Great Ormond Street Hospital for Children
NHS Foundation Trust

Clinical Guideline

Disclaimer

Clinical guidelines are best practice recommendations that are intended to assist clinical teams in the delivery of patient care at GOSH. Clinical guidelines attempt to reflect the best available research at the time of writing, but the interpretation and application of clinical guidelines remains the responsibility of the individual clinician. Caution is advised if using a GOSH clinical guideline outside of the organisation and/or beyond its review date.

Guidelines for the Treatment of Peritonitis in Children on Peritoneal Dialysis (PD)

Document Details	
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Guideline summary (up to 100 words):	The document highlights the modification in the antibiotic and the dosage according to the antibiotic sensitivity patterns in the hospital and the organisms isolated.
Key words:	'Best bet' word/term: **Peritonitis** 'Best bet' acronym (if applicable): **Peritoneal fluid** All other key words/terms: **Peritoneal Fluid analysis, Intraperitoneal (IP) antibiotics,**
Exclusions:	*N/A*

TABLE OF CONTENTS

1 Introduction 3
2 Scope 3
3 Definitions 3
4 Assessment 4
4.1 Assessment at GOSH 4
4.2 Assessment at local hospital 5
5 Management 5
5.1 Treatment 5
5.2 Treatment modification (after 48 hours according to culture sensitivities): 7
5.3 Fungal peritonitis 13
5.4 Tuberculous and Non-Tuberculous Mycobacterial Peritonitis 14
5.5 Discharge Planning: 14
5.6 Indications for removal of the catheter: 15
5.7 Eosinophilic peritonitis: 15
5.8 Post - surgical peritonitis (within 2 weeks of procedure) 16
5.9 Line Break / Contamination 16
5.10 Allergies to Antibiotics 17
5.11 Stability of antibiotic injections after addition to the PD solution 17
6 References 22
7 Appendix 1 - Guideline for performing a CAPD exchange to deliver loading doses of intraperitoneal antibiotics 23
8 Appendix 2 – Guideline for adding Intraperitoneal antibiotics to peritoneal dialysis fluid bags equipment 25
9 Document Control 26

1 Introduction

Infection-related complications remain the most significant cause for morbidity and peritoneal dialysis failure in infants, children and adolescents who receive maintenance peritoneal dialysis. Following the new 2024 update of the Clinical Practice Guideline for the Prevention and Management of Peritoneal Dialysis Associated Infection in Children recommended by the international group of pediatric dialysis[1], our hospital guidelines were revisited and modified where necessary, according to the evolution of antibiotic susceptibilities, and clinical registry data.

2 Scope

The guidelines include the outline of clinical assessment in the local hospital as well as in GOSH, emphasising prompt investigation and starting treatment early. We recommend use of intraperitoneal antibiotics where possible soon after diagnosis of peritonitis using microbiological definition. The antibiotic protocol for management empirically and after a positive culture along with the duration of treatment as well as the time for removal of catheter has been included.

3 Definitions

A diagnosis of peritonitis can be made when any 2 of the below features are present:

- Clinical features consistent with peritonitis (see section 4.1)
- Dialysis fluid (after a dwell time of at least 2 hours) (see below 3.1)
- Positive dialysis fluid culture results.

- 3.1 Dialysis fluid microbiology result <u>If > 100 WBC x 10^6/litre and > 50% neutrophils **± Organisms on gram stain, gram positive/negative or yeasts) ± Positive culture =** Start antibiotic treatment **(see section 4 for guidance re sepsis 6 or IPABs)**</u>

- **If WCC between 50 - 100 x 10^6/litre,** > 50% neutrophils and patient's symptoms/signs are suggestive of peritonitis **= Initiate treatment immediately.**

- **If WCC between 50 - 100 WBC x 10^6/litre** and patient is asymptomatic = Hold dialysis and repeat specimen after 2 to 4hrs

Commence treatment immediately after sending dialysate samples if clinical symptoms are present**.** **DO NOT** wait for lab results.

<u>ISPD guideline Standards</u>[2,3]:
Peritonitis should occur at a maximum rate of <0.5 episodes per 12 patient months.

4 Assessment

4.1 Assessment at GOSH

If patient presents with any of the following: temperature greater than 37.5 degrees centigrade, cloudy effluent fluid, abdominal pain, unusual vomiting, consider peritonitis. (NOTE: The temperature threshold for peritonitis patients is much lower – needing more prompt assessments)

NOTE: Patients can have peritonitis without any signs of sepsis – early diagnosis and treatment is crucial. Also the patients with peritonitis may not be symptomatically septic until much later in the course of illness.

If at presentation, patient looks septic and / or septicaemic shock (symptoms and signs - look below 5.1.1), go straight for IV antibiotic treatment and Sepsis 6 management.

Consider PD catheter removal in severe intra-abdominal sepsis and/or septicaemic shock.

Once suspicion for peritonitis established:

1. Take an urgent PD sample from the patient using EPIC:

   - Order 'PDF – microscopy and culture – fluid', request as **urgent**
   - Order 'Body fluid cell count', request as **urgent**.

Specimen: body fluid

Specimen type: Peritoneal dialysis fluid

2. SOP for sending the specimen fluid :
   - Scan patient wristband
   - Print labels
   - Collect PD specimen from patient – this specimen should be at least 50mls in volume (if possible), and ideally should have been dwelling in the patient for 2 hours+, (minimum dwell time is 1 hour).
   - Scan 'PDF – microscopy and culture - fluid' label and attach to PD effluent bag
   - Scan 'Body fluid cell count' label and attach to an empty universal container (ie. Empty urine bottle)
   - Send both PD bag and empty bottle together in 1 bag to microbiology – Microbiology will divide the effluent into 2 samples under sterile conditions and will send an aliquot to haematology for WBC differential (ie. neutrophil and eosinophil %)

NOTE: Microbiology will only measure the total polymorphonuclear leukocyte count if >100 WBC x 10^6/litre.

