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

1. Purpose	A Business Rule 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. National Standards	1 – Clinical Governance 3 – Preventing and Controlling Infections 4 – Medication Safety 5 – Comprehensive Care
4. Employees it Applies to	Registered Nurses (RN) Medical Officers (MO)

5. 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 – An infection at the catheter – epidermal interface
2. Tunnel infection – An occult infection between the internal cuffs, usually occurs in the presence of an exit site infection and rarely occurs on its own.

5.1 DIAGNOSING PDC INFECTION

5.1.1 Exit site infection (ESI) signs and symptoms

- Purulent or bloody discharge from the exit site
- Swelling and/or erythema surrounding exit site may be present
- Area may be tender or painful and/or warm to touch
- Fever and/or chills may be present

5.1.2 Tunnel infection signs and symptoms

- Erythema, oedema, pain 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
- Fever and/or chills may be present
- 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

5.2 MANAGEMENT OF TUNNEL AND ESI PRESENTATION

Note: PDC connection, exit site swab and/or dressing can be performed by (or under the supervision of) 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 SGH WPI 146 *PD – Fluid Specimen Collection via APD* or SGH WPI 145 *PD –Fluid Specimen Collection via CAPD Freeline Solo Exchange* preferably before any antibiotic treatment is given
   - 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 SGH CLIN 402 *PDC – Daily Care, Dressing and Management* or SGH CLIN 414 *PDC – Post insertion Catheter Care, Dressing and Management*, whichever is applicable
7. Notify PD team (PD CNC page 1091 and/or PD CNS 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

5.3 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 or more clinical signs and symptoms of PDC exit site or tunnel infection as per section 5.1, increase frequency of exit site dressing change to twice a day as per SGH CLIN 402 *Peritoneal Dialysis Catheter (PDC) – Daily Care, Dressing and Management* and 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 every 8 hours until organism identification and sensitivity/susceptibility results are confirmed

      OR

      Patients with no history of MRSA or Pseudomonas infection **allergic to cephalosphorins**: oral amoxicillin/clavulanate 875 mg/125 mg every 12 hours until organism identification and sensitivity/susceptibility results are confirmed
   b) Patients with history of MRSA infection not susceptible to clindamycin: IP vancomycin 30mg/kg (maximum 2g), as per Vancomycin section of *SGH CLIN*

Peritoneal Dialysis – Intraperitoneal Antibiotics Dosage, Duration, Compatibility and Stability

- Check trough vancomycin level on day 3 – 5
- Patient should receive another dose if trough serum levels is <15mg/mL. Adjust repeat dose based on trough serum level
- Timing of repeated dosing should be based on trough serum level and is likely to be every 3 – 5 days. Levels are not required if dosing is weekly;

OR

c) Patients with history of MRSA infection susceptible to clindamycin: oral clindamycin 450 mg every 8 hours

OR

d) Patients with history of Pseudomonas infection: oral ciprofloxacin 500 mg daily

OR

e) Patients with history of combined MRSA and Pseudomonas infection: oral ciprofloxacin 500 mg daily and IP vancomycin 30mg/kg (maximum 2g) as per *SGH CLIN Peritoneal Dialysis – Intraperitoneal Antibiotics Dosage, Duration, Compatibility and Stability*

- Check trough vancomycin level on day 3 – 5
- Patient should receive another dose if trough serum levels is <15mg/mL. Adjust repeat dose based on trough serum level
- Timing of repeated dosing should be based on trough serum level and is likely to be every 3 – 5 days. Levels are not required if dosing is weekly;

3. Renal medical officers or prescribing medical officers must obtain antibiotic approval and guidance from ID (Infectious Diseases) team as per *SGH-TSH CLIN444 Antimicrobial Stewardship and Antibiotics – Approval and Administration Process, St George and Sutherland Hospitals*
4. Continue antimicrobial treatment whilst organisms identification and susceptibility are not available
5. Commence prophylactic antifungal treatment: oral nystatin 500 000 units every 6 hours. Continue prophylactic antifungal treatment whilst patient is on antibiotics. For patients on vancomycin, continue prophylactic antifungal treatment for another 7 days after last dose of vancomycin.

