PERITONEAL DIALYSIS CATHETER (PDC) INFECTION – EXIT SITE and TUNNEL INFECTION MANAGEMENT AND TREATMENT

Cross References (including NSW Health/ SESLHD policy directives)	NSW Health PD2013_043 - Medication Handling in NSW Public Health Facilities NSW Health PD2007_036 - Infection Control Policy SGH-TSH CLIN027 - Aseptic Technique - Competency and Education Requirements NSW Health PD2012_007 - User applied Labelling of Injectable Medicines, Fluids and Lines SGH CLIN Peritoneal Dialysis (PD) – Peritonitis Management and Treatment SGH CLIN Peritoneal Dialysis (PD) – Nasal Swab And Mupirocin Renal SGH WPI Peritoneal Dialysis – Intraperitoneal Cefepime (1g) Renal SGH WPI Peritoneal Dialysis – Intraperitoneal Ceftazidime (1g) Renal SGH WPI Peritoneal Dialysis – Intraperitoneal Ceftazidime Administration (250 mg) Renal SGH WPI Peritoneal Dialysis – Intraperitoneal Fluconazole Renal SGH WPI Peritoneal Dialysis – Intraperitoneal Gentamicin Administration (40 mg) Renal SGH WPI Peritoneal Dialysis – Intraperitoneal Vancomycin Administration Renal SGH WPI 062 Peritoneal Dialysis –Fluid Specimen Collection via Automated PD (APD) Renal SGH WPI 063 Peritoneal Dialysis –Fluid Specimen Collection via CAPD Freeline Solo Exchange
1. What it is	A guideline and procedure for the early diagnosis of PDC exit site and tunnel infection and timely management with antimicrobial therapy according to best practice guidelines
2. Risk Rating	Medium
3. Employees it Applies to	Registered Nurses (RN) Medical Officers (MO)

4. Process

PDC infection is one of the major complications of PD. Early diagnosis, rapid intervention and treatment with antimicrobial therapy are necessary measures to prevent peritonitis and further complications. There are 2 types of PDC infection:

1. Exit site infection – presence of purulent discharge, with or without erythema of the skin surrounding the PD catheter
2. Tunnel infection – presence of erythema, oedema and/or tenderness or ultrasound evidence of collection along the PD catheter tunnel. An occult infection between the internal cuffs, usually occurs in the presence of an exit site infection and rarely occurs on its own.

4.1 Diagnosing PDC Infection

4.1.1 Exit site infection (ESI) signs and symptoms
- Purulent discharge from the exit site
- Swelling and erythema surrounding exit site
- Painful area to touch

4.1.2 Tunnel infection signs and symptoms
- Erythema, oedema and/or tenderness over the subcutaneous pathway of the PD catheter
- Purulent or bloody drainage that discharges spontaneously or after applying pressure on the cuff
- Confirm peri-catheter abscess or collection with ultrasound. Other indications for PDC tunnel ultrasound examination are:
  - Staphylococcus aureus ESI even without symptoms of tunnel infection
  - Relapsing peritonitis episodes
  - Follow-up of combined exit-site and tunnel infection 1 week after completion of antibiotic treatment

4.2 Management of Tunnel and ESI presentation

Note: PDC connection, exit site swab and/or dressing can be performed by (or under the supervision of) an accredited staff only

1. Upon patient presentation, remove dressing covering the PDC exit site and review for signs and symptoms of tunnel and ESI
2. Clean PDC exit site with normal saline soaked gauze
3. Swab PDC exit site and send for microscopy, culture and sensitivity (MCS); and collect PD fluid specimen for MCS, cell count and cell differential as per Peritoneal Dialysis - Fluid Specimen Collection via CAPD or APD; Renal SGH WPIs <u>preferably before any antibiotic treatment is given</u>
   - For exit site with exudate: Swab exudate at exit site with a dry bacteriological (usually rayon) swab
   - For dry exit site: Pre-moisten a standard bacteriological swab with either sterile saline or the transport medium accompanying the swab

