

Intra-Peritoneal Antibiotic Guidance

Patients on peritoneal dialysis commonly develop peritonitis. When this occurs, data show potentially better outcomes if the infection is treated intra-peritoneally instead of systemically unless the patient is septic. This document provides general guidance on appropriate dosing and procedures for intra-peritoneal antibiotics.

Antibiotic Administration¹

- A. Initial empiric antibiotics should cover both gram-positive and gram-negative organisms. Intra-peritoneal antibiotics available for use at NM hospitals include:
 - Cefazolin
 - Ceftazidime
 - Gentamicin
 - Vancomycin
 - Alternative antibiotics may be appropriate depending on the patient's culture history, compatibility with dialysate fluid, and dosing schedule
- B. Antibiotics instilled intra-peritoneally should be allowed to dwell at least 6 hours
- C. Daily intermittent dosing of the antibiotics is preferred
- D. Recent studies suggest that dose adjustment of the antibiotic in patients who have substantial residual renal function is not necessary
- E. Antibiotics to be administered intra-peritoneally will be either be added to the dialysate bag(s) in the cleanroom within the pharmacy prior to initiation of the peritoneal dialysis (Delnor, CDH, KH/VW, LFH, Northwest Region) or dispensed from the pharmacy in a syringe and administered by the PD nurse (NMH).
 - a. It is necessary to verify stability of the antibiotic combination to be sure they can all be added to the same dialysate bag together.
 - b. In general, it is considered safe to combine vancomycin and gentamicin or cephalosporins in the same bag (but not necessarily in a concentrated syringe).

Antibiotic Dosing^{1,4}

The following table is from the most recent ISPD Peritonitis Guideline from 2022. It outlines recommended dosing for both intermittent and continuous dosing of many antibiotics. Information that will be needed prior to determining the dose to be added to the dialysate bags includes:

- Patient weight (use recommended dosing weight per selected antibiotic)
- The size of the dialysate bags to be used (easier if they plan to use one size for all exchanges if doing continuous)
- Exchange rate and duration
- Presence of residual renal function (if still present, consider increasing dose for renally cleared drugs³)

Intermittent Antibiotic Dosing

For simplicity and standardization, intermittent dosing for all antibiotics is recommended when possible.

- Verify with the ordering physician that intermittent dosing is ok (if continuous ordered)
- Antibiotic will be added to the last bag of the dialysis session and will dwell for the specified time per the physician. ("Last Bag Fill")
 - As noted previously, a minimum dwell time of 6 hours will be necessary for adequate antibiotic exchange
- Will need to verify bag size and type of dialysate, specifically what bag size will be for the last bag that will dwell post-treatment
- Calculate dose of each antibiotic based on the "Intermittent" column in the table below

Continuous Antibiotic Dosing

*Typically not done at NMH

Some physicians prefer continuous antibiotic dosing. This requires more antibiotic compounding, but less overall manipulation of the access site. The recommended concentration below will be added to each of the dialysate bags prior to initiation of dialysis and will be run overnight during the entire exchange. If a loading dose is required, it would be placed in the first exchange bag(s), followed by the maintenance dose in all subsequent bags (separate entries in Epic).

Table 5. IP antibiotic dosing recommendations for treatment of peritonitis.

Antibiotic	Intermittent (1 exchange daily for at least 6 h)	Continuous (all exchanges)
Aminoglycosides		
Amikacin	2 mg/kg daily ¹⁷³	Not advised
Gentamicin	0.6 mg/kg daily ^{174,175}	Not advised
Netilmicin	0.6 mg/kg daily ¹⁶⁵	Not advised
Tobramycin	0.6 mg/kg daily	Not advised
Cephalosporins		
Cefazolin	15 mg/kg daily (for long dwell) ^{176,177} 20 mg/kg daily (for short dwell) ^{178,176}	LD 500 mg/L, MD 125 mg/L ^{d 168,179}
Cefepime	1000 mg daily	LD 500 mg/L, MD 125 mg/L ^{d 168}
Cefoperazone	No data	LD 500 mg/L, MD 62.5–125 mg/L ¹⁸⁰
Cefotaxime	500–1000 mg daily ¹⁸¹	no data
Ceftazidime	1000–1500 mg daily (for long dwell) 20 mg/kg daily (for short dwell) ¹⁷⁸	LD 500 mg/L, MD 125 mg/L ^{d 168,182}
Ceftriaxone	1000 mg daily ¹⁸³	No data
Penicillins		
Penicillin G	No data	LD 50,000 unit/L, MD 25,000 unit/L ¹³
Amoxicillin	No data	MD 150 mg/L ¹⁸⁴
Ampicillin ^a	4 gm daily ¹⁸⁵	MD 125 mg/L ¹⁸⁶
Ampicillin/ sulbactam	No data	LD 1000 mg/500 mg, MD 133.3 mg/66.7 mg ^{187,188}
Piperacillin/ tazobactam	No data	LD 4 gm/0.5 gm, MD 1 gm/0.125 gm ¹⁸⁹
Ticarcillin/clavulanic acid	No data	LD 3 gm/0.2 gm, MD 300 mg/20 mg/L ¹⁹⁰
Others		
Aztreonam	2 gm daily ¹⁹¹	LD 500 mg/L ¹⁹² , MD 250 mg/L ^{192,193}
Ciprofloxacin	No data	MD 50 mg/L ¹⁹⁴
Clindamycin	No data	MD 600 mg/bag ¹⁹⁵
Daptomycin	300 mg daily ¹⁹⁶	LD 100 mg/L ^{197,198,199} , MD 20 mg/L ^{197,200}
Fosfomycin	4 g daily ^{201,202}	No data
Imipenem/cilastatin	500 mg in alternate exchange ²⁰³	LD 250 mg/L, MD 50 mg/L ¹⁸²
Ofloxacin	No data	LD 200 mg, MD 25 mg/L ²⁰⁴
Polymyxin B	No data	MD 300,000 unit (30 mg)/bag ¹⁸⁸
Quinupristin/ dalbopristin	25 mg/L in alternate exchanges ^{b205}	No data
Meropenem	500 mg daily (for long dwell in APD) ²⁰⁷ 1000 mg daily (for short dwell in CAPD) ^{208,209}	MD 125 mg/L ²⁰⁶
Teicoplanin	15 mg/kg every 5 days ²¹⁰	LD 400 mg/bag, MD 20 mg/L ^{211,140}
Vancomycin	15–30 mg/kg every 5–7 days ^{c141,212} for CAPD 15 mg/kg every 4 days ²¹³ for APD	LD 20–25 mg/kg, MD 25 mg/L ²¹⁴
Antifungal		
Fluconazole	IP 150–200 mg every 24 to 48 h ^{215,216} (oral route is preferred: see Table 6)	No data
Voriconazole	IP 2.5 mg/kg daily ²¹⁷ (oral route is preferred: see Table 6)	No data