NOTE: If the child does not have a last bag fill or fluid in the peritoneum, manually fill with 1.36% Physioneal 40 to their normal fill volume and dwell for 2 hours (the minimum dwell time is 1 hour) before collecting the sample.

If clinically indicated, bloods should be taken for:

- WBC and differential
- CRP
- Blood Cultures

Assess and document the appearance of PD exit site and send skin swab for MC&S.

4.2 Assessment at local hospital

Parents to contact the PD team with any of the following: temperature greater than 37.5 degrees centigrade, cloudy effluent fluid, abdominal pain, unusual vomiting. PD team to direct the family to the local hospital and inform the outlier renal registrar.

Outlier renal registrar to liaise with local paediatric team:

- If patient presents with a temperature greater than 37.5 degrees centigrade with severe abdominal pain, is septic and / or septicaemic shock give IV AB's immediately (see section 4)

- Parents will collect PD sample from child following ANTT guidelines, into a sterile effluent sample bag. This needs to be sent urgently to microbiology for MC& S and WC differential. Reason for request – PD patient, suspected peritonitis.

If **OUT OF HOURS,** please ask the registrar covering Eagle to call the on-call paediatric registrar at the local hospital.

The local team must contact the on-call microbiologist and state that this sample must be processed urgently (i.e., treat the sample like CSF). If the microbiology service is off site, this sample must be urgently couriered to their out-of-hours lab to be processed.

It cannot wait until the morning.

If clinically indicated, bloods should be taken for:

- WBC and differential blood cell counts
- CRP
- Blood Cultures

5 Management

5.1 Treatment

Treatment should be commenced immediately after sending dialysate samples if clinical symptoms are present**. DO NOT** wait for lab results.

Intraperitoneal (IP) antibiotics should be prescribed on EPIC and administered by adding directly into PD dialysate

Treatment should be aimed at **preservation of the peritoneal membrane** not the catheter.

ISPD guideline Standards[2,3]:

5.1.1 Is the patient septic? Assess using PAEDIATRIC SEPSIS 6

Early diagnosis before onset of sepsis is crucial in the treatment of PD patients.
They may not be visibly septic until later in the evolution of disease and it is to be noted that the temperature cut off for suspicion of peritonitis is much lower at 37.5 degree centigrade.

The sepsis 6 protocol can be found at:
Sepsis 6 Guideline - Our GOSH

Alongside Sepsis 6 algorithm, also start**:**

- **Heparin (500units/L) IP with PD cycling for 48 hours**
  (see dialysis regimen below)
- **Nystatin oral suspension 100,000 units QDS for duration of antibiotics**

Rationale: Do not forget the peritoneum when treating sepsis.

5.1.2 <u>If patient has local signs/minor systemic illness – suspected peritonitis</u>

While cultures are pending**, start empiric intraperitoneal antibiotics (IPAB)** for peritonitis**:**

- **IP (intraperitoneal) Vancomycin** loading dose 500mg/L followed by 25mg/L
- **IP Ciprofloxacin** 50mg/L (NOTE – Increased dose from old guideline)
- **IP Heparin** (500units/L) IP with PD cycling for 48 hours see dialysis regimen below.
- **Nystatin oral suspension** 100,000units (1ml) qds for duration of antibiotics.

Note: IV medications are reconstituted according to the product information leaflet and the required volume added to the prescribed dialysate bags.

If the patient is at their local hospital and needs to be safely transferred to GOSH to start IPAB treatment but is NOT SEPTIC, advise the **local team** to give a stat dose of **IV vancomycin (10mg/kg) and IV ciprofloxacin (5mg/kg) prior to transfer.**

NOTE. <u>If patient has received IV Vancomycin, do not give loading IP Vancomycin, commence directly with cycling dose</u>.

NOTE: If the patient requires loading with IP Vancomycin, this will be administered with also IP Ciprofloxacin and IP Heparin (as per dosing above) using a CAPD exchange of 1.36% Physioneal 40 (or 2.27% Physioneal 40 if hypertensive). Leave to dwell for **3 hours**, prior to commencing CCPD using the PD cycling regimen (below) with maintenance doses of IP Vancomycin, Ciprofloxacin and Heparin.

- CAPD bags only routinely stocked as Physioneal 40's on Eagle ward.

NOTE. Please use ciprofloxacin with caution in patients who have a history of epilepsy, as it can lead to an increased frequency of seizures.

PD cycling regimen:

- TTV: child's normal fill volume x 7
- Time: 24
- Fill: normal fill
- LBF: normal LBF
- Cycles: 7
- Dwell: at least 3 hours

If necessary, adjust dwell time after the first 24 hours cycling according to clinical signs, weight, BP, peripheral temperature

Close observations of fluid balance and plasma potassium levels should be performed.

Rationale for the empiric antibiotic and guidance for GOSH: **An empirical regime is only applicable in the context of the absence of known resistance**.The committee guides towards looking for any previous history of resistance, both at the local hospital and at GOSH with previous microbiology

results in the 'assessment' section and avoiding those in the empiric therapy. The treatment then shall be directed after discussion with the microbiologist.
Empirical treatment with single agent for a possible Gram negative infection would not be appropriate if there is documented resistance to that agent either in previous peritoneal fluid specimens or colonisation at other sites.

Rationale for lengthening the dwell time during first 24–48hrs cycling[3]:
Children on automated PD characteristically receive short dwell times (≤2 hours) dialysis to enhance solute and fluid removal. However, cellular components and opsonins of local host defense mechanisms are also depleted by frequent exchanges. In addition, the inherent cytotoxicity of fresh conventional dialysis solution (d/t hyperosmolality,high glucose & lactate content) compromises the function of peritoneal macrophages, leukocytes, and mesothelial cells. Therefore, prolonged dwell time, to facilitate partial normalization of the peritoneal "milieu" and improved bacterial killing occurs, is a reasonable alteration to the dialysis prescription to aid in early peritonitis treatment'

Rationale for Antibiotics and Heparin should be added to ALL dialysis fluid bags as above

- Heparin is utilized to prevent occlusion of the catheter by fibrin
- Antibiotic cover round the clock.