   Note: If patient was on antibiotic/s prior to exit site swab and PD fluid collection, note down all the antibiotics patient received on the pathology request form
4. Notify renal team to review patient. Patients manifesting clinical signs of tunnel infection must have ultrasound examination to confirm peri-catheter abscess or collection
5. Patients manifesting clinical signs and symptoms of ESI or tunnel infection must commence empirical antibiotic treatment immediately
6. Replace PDC exit site dressing as per Peritoneal Dialysis Catheter – Exit Site Care (Post Op) or (Regular Daily) Dressing; Renal SGH WPIs, whichever is applicable
7. Notify PD CNC (page 1091) and PD unit (ext 33770)
8. PD nurse to conduct a root cause analysis for any PD related infective episode, including a review of patient/carer's dressing technique and hand hygiene practices. PD nurse to provide PD catheter care retraining as required

4.3 Recommended empiric antibiotic therapy and management before organisms known

1. Positive culture in the absence of clinical signs and symptom of ESI and tunnel infection suggests colonisation and **not** infection, do not treat with antibiotics

2. In the presence of at least 1 clinical signs and symptoms of PDC exit site or tunnel infection, initiate antimicrobial treatment immediately after obtaining PDC exit site swab and PD fluid specimen:
   a) Patients with **no** history of MRSA or Pseudomonas infection: Oral Cephalexin 500 mg TDS and Mupirocin ointment to exit site BD (requires BD exit site dressing change)
   b) Patients with history of MRSA infection sensitive to Clindamycin: Oral Clindamycin 300 – 450 mg TDS
   c) Patients with history of MRSA infection not sensitive to Clindamycin: IP Vancomycin 30mg/kg (maximum 2g) weekly, as per Peritoneal Dialysis – Intraperitoneal Vancomycin Administration; Renal SGH WPI
   d) Patients with history of Pseudomonas infection: Oral Ciprofloxacin 500 mg daily and Tobramycin 0.3% topical drops to exit site BD (requires BD exit site dressing change)
   e) Patients with history of combined MRSA and Pseudomonas infection: IP Vancomycin 30mg/kg (maximum 2g) weekly and IP Gentamicin 40mg daily combined in a PD fluid bag as per Peritoneal Dialysis – Intraperitoneal Vancomycin and Gentamicin Administration (40 milligram); Renal SGH WPIs
3. Continue antimicrobial treatment whilst organisms and sensitivity are not available
4. Commence prophylactic antifungal treatment: oral Nystatin 500 000 units QID. Continue prophylactic antifungal treatment whilst patient is on antibiotics. For patient on Vancomycin, continue prophylactic antifungal treatment for another 7 days after last dose of Vancomycin.

4.4 Recommended antimicrobial therapy and management after organisms known

Table 1

1. Treat according to culture and sensitivity results from PDC exit site swab
2. If swab grows an organism but no erythema or exudate present at exit site, do not treat with antibiotics as most likely colonisation rather than infection
3. Aggressive and minimum of 3 weeks antibiotic treatment is recommended for tunnel infection, MRSA and Pseudomonas ESIs
4. Continue antifungal prophylaxis with Nystatin (500 000 units orally QID) for the duration of antibiotic treatment. For patients on Vancomycin, continue oral antifungal prophylaxis for another 7 days after last dose of Vancomycin
5. Immediate PD catheter removal is recommended for:
   - Refractory tunnel and ESI – patients with unresolved signs and symptoms of tunnel and ESI after 3 weeks on appropriate antibiotic treatment
   - Tunnel or ESI in conjunction with peritonitis of same organism
   - Tunnel or ESI progressing to peritonitis
6. Reinsertion of PD catheter may be considered 2 weeks after treatment completion & resolution of infective symptoms for simultaneous tunnel or ESI **with peritonitis**
7. Simultaneous removal and reinsertion of PD catheter to an alternate exit site with antibiotic cover may be considered for refractory tunnel and ESI **without peritonitis**
8. Repeat PDC exit site swab and PD fluid MCS, cell count and cell differential 7 days after completion of appropriate antibiotic therapy
9. For tunnel infection with or without ESI: repeat tunnel ultrasound 7 days after completion of appropriate antibiotic therapy
10. For staphylococcus aureus ESI with or without tunnel infection: request for a tunnel ultrasound 7 days after completion of appropriate antibiotic therapy

