STABILITY OF ANTIBIOTICS FOR INTRAPERITONEAL ADMINISTRATION IN EXTRANEAL 7.5% ICODEXTRIN PERITONEAL DIALYSIS BAGS (STAB STUDY)

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◆ **Background and objectives:** Patients with peritoneal dialysis (PD)-associated peritonitis may be advised to store PD-bags with pre-mixed antibiotics at home, although there is a paucity of antibiotic stability studies in the commonly used icodextrin solutions. The purpose of this study was to assess the stability of various antibiotics in PD-bags when stored at different temperatures over a 14-day period.

◆ **Methods:** 7.5% icodextrin PD-bags were dosed with gentamicin 20 mg/L ($n = 9$), vancomycin 1,000 mg/L ($n = 9$), cefazolin 500 mg/L ($n = 9$) and ceftazidime 500 mg/L ($n = 9$) as for intermittent dosing. Combinations of gentamicin/vancomycin ($n = 9$), cefazolin/ceftazidime ($n = 9$), and cefazolin/gentamicin ($n = 9$) were also tested. Nine drug-free bags were used as controls. Bags were stored in triplicate at 37°C, room-temperature (25°C), and refrigeration (4°C). Antibiotic concentrations were quantified at various time intervals using validated chromatography. Storage duration was considered unstable if the concentration of the antibiotic dropped $\leq 90\%$ of the initial value.

◆ **Results:** Gentamicin was stable for 14 days at all temperatures. Vancomycin was stable for 4 days at 37°C and for 14 days at both 25°C and 4°C. The gentamicin and vancomycin combination was stable for 4 days at 37°C and for 14 days at 25°C and 4°C. Cefazolin alone was stable for 24 hours at 37°C, 7 days at 25°C, and 14 days at 4°C. Ceftazidime alone was stable for only 6 hours at 37°C, 2 days at 25°C, and 14 days at 4°C. The cefazolin and ceftazidime combination was stable for 24 hours at 37°C, 2 days at 25°C, and 14 days at 4°C. The cefazolin and gentamicin combination was stable for 1 day at 37°C, 4 days at 25°C, and 14 days at 4°C.

◆ **Conclusions:** Antibiotics premixed in icodextrin PD-bags have varying stabilities with stability generally least at 37°C and best at 4°C, permitting storage for 14 days when refrigerated and pre-warming to body temperature prior to administration. Further research confirming the sterility of these antibiotic-containing bags is recommended.

KEY WORDS: Cefazolin; ceftazidime; vancomycin; gentamicin; peritonitis; stability.

Peritonitis is a major infectious complication in peritoneal dialysis (PD) patients and remains one of the main reasons for the transfer of patients from PD to hemodialysis (1). Intraperitoneal (IP) antibiotic therapy is preferred for the treatment of peritonitis as it ensures maximal antibiotic concentrations in the peritoneal cavity, which is the principal site of infection. In clinical practice, antibiotics are added to the PD solution and allowed to dwell in the peritoneal cavity for at least 6 hours.

Guidelines from the International Society for Peritoneal Dialysis (ISPD) advise empirical treatment to cover gram-positive and gram-negative organisms in PD-related peritonitis (2). Peritoneal dialysis centers administer a first generation cephalosporin such as cefazolin or vancomycin in combination with either gentamicin or ceftazidime for empiric or directed coverage of both gram-positive and gram-negative organisms. Patients are often required to complete a 2–3 week course of IP antibiotic therapy at home. Some patients can be trained to add the antibiotics to their PD bags themselves immediately prior to their dialysis exchange; however for many patients, the antibiotics need to be pre-added to the PD bags by nurses and then stored at the patient's home until they are used. In the absence of robust stability data, this may necessitate regular home nursing visits for administration of antibiotics into PD bags, representing significant staffing and transportation costs.

