L of dialysate. Ceftazidime, when used, was administered at a loading concentration of 500 mg/L, followed by a maintenance concentration of 125 mg/L. For piperacillin/tazobactam, a loading dose of 4 g/0.5 g in a 2-L bag corresponded to concentrations of 2,000 mg/L and 250 mg/L, respectively; maintenance doses of 1 g/0.125 g in a 2-L bag corresponded to 500 mg/L and 62.5 mg/L, respectively. These are the regimens administered at our center, with dosing informed by ISPD recommendations [1]. The uniform 21-day duration describes local treatment practice and is not proposed as the recommended duration for every causative organism.

Patients receiving APD continued this modality throughout the antibiotic course, without temporary conversion to CAPD. Antibiotics were added to all dialysis solution bags used for APD. For doses expressed in mg/L, the amount of antibiotic added to each bag was calculated according to its dialysate volume to achieve the concentrations specified above.

Empirical treatment consisted of intraperitoneal vancomycin plus ceftazidime. Following organism identification and antimicrobial susceptibility testing, treatment was modified when necessary; the initial regimen was continued when appropriate, including in culture-negative episodes with a satisfactory clinical response. The combinations reported in Table *3* are the final regimens after this review: vancomycin plus ceftazidime in 10 (76.9%) episodes and vancomycin plus piperacillin/tazobactam in three (23.1%). They should not be interpreted as the regimens necessarily administered from the first antibiotic dose. The total antibiotic course lasted 21 days in every episode; the exact duration of exposure to each individual agent before and after any change was not separately extracted for this analysis.

Dual antibiotic coverage was generally maintained as part of the local prescribing approach. The treating team's rationale included concern about potential contamination during repeated treatment-related manipulations, including antibiotic addition to dialysis bags. This describes local practice and does not establish a benefit from continued dual coverage. Modification according to susceptibility results did not necessarily involve reduction to a single agent, and the appropriateness of prolonged dual coverage was not evaluated in this study.

Oral fluconazole was administered at 100 mg once daily throughout the antibiotic course as antifungal prophylaxis. This dosage describes the regimen used at our center.

Three instillations of TauroLock-U25.000 (TauroPharm GmbH, Waldbüttelbrunn, Germany) were administered at approximately 5-7-day intervals during the antibiotic course. The initial dialysate culture report was generally available 3-5 days after sample collection, reflecting the usual laboratory turnaround time. The first lock was administered upon availability of this report. Empirical intraperitoneal antibiotic therapy had already been initiated while awaiting the culture results.

For the presentation containing 25,000 international units (IU) of urokinase, the manufacturer specifies reconstitution with 5 mL of taurolidine-citrate solution, corresponding to a nominal urokinase concentration of 5,000 IU/mL [14]. The product is intended for central venous access systems; its use in a PD catheter is off-label.

Straight, double-cuff Tenckhoff catheters were used. The instilled volume was 2.8 or 3.0 mL, according to catheter length. Before clinical use, the lumen filling volume was measured using a new catheter corresponding to the type and length of the implanted catheter. This preliminary measurement informed volume selection but did not establish that the solution remained confined to the catheter lumen after instillation.

All lock procedures were performed in the hospital by nurses under medical supervision, using the same administration sequence for CAPD and APD patients. The prescribed antibiotic-containing dialysate was infused first. With the abdomen remaining full, the transfer set was removed, and the selected volume of lock solution was slowly instilled into the catheter lumen. The transfer set was therefore not included in the locked volume. The protocol prescribed an interval of at least three hours between lock instillation and subsequent drainage, with antibiotic-containing dialysate remaining in the peritoneal cavity. The dialysate was then drained, followed by instillation of fresh antibiotic-containing dialysis solution. The lock solution was not separately aspirated before drainage. Patients receiving APD continued their usual modality outside these hospital procedures.

The dates of lock administration were documented in the clinical records. Exact instillation and drainage times were not recorded; therefore, the actual duration of each administration interval and adherence to the prescribed minimum duration could not be independently verified retrospectively. The prescribed interval also does not establish the actual duration of intraluminal drug residence.

Antibiotic-containing dialysate and the catheter lock were intended to address peritoneal infection and a possible intraluminal reservoir, respectively. Lock dispersion through catheter side holes, local drug concentrations, and pharmacological compatibility were not measured. The procedure therefore does not demonstrate spatially isolated drug compartments or a proven interaction between components.