11. Administration of quinolones (i.e. Ciprofloxacin) should be separated from sevelamer , calcium, oral iron, zinc preparations, sucralfate, magnesium-aluminium antacids, or milk by 2 hours to prevent chelation interactions reducing quinolone absorption (administer quinolone first)
12. Root cause analysis for every tunnel and ESI episode should be conducted by the PD nurses which may include reassessment and retraining of patient/carer's PD catheter care and dressing technique including hand hygiene

1. Staphylococcus Aureus, Coagulase-Negative Staphylococcus, Staphylococcus Epidermidis and other Gram Positive Organisms (including multiple gram positive organisms)
   a) Continue with Oral Cephalexin 500 mg TDS and Mupirocin ointment to exit site BD (requires BD exit site dressing change) for 2 weeks (or 3 weeks for tunnel infection)
      Or
      Change to another oral, IP or IV antibiotic based on sensitivity
   b) For severe, slow responding or non-responding Staphylococcus aureus tunnel and/or ESI: add oral Rifampicin 450-600mg/day (in single or split dose) for 7 days as adjunctive treatment
      Note: Rifampicin should never be given as a monotherapy
   c) For Staphylococcus aureus tunnel and/or ESI, collect body swabs (i.e. nasal, groin, axilla and umbilicus) to determine if the patient is a carrier of this organism.
      - For nasal carrier, patient must commence on nasal mupirocin treatment immediately as per SGH CLIN Peritoneal Dialysis (PD) Catheter – Nasal Swab And Mupirocin
   d) Refer to Table 1 and 2 for subsequent management and dosage of other antibiotics
   e) If clinical signs and symptoms of tunnel and/or ESI are resolving, continue appropriate antibiotic therapy for a total duration of 14 days for ESI or 21 days for tunnel infection.

2. Methicillin or Multiple Resistant Staphylococcus Aureus (MRSA) or Methicillin or Multiple Resistant Staphylococcus Epidermidis (MRSE) (including Non-resolving Gram Positive Organism)
   a) Adjust or change antibiotic treatment based on sensitivity
   b) ESI organism sensitive to Clindamycin: Continue with or start oral Clindamycin 450 mg TDS
   c) ESI organism sensitive to Suphamethoxazole/trimethoprim: Commence Oral Suphamethoxazole/trimethoprim (Bactrim D/S) 800/160mg daily
   d) Combined tunnel and ESI: Continue with or start IP Vancomycin 30mg/kg (up to a maximum of 2g) at least weekly for 21 days
      - Check trough Vancomycin level on day 5
      - Patient should receive another dose if trough serum levels is <15mg/mL
      - Timing of repeated dosing should be based on trough serum level and is likely to be every 5-7 days. Levels are not required if dosing is weekly.
   e) MRSA tunnel and/or ESI in conjunction with or progressing to peritonitis: add rifampicin 450-600mg/day orally (in single or split dose) for 7 days as adjunctive treatment
      Note: Rifampicin should never be given as a monotherapy
   f) Collect body swabs (i.e. nasal, groin, axilla and umbilicus) to determine if patient is a MRSA carrier
   g) Refer to Table 1 and 2 for subsequent management and dosage of other antibiotics
   h) If clinical signs and symptoms of tunnel and/or ESI are resolving, continue antibiotic therapy for a total duration of 21 days on appropriate antibiotics