5.4 RECOMMENDED ANTIMICROBIAL THERAPY AND MANAGEMENT AFTER ORGANISMS KNOWN

Note: Prescribing medical officers must obtain antibiotic approval and guidance from ID (Infectious Diseases) team as per *SGH-TSH CLIN444 Antimicrobial Stewardship and Antibiotics – Approval and Administration Process, St George and Sutherland Hospitals*

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 or oral amoxicillin/clavulanate 875 mg/125 mg (**if allergic to cephalosphorins**) BD for 2 weeks (or 3 weeks for tunnel infection)

   OR

Change to another oral, IP or IV antibiotic based on susceptibility/sensitivity

b) For severe, slow responding or non-responding Staphylococcus aureus tunnel and/or ESI: Consult Infectious Disease team for adjuvant treatment advice

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 CLIN434 *PD Catheter – Nasal Swab And Mupirocin (Nasal Staphylococcus Aureus Eradication Treatment)*
   - For body carrier, patient must undergo decolonisation as per SESLHDPR/681 *Staphylococcus aureus (MSSA and MRSA) decolonisation*

d) Refer to Tables 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 resistant Staphylococcus aureus (MRSA) or methicillin resistant Staphylococcus epidermidis (MRSE) (including non-resolving Gram positive organism)

   a) Adjust or change antibiotic treatment based on sensitivity/susceptibility;

   b) ESI organism susceptible to clindamycin: Continue with or start oral clindamycin 450 mg every 8 hours

      OR

   c) ESI organism susceptible to sulphamethoxazole / trimethoprim: Commence oral sulphamethoxazole / trimethoprim 800/160mg every 12 hours for 3 days then daily

      OR

   d) Combined tunnel and ESI: Continue with or start IP vancomycin 30mg/kg (up to a maximum of 2g) as per Vancomycin section of *SGH CLIN Peritoneal Dialysis – Intraperitoneal Antibiotics Dosage, Duration, Compatibility and Stability* for 21 days
      - Check trough vancomycin level on day 3 – 5
      - Patient should receive another dose if trough serum levels is <15mg/mL. Adjust repeat dose based on trough serum level
      - Timing of repeated dosing should be based on trough serum level and is likely to be every 3 – 5 days. Levels are not required if dosing is weekly;

      OR

   e) MRSA tunnel and/or ESI in conjunction with or progressing to peritonitis: Continue with antibiotic treatment based on susceptibility and consult Infectious Disease team for adjuvant treatment advice

   f) Collect body swabs (i.e. nasal, groin, axilla and umbilicus) to determine if patient is a MRSA carrier.
      - For nasal carrier, patient must commence on nasal mupirocin treatment immediately as per SGH CLIN434 *PD Catheter – Nasal Swab And Mupirocin (Nasal Staphylococcus Aureus Eradication Treatment)*
      - For body carrier, patient must undergo decolonisation as per SESLHDPR/681 *Staphylococcus aureus (MSSA and MRSA) decolonisation*

   g) Refer to Tables 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/susceptibility

       OR

       Start and/or continue with oral ciprofloxacin 500 mg daily.
    b) For recurrent, severe, slow responding or non-responding gram negative tunnel and/or ESI: stop oral ciprofloxacin and change to daily IP cefepime 1g as per Cefepime section of SGH CLIN *Peritoneal Dialysis – Intraperitoneal Antibiotics Dosage, Duration, Compatibility and Stability*

       AND/OR

       Add or change to daily IP gentamicin 40 mg if needed as per Gentamicin section of SGH CLIN *Peritoneal Dialysis – Intraperitoneal Antibiotics Dosage, Duration, Compatibility and Stability*
        - Take serum trough level after 3 days of daily treatment
        - For daily serum trough level if patient is on daily Gentamicin for ≥3 days
        - Withhold gentamicin if serum trough level is >1 mg/L
        - For regular hearing and vestibular function testing if gentamicin treatment is ≥5 days
    c) Refer to Tables 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 the 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

       OR
    b) For recurrent, severe, slow responding or non-responding Pseudomonas tunnel and/or ESI: Stop oral ciprofloxacin and commence IP ceftazidime 1g loading dose, then 250mg/2L in each bag every 6 hours as per Ceftazidime section of SGH CLIN *Peritoneal Dialysis – Intraperitoneal Antibiotics Dosage, Duration, Compatibility and Stability*

       OR

       Stop oral ciprofloxacin and commence daily IP cefepime 1g as per Cefepime section of SGH CLIN *Peritoneal Dialysis – Intraperitoneal Antibiotics Dosage, Duration, Compatibility and Stability*