Definitions and outcomes

ISPD diagnostic criteria require at least two of the following: compatible symptoms or cloudy effluent; an effluent leukocyte count above 100 cells/µL after a dwell of at least two hours, with more than 50% polymorphonuclear leukocytes; or a positive effluent culture [1]. In all episodes, dialysate leukocyte counts with differential were obtained at initial symptomatic presentation, and serial counts were used to assess treatment response. All episodes, including E06 and E08, met the clinical and effluent cell-count criteria. For E06, the unavailable document was the effluent microbiology report; for E08, the microbiology specimen was labeled “miscellaneous fluids.” These limitations concern microbiological reporting and do not replace the clinical and cell-count basis of diagnosis. Culture-negative peritonitis denotes episodes meeting the clinical and effluent cell-count criteria without an organism identified on culture.

Subsequent episodes were classified according to their timing and microbiology [1]. Treatment completion refers to the last day of antibiotic administration. Relapsing peritonitis denotes an episode occurring within four weeks after completion of therapy for a prior episode, with the same organism or one sterile (culture-negative) episode [1]. Recurrent peritonitis denotes a new episode within four weeks after completion of treatment for the preceding episode, involving a different organism. Repeat peritonitis denotes a new episode more than four weeks after completion of treatment for the preceding episode, involving the same organism. The principal descriptive endpoints were catheter retention during active infection and relapsing or recurrent peritonitis among episodes with at least 28 days of observation after the last antibiotic dose at the administrative cutoff.

Clinical resolution was assessed from the documented disappearance of symptoms, clearing of dialysis effluent, and follow-up effluent leukocyte counts. Following completion of antibiotic treatment, effluent leukocyte counts and cultures were performed weekly for four weeks to monitor for relapsing or recurrent peritonitis. Clinical resolution, catheter retention, and subsequent peritonitis were reported as separate outcomes rather than combined into a single medical-cure endpoint. Eligibility for the four-week endpoint analysis depended on completion of the post-antibiotic observation period by September 1, 2026.

Other outcomes were completion of the three-lock schedule, recorded adverse symptoms, subsequent peritonitis during available observation, associated exit-site infection, PD continuity, and PET transport category. Adverse symptoms, including transient abdominal pain or burning during hospital lock administration, were recorded by nursing and medical staff and identified retrospectively from their clinical documentation. Subsequent clinical events were also ascertained from routine records. Safety assessment was not based on a standardized prospective surveillance protocol and may therefore have missed unrecorded adverse events.

Routine PET was performed using 2,000 mL of dialysis solution containing 3.86% glucose, with a four-hour dwell. Peritoneal transport classification was based on the four-hour dialysate-to-plasma creatinine ratio, and the documented transport categories were extracted from routine PET reports. The post-peritonitis transport category was compared with the pre-peritonitis category. Reassessment was performed at least 30 days after clinical resolution of peritonitis, in the absence of other potentially confounding inflammatory conditions; this interval was measured from clinical resolution rather than automatically from episode onset or antibiotic completion. Subsequent timing varied according to clinical needs. Post-peritonitis PET was available for 12 patients at the administrative cutoff. E01 had not yet undergone reassessment and was excluded from the PET comparison at that cutoff. Only categorical PET results were available for this analysis; paired numerical D/P creatinine values and quantitative ultrafiltration measurements were unavailable in the analytic dataset.

For the primary analysis, follow-up ended at the administrative cutoff for patients remaining on PD or at PD discontinuation or death, whichever occurred first. Caregiver-related PD discontinuation and death from a stroke reported as unrelated to peritonitis were described separately from infection-related technique failure. No competing-risk analysis was performed.

Statistical analysis

Continuous variables are summarized as mean with sample standard deviation (SD) or median with interquartile range (IQR) and range. Quartiles were calculated by linear interpolation. Categorical findings are presented as n (%), with the relevant denominator stated in the text or table notes. The default denominator is 13. The four-week infection endpoint and the paired PET category comparison each use 12 evaluable episodes at the original administrative cutoff: E01 lacked a complete four-week post-antibiotic observation period and had not yet undergone post-peritonitis PET. Two-sided exact Clopper-Pearson 95% confidence intervals (CIs) were calculated for selected proportions. Each patient contributes one episode to the current analysis. No hypothesis tests, historical-control comparisons, pooled estimates with earlier reports, or causal comparisons with external cohorts were performed.