Icodextrin is a starch-derived glucose polymer that is used as an alternative to glucose in PD solutions. Extraneal (Baxter Healthcare Pty Ltd., New South Wales, Australia) is a 7.5% icodextrin solution currently used worldwide among PD patients, especially for long dwells during the day in automated PD (APD) patients, or as a nighttime dwell in continuous ambulatory PD (CAPD) patients. In PD-related peritonitis, IP antibiotics are administered either continuously in all bags or intermittently in 1 of the bags (long dwell) such as icodextrin. Patients on APD have to be converted to CAPD if antibiotics are administered continuously, but it is not always practical

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to shift them from APD to CAPD (2). Continuous dosing and intermittent dosing are found to be equally efficacious in the management of peritonitis (2). Therefore IP antibiotics are commonly administered intermittently in icodextrin during the long dwell. Whilst some antibiotics have demonstrated *in vitro* compatibility with icodextrin (3), data on drug stability are sparse. Previous studies on the stability of some antibiotics in icodextrin provide only minimal information because they do not fully cover the entire range of temperature storage conditions and likely storage time periods encountered in clinical practice (4–9). Patel *et al.* examined the stability of the combination of cefazolin and ceftazidime in icodextrin but did not study the combination of either cefazolin and gentamicin, vancomycin and ceftazidime, or gentamicin in icodextrin (10). The aim of this study was to describe the stability of commonly used IP antibiotics in a 7.5% icodextrin solution, at a dosage recommended by ISPD for intermittent dosing (2), a practice followed by many centers, at 3 different temperatures for a period of up to 2 weeks.

MATERIALS AND METHODS

This study was reviewed by the Chairperson of the Human Research and Ethics Committee (HREC) of Royal Brisbane & Women's Hospital, who confirmed the project was negligible-risk research without use of human data and so exempted from HREC review (HREC/14/QRB/57).

SAMPLE PREPARATION

A total of 72 Extraneal PD 2-L bags with 7.5% w/v icodextrin (Polyvinyl Chloride Extraneal Bags; Baxter Healthcare Pty Ltd., New South Wales, Australia) were used. Nine each were dosed with ceftazidime only, cefazolin only, vancomycin only, gentamicin only, ceftazidime and cefazolin in combination, cefazolin and gentamicin in combination, and vancomycin and gentamicin in combination. Nine bags were not dosed with antibiotic and were stored and sampled as controls. For each single drug and drug-drug combination, triplicate bags were incubated at 3 different temperatures: room temperature (25°C), body temperature (37°C), and refrigeration (4°C). Bags were incubated at the required temperatures overnight prior to dosing. Cefazolin sodium powder for injection 1 g (Hospira Inc, Victoria, Australia), ceftazidime powder for injection (Sandoz Pty Ltd, New South Wales, Australia), and vancomycin hydrochloride for intravenous (IV) infusion, 1 g, (Hospira Australia Pty Ltd, Victoria, Australia) were reconstituted with water for injection according to the manufacturer's instructions. Gentamicin injection BP/IV use 80 mg/2 mL (Pfizer Australia, New South Wales, Australia) required no dissolution. All of the drugs were injected using a sterile 10 mL plastic syringe (Becton, Dickinson and Company BD Pty Ltd, New South Wales, Australia) into bags via a sterile accessory spike (Gambro Pty Ltd, New South Wales, Australia) that was inserted into the tubing of the bag. The concentrations tested were of 500 µg/mL for cefazolin and ceftazidime, 20 µg/mL for gentamicin, and 1,000 µg/mL for

vancomycin. The drug combinations were administered in the same manner and at the same concentrations with both drugs injected into the PD bag one after the other. The syringe was used to withdraw and expel fluid back into the bag 3 times to ensure that there was no residual drug remaining in the syringe and needle. Each bag was then gently shaken by inversion for 1 minute to ensure proper mixing. For each drug and drug-drug combination bag, the body temperature storage was simulated in an incubator at 37°C, the room temperature bags in boxes in a temperature-controlled room at 25°C, and the refrigerated bags in a refrigerator at 4°C. All bags were shielded from light during storage. For each temperature, 3 control bags were prepared and stored in the same manner.

Samples were collected aseptically prior to addition of the drug at time 0 and after mixing of the bag at 1 minute, and then again at 6, 24, 48, 96, 168, and 336 hours. At each time point, after mixing and visually inspecting the bag for turbidity and color changes, a 10-mL plastic syringe (BD Pty Ltd, New South Wales, Australia) was used via the sterile accessory spike to withdraw a 2-mL volume which was then discarded to ensure that the sample taken was filled with freshly mixed PD solution from within the bag. A 7-mL sample was then collected in a labeled 10-mL polypropylene tube (Sarstedt Australia Pty Ltd, South Australia) from which 1 mL was stored in a 2-mL polypropylene micro tube (Sarstedt Australia Pty Ltd, South Australia) at -80°C. The balance of the sample was used to measure the pH and assess the color and turbidity to check for precipitation. Control samples were taken using the same method.