       AND/OR

       Add or change to daily IP gentamicin 40 mg if needed as per Gentamicin section of SGH CLIN *Peritoneal Dialysis – Intraperitoneal Antibiotics Dosage, Duration, Compatibility and Stability*
        - Take serum trough level after 3 days of daily treatment
        - For daily serum trough level if patient is on daily Gentamicin for ≥3 days
        - Withhold gentamicin if serum trough level is >1 mg/L
        - For regular hearing and vestibular function testing if gentamicin treatment is ≥5 days
    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

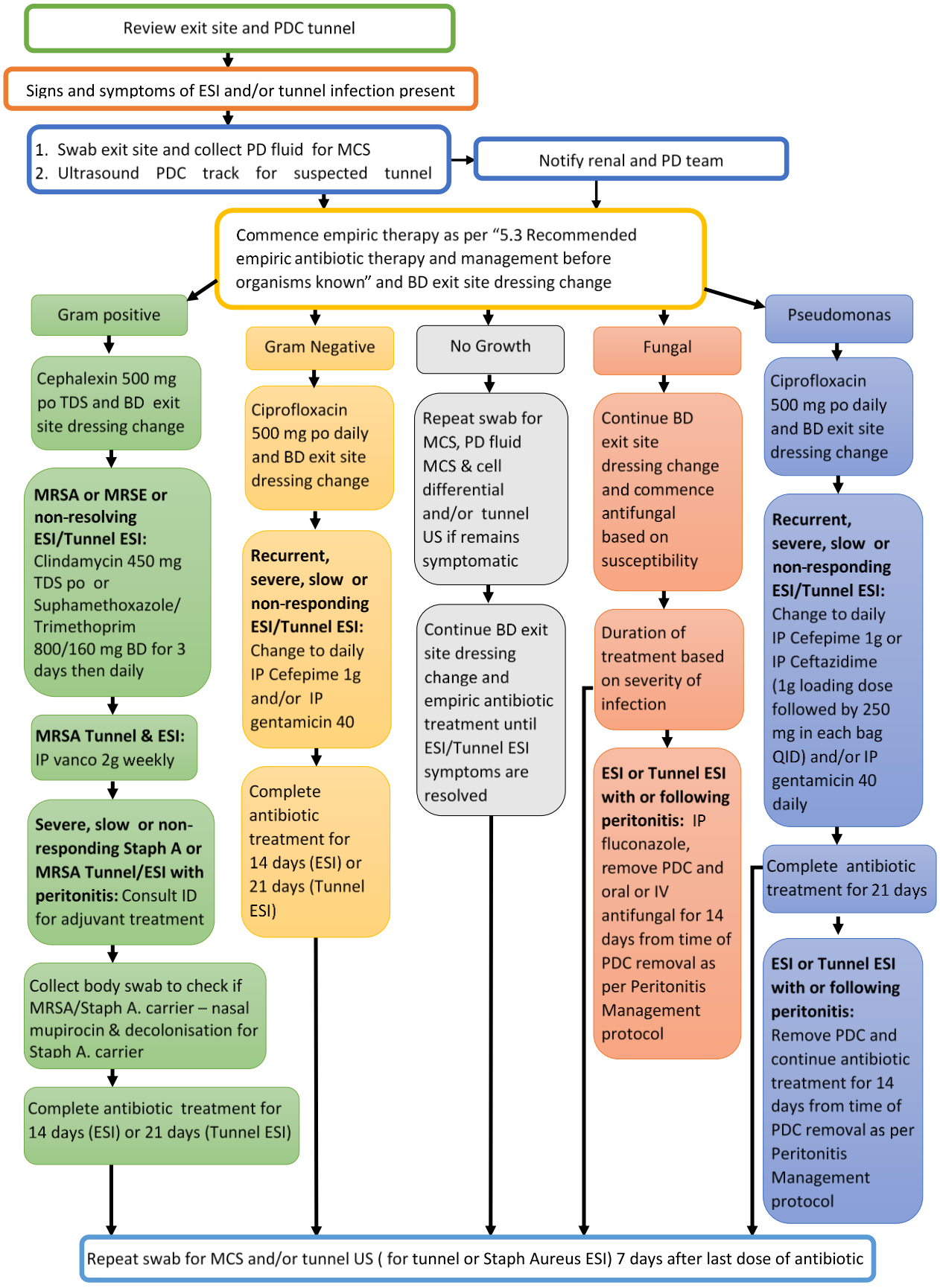
5. Pseudomonas tunnel and/or ESI with or following peritonitis
   a) Arrange for immediate PD catheter removal.
   b) Continue IP Cefepime 1g daily as per Cefepime section of SGH CLIN *Peritoneal Dialysis – Intraperitoneal Antibiotics Dosage, Duration, Compatibility and Stability* whilst PD catheter is insitu
   c) Refer to Table 1 and SGH CLIN 442 *Peritoneal Dialysis (PD) – Peritonitis Management and Treatment* for subsequent management
   d) Continue with oral or systemic antibiotics based on sensitivity/susceptibility for 14 days from time of PD catheter removal
6. Fungal tunnel and/or ESI
   a) Stop empiric IP antibiotics
   b) Without peritonitis: Adjust or change antifungal treatment based on sensitivity/susceptibility. 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 as per Fluconazole section of SGH CLIN *Peritoneal Dialysis – Intraperitoneal Antibiotics Dosage, Duration, Compatibility and Stability* and Stability whilst PD catheter is insitu
   d) Once PD catheter is removed, treat with appropriate oral or IV antifungal treatment for 14 days from time of PD catheter removal as per SGH CLIN 442 *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 including cell count, cell differential, AFB and fungal culture.
   b) Continue empiric antibiotic treatment until clinical signs and symptoms are resolved
8. Mycobacterial (M) tunnel and/or ESI
   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 1:

1. Increase frequency of PDC exit site dressing change to twice a day SGH CLIN 402 *Peritoneal Dialysis Catheter (PDC) – Daily Care, Dressing and Management* for confirmed or suspected exit site and/or tunnel infection.
2. Treat according to culture and susceptibility results from PDC exit site swab
3. Prescribing medical officers i.e. renal medical officers must obtain antibiotic approval and guidance from ID (Infectious Diseases) team as per *SGH-TSH CLIN444 Antimicrobial Stewardship and Antibiotics – Approval and Administration Process, St George And Sutherland Hospitals*
4. 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
5. Aggressive and minimum of 3 weeks antibiotic treatment is recommended for tunnel infection, MRSA and Pseudomonas ESIs
6. 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.
7. 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
8. Reinsertion of PD catheter may be considered 2 weeks after treatment completion and resolution of infective symptoms for simultaneous tunnel or ESI **with peritonitis**
9. 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**
10. Repeat PDC exit site swab and PD fluid MCS, cell count and cell differential 7 days after completion of appropriate antibiotic therapy
11. For tunnel infection with or without ESI: repeat tunnel ultrasound 7 days after completion of appropriate antibiotic therapy
12. For staphylococcus aureus ESI with or without tunnel infection: request for a tunnel ultrasound 7 days after completion of appropriate antibiotic therapy
13. 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)
14. 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

Table 2:	
Oral Antibiotics Used in Catheter-Related Infections	
Amoxicillin	250-500mg BD
Amoxicillin / clavulanate	875mg/125mg BD
Cephalexin	500mg BD to TDS
Ciprofloxacin	250mg BD ***or*** 500mg Daily
Clarithromycin	500mg loading, then 250mg BD
Clindamycin	300-450mg TDS
Erythromycin	Check dosing with ID team
Flucloxacillin	500mg QID
Fluconazole	Oral 200mg loading then 50-100mg daily
Linezolid	300-450mg BD
Metronidazole	400mg BD
Moxifloxacin	400mg daily
Rifampicin	450mg daily for body weight <50kg 600mg daily for body weight ≥ 50kg
Trimethoprim / sulfamethoxazole	80mg / 400mg daily to 160mg / 800mg BD
	(Adapted from ISPD 2017 Guidelines)