Rationale for use of Nystatin for duration of intraperitoneal antibiotic therapy:[4,5] Nystatin was introduced 10 years ago after the last case of fungal peritonitis in GOSH as prophylaxis with I/P antibiotic treatment. Use includes prevention of potential fungal transmission to the PD exit site, prevention of oral thrush while on antibiotics, and its administration involves relatively low harm while patients are on intraperitoneal antibiotics.

5.2 Treatment modification (after 48 hours according to culture sensitivities):

- Chase initial PD fluid culture result and follow the guide below based on bacterial growth.

- After 48hrs of CCPD, (Continuous cycling peritoneal dialysis) take a repeat PD specimen (with a minimum 2-hour dwell) from the patient using EPIC:
  - Order 'PDF – microscopy and culture – fluid', request urgent
  - Order 'Body fluid cell count', request urgent.

Specimen: body fluid
Specimen type: peritoneal dialysis fluid

- Scan patient wristband
- Print labels
- Collect PD specimen from patient
- Scan 'PDF – microscopy and culture - fluid' label and attach to PD effluent bag
  Scan 'Body fluid cell count' label and attach to an empty universal container (ie. Empty urine bottle)

- Send both PD bag and empty bottle together in 1 bag to microbiology – Microbiology will divide the effluent into 2 samples under sterile conditions and will send an aliquot to haematology for WBC differential (ie. neutrophil and eosinophil %)

NOTE: Microbiology will only measure the total polymorphonuclear leukocyte count if >100 WBC x 10^6/litre.

Rationale: Antibiotic modification is done so that the narrowest effective antibiotic can be used. Broad spectrum antibiotic given for longer duration can cause antibiotic resistance and increase the chances of fungal peritonitis and probabale higher risks of adverse effects.[6]

Summary Table – For treatment modification at 48 hours as per culture

Organism isolated	WBC in peritoneal fluid @48 hours	Vancomycin	Ciprofloxacin	Additional antimicrobials	Duration	Comments
Staph aureus	<100 x 10^6/litre	IP 25mg/L	STOP	Oral Nystatin	21 days	If Cefazolin sensitive, replace Vancomycin with IP Cefazolin loading 500mg/L followed by 125mg/L If allergic to vancomycin, replace to IP Teicoplanin 20mg/L. Proceed with caution if true allergy as risk of cross sensitivity
Coagulase negative Staph	<100 x 10^6/litre	IP 25mg/L	STOP	Oral Nystatin	14 days	If Cefazolin sensitive, replace with IP Cefazolin loading 500mg/L followed by 125mg/L If allergic to vancomycin, replace to IP Teicoplanin 20mg/L. Proceed with caution if true allergy as risk of cross sensitivity
Enterococci	< 100 x 10^6/litre	IP 25mg/L ***	STOP	Consider oral amoxicillin or IP 150mg/L amoxicillin if sensitive. Oral nystatin	21 days	If allergic to vancomycin, replace to IP Teicoplanin 20mg/L If allergic to penicillin, continue with IP Vancomycin 25mg/L
Corynebacterium	< 100 x 10^6/litre	IP 25mg/L	STOP	Oral Nystatin	21 days	If allergic to vancomycin, replace to IP Teicoplanin 20mg/L
Pseudomonas	< 100 x 10^6/litre	STOP	STOP	IP Amikacin 25mg/L loading dose then 12mg/L and IP Ceftazidime 500mg/L	21 days	

				loading dose then 125mg/L * + Oral Nystatin		
Gram negative (unidentified)	< 100 x 10^6/litre	STOP	IP 50mg/L and then oral 20mg/kg/d**	Oral Nystatin	21 days	
Mixed organisms - others	< 100 x 10^6/litre	IP 25mg/L	IP 50mg/L	Oral Nystatin	14 days	If allergic to vancomycin, replace to IP Teicoplanin 20mg/L
No growth or culture negative	< 100 x 10^6/litre	IP 25mg/L	IP 50mg/L and then oral 20mg/kg/d **	Oral Nystatin	14 days	If allergic to vancomycin, replace to IP Teicoplanin 20mg/L
Fungal growth	Any	STOP	STOP	IV Caspofungin	3-6 weeks post catheter removal	Plan for immediate catheter removal Discuss with microbiology for duration
Tubercular growth	Any	STOP	STOP	Antitubercular drugs		Contact ID team (see 5.2.11) for duration and drugs to be used

*Ceftazidime needs initial loading and then maintainence with antibiotics added to the bags every 24 hours

**Only if patient clinically improving and there is no vomiting with good oral compliance

*** Stop when culture negative and convert to high dose amoxicillin

5.2.1 <u>If Staph Aureus growth</u> and WBC is < 100 x 10^6/litre on repeat sample:

- Stop IP ciprofloxacin.
- Return to usual dialysis regimen adding Intraperitoneal (IP) vancomycin to PD fluid as above (including last bag fill if on CCPD). OR
- If Cefazolin sensitive, IP Vancomycin can be replaced with IP Cefazolin.
- Duration of antibiotic and antifungal (oral nystatin) treatment: **21 days**

Rationale: A large number of Staphylococcus aureus isolated were resistant to methicillin (MRSA) and hence recommended to continue Vancomycin. Committee also suggested that Vancomycin could be better than Cefazolin as it s doesn't cover MRSA. As IV antibiotics are given only for the clinically septic it is better to give the antibiotic for a longer duration (3wk vs 2 wk) to ensure complete eradication. Cefazolin can replace Vancomycin if sensitive, hence narrowing the spectrum further helping in reducing the chances of developing resistance.[7]

