CLINICAL INVESTIGATION

Antibiotic availability for outpatient treatment of acute peritonitis in chronic peritoneal dialysis patients: A case series

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ABSTRACT

Background: Peritoneal dialysis (PD) is a commonly used form of renal replacement therapy for patients that have reached end-stage renal disease. Acute bacterial peritonitis (ABP) in chronic PD patients results in pain, increased costs, injury to the peritoneal membrane, and PD modality failure. Optimal antibiotic treatment of acute bacterial peritonitis (ABP) in chronic PD patients should be intraperitoneal, outpatient-based, appropriate, prompt, and uninterrupted. We investigated the frequency of and predisposition to suboptimal antibiotic courses for ABP in our chronic PD patients.

Methods: Twenty-four charts of patients with ABP were reviewed, to test the null hypothesis that all ABP patients received antibiotics optimally.

Results: After 12 patient exclusions (hospitalization), 9 suboptimal antibiotic events were detected in 6 of the remaining 12 patients, disproving the null hypothesis ($p < 0.02$). Most suboptimal antibiotics courses (7 of 9) resulted from delays and/or gaps in therapy or antibiotics prescribed outside of community standard. Suboptimal antibiotic events occurred on nights and weekends rather than during the workweek ($p < 0.02$) and in the emergency room rather than the PD clinic ($p < 0.02$).

Conclusions: Suboptimal ABP antibiotic therapy occurs commonly and is influenced by time and location of presentation and lack of knowledge by patients and physicians. Prevention of suboptimal antibiotic courses in the treatment of ABP in chronic PD patients includes education of patients and providers and allowing emergency rooms and PD clinics to dispense antibiotics for home use.

Keywords: Peritoneal dialysis; Antibiotic therapy; Acute bacterial peritonitis+. **[Am J Med Sci 2022;■(■):1–7.]**

INTRODUCTION

Peritoneal dialysis (PD) is an effective home-based renal replacement modality for patients with end stage kidney disease. The peritoneal lining functions as the semipermeable membrane for dialysis, once PD fluid is instilled into the peritoneal space via an indwelling catheter. PD is the dialysis modality for approximately 11% of the global dialysis population. Acute bacterial peritonitis (ABP) is a common complication of PD, usually presenting with cloudy PD effluent and abdominal pain. Although ABP episodes rarely result in death, severe or prolonged infection may cause peritoneal membrane failure and in fact is the main reason for change in dialysis modality from PD to in-center hemodialysis.[1–3] Best practice guidelines recommend intraperitoneal as the preferred route of antibiotics for the treatment of ABP. Unless features of sepsis or intractable pain are present, ABP should be treated on an outpatient basis. Once a sample of dialysis effluent has been collected in the peritoneal dialysis clinic (PDC) or the emergency room (ER) and sent for analysis, intraperitoneal antibiotics should be administered without delay, with daily antibiotic therapy to continue for 14–21 days, depending upon the organism cultured.

Unfortunately, there are barriers to expeditious diagnosis and treatment of ABP. Diagnosis may be delayed and/or inaccurate if patients do not realize that they have acquired ABP or if they live far from their PDC or an ER. We are particularly interested in barriers to prompt and continuous outpatient treatment of ABP, once PD fluid analysis and clinical evaluation have suggested the diagnosis of ABP. In our local health care system, we have observed a number of episodes of suboptimal outpatient intraperitoneal antibiotic treatment, after patients have presented with cloudy PD fluid and abdominal pain to a PDC or ER. However, it is unclear how common these episodes are and what clinical factors predispose to them. Clinical relevance is high, in that delayed, discontinuous, or inappropriate intraperitoneal antibiotic therapy predisposes to prolonged pain, increased risk of bacteremia, sepsis, death, prolonged peritoneal inflammation, scarring of the peritoneal membrane, PD modality failure, and excessive medical costs.

To determine the frequency of chronic PD patients not receiving appropriate outpatient intraperitoneal antibiotics for ABP promptly and consistently, as well as to assess the risk factors for these inconsistencies, we reviewed all cases of ABP from a single PDC over a 17-month period. We tested the null hypothesis that all chronic PD patients with ABP received appropriate outpatient intraperitoneal antibiotics promptly upon presentation to the PDC or ER with subsequent continuous (ie daily) therapy on an outpatient basis, without gaps in therapy for the entire prescribed length of therapy. To our knowledge, this type of analysis has not been performed previously.