HIGH PERFORMANCE LIQUID CHROMATOGRAPHY ASSAYS

Ceftazidime, cefazolin, and vancomycin assays were performed separately on the same high performance liquid chromatography (HPLC) system. The HPLC system consisted of a Waters Pump Control Module, a Waters Model 510 pump, a Waters 717 plus Autosampler, a Waters 486 Tunable Absorbance Detector and Empower2 software (Waters Corp., New South Wales, Australia). The stationary phase was a Phenomenex Luna C18(2), 4.6 x 150 mm, 5.0 µm, 100 Å, with C18 guard cartridge (Phenomenex, New South Wales, Australia). The mobile phase used was a 10% acetonitrile: 90% 50 mM PO₄ buffer at pH 3.0 for ceftazidime and vancomycin. The mobile phase used was a 12% acetonitrile: 88% 10 mM PO₄ buffer at pH 6.5 for cefazolin. High performance liquid chromatography conditions consisted of a flow rate of 1 mL/minute with ultraviolet (UV) detection at 254 nm. Ceftazidime eluted at ~5 minutes, vancomycin at ~6.8 minutes and cefazolin at ~8 minutes; the total run time was therefore 10 minutes with an injection volume of 10 µL.

LIQUID CHROMATOGRAPHY TANDEM MASS SPECTROMETRY ASSAY

Gentamicin was measured in PD fluid by liquid chromatography tandem mass spectrometry (LC-MS/MS) with a hydrophilic interaction liquid chromatography (HILIC) guard column on a Shimadzu Nexera system coupled to a Shimadzu 8030+ triple

quadruple mass spectrometer (Kyoto, Japan). The sample (50 μ L) was spiked with internal standard (tobramycin) and 15% trifluoroacetic acid added. An aliquot of 1 μ L of the solution was injected onto the LC-MS/MS. The stationary phase was a SeQuant zic-HILIC column, 2.1 $\times$ 20 mm, 5.0 μ m analytical guard column. The mobile phase was run isocratically with 70% mobile phase A (consisting of 0.2% formic acid) and 30% mobile phase B (consisting of acetonitrile with 0.2% formic acid). The flow rate was 0.5 mL/min. Gentamicin was monitored with 3 mass transitions in positive mode (M.H⁺) at 464.2 $\rightarrow$ 322.3, 478.2 $\rightarrow$ 322.3, and 450.2 $\rightarrow$ 322.2. The internal standard, tobramycin, was monitored with 2 mass transitions in positive mode (M.H⁺) at 468.1 $\rightarrow$ 163.2 and 468.1 $\rightarrow$ 324.2.

ASSAY PERFORMANCE

The stock standards and quality controls (QCs) were prepared in Extraneal PD solution with 7.5% w/v icodextrin and used for calibration and validation of the HPLC assay method. Validation of the method was assessed using linearity, lower limit of quantification (LLOQ), intra-batch precision and accuracy, long-term stability, freeze-thaw stability and specificity against degradation products. For specificity validation QCs were placed in a 50°C incubator for 24 hours to force degradation. The degradation products formed were well-resolved from the un-degraded drug and did not affect quantitation. The maximum intra- and

inter-assay precision and accuracy value of the 3 concentrations measured, and the concentration range, of the assays were: cefazolin within 3.5% for 50 to 600 μ g/mL; ceftazidime within 4.7% for 50 to 600 μ g/mL; vancomycin within 4.0% for 100 to 1,200 μ g/mL; gentamicin within 10.7% for 2 to 24 μ g/mL (the precision and accuracy were within 4.1% at the gentamicin concentrations found in study samples).

DATA ANALYSIS

The initial drug concentration of the 0-hour sample was considered as 100%. The concentrations determined chromatographically were used to calculate the percentage of drug remaining in each subsequent sample. The criterion for stability was that the average percentage of drug remaining in the 3 bags was at least 90%.

RESULTS

Table 1 shows that cefazolin alone and in combination was stable for 14 days once refrigerated, but only 1 day when incubated at 37°C. At room temperature, cefazolin alone and in combination with ceftazidime was stable for 7 days, and 4 days when in combination with gentamicin.