3. Gram Negative Organisms (including Citrobacter, Enterobacter, E.Coli, Klebsiella, Proteus, Providentia, Serratia etc)
   a) Adjust or change antibiotic treatment based on sensitivity
      Or
      Continue with or start oral Ciprofloxacin 500 mg daily and Tobramycin 0.3% topical drops to exit site BD (requires BD exit site dressing change)
   b) For recurrent, severe, slow responding or non-responding gram negative tunnel and/or ESI: add daily IP Cefepime 1g as per Peritoneal Dialysis – Intraperitoneal Cefepime (1g); Renal SGH WPI
      Or
      Add daily IP Gentamicin 40 mg as per Peritoneal Dialysis – Intraperitoneal Gentamicin Administration (40 milligram); Renal SGH WPI
   c) Refer to Table 1 and 2 for subsequent management and dosage of other antibiotics
   d) If clinical signs and symptoms of tunnel and/or ESI are resolving, continue appropriate antibiotic therapy for a total duration of 14 days for ESI or 21 days for tunnel infection

4. Pseudomonas tunnel and/or ESI without Peritonitis
   a) Continue with or start oral Ciprofloxacin 500 mg daily and Tobramycin 0.3% topical drops to exit site BD (requires BD exit site dressing change)
   b) For recurrent, severe, slow responding or non-responding Pseudomonas tunnel and/or ESI: Add IP ceftazidime 1g loading dose, then 250mg/2L in each bag as per Intraperitoneal Ceftazidime Administration (1g) and (250mg); Renal SGH WPIs
      Or
      Add daily IP Cefepime 1g as per Peritoneal Dialysis – Intraperitoneal Cefepime (1g); Renal SGH WPI
   c) Refer to Table 1 and 2 for subsequent management and dosage of other antibiotics
   d) If clinical signs and symptoms of tunnel and/or ESI are resolving, continue antibiotic therapy for a total duration of 21 days on appropriate antibiotics

5. Pseudomonas tunnel and/or ESI with or following peritonitis
   a) Arrange for immediate PD catheter removal.
   b) Continue with dual treatment of IP Cefepime 1 g daily and oral Ciprofloxacin 500 mg daily whilst PD catheter is insitu
   a) Refer to Table 1 and SGH CLIN Peritoneal Dialysis (PD) – Peritonitis Management and Treatment for subsequent management
   c) Continue with oral or systemic antibiotics based on sensitivity for 14 days from time of PD catheter removal

6. Fungal
   a) Stop empiric IP antibiotics
   b) Without peritonitis: Adjust or change antibiotic treatment based on sensitivity. Duration of treatment and decision to remove PD catheter should be based on the extent or severity of infection
   c) Tunnel and/or ESI in conjunction with or progressing to peritonitis: Arrange for urgent PD catheter removal, commence IP Fluconazole whilst PD catheter is insitu and treat with appropriate oral or IV antifungal treatment for 14 days from time of PD catheter removal as per SGH CLIN Peritoneal Dialysis (PD) – Peritonitis Management and Treatment

7. No Growth (Culture Negative)
   a) Confirm if patient is on any antibiotic treatment at time of swab collection for MCS. If continues to have clinical signs and symptoms of tunnel and/or ESI, repeat tunnel ultrasound, PDC exit site swab and PD fluid MCS, cell count and cell differential.
   b) Continue empiric antibiotic treatment until clinical signs and symptoms are resolved

8. Mycobacterial (M)
   a) Type and duration of treatment for mycobacteria tunnel and/or ESI is to be based on sensitivities and in consultation with the Infectious Diseases team