For patients remaining on PD, follow-up was calculated as the cutoff date minus the episode index date. The reported observation times of 293 and 172 days were retained for caregiver-related discontinuation and death, respectively. Follow-up duration is measured from episode onset and is distinct from the post-antibiotic window used for relapsing or recurrent peritonitis.

Additional follow-up for E01 obtained after the original administrative cutoff is reported separately as a post-cutoff clinical update. It was not incorporated into the original four-week endpoint denominator, CI, or follow-up summaries in the tables and figures.

Results

Patients and microbiology

The cohort included 13 patients with 13 episodes. Mean age was 64.3 ± 15.3 years; median age was 68 years (IQR, 54-75; range, 38-90). There were seven (53.8%) male and six (46.2%) female patients. CAPD was used

by seven (53.8%) patients and APD by six (46.2%). Baseline characteristics and outcomes are summarized in Table 1.

Characteristic or outcome	Value
Patients	13
Episodes	13
Age in years, mean ± SD	64.3 ± 15.3
Age in years, median (IQR)	68 (54–75)
Age in years, range	38–90
Male patients	7 (53.8%)
Female patients	6 (46.2%)
CAPD	7 (53.8%)
APD	6 (46.2%)
Culture-positive episodes	11 (84.6%)
Culture-negative episodes	2 (15.4%)
Vancomycin + ceftazidime	10 (76.9%)
Vancomycin + piperacillin/tazobactam	3 (23.1%)
Completion of three-lock schedule	13 (100.0%)
Clinical resolution with catheter retention	13 (100.0%)
Mild transient discomfort	7 (53.8%)
Lock protocol discontinuation	0 (0.0%)
Associated exit-site infection	0 (0.0%)
Evaluable four weeks after antibiotics	12 (92.3%)
Relapsing or recurrent peritonitis (N = 12)	0 (0.0%)
Any subsequent peritonitis during observation	0 (0.0%)
Infection-related technique failure	0 (0.0%)
Ongoing PD at administrative cutoff	11 (84.6%)
PD stopped because caregiver unavailable	1 (7.7%)
Death from stroke reported as unrelated	1 (7.7%)
Post-peritonitis PET available at administrative cutoff	12 (92.3%)
PET category unchanged (N = 12)	12 (100.0%)
Follow-up in days, median (IQR)	241 (147–293)
Follow-up in days, range	40–419

TABLE 1: Characteristics and outcomes of the current cohort

Categorical values are n (%), using N = 13 unless specified. Relapsing or recurrent peritonitis was assessed in N = 12 episodes because E01 lacked a complete 28-day observation period after antibiotic completion at the administrative cutoff. The PET comparison also used N = 12 because E01 had not yet undergone post-peritonitis reassessment. Exact 95% CIs were 75.3%–100.0% for catheter retention, 73.5%–100.0% for unchanged PET category, and 0.0%–26.5% for relapsing or recurrent peritonitis. Follow-up was measured from episode onset until September 1, 2026, PD cessation, or death, whichever occurred first.

PD, peritoneal dialysis; CAPD, continuous ambulatory peritoneal dialysis; APD, automated peritoneal dialysis; PET, peritoneal equilibration test; SD, standard deviation; IQR, interquartile range; CI, confidence interval.

At presentation, all 13 episodes had effluent leukocyte counts above 1,000 cells/μL, with more than 60% polymorphonuclear leukocytes. Follow-up effluent cell-count assessments were reported as normalized by day 5 of antibiotic treatment in all episodes. Individual numerical baseline and day 5 values were not extracted into the analytic dataset; these results are therefore reported as a baseline threshold and a qualitative assessment of response rather than as numerical trajectories. E01 and E13 were the first episodes of peritonitis and were managed without inpatient admission, with hospital attendance for the lock procedures. Both patients presented with moderate abdominal pain, cloudy dialysis effluent, and reduced ultrafiltration.