5.2.2 <u>If Coagulase negative Staph growth</u> and WBC is < 100 x 10^6/litre on repeat sample<u>:</u>

- Stop IP ciprofloxacin.
- Return to usual dialysis regimen adding Intraperitoneal (IP) vancomycin to PD fluid as above (including last bag fill if on CCPD). OR
- If sensitive to Cefazolin, Vancomycin can be replaced with IP Cefazolin.
- Duration of antibiotic and antifungal (oral nystatin) treatment**: 14 days**

*Rationale***:** Though less virulent, majority are methicillin resistant and that makes vancomycin the drug of choice. They do not need as long an antibiotic course like staph aureus. Cefazolin with be a great narrow spectrum first generation it sensitive to prevent resistance and other complications

5.2.3 <u>If Enterococci growth</u> and WBC is < 100 x 10^6/litre on repeat sample:

- Use of oral amoxicillin plus IP vancomycin until cultures were clear/WCC normalised and then transition to high dose oral amoxicillin.
- Stop IP when the culture is negative.
- Duration of antibiotic and antifungal (oral nystatin) treatment: **21 days from change of antibiotics.**

Rationale: Enterococci are intrinsically sensitive to ampicillin and resistant to cephalosporins, But IP ampicillin has impaired activity in the peritoneal fluid and oral amoxicillin seems to be a great alternative as it achieves a good peritoneal concentration. To cover the ampicillin resistant variants IP Vancomycin should be given with a possible withdrawal for those sensitive to ampicillin.

5.2.4 <u>If Corynebacterium growth</u> and WBC is < 100 x 10^6/litre on repeat sample:

- Stop IP ciprofloxacin.
- Return to usual dialysis regimen adding IP vancomycin to PD fluid as above (including last fill if on CCPD).
- Duration of antibiotic and antifungal (oral nystatin) treatment: **21 days**

5.2.5 If Gram Negative growth and WBC is < 100 x 10^6/litre on repeat sample:

- Stop IP vancomycin.
- Return to usual dialysis regimen adding IP Ciprofloxacin (or appropriate antibiotic, based on sensitivities) to PD fluid as above (including last bag fill if on CCPD).
- IP Ciprofloxacin can be converted to Oral Ciprofloxacin if the child is compliant and tolerating oral medications.
- Liaise with micro/Infectious disease to select most appropriate antimicrobial agent and duration of therapy.
- Duration of antibiotic and antifungal (oral nystatin) treatment: **21 days**

Rationale : All gram negative organisms are sensitive to Ciprofloxacin, except Strenotrophomonas. The duration of IP antibiotics remains 3 weeks for simplicity and elimination of potential error when differentiating the other Gram negatives from Pseudomonas, Acinetobacter and Stenotrophomonas.

5.2.6 If Pseudomonas growth and WBC is < 100 x 10^6/litre on repeat sample:

- Change IP antibiotics to dual therapy:
  IP AMIKACIN (25mg/L LOADING dose then 12mg/L maintenance dose) AND
  IP CEFTAZIDIME (500mg/L LOADING dose then 125mg/L maintenance dose)
- Loading doses to be delivered as a CAPD (Continuous Ambulatory Peritoneal Dialysis) exchange (see appendix 2). The dwell time of the IP loading doses should be at least 3 hours, before commencing APD cycling with. maintenance antibiotic doses to PD fluid as above (including last bag fill if on CCPD).
- IP ceftazidime must be added to PD bags every 24 hours NOT every 48hrs, based on the available stability data.
- Duration of antibiotic and antifungal (oral nystatin) treatment: **21 days** from change of antibiotics

Rationale: Infections with pseudomonas are generally difficult to treat as biofilm formation occurs quickly, lowering the chances of successful treatment without catheter removal. Dual therapy with ceftazidime and an aminoglycoside improves the chances of salvaging the catheter. Monotherapy is not favoured in contemplation of potential selection or induction of resistance.

5.2.7 If other positive culture growth (different from above but mixed organisms) and WBC is < 100 x 10^6/litre on repeat sample:

- Return to usual dialysis regimen. Continue to add IP vancomycin & IP ciprofloxacin to PD fluid as above (including last fill if on CCPD), unless bacterial sensitivities direct you accordingly.
- Duration of antibiotic and antifungal (oral nystatin) treatment**: 14 days**

5.2.8 If Culture Negative and WBC is < 100 x 10^6/litre on repeat sample:

- Return to usual dialysis regimen. Continue to add IP vancomycin to PD fluid as above (including last fill if on CCPD).
- IP Ciprofloxacin can be changed to **oral ciprofloxacin** in preparation for discharge – for the completion of the treatment course. Dose 20mg/kg every 24 hours according to renal dosing guidelines.
- Duration of antibiotic and antifungal (oral nystatin) treatment**: 14 days**
- Consider eosinophilic peritonitis see section 8
  Rationale: These cases should be treated with empirical antibiotics for full duration of treatment with upgrade of antibiotics in any case that they seem to deteriorate, as we have no definitive cause identified.

5.2.9 Child remains unwell / symptomatic but no signs of systemic sepsis and WBC is > 100 x 10^6/litre on repeat sample:

- Repeat cycling regimen for another 48 hours
- Change to appropriate IP antibiotics (see 5a-5g) based on the culture growth and sensitivities
- If culture negative BUT patient remains symptomatic**,** contact consultant microbiologist to screen PD samples for Aspergillus and mycobacterium – catheter removal will need to be considered if either of these growths are identified
- If antifungals are recommended the duration of treatment should be a minimum of 21 days
- After another 48hrs, send a repeat sample:
  - ⇒ If WBC is now < 100 x 10^6/litre follow treatment plan described above (5.2)
  - ⇒ If WBC is > 100 x 10^6/litre, See 'Indications for removal of the catheter' (5.4) and discuss with Consultant on call.