METHODS

Patient selection

We reviewed every case of ABP from January 2020 through May 2021 for this single-center study. Our PDC had a variable census during that time interval of 40 to 60 patients. Our PDC is a cooperative effort between Dialysis Clinic Incorporated (Nashville TN) and the Division of Nephrology at our institution (Medical University of South Carolina) in Charleston. The PDC is located 19 miles west of our institution. We used the International Society of Peritoneal Dialysis definition of ABP in our study: abdominal pain with hazy or cloudy PD effluent, greater than 100 nucleated cells/mm^3, and greater than 50% of nucleated cells being polymorphonuclear leukocytes. Virtually all patients were maintained on nighttime cycler PD, with day-time dwells included if necessary to achieve clearance targets for urea nitrogen.

Exclusion criteria

Patients with ABP were excluded from analysis if patient age was less than 18 years or if they were admitted to the hospital for intractable pain or concern for sepsis (hemodynamic instability). We excluded hospitalized patients because: (1) our study focused on intraperitoneal antibiotic availability in the outpatient setting, and (2) antibiotics are readily administered in the inpatient setting.

Suboptimal intraperitoneal antibiotic course (SIPAC)

For the purpose of our study, we defined a SIPAC as an intraperitoneal antibiotic course that was: substandard, delayed, non-continuous, excessively costly because of inappropriate hospitalization, and/or initiated outside the scope of nursing practice. Prior to the initiation of the chart review, we conceived of 6 specific SIPACs, which are listed in Table 1. Our rationale for each of the 6 being suboptimal are included here. *Dispensing of antibiotics by a PD nurse for patient intraperitoneal self-administration at home* was considered suboptimal because medication dispensing by nurses is not consistent with state statute in 46 out of 50 states in the United States. In most states, including South Carolina, where our research was conducted, medication dispensing may be performed by physicians, pharmacists, and advanced practice providers but not nurses. *A PDC nurse coming to the PDC on a night or weekend to administer intraperitoneal antibiotics* was considered suboptimal because of safety issues (a nurse alone in the clinic) and potential for nurse burn-out (the stress of working on nights or weekend days). *Admission of patients to the hospital solely for intraperitoneal antibiotic treatment* was considered suboptimal due to increased cost. *An alteration in antibiotic regimen from that desired by the nephrologist to a regimen easier to achieve in the outpatient setting* was considered suboptimal because antibiotics should be selected for efficacy rather than convenience. *A delay/gap in intraperitoneal antibiotic treatment was considered suboptimal* because pain, bacteremia, sepsis, and peritoneal membrane injury could result. *Prescription of antibiotics outside of community standard by the nephrologist* was considered suboptimal because of risk of delayed recovery or poor outcomes. In general, the 6 SIPACs in our study covered the areas of patient non-compliance, lack of patient knowledge, lack of physician (nephrologists and non-nephrologists) knowledge, systems issues, excess cost, nursing overreach, nurses' safety, nurses' job satisfaction, and legal complexity.

Table 1. SIPACs (suboptimal intraperitoneal antibiotic courses).

Dispensing of antibiotics by a PD nurse for patient intraperitoneal self-administration at home
A PDC nurse coming to the PDC on a night or weekend to administer intraperitoneal antibiotics
Admission of the patient to the hospital solely for intraperitoneal antibiotic treatment
An alteration in antibiotic regimen from that desired by the nephrologist to a regimen easier to achieve in the outpatient setting
A delay/gap in intraperitoneal antibiotic treatment
Prescription of antibiotics outside of community standard by the nephrologist

Statistical considerations

Data were expressed as number of patients (% of patients) or mean ± standard deviation. We used the Fisher's Exact Test to test the null hypothesis as well as frequency difference between groups and the 2-sided Student's *t*-test to compare numerical data means, with significance at the level of 0.05.

RESULTS

During the time frame of our study, we identified 24 patients with ABP. Twelve were excluded from this study, 11 because of hospitalization for suspected sepsis and 1 because of hospitalization for extracellular fluid overload. Of the remaining, non-excluded 12 patients, 6 received intraperitoneal antibiotics appropriately on presentation and during the subsequent treatment course, and the other 6 did not; ie SIPAC events occurred. Nine SIPAC

Table 2. Patient demographic data and laboratory values for SIPAC and non-SIPAC patients.