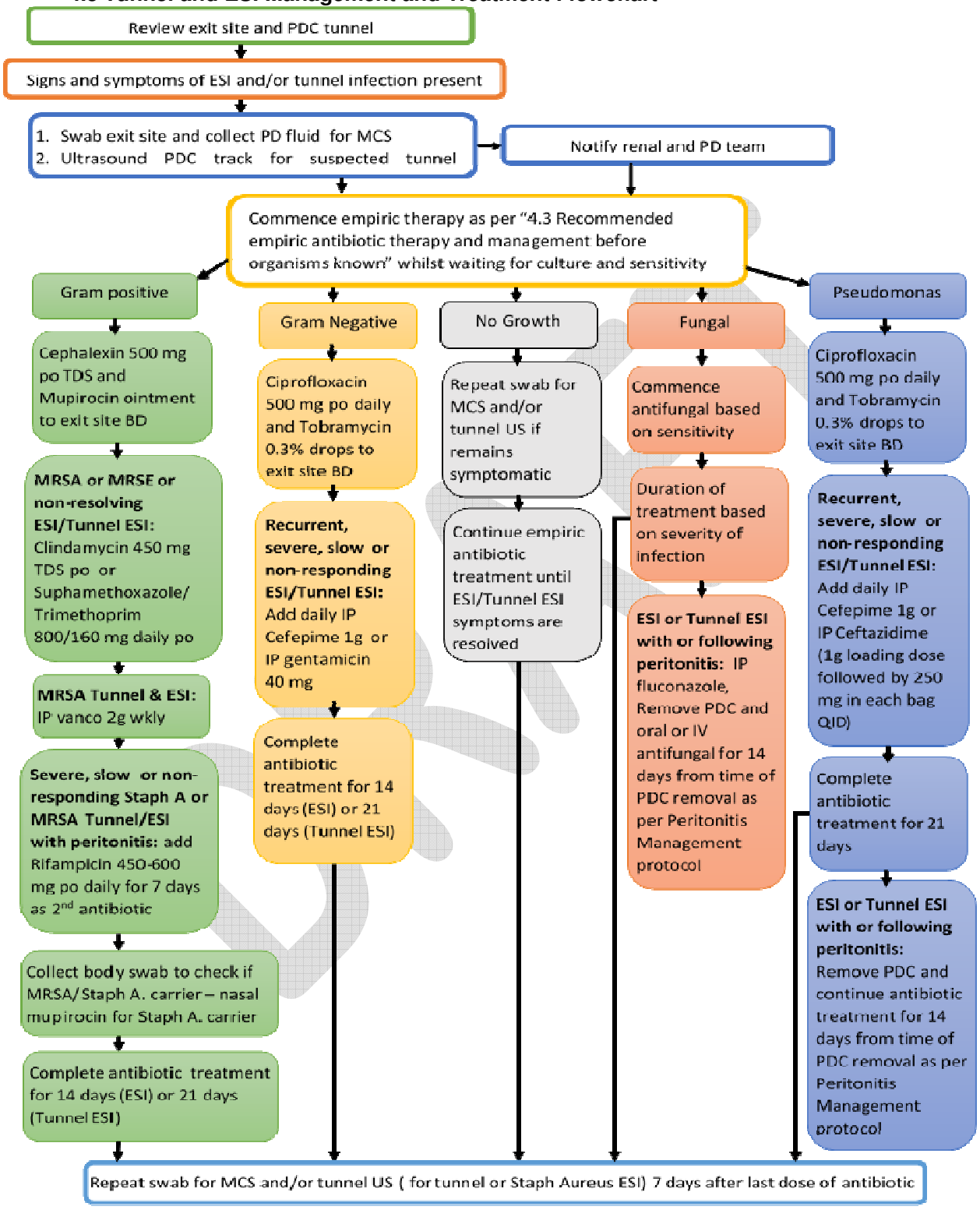
Table 2 (from ISPD 2017 Guidelines)

Oral Antibiotics Used in Catheter-Related Infections

Amoxicillin	250–500 mg BD (182)
Amoxicillin/clavulanate	875 mg/125 mg BD (183)
Cephalexin	500 mg BD to TID (86)
Ciprofloxacin	250 mg BD (164) or 500 mg daily (184)
Clarithromycin	500 mg loading, then 250 mg BD (165)
Clindamycin	300–450 mg TID (185)
Cloxacillin/flucloxacillin	500 mg QID (186)
Erythromycin	250 mg QID (187)
Fluconazole	oral 200 mg loading, then 50–100 mg daily (188)
Levofloxacin	300 mg daily (189)
Linezolid	300–450 mg BD (190–192)
Metronidazole	400 mg TID (193)
Moxifloxacin	400 mg daily (194)
Rifampicin	450 mg daily for BW <50 kg; 600 mg daily for BW ≥50 kg (144,145)
Trimethoprim/ sulfamethoxazole	80 mg/400 mg daily (8) to 160 mg/800 mg BD (195)

BD = two times per day; TID = three times per day; QID = four times per day; BW = body weight.