Rationale: The patient who remains symptomatic despite the initial treatment should alert towards resistant or refractory causes and need more aggressive treatment with a possible catheter removal. High suspicion for fungal, mycobacterial and non-mycobacterial infection should be kept.

5.3 Fungal peritonitis

If culture negative and patient is persistently unwell with white cells, consider fungal infection. Discuss with clinical microbiology.

Plan for immediate catheter removal if fungi identified in PD effluent.

Start IV caspofungin empirically.
Liaise with consultant microbiologist to identify best anti-fungal agent for specific growth.

Continue IV treatment for 3-6 weeks post catheter removal.

Rest peritoneum for 3 months if possible – although the Paediatric International Society for peritoneal dialysis guidelines suggest a new PD catheter can be replaced sooner than this, our experience advises against early replacement.

Children most at risk:

1. Recent antibiotic usage.

2. Frequent peritonitis
3. Immunosuppressed post-transplant with PD catheter in situ.

5.4 Tuberculous and Non-Tuberculous Mycobacterial Peritonitis

Consider TB and non-TB mycobacterial peritonitis diagnosis in any patient with refractory or relapsing peritonitis with negative bacterial cultures. Symptoms are similar to standard bacterial peritonitis but lymphocytosis in PD fluid effluent eventually also occurs.

- Contact the ID team if mycobacterial peritonitis is suspected.
- In mycobacterial peritonitis, the clinical features are indistinguishable to bacterial causes and the polymorphonuclear cellular response is also similar to bacterial peritonitis.
- In non-tuberculous mycobacteria peritonitis, the clinical features are refractory, culture negative peritonitis that may or may not be associated with an exit site infection.
- If non-tuberculous mycobacteria (NTM) is suggested treat with both effective antibiotics and catheter removal due to higher likelihood of biofilm formation.
- Appropriate mycobacterial testing should include gram stain, AFB prolonged culture, TB PCR in PD fluid. Extraperitoneal tests (e.g. Chest x ray, USS abdomen, quantiferon) may also be useful.
- Antituberculosis therapy: Discuss with microbiology, do not empirically remove the PD catheter until further discussion with microbiology and renal team.

Liaise with antimicrobial team for treatment regimens based on culture sensitivities.

5.5 Discharge Planning:

Discharge Planning can commence when:

- The repeat PD effluent sample has <100 x 10^6/litre WBC
- The child has become asymptomatic
- PD cycling has finished
- Correct IP antibiotics and duration of treatment have been identified.

The PD child can complete their IPAB treatment at home. These additives will be instilled every 24 -48 hours depending on the antibiotic by either:

1. Parents – once deemed competent. This is documented in the Education Tab on EPIC.
2. Clildren's community nursing (CCN) team (if 7 days / week service). On rare occasions, by nurses at the local children's hospital in-patient ward.

Essential discharge provisions:

1. TTO supply of antibiotic injections
2. Heparin ampoules
3. Water for injection for reconstitution of antibiotics supplied as a powder
4. Nystatin.
5. Consider changing IP ciprofloxacin to oral ciprofloxacin on discharge (ensure no vomiting and good oral compliance for antibiotics).
6. Provide sufficient ancillaries including syringes and needles for the IP administration process - Supplied from the renal ward.
7. Guidelines for non-touch techniques when adding IP medicines to the PD bag- Supplied from the renal ward.
8. If the CCN team are assisting - Yellow prescription administration chart with the IP additivities prescribed which has been screened by a pharmacist.

5.6 Indications for removal of the catheter:

- Fungal peritonitis
- Mycobacterial peritonitis
- Severe intra-abdominal sepsis and septicaemic shock
- Exit site or tunnel infection due to the same organism as that causing the peritonitis
- Relapsing peritonitis: A recurrence with the same organism within 4 weeks of stopping therapy
- Peritonitis secondary to leaking PD catheter tunnel
- Persistently raised WCC & neutrophils, after 4 days of cycling if infection severe (ie refractory, relapsing peritonitis)
- Child remains symptomatic after 3 to 4 days of treatment

Duration of IV antibiotics post PD catheter removal will depend on the culture growth – decision to be made by the Consultant on call and Consultant microbiologist.

5.7 Eosinophilic peritonitis:

This occurs when greater than 10% eosinophils of total WBC count and less than 50% neutrophils and culture negative PDF sample**.**

Eosinophilic peritonitis should be considered in an **asymptomatic** patient if:

- PD specimen WCC is > 100, but shows no growth (culture negative)
- The PD fluid is cloudy but shows no growth (culture negative)
- The child has a raised WCC in their PD fluid, but has had surgery within the last 2 weeks
- The WCC remains persistently raised / OR rises again during treatment with IP antibiotics for peritonitis but the child is asymptomatic (positive or culture negative) – this may be secondary eosinophil peritonitis.
- The child has a peripheral blood eosinophilia.

If Eosinophilic peritonitis and child is asymptomatic (+/- cloudy fluid):

- IP antibiotic treatment can be stopped after 48hours (this decision should be made by the on call Consultant).
- Start sodium cromoglicate as per dosing below.

Age (years)	Weight	Dose/Frequency
< 2	< 5 kg	50 mg TDS (max:20mg/kg/day)
	5.1 to 10	50mg QDS
2 to 14	>10 kg	100 mg QDS (max 40mg/kg/day)
14 to 18	>10kg	200 mg QDS

- Montelukast[10] for eosinophilic peritonitis (if unresponsive or intolerant of sodium cromoglycate) and fibrin prophylaxis (off label use) as per dosing below.

Age (years)	Dose/Frequency
6 months to 5 years	4mg OD
6 to 14	5mg OD
15 to 17	10 mg OD

Note: Eosinophilic peritonitis may occur in association with fungal and parasitic infections.