Of 13 episodes, 11 (84.6%) were classified as culture-positive and two (15.4%) as culture-negative. *Staphylococci* accounted for six (46.2%) episodes, streptococci for two (15.4%), *Escherichia coli* for two (15.4%), and a polymicrobial infection for one (7.7%). The polymicrobial episode, E04, involved *Aeromonas hydrophila* and *Enterococcus faecalis* and was counted once. Abdominal computed tomography showed diverticulosis without findings requiring urgent surgical intervention. Enteric translocation was considered a possible source but was not demonstrated. In E09, the ESBL-producing Escherichia coli isolate was reported as susceptible to piperacillin/tazobactam. Table *2* and Figure *1* describe the microbiological distribution; Table *3* provides individual episode data.

Organism or category	Episodes n (%)
Culture-negative	2 (15.4%)
Escherichia coli	2 (15.4%)
Staphylococcus hominis subsp. hominis	2 (15.4%)
Streptococcus dysgalactiae	1 (7.7%)
Staphylococcus aureus	1 (7.7%)
Staphylococcus cohnii subsp. urealyticus	1 (7.7%)
Streptococcus mitis/oralis	1 (7.7%)
Staphylococcus warneri	1 (7.7%)
Staphylococcus epidermidis	1 (7.7%)
Polymicrobial	1 (7.7%)
Total	13 (100.0%)

TABLE 2: Microbiology of the 13 current episodes

Each episode is counted once; N = 13 includes culture-negative episodes. The polymicrobial episode involved Aeromonas hydrophila and Enterococcus faecalis. Organism names retain the identification level reported in the source records. Percentages are rounded to one decimal place and may not sum exactly to 100%.

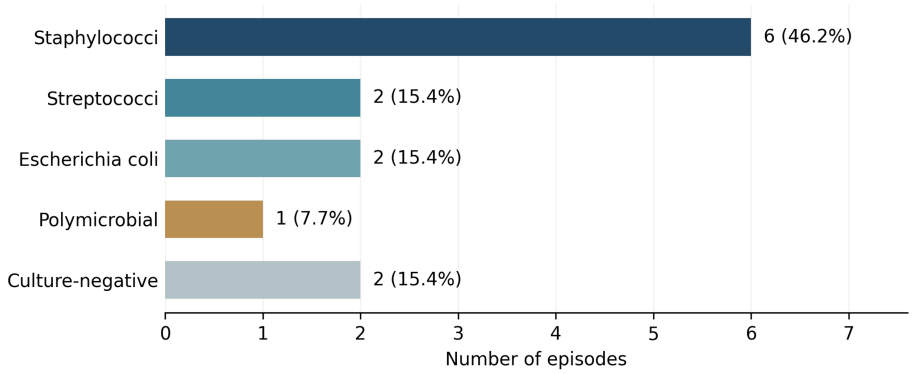


FIGURE 1: Microbiological groups in the 13 current episodes

Labels show the number of episodes and corresponding percentage, n (%), using N = 13. Each episode is counted once. The polymicrobial episode involved *Aeromonas hydrophila* and *Enterococcus faecalis*. Culture-negative episodes are included in the denominator. Percentages are rounded to one decimal place and may not sum exactly to 100%.

ID	Age (years)	Sex	Index date	PD	Organism or category	IP companion	Baseline PET category	Follow-up (days)	Endpoint
E01	38	F	2026-07-23	CAPD	Streptococcus dysgalactiae	CAZ	High-average	40	Ongoing PD
E02	40	F	2025-10-06	CAPD	Staphylococcus aureus	CAZ	Low-average	330	Ongoing PD
E03	75	M	2026-04-07	CAPD	Escherichia coli	CAZ	Low-average	147	Ongoing PD
E04	59	M	2026-05-08	APD	Polymicrobial	CAZ	High-average	116	Ongoing PD
E05	73	M	2026-05-08	APD	Staphylococcus cohnii subsp. urealyticus	P/T	High-average	116	Ongoing PD
E06	78	F	2025-09-11	CAPD	Staphylococcus hominis subsp. hominis	CAZ	Low	293	PD stopped
E07	54	F	2025-11-22	APD	Staphylococcus hominis subsp. hominis	P/T	Low	283	Ongoing PD
E08	75	F	2026-01-03	APD	Streptococcus mitis/oralis	CAZ	High-average	241	Ongoing PD
E09	74	M	2026-02-09	CAPD	Escherichia coli	P/T	Low	172	Death
E10	58	F	2025-07-09	CAPD	Staphylococcus warneri	CAZ	High-average	419	Ongoing PD
E11	54	M	2026-02-13	APD	Culture-negative	CAZ	Low-average	200	Ongoing PD
E12	68	M	2025-09-02	APD	Staphylococcus epidermidis	CAZ	High	364	Ongoing PD
E13	90	M	2026-01-02	CAPD	Culture-negative	CAZ	High-average	242	Ongoing PD