4.5 Tunnel and ESI Management and Treatment Flowchart



5. Keywords	Exit site Infection, Tunnel Infection, Peritonitis, Peritoneal dialysis
6. Functional Group	Renal, Peritoneal Dialysis
7. External References	Ballinger, A. P., Suetonia; Wiggins, Kathryn; Craig, Jonathan; Johnson, David; Cross, Nicholas; Strippoli, Giovanni (2014). Treatment for peritoneal dialysis-associated peritonitis. *Cochrane Database of Systematic Reviews, 4*. doi: 10.1002/14651858.CD005284.pub3 Bender F., Bernardini, J., Piraino, B. Prevention of Infectious Complications in Peritoneal Dialysis: Best Demonstrated Practices. Kidney International 70: S44-S54, 2006 Campbell, D. J., Johnson, D. W., Mudge, D. W., Gallagher, M. P., & Craig, J. C. (2014). Prevention of peritoneal dialysis-related infections. *Nephrology Dialysis Transplantation*. doi: 10.1093/ndt/gfu313 Cho, Y., & Johnson, D. W. (2014). Peritoneal Dialysis–Related Peritonitis: Towards Improving Evidence, Practices, and Outcomes. *American Journal of Kidney Diseases, 64*(2), 278-289. doi: http://dx.doi.org/10.1053/j.ajkd.2014.02.025 Dombros, N., Dratwa, M., Feriani, M., Gokal, R., Heimburger, O., Krediet, R., . . . Verger, C. (2005). European best practice guidelines for peritoneal dialysis. 4 Continuous ambulatory peritoneal dialysis delivery systems. *Nephrology Dialysis Transplantation, 20 Suppl 9*, ix13-ix15. doi: 10.1093/ndt/gfi1118 Li, P. K.-T., Szeto, C. C., Piraino, B., de Arteaga, J., Fan, S., Figueiredo, A. E., . . . Johnson, D. W. (2016). ISPD Peritonitis Recommendations: 2016 Update on Prevention and Treatment. *Peritoneal Dialysis International, 36*(5), 481-508. doi: 10.3747/pdi.2016.00078 Li, P. K., Szeto, C., Piraino, B., Bernardini, J., Figueiredo, A., Gupta, A., Johnson, D., Kuijper, E., Lye, W., Salzer, W., Shaefer, F., and Struijk, D. G. (2010). Peritoneal Dialysis – Related Infections Recommendations 2010 Update. *Peritoneal Dialysis International*, 30(4), 393-423. doi: 10.3747/pdi.2010.00049 Lo, M. W., Mak, S. K., Wong, Y. Y., Lo, K. C., Chan, S. F., Tong, G. M., . . . Wong, A. K. (2013). Atypical mycobacterial exit-site infection and peritonitis in peritoneal dialysis patients on prophylactic exit-site gentamicin cream. *Perit Dial Int, 33*(3), 267-272. doi: 10.3747/pdi.2011.00184 Mahoney, M. V. G. (2015). Clarification of Trimethoprim/Sulfamethoxazole Dose in CAPD. *Peritoneal Dialysis International, 35*(1), 116-118. doi: 10.3747/pdi.2013.00173 Piraino B., Baile, G., Bernardini, J. and et al. ISPD