Table 2 shows that ceftazidime alone and in combination was stable for 14 days once refrigerated, but for 1 day or less

TABLE 1
Percentage of Cefazolin 500 mg/L Remaining in 7.5% Icodextrin Peritoneal Dialysis Fluid at 3 Temperatures

Day	Cefazolin alone			With ceftazidime			With gentamicin		
	37°C	25°C	4°C	37°C	25°C	4°C	37°C	25°C	4°C
Initial concentration	493	475	469	463	465	467	469	472	477
0.25	96$\pm$5	100$\pm$0	101$\pm$0	98$\pm$1	101$\pm$1	101$\pm$2	99$\pm$0	100$\pm$0	100$\pm$0
1	91$\pm$5	98$\pm$1	99$\pm$2	93$\pm$2	99$\pm$1	101$\pm$2	95$\pm$1	97$\pm$1	100$\pm$0
2	86 $\pm$ 5	97$\pm$1	100$\pm$0	87 $\pm$ 3	98$\pm$1	101$\pm$4	89 $\pm$ 2	96$\pm$1	100$\pm$0
4	76 $\pm$ 6	94$\pm$1	100$\pm$1	76 $\pm$ 5	96$\pm$1	98$\pm$5	77 $\pm$ 6	93$\pm$1	99$\pm$0
7	63 $\pm$ 8	90$\pm$0	100$\pm$0	63 $\pm$ 7	93$\pm$1	100$\pm$4	64 $\pm$ 6	89$\pm$1	99$\pm$0
14	42 $\pm$ 9	81 $\pm$ 0	99$\pm$0	41 $\pm$ 9	87 $\pm$ 1	99$\pm$2	43 $\pm$ 9	84 $\pm$ 7	98$\pm$0

Bolding indicates the presence of sufficient drug stability.

TABLE 2
Percentage of Ceftazidime 500 mg/L Remaining in 7.5% Icodextrin Peritoneal Dialysis Fluid at 3 Temperatures

Day	Ceftazidime alone			With cefazolin		
	37°C	25°C	4°C	37°C	25°C	4°C
Initial concentration	409	470	482	420	442	471
0.25	96$\pm$8	99$\pm$0	100$\pm$2	107$\pm$20	100$\pm$1	101$\pm$2
1	84 $\pm$ 4	97$\pm$0	103$\pm$7	92$\pm$7	98$\pm$2	98$\pm$1
2	72 $\pm$ 4	95$\pm$2	106$\pm$11	83 $\pm$ 14	94$\pm$1	97$\pm$2
4	56 $\pm$ 5	86 $\pm$ 2	105$\pm$5	58 $\pm$ 13	88 $\pm$ 1	98$\pm$2
7	43 $\pm$ 9	80 $\pm$ 1	108$\pm$11	38 $\pm$ 9	79 $\pm$ 1	94$\pm$0
14	17 $\pm$ 5	63 $\pm$ 0	101$\pm$9	17 $\pm$ 7	63 $\pm$ 1	92$\pm$1

Bolding indicates the presence of sufficient drug stability.

when alone or in combination with cefazolin when incubated at 37°C. At room temperature, ceftazidime alone and in combination with cefazolin was stable for 2 days.

Table 3 shows that gentamicin alone and in combination was stable for 14 days at all temperature conditions except for gentamicin with cefazolin at 37°C, which was only stable for 7 days.

Vancomycin concentrations remained stable either alone or in combination with gentamicin for 14 days at 4°C and 25°C but only for 4 days at 37°C (Table 4).

Across all bags dosed, the precision and accuracy, respectively, of the initial dose was: cefazolin 2.9 and -5.5% ($n = 27$); gentamicin 3.7 and -9.1% ($n = 27$); ceftazidime 7.0 and -10.2% ($n = 18$); vancomycin 7.3 and -12.6% ($n = 18$). The low and variable dosing is attributed to the handling and type of syringes used in the dosing process.

The pH of dialysis fluid remained relatively constant at approximately 5.3 in all bags and did not reveal any trends over the 14-day period. Visual inspection of the solution revealed no turbidity or discoloration, with the exception that all bags that contained ceftazidime (either alone or in combination with cefazolin) were a discernable yellow at 14 days at 25°C and 37°C.

The storage conditions that meet the stability criteria for drugs alone and in combination are summarized in Table 5.