TABLE 3: Individual data for the 13 current episodes

All episodes (E01-E13) received 21 days of intraperitoneal antibiotics and three-lock instillations. Initial empirical therapy was vancomycin plus ceftazidime; the companion antibiotic shown represents the final regimen with vancomycin after susceptibility review. Individual drug durations were not extracted. Initial effluent leukocytes exceeded 1,000 cells/μL with >60% polymorphonuclear cells in every episode; counts were reported as normalized by day 5. Exact numerical trajectories are not presented. All episodes had recorded clinical resolution and catheter retention.

PET categories are baseline values. At the cutoff, 12 patients had post-peritonitis PET, all unchanged. E01 lacked both post-peritonitis PET and complete four-week post-antibiotic observation; later findings are reported separately.

E04: *Aeromonas hydrophila* plus *Enterococcus faecalis*; abdominal CT showed diverticulosis without urgent surgical findings. E02: methicillin-susceptible *S. aureus*; E05-E06: methicillin-resistant staphylococci; E07: methicillin-susceptible *S. hominis*. E09: ESBL-producing *E. coli* susceptible to piperacillin/tazobactam. For E06, the microbiologist confirmed effluent/blood organism concordance, but the effluent microbiology report was unavailable. E08's specimen labeled “miscellaneous fluids” was identified as PD effluent from the clinical context. Both met clinical and effluent cell-count diagnostic criteria.

Follow-up ended on September 1, 2026, PD cessation, or death, whichever occurred first. E06 stopped PD because of caregiver unavailability; E09 died from a stroke reported as unrelated to peritonitis.

F/M, female/male; IP, intraperitoneal; CAZ, ceftazidime; P/T, piperacillin/tazobactam; PD, peritoneal dialysis; CAPD/APD, continuous ambulatory/automated PD; PET, peritoneal equilibration test; ESBL, extended-spectrum beta-lactamase.

Treatment completion and catheter outcomes

All 13 (100.0%) episodes completed the three-lock schedule and the reported antibiotic course, with recorded clinical resolution and catheter retention during active infection. Treatment completion and catheter retention were observed outcomes, not eligibility criteria, and no treated episode was excluded on the basis of these outcomes. The exact 95% CI for catheter retention was 75.3%-100.0%. Mild transient

abdominal pain or burning during hospital lock administration was documented by nursing and medical staff in seven (53.8%) episodes and resolved spontaneously. No episode required discontinuation of the lock protocol. No associated exit-site infection or infection-related technique failure was reported. These findings describe documented tolerability in this cohort; retrospective records do not provide comprehensive prospective safety surveillance.

At the original September 1, 2026 administrative cutoff, 12 (92.3%) of the 13 episodes had at least 28 days of observation after antibiotic completion. Relapsing or recurrent peritonitis was reported in 0 (0.0%) of these 12 episodes; the upper limit of the two-sided exact 95% CI was 26.5%. E01 had 40 days of follow-up from onset to the cutoff, without a documented complete four-week window after antibiotic completion, and was excluded from this endpoint.

No further peritonitis of any cause, including repeat same-organism infection, was reported during the observation periods included in the original analysis: 0 (0.0%) of 13 episodes. This descriptive count includes unequal observation periods and is not an incidence rate or a time-to-event estimate.

At the time of manuscript revision, additional follow-up after the original administrative cutoff was available for E01. This patient subsequently completed the four-week post-antibiotic surveillance schedule, including weekly effluent leukocyte counts and cultures, with continued clinical resolution and no further peritonitis. A post-peritonitis PET performed on October 15, 2026, 84 days after episode onset, showed an unchanged high-average transport category. These observations are reported separately as a post-cutoff clinical update and were not incorporated into the original four-week endpoint analysis, the paired PET analysis at the cutoff, or the follow-up summaries in the tables and figures.