5.5 TUNNEL AND ESI MANAGEMENT AND TREATMENT FLOWCHART



6. Cross References	Clinical Excellence Commission *COVID-19 Infection Prevention and Control Manual* Australian Guidelines for the Prevention and Control of Infection in Healthcare Australian Commission on Safety and Quality in Health Care *National Standard for User-applied Labelling of Injectable Medicines, Fluids and Lines* NSW Health PD2020_049 *Clinical and Related Waste Management for Health Services* NSW Health PD2013_043 *Medication Handling in NSW Public Health Facilities* NSW Health PD2017_013 *Infection Prevention and Control Policy* NSW Health PD2016_058 *User applied Labelling of Injectable Medicines, Fluids and Lines* SESLHDPD/271 *Aseptic Technique* SESLHDPR/681 *Staphylococcus aureus (MSSA and MRSA) decolonisation* *SGH-TSH CLIN444 Antimicrobial Stewardship and Antibiotics – Approval and Administration Process, St George And Sutherland Hospitals* SGH-TSH CLIN027 *Aseptic Technique - Competency and Education Requirements* SGH CLIN 442 *Peritoneal Dialysis (PD) – Peritonitis Management and Treatment* SGH CLIN443 *Peritoneal Dialysis – Intraperitoneal Additives and Antibiotics* SGH CLIN *Peritoneal Dialysis – Intraperitoneal Antibiotics Dosage, Duration, Compatibility And Stability* SGH CLIN434 *PD Catheter – Nasal Swab And Mupirocin (Nasal Staphylococcus Aureus Eradication Treatment)* SGH CLIN 402 *PD Catheter (PDC) – Daily Care, Dressing and Management* SGH CLIN 414 *PD Catheter (PDC) – Post insertion Catheter Care, Dressing and Management* SGH WPI 146 *PD – Fluid Specimen Collection via APD* SGH WPI 145 *PD –Fluid Specimen Collection via CAPD Freeline Solo Exchange*
7. Keywords	Exit site Infection, Tunnel Infection, Peritonitis, Peritoneal dialysis
8. Document Location	Renal, Peritoneal Dialysis
9. External References	1. Au, C., Yap, D., Chan, J., Yip, T., & Chan, T. M. (2021). Exit site infection and peritonitis due to Serratia species in patients receiving peritoneal dialysis: Epidemiology and clinical outcomes. *Nephrology (Carlton,*

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10. Consumer Advisory Group (CAG) approval	Not applicable
11. Aboriginal Health Impact Statement	The Aboriginal Health Impact Statement does not require completion because there is no direct or indirect impact on Aboriginal people. Management and treatment of PD catheter exit site and tunnel infection are similar for patients of Aboriginal and non-aboriginal background. Approval: T22/
12. Implementation and Evaluation Plan	**Implementation:** The document will be published on the SGH-TSH business rule webpage and distributed via the monthly SGH-TSH CGD report. **Evaluation:** Incident Monitoring
13. Knowledge Evaluation	**Q1: What are the initial signs and symptoms of ESI?** *A1: ESI may present with purulent or bloody discharge, with or without erythema, swelling or tenderness of the skin surrounding the PD catheter. Fever and chills may be present.* **Q2: What are the signs and symptoms of tunnel infection and/or ESI?** *A2: Erythema, oedema and/or tenderness, purulent or bloody discharge and presence of collection along the PDC tunnel. Fever and chills may be present.* **Q3: What is the management of patients with suspected Tunnel and/or ESI?** *A3: 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? *A4: Preferably after the PDC exit site swab and PD fluid specimen are collected for MCS & cell differential on symptomatic patients.*
14. Who is Responsible	Director of St George and Sutherland Renal Service Nurse Manager, Medicine

Approval for: Peritoneal Dialysis Catheter (PDC) Infection – Exit Site and Tunnel Infection Management and Treatment	
Specialty/Department Committee	Committee: Peritoneal Dialysis Committee Chairperson: Dr Franziska Pettit, Staff Specialist Date: 18.11.2021
Nurse Manager (SGH)	Christine Day, Nurse Manager Medicine Date: 02.12.2021
Medical Head of Department (SGH)	George Mangos, Department Head Renal Services Date: 18.11.2021
Safe Use of Medicines Committee (SGH)	Chairperson: A/Prof Winston Liauw Date: 15.03.2022
Antimicrobial Stewardship (AMS) Committee	Chairperson: Pam Konecny Date: 20.06.2022
Executive Sponsor	George Mangos, Department Head Renal Services Date: 18.11.2021
Contributors to ClBR	**Contribution**: Dr Franziska Pettit, Staff Specialist, Dr George Mangos, Department Head Renal Services, Suman Adhikari, Senior Pharmacist, AMS & Critical Care Dr Mark Brown, Medical Director Division of Medicine Dr Sunil Badve, Staff Specialist

Revision and Approval History				
Revision Date	Revision number	Reason	Coordinator/Author (Position)	Revision Due
Mar 2018	0		Anna Claire Cuesta (PD CNC)	Mar 2021
Mar 2022	1	Review – Major	Anna Claire Cuesta (PD CNC)	Mar 2025

General Manager's Ratification	
Angela Karooz (SGH)	Date: 22.03.2022