DISCUSSION

In this study, we have described the stability of the antibiotics commonly used for intraperitoneal therapy of PD-related peritonitis, cefazolin, ceftazidime, gentamicin, and vancomycin both alone and in various combinations and at various storage temperatures, in a 7.5% icodextrin solution. In all cases storage, in the refrigerator (4°C) has acceptable stability for 14 days. For storage at room temperature (25°C), this is limited to 2 days for bags containing ceftazidime. The storage interval at room temperature increases for cefazolin in combination with gentamicin (4 days) and cefazolin alone (7 days). Vancomycin and gentamicin alone and in combination are stable for 2 weeks at room temperature. Bags containing antibiotic are least stable at 37°C, although stability for at least 6 hours at this temperature demonstrates that warming of PD fluid bags to body temperature is acceptable which could enhance patient acceptability of treatment.

These data are highly valuable to clinicians working in dialysis units as they inform how many intraperitoneal antibiotic doses and combinations can be provided to a patient to take home for treatment of PD-related peritonitis.

The stability of cefazolin, ceftazidime, and vancomycin in 7.5% icodextrin solution has been previously studied. Nornoo *et al.* in their study of stability of vancomycin (500 mg/L) in icodextrin over a 7-day period concluded vancomycin

TABLE 3
Percentage of Gentamicin 20 mg/L Remaining in 7.5% Icodextrin Peritoneal Dialysis Fluid at 3 Temperatures

Day	Gentamicin alone			With vancomycin			With cefazolin		
	37°C	25°C	4°C	37°C	25°C	4°C	37°C	25°C	4°C
Initial concentration	17.7	17.4	18.1	18.8	18.2	18.1	18.1	18.4	18.8
0.5	100±0	100±0	100±0	102±4	98±2	100±0	99±1	103±3	100±6
1	98±2	98±1	98±1	97±2	100±0	100±1	99±0	102±3	101±6
2	98±2	99±2	99±0	98±5	98±2	101±3	97±1	102±2	99±5
4	96±3	97±0	98±1	97±2	98±0	100±1	94±2	101±3	102±6
7	97±2	99±1	98±0	96±2	99±1	100±1	92±2	100±3	101±7
14	95±3	98±1	98±1	95±1	99±1	102±3	86±4	97±5	102±5

Bolding indicates the presence of sufficient drug stability.

TABLE 4
Percentage of 1,000 mg/L Vancomycin Remaining in 7.5% Icodextrin Peritoneal Dialysis Fluid at 3 Temperatures

Day	Vancomycin alone			With gentamicin		
	37°C	25°C	4°C	37°C	25°C	4°C
Concentration	877	873	807	870	857	970
0.25	96±2	100±0	104±3	99±3	100±0	108±14
1	95±1	99±1	99±1	98±2	100±1	110±18
2	93±1	99±1	101±8	97±1	99±0	107±11
4	90±2	98±1	104±10	93±1	99±1	98±28
7	86±2	97±1	100±6	88±1	97±2	97±23
14	79±2	94±3	101±7	80±2	95±1	105±25

Bolding indicates the presence of sufficient drug stability.

TABLE 5
Stable Storage Conditions for Antibiotics in Peritoneal
Dialysis Fluid at 3 Temperatures

Antibiotics in PD bags	4°C	25°C	37°C
Cefazolin alone	14 days	7 days	1 day
Cefazolin with gentamicin	14 days	4 days	1 day
Cefazolin with ceftazidime	14 days	2 days	1 day
Ceftazidime alone	14 days	2 days	6 hours
Gentamicin alone	14 days	14 days	14 days
Vancomycin alone	14 days	14 days	4 days
Vancomycin with gentamicin	14 days	14 days	4 days

PD = peritoneal dialysis.