	Guidelines/Recommendations Peritoneal Dialysis Related Infections Recommendations: 2005 Update. *Peritoneal Dialysis International* 25: 107-131, 2005 Piraino, B., Bernardini, J., Brown, E., Figueiredo, A., Johnson, D. W., Lye, W.-C., . . . Szeto, C.-C. (2011). ISPD Position Statement on Reducing the Risks of Peritoneal Dialysis–Related Infections. *Peritoneal Dialysis International, 31*(6), 614-630. doi: 10.3747/pdi.2011.00057 Rho, M., Bia, F., & Brewster, U. C. (2007). Nontuberculous mycobacterial peritonitis in peritoneal dialysis patients. *Semin Dial, 20*(3), 271-276. doi: 10.1111/j.1525-139X.2007.00289.x Szeto, C.-C., Li, P. K.-T., Johnson, D. W., Bernardini, J., Dong, J., Figueiredo, A. E., . . . Brown, E. A. (2017). ISPD Catheter-Related Infection Recommendations: 2017 Update. *Peritoneal Dialysis International*, 37(2), 141-154. doi: 10.3747/pdi.2016.00120 Walker, A. (2014). Management of peritoneal dialysis-associated peritonitis in adults and children. *The KHA-CARI Guidelines – Caring for Australasians with Renal Impairment* [cited 2015 March]; Available from: http://www.cari.org.au/Dialysis/dialysis%20peritonitis/dialysis_peritonitis.html Wong PN, Lo KY, Tong GMW et al. (2007). Prevention of fungal peritonitis with nyastatin prophylaxis in patients receiving CAPD. *Perit Dial Int*; 27:531–6
8. Consumer Advisory Group (CAG) approval of patient information brochure (or related material)	N/A
9. Implementation and Evaluation Plan Including education, training, clinical notes audit, knowledge evaluation audit etc	- Included in the education tools developed to assist nurses in increasing their knowledge to the care of patients on peritoneal dialysis i.e. Renal care flip chart, advance and basic PD learning package and PD orientation package - Monthly inservice education by PD CNC/nurses to all renal nurses - PD tutorial to Junior Medical Officers by the PD CNC at the beginning of renal rotation
10. Knowledge Evaluation	Q1: What are the initial signs and symptoms of ESI? A: ESI may present with purulent discharge, with or without erythema, swelling or tenderness of the skin surrounding the PD catheter Q2: What are the signs and symptoms of Tunnel infection A: Erythema, oedema and/or tenderness, purulent or bloody

	discharge and presence of collection along the PDC tunnel Q3: What is the management of patients with suspected Tunnel and/or ESI? A: Review PDC exit site ± swab for MCS, collect PD fluid specimen for MCS, cell count & differential, tunnel ultrasound to confirm peri-catheter abscess or collection, commence empiric IP antibiotic and prophylactic anti-fungal treatment Q4: When would empiric antibiotic therapy commence? A: Preferably after the PDC exit site swab and PD fluid specimen are collected for MCS & cell differential on symptomatic patients.
11. Who is Responsible	Director of St George and Sutherland Renal Service. Nursing Unit Manager, Dialysis Unit

Approval for Peritoneal Dialysis Catheter (PDC) Infection – Exit Site And Tunnel Infection Management And Treatment	
***Specialty/Department Committee**	Committee title: Peritoneal Dialysis Committee Chairperson name/position: Franziska Pettit, Staff Specialist Signature Date
***Nursing/Midwifery Co-Director**	Name/position Christine Day, Nurse Manager Medicine Signature Date
***Medical Co-Director**	Name /position: Mark Brown, Department Head Renal Services Signature Date
***Drug and Therapeutics Committee (SGH)**	Chairperson's Name: Winston Liauw Signature Date
Executive Sponsor	Name/Position: Signature Date
Contributors to CIBR development e.g. CNC, Medical Officers (names and position title/specialty)	

Revision and Approval History

Date	Revision number	Author (Position)	Revision due
June 2017	0	Anna Claire Cuesta (PD CNC)	June 2020

General Manager's Ratification		
Name Leisa Rathborne	Signature	Date