Follow-up and peritoneal function

Median observed follow-up was 241 days (IQR, 147-293; range, 40-419). At the cutoff, 11 (84.6%) of 13 patients were reported to remain on the same PD modality and prescription. One (7.7%) stopped PD after 293 days because a caregiver was unavailable; one (7.7%) died after 172 days from a stroke reported as unrelated to peritonitis. Both had achieved clinical resolution without a reported subsequent infection before observation ended. Figure *2* shows the observed follow-up durations.

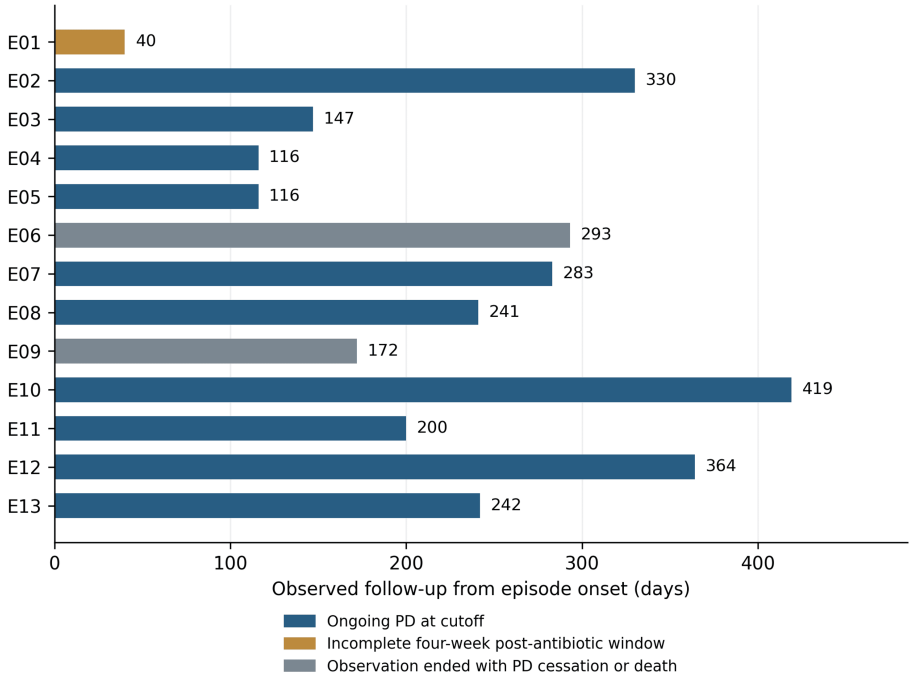


FIGURE 2: Observed follow-up of the current episodes

Observed follow-up from episode onset for each of the 13 patients. Blue indicates ongoing peritoneal dialysis (PD) at the September 1, 2026 administrative cutoff. Orange identifies E01, who remained on PD but lacked a documented complete 28-day observation period after antibiotic completion and was excluded from the four-week infection endpoint. Gray identifies observation ending because of caregiver-related PD discontinuation (E06) or death from a stroke reported as unrelated to peritonitis (E09). Bar labels indicate days. This chart describes individual observation periods and is not a survival analysis.

Post-peritonitis PET was available for 12 (92.3%) of the 13 patients at the administrative cutoff; E01 had not yet undergone reassessment. The transport category was unchanged in all 12 evaluable patients (100.0%; exact 95% CI, 73.5%-100.0%). Among these 12 patients, categories were high in one (8.3%), high-average in five (41.7%), low-average in three (25.0%), and low in three (25.0%). These categorical findings do not establish quantitative equivalence of membrane function or exclude subclinical injury.

Discussion

What the new episodes contribute

The current observations describe adjunctive lock treatment in all 13 PD-associated peritonitis episodes recorded at our center during the study period. The three-lock schedule was completed in all episodes, and catheter retention accompanied recorded clinical resolution in all 13. Completion and retention were observed outcomes, not conditions for inclusion. Nevertheless, treatment was clinician-directed, and the absence of a comparator prevents estimation of its incremental benefit. The organism mix included infections that commonly respond to appropriate antibiotics alone. The absence of relapsing or recurrent events in 12 evaluable episodes at the original administrative cutoff is imprecise: the upper exact CI limit of 26.5% remains compatible with a clinically relevant underlying risk. These findings support feasibility observations rather than an inference of efficacy.