Parameter	Non-SIPAC Patients	SIPAC patients	P value
Number of patients	6	6	NS
Age (years)	52 ± 19	44 ± 9	NS
Male sex	6 (100)	2 (33)	NS
Race	White 2 (33)	White 3 (50)	NS
	AA 2 (33)	AA 3 (50)	
	Asian 2 (33)		
Cause of kidney failure	DM 2 (33)	DM 1 (17)	NS
	LN 1 (17)	ADPKD 1 (17)	
	IgAN 2 (33)	HTN 2 (33)	
	FSGS 1 (17)	FSGS 1 (17)	
		OU 1 (17)	
Vintage (months on PD)	27 ± 21	27 ± 18	NS
Location of presentation with ABP	PDC 6 (100)	ER 5 (83)	< 0.02
		PDC 1 (17)	
Distance from home to site of presentation (miles)	17 ± 7	31 ± 43	NS
Time of day/week of presentation (workday vs night/weekend)	Workday 6 (100)	Workday 1 (17)	< 0.02
		Night/weekend 5 (83)	
Nucleated cell count (per mm^3)	2411 ± 1802	5997 ± 7700	NS
Bacterial organism			
	Culture neg 2 (33)	Culture neg 3 (50)	
	M abscessus 2 (33)	*Serratia* 1 (17)	
	Enterobacter 1 (17)	*E coli* 1 (17)	
	Enterococcus 1 (17)	*Coag neg Staph* 1 (17)	NS

Data are presented as number of patients (% of patients) or mean ± SD.
Abbreviations: AA, African American; ADPKD, autosomal dominant polycystic kidney disease; DN, diabetic nephropathy; FSGS, focal segmental glomerulosclerosis; HTN, hypertensive nephrosclerosis; IgAN, IgA nephropathy; LN, lupus nephritis; Neg, negative; OU, obstructive uropathy; SIPAC, suboptimal intraperitoneal antibiotic course; PDC, peritoneal dialysis clinic; ER, emergency room.

events occurred in these 6 patients. This unexpectedly high rate of SIPAC was statistically positive by the Fisher Exact Test at $p < 0.02$, in that the null hypothesis stated that all patients with ABP received their intraperitoneal antibiotics promptly, continuously, appropriately, and in abidance with legal statutes. Therefore, we disproved the null hypothesis. Table 2 displays the baseline demographics and laboratory values at the time of ABP for SIPAC and non-SIPAC patients. We found no differences between the SIPAC and non-SIPAC patients with regards to age, sex, race, PD vintage, cause of kidney failure, distance from home to PDC, peritoneal cell count, and organisms causing ABP. However, we found that, compared to non-SIPAC patients, patient with SIPAC events were more likely to present to a medical location with symptoms of ABP on nights and weekends rather than during workweek hours ($p < 0.02$) and to the ER rather than to the PDC ($p < 0.02$). Each of the 9 SIPAC events in 6 patients is briefly described below. The reader is encouraged to refer to the list of potential SIPAC events in Table 1 and the rationales for defining each of the 6 SIPACs as suboptimal in the Methods section above.

Case 1

A 49-year-old female noted symptoms of ABP on a Saturday but did not call her PDC until Sunday. She was told to take oral trimethoprim-sulfamethoxazole at home and to come into her PDC on Monday, when PD effluent samples were submitted and intraperitoneal vancomycin was administered. *Serratia marcescens* was cultured and her symptoms worsened, prompting presentation to the ED on the following day. This episode was a SIPAC event because of "*a delay/gap in intraperitoneal antibiotic treatment*" and "*prescription of antibiotics outside of community standard by the nephrologist.*"

Case 2

A 55-year-old male presented to the ER on a Sunday with symptoms of ABP. He was administered intraperitoneal gentamycin and vancomycin for a 6 h dwell, with instructions to return to PDC the following day (Monday) for additional antibiotics. Unfortunately, the patient did not present to the PDC on the following day but instead waited until Tuesday. This episode was a SIPAC event because of "*a delay/gap in intraperitoneal antibiotic treatment.*"

Case 3

A 52-year-old female presented to the ER on a Friday with symptoms of ABP. The patient was stable, not septic-appearing, and without intractable pain. However, the patient was admitted to the hospital to receive

intraperitoneal antibiotics over the weekend. This episode was a SIPAC event because of "*admission of the patient to the hospital solely for intraperitoneal antibiotic treatment*."