5.8 Post - surgical peritonitis (within 2 weeks of procedure)

A high PD fluid white cell count is often found following placement of PD catheter or other intraperitoneal procedures; symptoms of mild abdominal pain and vomiting can be present post operatively. A clinical suspicion will guide investigation.

The operative procedure should be covered with IV antibiotics (amikacin 10 mg /kg and teicoplanin 10 mg/kg stat). The catheter is flushed frequently (10ml/kg) until the dialysate is clear and then capped off.

If the catheter is being rested, it is flushed weekly (10ml/kg) with Physioneal 1.36%

A PD fluid sample should **only** be sent for microscopy and culture if the child is symptomatic (NB. fluid can often look cloudy on these weekly flushes)

5.9 Line Break / Contamination

If line break or contamination occurs when PD has commenced, the child should be brought to GOSH for an urgent PD specimen and to repair the PD catheter or perform a PD line change.

If WCC <100 WBC x 10^6/litre and patient is asymptomatic:

- If the child **can** be commenced on their usual PD regimen at home within **8 hours** of the line break, discharge home with 2 nights worth of IP vancomycin (25mg/L), ciprofloxacin (50mg/L) and heparin (500iu/L)and advise them to start their child's overnight dialysis immediately

- If the child **cannot** be commenced on their usual PD regimen at home within 8 hours of the line break, perform a CAPD (Continuous ambulatory peritoneal dialysis) fill with IP vancomycin (25mg/L), ciprofloxacin (50mg/L) and heparin (500iu/L) on the ward, prior to discharging home with 2 nights worth of IP vancomycin, ciprofloxacin and heparin, for their normal PD regimen.

If WCC >100 WBC x 10^6/litre and > 50% neutrophils:

Admit and start full treatment for peritonitis

5.10 Allergies to Antibiotics

- Vancomycin allergy – change patient to teicoplanin 20mg/L until PD cultures back. Then review best antibiotic based on sensitivities available.
- Penicillin allergy – instead of using amoxicillin for enterococci, consider changing to IP vancomycin (25mg/L), if organism sensitive. Discuss with microbiology if not.

5.11 Stability of antibiotic injections after addition to the PD solution

In general, icodextrin-based (extraneal) PD solutions are compatible with vancomycin, cefazolin, ceftazidime, and gentamicin. When premixed in icodextrin solution, these antibiotics are least stable at 37°C and most stable at 4°C, permitting storage for 14 days when refrigerated and pre-warming to body temperature prior to administration.[1]

Vancomycin

- stable for 28 days in dialysis solutions stored at room temperature, although higher ambient temperatures will reduce the duration of stability (1)

Heparin

- addition to PD fluid has no adverse influence.

Ceftazidime

- Ceftazidime was stable 24 hours in icodextrin, 12 hours in Physioneal 1.36% and 6 hours in Physioneal 3.86%. Must be used with caution due to lack of stability. (5)

Cefazolin is stable in dextrose based solution for at least 8 days at room temperature and 14 days when refrigerated. The addition of heparin has no adverse effects.

Ciprofloxacin

- In peritoneal dialysis solutions containing 1.5% and 4.25% dextrose, ciprofloxacin was stable for seven days at 25 degrees C and for 48 hours at 37 degrees C (7)

Amoxicillin:

- Amoxicillin: amoxicillin is stable 6 h, 4 h, and 8 h in Physioneal 1.36%, 3.86% and Extraneal, respectively. must be used with caution due to lack of stability. (5)

Gentamicin

- Gentamicin alone is stable for 14 days at temperatures of 4, 25, 37 degrees (6)

Stability comments

Vancomycin and gentamicin should preferably be injected in different bags of PD solution.[11]
Vancomycin should not be given into amino-acid based solution.[11]
Aminoglycosides should not be added to the same bag with penicillins because of chemical incompatibility.[1]

Drug	Temperature	Duration of stability	PD Fluid	Comments
Amikacin	No data	No data	No data	
Amoxicillin		6 hours[5]	Physioneal 1.36%,	Must be used with caution due to lack of stability
		4 hours[5]	Physioneal 3.86%	
		8 hours[5]	Extraneal 7.5%	
Cefazolin	Room temperature	8 days	Physioneal	
	Fridge 2-8°C	14 days	Physioneal	
	37°C	24 houirs	Extraneal	
	Room temperature	7 days	Extraneal	
	Fridge 2-8°C	14 days	Extraneal	
Ceftazidime	37°C	24 hours[5]	Extraneal 7.5% (Icodextrin)	Stability is affected by temperature[5]
	37°C	12.8 hours[5]	Physioneal 1.36%	
	37°C	6 hours[5]	Physioneal 3.86%	
	37°C	6 hours[6]	Extraneal 7.5%	
	25°C	2 days[6]	Extraneal 7.5%	
	4°C	14 days[6]	Extraneal 7.5%	
Ciprofloxacin[7]	25°C	7 days	1.5% and 4.25% dextrose	
	37°C	48 hours		
Gentamicin	4°C, 25°C, 37°C	14 days[6]	Extraneal 7.5%	duration of stability is reduced by admixture with heparin
Heparin	Stable	Stable		Stable
Vancomycin	room temperature	28 days[1]		higher ambient temperatures will reduce the duration of stability
	37°C	4 days[6]	Extraneal 7.5%	
	25°C and 4°C	14 days[6]	Extraneal 7.5%	

Definition of stability: A mean loss over 10% from baseline is taken as evidence of lack of stability[5]

Stability and Compatibility of Antibiotics in Peritoneal Dialysis Solutions [5]