Comparison with the earlier experience at our center

Our earlier publication described 13 episodes treated in 2022-2024, with catheter retention in 13 (100.0%) and transient discomfort in eight (61.5%) [15]. In the current 2025-2026 series, the corresponding observations were 13 (100.0%) and seven (53.8%). The earlier cohort was described as comprising infections caused by multidrug-resistant organisms or culture-negative peritonitis [15], whereas the current series included first episodes and a broader microbiological spectrum. The administration sequence also differed: the earlier publication described instillation after drainage of dialysate, whereas the current procedure was performed with antibiotic-containing dialysate remaining in the abdomen [15]. The populations and procedures therefore differ, and the earlier cohort is not a historical control. These differences, together with clinical treatment selection and unequal follow-up, prevent causal comparisons between the two periods. The reports describe continued experience within the same program, not independent replication or evidence of improvement over time.

Viewed together, the two separately reported series show the continuation of the center's clinical experience across different periods and microbial presentations. The current report adds individual follow-up durations, transparent four-week evaluability, routine PET category reassessment, and explicit accounting for noninfectious PD discontinuation. Previously published observations are confined to this contextual discussion; no combined success percentage, CI, incidence rate, or pooled efficacy analysis is presented.

One patient treated for an *Escherichia coli* episode in the earlier period later developed infection with methicillin-resistant *Staphylococcus cohnii* subsp. *urealyticus*, represented by E05 in the current dataset, and the same catheter was reportedly retained again. The current episode is counted once in this analysis. This individual experience illustrates continued use of adjunctive lock treatment but also shows that an initial favorable response should not be interpreted as protection from all future peritonitis. Historical PET reassessments were described as qualitatively comparable to baseline but were performed on varying schedules; they cannot be combined with current categorical observations to establish membrane protection.

Biological rationale and limits of inference

Biofilm formation is biologically plausible for several organisms encountered in PD infections. Clinical coagulase-negative staphylococci can form biofilm [16], as can non-diphtheriae *Corynebacterium* isolates [17]. Experimental observations on PD-catheter material support this mechanism for *Pseudomonas aeruginosa* [7], and catheter-associated structures interpreted as biofilm have been described in refractory clinical infection [18]. However, no catheter segment or isolate-level biofilm assay was examined in the present series. Organism identity and culture negativity alone cannot demonstrate a biofilm reservoir or its eradication.

Maintaining antibiotic-containing dialysate in the peritoneal cavity during lock administration was a deliberate component of the treatment strategy. The rationale was to maintain intraperitoneal antibiotic exposure, guided by susceptibility results when available, while administering taurolidine-citrate-urokinase into the catheter lumen to target a possible catheter-associated microbial reservoir. We hypothesized that the antimicrobial activity of taurolidine, together with urokinase-mediated disruption of fibrin-associated deposits, might facilitate antibiotic access to biofilm-associated microorganisms. Experimental findings on PD-catheter material provide indirect support for investigating this approach [7]. However, improved antibiotic penetration, biofilm disruption, and pharmacological synergy were not measured in this series and remain proposed mechanisms rather than demonstrated effects.

The presence of dialysate introduces uncertainty regarding intraluminal exposure. Using fluoroscopic

contrast observations, Wong and colleagues reported rapid dispersion of a lock solution in the presence of dialysate and greater intraluminal retention with an empty abdomen [19]. Although their formulation differed from ours, these findings raise a relevant concern about dilution and loss of sustained catheter exposure. Preliminary measurement of catheter filling volume does not establish confinement of the solution after instillation. Because dispersion and drug concentrations were not measured, the prescribed interval of at least three hours before drainage cannot be interpreted as confirmed intraluminal residence time. Distribution, antibiotic compatibility, and the comparative effects of full- and empty-abdomen administration require direct investigation; the observed clinical outcomes do not establish the anatomical site of drug action or validate the administration sequence.

Taurolidine has antimicrobial activity, citrate has anticoagulant properties, and urokinase is fibrinolytic. These functions provide a rationale for investigation, not proof of synergy. The contributions of the three components cannot be separated in an uncontrolled series receiving concurrent antibiotics. Randomized studies of intraperitoneal urokinase summarized in the ISPD guideline did not demonstrate improved major outcomes [1]. Their route and formulation differ from the present intraluminal strategy, but the results argue against assuming an independent clinical benefit from urokinase.