Case 4

A 40-year-old male presented to his PDC on a Thursday with symptoms of ABP. On this day and the next day, intraperitoneal gentamycin and cefazolin were administered in the PDC. However, antibiotics for the weekend had not arrived from the pharmacy by the end of the workweek on Friday, and the PDC nurse came to the PDC on Saturday and administered more intraperitoneal antibiotics. The patient did not receive intraperitoneal antibiotics on Sunday but was able to receive the rest of the daily intraperitoneal antibiotics on Monday and subsequent days. This episode was a SIPAC event because of "*a PDC nurse coming to the PDC on a night or weekend to administer intraperitoneal antibiotics*" and "*a delay/gap in intraperitoneal antibiotic treatment.*"

Case 5

A 38-year-old female presented to an outside ER with symptoms of ABP on a Tuesday. PD fluid was obtained for analysis, but she did not receive intraperitoneal antibiotics and was not discharged with any. It is unclear why the ER physician chose not to treat for peritonitis. She presented to her PDC on the following day for repeat PD fluid analysis and intraperitoneal antibiotics. This episode was a SIPAC event because of "*a delay/gap in intraperitoneal antibiotic treatment.*"

Case 6

A 32-year-old female presented to the ER on a Tuesday at 2:00 AM with symptoms of ABP. The on-call nephrologist, who was a first-year fellow, recommended intravenous vancomycin and cefepime for the sake of convenience. Given that the patient was stable, she was discharged and then followed up the next morning at her PDC, where she received intraperitoneal antibiotics. This episode was a SIPAC event because of "*a delay/gap in intraperitoneal antibiotic treatment*" and "*prescription of antibiotics outside of community standard by the nephrologist.*"

DISCUSSION

Restatement of results

Of the 12 patients on chronic PD with ABP not excluded from our study, 6 of them experienced 9 SIPAC events: 1 for the PDC nurse coming into the PDC over the weekend to administer intraperitoneal antibiotics, 1 for a patient being admitted to the hospital solely for intraperitoneal antibiotic treatment, 2 for the nephrologist prescribing antibiotics outside of community standard, and 5 for a delay or gap in intraperitoneal antibiotic treatment. There was no predilection to SIPACs based on patient age, sex, race, cause of renal failure, PD vintage, bacterial organism cultured, distance from the patient's home to the site of presentation, and severity of APB (nucleated cell count in PD fluid as surrogate). SIPACs were more likely to occur if patients presented to an ER rather than to a PDC ($p < 0.02$) and if patients presented with ABP during nights/weekends rather than during workday hours (9 am–5 pm), $p < 0.02$.

Comparison of our results to those from the literature

To the best of our knowledge, this is the first study assessing outpatient intraperitoneal antibiotic availability for ABP in chronic PD patients, including the risk factors for suboptimal therapy. In our study only 1 patient was hospitalized solely for intraperitoneal antibiotic administration. In a single-center retrospective study of incident PD patients over a 6-year period in France, peritonitis was the cause of hospitalizations in 30% of cases, and all hospitalizations were for treatment of ABP, even though very few of these patients were clinically unstable.[4] In our PDC and hospital system, PD patients with ABP are admitted to the hospital only with intractable pain and/or unstable systemic hemodynamics.

In our study, we found that SIPAC events were more likely to occur on nights and weekends rather than during workweek hours and after presentation to the ER rather than to the PDC. In the prospective, multicenter Prompt Study,[5] it was found that contact-to-treatment time, defined as the time from health care presentation to initiation of antibiotic, was positively associated with PD modality failure. Contact-to-treatment times were longer in ERs compared to PDCs, and presentation to a hospital was independently associated with PD failure, whereas presentation to a community-based home dialysis facility was not. The Prompt Study suggested that a major contribution to poor PD outcome is delay in starting antibacterial therapy, with each hour of delay increasing PD failure by 6.8%. In contrast to our study, the Prompt Study did not show an association between presentation outside of working hours and PD failure. Our study's results are relevant to those from the Prompt Study, in that a delay or gap in intraperitoneal antibiotic therapy was the most common SIPAC. We suspect that PDCs achieve better antibiotic availability than ERs because the waiting times to see the ER doctor is longer than those to see the PDC nurse, the PDC nurses are more familiar with treatment of peritonitis than ER staff, and the PDC nurses but not ERs have protocols for antibiotic therapy of ABP.