LD: loading dose in mg; MD: maintenance dose in mg; IP: intraperitoneal; APD: automated peritoneal dialysis.

^aIP ampicillin is not recommended for treatment of enterococcal peritonitis.²¹⁸

^bGiven in conjunction with 500 mg intravenous twice daily.

^cSupplemental doses may be needed for APD patients and dwell time of at least 6 h is preferred.

^dIncrease in doses by 25% may be needed for patients with significant residual kidney function.¹⁶⁸

Monitoring of Vancomycin and Gentamicin

Vancomycin¹

About 90% of intra-peritoneal vancomycin is absorbed in the presence of peritonitis. It is unclear whether monitoring levels for vancomycin is useful from an efficacy perspective, however, due to the potential toxicities of excessive vancomycin, monitoring from a safety perspective will be necessary. The amount of vancomycin that is anticipated to be cleared by peritoneal dialysis varies. Of note, treatment failure may be more likely in patients with residual renal function due to increased vancomycin clearance. It therefore may be necessary to be more aggressive in the dosing for these patients.³

Here are some general recommendations to follow for vancomycin monitoring:

Intermittent Dosing

- For intermittent exchanges, it is expected that re-dosing every 4 to 5 days will be needed
- Check a random level (preferably at least 4 hours after the last exchange is complete)
 - About every 4-5 days post-dose for intermittent (depending on prior levels and patient-specific factors)
 - Consider redosing when vancomycin level is ≤ 15 mcg/mL

Continuous Dosing

- For continuous exchanges, an initial load of 15-20mg/kg of vancomycin should be given in the first bag
 - Follow by a maintenance dose of 15mg/L of fluid added to each remaining dialysate bag to maintain the systemic level at 15mcg/mL
- Check random level about every 3-4 days for continuous dosing depending on patient (less frequent once stable levels achieved)

Gentamicin²

With the recommended dosing regimen, about 50% of patients may still be exposed to excessive systemic gentamicin levels. Little evidence exists to support monitoring of levels to mitigate toxicity or improve efficacy, however. Due to the risk of ototoxicity and further renal damage, it is recommended that therapy be changed to target the organisms present as soon as identification and susceptibilities are known. Of note, treatment failure may be more likely in patients with residual renal function due to increased gentamicin clearance. It therefore may be necessary to be more aggressive in the dosing for these patients (doses up to 0.9 mg/kg have been used).³

Here are some general recommendations to follow for gentamicin monitoring in case of prolonged administration while awaiting culture data:

- Check a random gentamicin level (preferably at least 4 hours after last exchange complete) after 2nd day/round of treatment
- Redose gentamicin when 'trough' level is ≤ 0.5 mcg/mL
- Recheck random levels daily and redose as above while therapy is continued
- Not recommended to continue longer than 5 days without ID consult

References

1. Li PKT, Szeto CC, Piraino B, et al. ISPD peritonitis recommendations: 2016 update on treatment and prevention. *Perit Dial Int* 2016; 36(5):481-508.
2. Tang W, Cho Y, Hawley C, et al. The role of monitoring gentamicin levels in patients with gram-negative peritoneal dialysis-associated peritonitis. *Perit Dial Int* 2014; 34(2):219-26.
3. Piraino B. Effective treatment of PD peritonitis. *Clin J Am Soc Nephrol* 2017; 12:1919-21.
4. Li PKT, Chow KM, Cho Y, et al. ISPD peritonitis guideline recommendations: 2022 update on prevention and treatment. *Perit Dial Int* 2022; 42(2):110-53. doi: 10.1177/08968608221080586.