Associated exit-site and tunnel infections require management according to the ISPD catheter-related infection recommendations [20].

Relationship to other clinical reports

Published PD experience remains small and heterogeneous. Klimek and colleagues reported responses in four (80.0%) of five patients, with catheter removal in the remaining one (20.0%) [9]. Sosa Barrios and colleagues described favorable responses in five (83.3%) of six patients and a same-organism relapse in one (16.7%) [10]. Alvarez Nadal and colleagues reported a *P. aeruginosa* case with prolonged relapse-free follow-up after a nine-dose course [11]. These latter reports share investigators and may contain overlapping clinical experience; they should not be summed as independent cohorts without confirmation. Rycen and colleagues described continued home PD without further peritonitis two years after a different taurolidine-citrate regimen [13]. Differences in case selection, organisms, formulations, administration schedules, and follow-up prevent a pooled treatment-effect interpretation.

These reports provide clinical context but cannot serve as matched control groups for the current series. No institutional comparator cohort treated without the lock was analyzed. Catheter preservation can help sustain home therapy, but this study cannot determine how many removals were avoided because of the lock. Stable PET categories are also useful follow-up observations, yet do not establish membrane safety, protection, or preserved ultrafiltration. Quantitative paired measurements and standardized timing are required to evaluate these questions.

Clinical boundaries and study limitations

This small, retrospective, single-center series lacks a comparator group and standardized prospective outcome and safety assessment. Although all 13 peritonitis episodes recorded in the unit during the study period were included, treatment decisions remained clinician-directed, and the findings may not apply to patients requiring urgent catheter removal. Concurrent antibiotic treatment prevents attribution of the observed outcomes to the lock or its individual components. Initial effluent leukocyte counts were reported as above 1,000 cells/µL in all episodes, with more than 60% polymorphonuclear leukocytes, and follow-up cell-count assessments were reported as normalized by day 5. However, individual numerical trajectories were not extracted, limiting quantitative assessment of baseline severity and response. Detailed prior peritonitis histories, PD vintage, individual catheter lengths, the actual days of lock administration relative to antibiotic initiation, and the duration of exposure to each antibiotic before and after any change were not systematically extracted for this analysis. The ISPD medical-cure composite was not formally adjudicated; clinical resolution, catheter retention, and subsequent peritonitis were reported separately. Exact instillation and drainage times were not recorded, preventing retrospective verification of the prescribed minimum three-hour interval. Retrospective nursing and medical documentation may have missed adverse events.

Follow-up was unequal, and observation ended for noninfectious reasons in two patients. At the original administrative cutoff, E01 had neither completed the four-week post-antibiotic observation period nor undergone post-peritonitis PET, leaving 12 evaluable patients for each analysis. Subsequent observations for E01 are reported separately and do not change those denominators or CIs. PET assessment was limited to transport categories, without paired numerical D/P creatinine or ultrafiltration measurements. Reassessment occurred at least 30 days after clinical resolution, but individual pre- and post-episode PET intervals were not systematically extracted. Stable categories cannot exclude smaller functional changes or establish membrane safety. These limitations restrict interpretation to observed feasibility and clinical outcomes under the combined treatment strategy.

Future studies should prospectively specify selection criteria, baseline severity, the entire eligible population, lock volume and disposal, antibiotic exposure and subsequent adjustments, microbiological

outcomes, adverse-event ascertainment, and quantitative membrane assessments. Drug distribution and compatibility require direct investigation. Comparative designs should evaluate the incremental contribution of the lock, account for repeated episodes and treatment discontinuation, and use consistent post-antibiotic and longer-term follow-up windows.

Conclusions

In this retrospective series of all 13 PD-associated peritonitis episodes recorded at our center during the study period, adjunctive taurolidine-citrate-urokinase treatment was completed in all episodes and was accompanied by recorded clinical resolution with catheter retention. These observations describe treatment delivery and subsequent clinical course under concurrent intraperitoneal antibiotic therapy. They do not establish an incremental benefit of the lock, sustained intraluminal exposure, biofilm eradication, or peritoneal membrane safety. Prospective comparative studies with standardized eligibility criteria, outcome documentation, and assessment of drug distribution are needed. This off-label approach must not delay catheter removal when indicated.

Additional Information

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All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Disclosures

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