Clinical significance of SIPAC events

Of the 12 patients included in the study, 6 of them experienced SIPAC events, which was a far higher rate than we expected. In 1 of our patients (Case 1), oral antibiotics were administered initially to treat ABP, and in another patient (Case 6), intravenous rather than

intraperitoneal administration of antibiotics was initiated. In a systematic review and meta-analysis, intraperitoneal antibiotic administration for ABP was found to be more effective and safer than intravenous antibiotic administration.[6] Another patient (Case 3) without intractable pain or hemodynamic instability was admitted to the hospital for intraperitoneal antibiotic therapy, which would result in increased healthcare costs (see next paragraph) and the potential for nosocomial infections. Our most commonly observed SIPAC was delayed or interrupted intraperitoneal antibiotic therapy. Such events may contribute to increased morbidity, including sepsis, catheter revision due to colonization, increased risk of antibiotic resistance, and inflammation/fibrosis of the peritoneal membrane. Fibrosis of the peritoneal membrane predisposes to PD failure and transfer from PD to in-center hemodialysis, which is unfortunate, since several studies have suggested that PD patients report a better quality of life than hemodialysis patients.[7,8]

Financial considerations

It is estimated that the cost of managing dialysis-dependent patients represents 2–3% of the budget allocated to health in developed countries.[9,10] Similarly, total Medicare-related expenditures for dialysis patients rose to $49.2B in 2018.[11] In our study, we observed 1 SIPAC for unnecessary hospitalization for intraperitoneal antibiotic therapy. Clearly, cost of outpatient intraperitoneal antibiotic therapy for ABP is much less than that for inpatient care antibiotic therapy. Delays or gaps in therapy with intraperitoneal antibiotics or treatment with incorrect antibiotics could result in morbidity, such as increased pain, sepsis, inflammation and fibrosis or the peritoneal membrane, and PD failure with switch to in-center hemodialysis, all of which would increase cost of medical care. Patients who incur a modality switch from PD to in-center hemodialysis have been shown to have higher rates of hospitalization days. PD technique failure increases hospitalization (approximately 9 more days per year), with attendant increase in cost.[12–14] Chui et al. found that technique failure added $7972 for inpatient costs at 1 year.[13]

In July of 2019 in the United States, the White House and the Department of Health and Human Services unveiled the Advancing American Kidney Health Initiative. In this ambitious executive order, 1 of the goals set was for 80% of new American kidney failure patients to receive dialysis in the home or receive a transplant by 2025. Therefore, more patients will be started on PD with fewer started on in-center hemodialysis for renal replacement therapy in the upcoming years. PD has been shown to be significantly less expensive overall than in-center hemodialysis, since the latter requires more personnel with higher consequent salary costs. Annual health care costs of patients on in-center hemodialysis are $15,000 to $30,000 higher compared to those on PD.[15] Furthermore, increasing use of PD has been estimated to lead to an annual cost savings of up to 40% compared to in-center hemodialysis.[10] Therefore, if more patients are started on PD rather than in-center hemodialysis due to the new initiative and if suboptimal antibiotic availability to treat ABP predisposes to PD failure, then health care costs after these patients transition to in-center hemodialysis will inevitably increase. Therefore, proper and appropriate intraperitoneal antibiotic therapy will help control health care costs.

Limitations of this study

Our research is a small, single-center study. Being that this is, to our knowledge, the first study of its kind, studies with more patients and in different geographies are needed to determine if our results are generalizable. On the other hand, our study is generalizable in that South Carolina, where our research was conducted, is one of the 46 states (ie greater than 90% of the 50 states) in which nurses are not allowed to dispense medications. Additional studies would allow further definition of the prevalence, risk factors, and solutions to suboptimal outpatient intraperitoneal antibiotic therapy for ABP. A larger study may have demonstrated particular SIPAC events which we did not conceive of or observe. We thought a priori that SIPACs might occur when PDC nurses dispensed antibiotics to the patients for them to self-administer at home or when nephrologists in the ER changed their selections of intraperitoneal antibiotics to a second-line but more convenient therapy for home usage, but we did not observe either of these SIPACs. Another limitation is that this was a retrospective observational study; we the investigators were not on site at the times of presentation to directly interview the providers and/or nurses. Follow-up was done by telephone calls to the PD nurses or nephrologists involved in the cases and by chart review. Thus, information collected hours, days, or weeks later, such as the rationale for antibiotic use, may have been incomplete and/or not completely accurate.