Summary of Drug Stability*

	Physioneal 1.36%	Physioneal 3.86%	Extraneal
Amoxicillin (50 mg/L)	6 h 41% @ 24h	4 h 32% @ 24h	8 h 82% @ 24h
Cefazolin (125 mg/L)	>24 h 99% @ 24h	>24 h 92% @ 24h	>24 h 92% @ 24h
Ceftazidime (125 mg/L) (±tobramycin) (±vancomycin)	12.8 h 77% @ 24h	6 h 48% @ 24h	>24 h 92% @ 24h
Cefepime (125 mg/L)	10 h 60% @ 24h	5 h 29% @ 24h	>24 h 96 % @ 24h
Sulfamethoxazole (400 mg/L)	>24 h 97% @ 24h	>24 H 99% @ 24h	>24 h 100% @ 24h
Trimethoprim (80 mg/L)	>24 h 96% @ 24h	>24 h 100% @ 24h	>24 h 100% @ 24h
Imipenem (200 mg/L)	2 h 12% @ 24h	2 h 4% @ 24h	6 h 26% @ 24h
Imipenem (50 mg/L)	2 h 12% @ 24h	2 h 5% @ 24h	6 h 24% @ 24h
Tobramycin (4 mg/L) (±ceftazidime)	>24 h 91% @ 24h	>24 h 93% @ 24h	>24 h 91% @ 24h
Vancomycin (30 mg/L) (±ceftazidime)	>24 h 93% @ 24h	>24 h 91% @ 24h	>24 h 96% @ 24h

* Time (in hours) necessary to reach 10% of drug degradation and percentage of drug remaining after 24 hours.[5]

Drug	PD solution			Stability	Storage conditions		
	Dextrose-based	Icodextrin-based	pH-neutral		Refrigeration	Room temperature	37°C
Cefazolin		✓	✓	1 day			✓
	✓			8 days		✓	
		✓	✓	7 days		✓	
	✓	✓	✓	14 days	✓		
Cefepime	✓			14 days	✓[388]		
			✓	4 days		✓	
		✓	✓[408]	7 days	✓[389]		
		✓	✓[408]	12 hours			✓[393]
	✓			2 days			✓
	✓			7 days		✓	
Ceftazidime	✓			4 days		✓	
	✓		✓	7 days	✓		
		✓	✓	2 days		✓[409, 410]	
		✓		14 days	✓		
		✓		8 hours			✓
			✓	24 hours			✓
	✓			12 hours			✓
Vancomycin	✓			28 days		✓	
		✓[411]		14 days	✓	✓	
	✓		✓	1 day			✓
			✓	1 day	✓	✓	
		✓		4 days			✓
Daptomycin[c]			✓	5 days	✓		
			✓	12 hours			✓
	✓		✓	1 day		✓	
	✓			1 day	✓		
	✓			6 hours			✓
Gentamicin	✓	✓		14 days	✓	✓	✓
			✓	<24 hours		✓	
Tobramycin	✓			1 days		✓	
		✓		14 days	✓		
		✓		7 days		✓[391]	
		✓		1 day			✓
			✓	<24 hours		✓	✓
Meropenem + heparin	✓	✓		7 days	✓[392]		
	✓			10 hours			✓
Meropenem		✓[412]		7 days	✓		
Ciprofloxacin[413]		✓	✓	14 days	✓[250]		
	✓	✓		7 days		✓	
		✓	✓	1 day			✓
	✓			2 days			✓

Stability data of antibiotics added to peritoneal dialysis solutions

For Peer Review

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7 Appendix 1 - Guideline for performing a CAPD exchange to deliver loading doses of intraperitoneal antibiotics

GUIDELINE FOR PERFORMING A CAPD EXCHANGE TO DELIVER LOADING DOSES OF INTRAPERITONEAL ANTIBIOTICS

Directions using Non-Touch Technique

1. Confirm patient readiness for procedure and establish consent.
2. Ensure all windows and doors in the patients room and preparation area are closed.
3. Ensure all medications are prescribed on EPIC.

4. Collect equipment required:
   1 x 1.36% Physioneal 40 CAPD (OR 2.27% Physioneal 40 if hypertensive)
   (Only Physioneal 40 bags are routinely stocked on Eagle ward for CAPD)

Syringe for each medication	Balance Scales and drip stand
Filter needles x 2 for each syringe	Connection shield
Water for Injection	Minicap
2% chlorhexidine/70% alcohol wipe (e.g. Clinell®)	Blue clamps x 2
Clinell universal surface wipes	

5. Perform hand hygiene.
6. An IV tray and trolley should be decontaminated with an appropriate wipe.
7. Equipment should be prepared in the IV tray and medications drawn up as per product information leaflet and prescription using ANTT®, packets should be carefully peeled and utilised to protect key parts. Do not re-sheath needles.
8. Change and prime the needle on each syringe, (due to the risk of glass shards and bung coring) until the prescribed volume is left in the syringe.
9. Dispose of any sharps in a sharps bin.
10. Place the CAPD Physioneal bag onto the clean trolley and open the outer packaging to expose the needle port attached to the fluid bag.
11. Perform hand hygiene.
12. Scrub the needle port on the CAPD Physioneal bag with a 2% chlorhexidine/70% alcohol wipe (e.g. Clinell®) for 15 seconds and allow to dry prior to inoculation.
13. Add the prescribed medications to the CAPD fluid bag.
14. Place the appropriate drug labels onto the CAPD bag.
15. Take trolley to the patient's room, with the remaining pieces of unused equipment.
16. Close the door behind you.
17. Perform hand hygiene.
18. Open connection shield and leave in the packet on top of trolley with the CAPD bag.
19. Perform hand hygiene.
20. Uncoil lines attached to the CAPD set, remove the cap from the patient line and attach the connection shield.
21. Connect the CAPD patient line to the patients PD catheter.
22. **Mix the two Physioneal chambers** of the CAPD Physioneal bag by breaking the green seal and hanging it onto the drip stand.