concentrations were $99.7 \pm 0.5\%$ at 168 hours, $97.5 \pm 3.4\%$ at 168 hours, and $94.3 \pm 3.9\%$ at 24 hours at 4, 24, and 37°C respectively (6). Our study has shown that vancomycin (500 mg/L) in icodextrin can be kept at room temperature and in a refrigerator for 14 days. Pallota *et al.* assessed the stability of ceftazidime (500 mg/L) in icodextrin solution and determined the concentrations are stable for 168, 48, and 8 hours respectively when stored at 4°C, 25°C, and 37°C (7). Robinson *et al.* studied the stability of cefazolin (125 mg/L and 500 mg/L) in icodextrin at 38°C only for 4 days and found it to be stable for at least 48 hours (8). Lin *et al.* determined stability of cefazolin (500 mg/L) only in icodextrin solution at 4°C and 25°C for 30 days and at 37°C for 24 hours and found cefazolin to be stable for 30 days at 4°C, 7 days at 25°C, and 24 hours at 37°C (11). These studies did not address the stability of combinations of antibiotics in icodextrin solution. Patel *et al.* found that premixed ceftazidime (125 mg/L) and cefazolin (125 mg/L) in 7.5% icodextrin and pH neutral PD solution is stable for at least 7 days when refrigerated (10). The current study has demonstrated that higher doses of these drugs (500 mg/L), the dosages recommended by the ISPD for intermittent dosing, are stable alone or in combination for 14 days when refrigerated. Further, Patel *et al.* did not address the stability of cefazolin premixed with gentamicin or gentamicin alone in these bags (10). At the same time, Singh *et al.* showed cefazolin and gentamicin, either alone or in combination, is stable in lactate-buffered glucose-based 2.3% Fresenius PD fluid (Fresenius Medical Care Australia Pty Ltd. New South Wales, Australia) for up to 7 days when stored at room temperature. Unfortunately, the authors in this study did not address the stability of cefazolin when premixed with ceftazidime (12). Voges *et al.* studied the stability of gentamicin in Extraneal PD solution for 24 – 28 hours only (9). Keeping in mind the ISPD recommendation to administer a combination of cefazolin or vancomycin with gentamicin or ceftazidime in PD-related peritonitis, we studied the stability of these antibiotics either alone or in combination and demonstrated stability at 4°C for 14 days. Our study therefore demonstrates that in many cases, PD bags with pre-loaded antibiotics can be prepared in advance, thereby avoiding daily preparation. If gentamicin is used for

initial gram-negative pathogen coverage, the ISPD recommends intermittent dosing and to limit the course to 2 weeks (2), though some centers limit gentamicin administration to shorter durations unless recommended by an infectious disease physician, as there is an increased need to limit the risk of oto- and vestibular toxicity, in particular if mixed with vancomycin (13).

The strengths of this comprehensive study of stability of antibiotics either alone or in many combinations are that it not only determined drug physicochemical stability but also described other aspects of drug compatibility (e.g. pH, observed physical incompatibility) that have not been reported in many previously published studies. Further, unlike previous studies with icodextrin, we studied drug stability at different storage temperatures (4°C, 25°C, and 37°C) as well as at various time points up to a period of 2 weeks.

The limitations of this study are that there may be more, but less common, combinations of antibiotics that some centers may use which were not studied here. Further, the effects of fluctuations in temperature within the storage period were not investigated, but these are unlikely to occur in most storage settings. This study did not address the sterility of these reconstituted PD bags. Whilst it appears common practice in renal units to reconstitute bags days in advance of when the bag may be administered, references including The United States Pharmacopeia support sterility testing of these preparations to confirm appropriateness of storing the product for more than 24 hours at room temperature and 3 days under refrigeration. Given that these are antibiotic-containing bags, with appropriate sterile preparation, sterility is likely, but requires further confirmatory study (14).

In conclusion, at 4°C, all antibiotics at a dosage recommended for intermittent dosing, whether alone or in combination, are stable for 14 days. This study also demonstrates that dosing in 1 bag per 24 hours reduces the number of bags the patient may need to store at 4°C. At 25°C, ceftazidime alone is stable for 2 days, cefazolin alone is stable for 7 days, the combination of cefazolin and ceftazidime is stable for 2 days, and cefazolin and gentamicin combination is stable for 4 days. At 37°C, the stability of antibiotics is markedly reduced: ceftazidime is stable for 6 hours only, cefazolin either alone or in combination with ceftazidime and vancomycin is stable for 1 day only; vancomycin alone or with gentamicin is stable for 4 days, whilst gentamicin is stable for 14 days and is thus the most stable antibiotic. These findings also demonstrate that PD bags mixed with antibiotics can be safely warmed to body temperature before instillation. The results from this study provide evidence-based data to assist clinicians in every-day practice for ensuring effective antibiotic therapy for IP treatment of peritonitis in PD patients.

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DISCLOSURES

The authors have no financial conflicts of interest to declare.

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