What changes should be made

In this study, the most common SIPAC events were delays/gaps in intraperitoneal antibiotic treatment (5 instances). Certain barriers to prompt and continuous intraperitoneal antibiotic therapy need to be addressed to help eliminate these occurrences. Because PD patients perform their own PD at home, they are in general more self-sufficient and health-care literate than in-center hemodialysis patients. However, Case 1 and Case 2 (see Results section above) demonstrate that PD patients may not understand the importance of immediate presentation to a medical facility when symptoms of ABP arise and of continuous (ie daily) intraperitoneal antibiotic therapy to achieve optimal outcomes. Education of PD patients on an ongoing basis in the PDC and acutely by the nephrologist in the ER is essential for preventing delays or gaps in intraperitoneal antibiotic therapy.

One common scenario that results in a gap in treatment is when patients present to their PDC or an ER with

symptoms of ABP, receive empiric treatment with intraperitoneal antibiotics, and are then discharged to home with instructions to follow up at the PDC on the next day. This works well if the initial encounter occurs on Sunday through Wednesday, since the PDC will be open on Monday through Friday for formulation and execution of the treatment plan. If the initial presentation occurs at an ER, it would be helpful if the ER staff or the nephrologist consulted in the ER were to call the PDC on the following day to alert the PDC staff about the ABP episode to ensure proper follow-up and expedite the antibiotic order from the pharmacy. When a patient with ABP is seen in the PDC on the day after initial presentation, another dose of intraperitoneal antibiotics is administered, and PDC nurses order antibiotics to be sent from the Dialysis Clinic Incorporated pharmacy (Nashville TN), which arrive to the PDC 2 days later. The sealed mailing packages containing antibiotics are handed to the patients to take home; in this way, the PDC acts as a post office rather than as a dispensing clinic. Thus, the patient must visit the PDC on the third day, ie on the day when the antibiotics are in the mail, for more intraperitoneal antibiotic administration. This sequence is a burden if the patients live far from their PDCs. Additionally, if this sequence runs into a Saturday (eg initial presentation on Thursday, PDC visit on Friday, need for antibiotics administration or pick-up on Saturday), a logistical problem arises, since PDC units are closed on Saturday. Sometimes, devoted PDC nurses meet the patients at the PDC on weekend days to administer more intraperitoneal antibiotics (Case 4 above), but this is not optimal due to nurse burnout or lack of safety for the nurse. These issues could be obviated if an outpatient pharmacy, ER, or PDC were allowed to dispense a course of intraperitoneal antibiotics for the patients to self-administer at home, under a protocol created by the nephrologist as medical director, but this sequence has not occurred in our area. ERs and pharmacies do not routinely dispense antibiotics for parenteral use, and nurses at PDCs are allowed by state law to administer but not to dispense antibiotics in most (46 of 50 states) of the United States.[16] It may take a petition of state legislatures by health policy-motivated nephrologists to change medication-dispensing practices to achieve the abovementioned goal. In anticipation of these barriers, some programs send their patients home after the completion of PD training with a “peritonitis kit”, containing antibiotics for intraperitoneal use. However, such a system has distinct disadvantages, such as surpassing expiration dates and inability of the nephrologist to tailor antibiotics for the suspected type of peritonitis. Thus, we do not utilize such kits in the Charleston SC area.

Two SIPAC events occurred when nephrologist prescribed antibiotics outside of community standard. Intravenous antibiotic administration may be easier to accomplish in the ER, rather than the more difficult logistic of summoning a PD nurse from a floor ward for intraperitoneal antibiotic administration. However, intravenous antibiotics are less efficacious than intraperitoneal antibiotics for the treatment of ABP.[6] As mentioned above with regards to gaps in the antibiotic course, education (nephrology fellows by their training programs and ER staff by nephrologists) is vital for prevention of non-intraperitoneal or suboptimal intraperitoneal antibiotic prescription. Indeed, 1 study cited concerns that many United States nephrology training programs either do not have an appropriate number of PD patients or do not allocate appropriate time to ensure the preparedness of fellows in providing independent care for patients undergoing PD.[17] Going forward, more thorough PD training should be implemented.

ETHICAL APPROVAL

Ethical approval has been provided by the IRB of the Medical University of South Carolina

ACKNOWLEDGMENT

We thank the nursing staff of our PDC for their professional assistance with the care of our PD patients and Dr Wayne R Fitzgibbon for statistical assistance. There was no outside funding to support this research. Neither of the authors had a conflict of interest.

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Submitted February 18, 2022; accepted December 9, 2022.

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