23. Weigh the empty drain bag using the balance scales and record.
24. Unclamp the patient's PD catheter and allow previous fill to drain. This may take up to 20 minutes.
25. When the line leaving the patient feels cool to touch, the fluid has stopped draining.
26. Re-clamp the patients PD catheter. Measure the drain fluid using the balance scales and record volume on EPIC.
27. **Ensuring the PD catheter is clamped using twist clamp,** break the green seal on the fill line to allow the full CAPD set to prime through to the drain bag.
28. Clamp the drain line with a blue clamp once the set is fully primed with the Physioneal fluid.
29. Place the CAPD Physioneal bag on the balance scales and zero the scales.
30. Unclamp the twist clamp on the patient's PD line (drain line MUST BE CLAMPED) and allow patient to fill with the prescribed volume.
31. Once the prescribed volume is achieved, clamp the fill line with a blue clamp and close the twist clamp on patients PD catheter.

Disconnection

1. Perform hand hygiene.
2. Open new minicap.
3. Perform hand hygiene.
4. Disconnect the CAPD set from the patient's PD catheter and attach a minicap.
5. Dispose of all equipment as appropriate.
6. Perform hand hygiene.
7. Record the CAPD exchange on EPIC.
8. Ensure this PD fluid is left insitu for at least **3 hours,** before starting CCPD with maintenance medication doses.

Written by M. Blaauw (PD CNS) Nov 2020
Updated by N Baugh (PD CNS) July 2025

8 Appendix 2 – Guideline for adding Intraperitoneal antibiotics to peritoneal dialysis fluid bags equipment

GUIDELINE FOR ADDING INTRAPERITONEAL ANTIBIOTICS TO PERITONEAL DIALYSIS FLUID BAGS EQUIPMENT:

Directions using Non-Touch Technique

1. Ensure all windows and doors in the preparation area are closed.
2. Ensure all medications are prescribed on EPIC.
3. Collect equipment required:

   Prescribed PD fluid bags
   Syringe for each medication
   Filter needles x 2 for each syringe
   Water for Injection
   2% chlorhexidine/70% alcohol wipe (e.g. Clinell®)
   Clinell universal surface wipes
   Balance Scales and drip stand
   Connection shield
   Minicap
   Blue clamps x 2

   Heparin (1000units/ml) AND Antibiotics as required

4. Perform hand hygiene.
5. An IV tray, trolley and surface should be decontaminated with an appropriate wipe.
6. Equipment should be prepared in the IV tray and medications drawn up as per product information leaflet and prescription using ANTT®, packets should be carefully peeled and utilised to protect key parts. Do not re-sheath needles.
7. Change and prime the needle on each syringe, (due to the risk of glass shards and bung coring) until the prescribed volume is left in the syringe.
8. Dispose of any sharps in a sharps bin.
9. Place the prescribed PD bags onto the clean surface.
10. Open the outer packaging fully or if preparing bags in advance, cut out a window into the outer packaging with clean scissors, to expose the ports.
11. Perform hand hygiene
    a. For 2L PD bags scrub the needle port with a 2% chlorhexidine/70% alcohol wipe (e.g. Clinell®) for 15 seconds and allow to dry prior to inoculation.
    b. For 5L PD bags remove blue lid from needle port on each bag to expose the rubber seal.
12. Perform hand hygiene
13. Add the prescribed medications into each PD bag via the needle port.
14. Place the appropriate drug labels onto the PD bags.
15. Dispose of all equipment as appropriate.
16. Perform hand hygiene.

The PD bags are viable for (note differences for Cefazolin):

24hrs if instilled with Amoxicillin, Amikacin, Ceftazidime, Teicoplanin, [Cefazolin in extraneal bags]
48hrs if instilled with Heparin, Ciprofloxacin, Vancomycin, [Cefazolin in Physioneal bags]
For all other additives please refer to the Peritonitis protocol.

Written by M. Cantwell (PD CNS) Nov 2007
Revised by N. Baugh (PD CNS) July 2025

9 Document Control

Document Control	
Hosting Clinical Directorate:	Body. Bones and Mind
Clinical specialty/specialties to be published under:	Nephrology
Version Information	
New guideline ☐ Scheduled review ☒ Amended due to updates ☐	
Version number:	2
Previous title (if applicable):	Guidelines for the Treatment of Peritonitis in Children on Peritoneal Dialysis (PD)
Last version number (if applicable):	1
Last approval date (if applicable):	January 2025
Major amendments made (if applicable):	Empirical treatment now to include increased a loading dose of IP vancomycin, also increased doses of ciprofloxacin and heparin.
Consultation	
Individuals/groups/teams consulted on the guideline development/updates:	Peritoneal dialysis team. Microbiology
Local Ratification Process	
Committees that have ratified the guidelines prior to presentation at Clinical Guidelines Committee:	Antimicrobial Policy Group (APG) Drugs and Therapeutics Committee
Legal Team sign off (if applicable):	
Does the guideline include information about consent?	No
If yes, has the Legal Team reviewed the guideline and signed it off?	n/a
Drugs and Therapeutics Committee sign off (if applicable):	
Does the guideline include information about drugs or therapeutic agents?	Yes
If yes, and the specialist pharmacist has confirmed that DTC approval is required, has this been done?	Yes - DTC approval for Cefazolin, Vancomycin and Ciprofloxacin as changes in dose. The rest are approved
Nutrition Steering Committee sign off (if applicable):	

Does the guideline include information about nutrition or feeds or nutrition-related products?	No
If yes, has the NSC approved the described nutrition or feeds or nutrition-related product guidance?	n/a
Medical Equipment and Supplies Group sign off (if applicable):	
Does the guideline include information about use of a medical device or medical equipment that is to be used innovatively / is not what the manufacturer has intended as its use?	No
If yes, has the MESG approved the described innovative use of medical devices/equipment?	n/a
Clinical Guidelines Committee approval:	
Date Approved by Guideline Committee:	**July 2025**
Guideline Expiry Date:	**July 2028**