

Paediatric Empyema

excluding neonates

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Note:

This guideline provides advice of a general nature. This state-wide guideline has been prepared to promote and facilitate standardisation and consistency of practice, using a multidisciplinary approach. The guideline is based on a review of published evidence and expert opinion.

Information in this state-wide guideline is current at the time of publication.

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Health practitioners in the South Australian public health sector are expected to review specific details of each patient and professionally assess the applicability of the relevant guideline to that clinical situation.

If for good clinical reasons, a decision is made to depart from the guideline, the responsible clinician must document in the patient's medical record, the decision made, by whom, and detailed reasons for the departure from the guideline.

This state-wide guideline does not address all the elements of clinical practice and assumes that the individual clinicians are responsible for discussing care with consumers in an environment that is culturally appropriate and which enables respectful confidential discussion. This includes:

- The use of interpreter services where necessary,
- Advising consumers of their choice and ensuring informed consent is obtained,
- Providing care within scope of practice, meeting all legislative requirements and maintaining standards of professional conduct, and
- Documenting all care in accordance with mandatory and local requirements

Explanation of the aboriginal artwork:

The aboriginal artwork used symbolises the connection to country and the circle shape shows the strong relationships amongst families and the aboriginal culture. The horse shoe shape design shown in front of the generic statement symbolises a woman and those enclosing a smaller horse shoe shape depicts a pregnant women. The smaller horse shoe shape in this instance represents the unborn child. The artwork shown before the specific statements within the document symbolises a footprint and demonstrates the need to move forward together in unison.



Cultural safety enhances clinical safety.

To secure the best health outcomes, clinicians must provide a culturally safe health care experience for Aboriginal children, young people and their families. Aboriginal children are born into strong kinship structures where roles and responsibilities are integral and woven into the social fabric of Aboriginal societies.

Australian Aboriginal culture is the oldest living culture in the world, yet Aboriginal people currently experience the poorest health outcomes when compared to non-Aboriginal Australians.

It remains a national disgrace that Australia has one of the highest youth suicide rates in the world. The over representation of Aboriginal children and young people in out of home care and juvenile detention and justice system is intolerable.

The accumulated effects of forced removal of Aboriginal children, poverty, exposure to violence, historical and transgenerational trauma, the ongoing effects of past and present systemic racism, culturally unsafe and discriminatory health services are all major contributors to the disparities in Aboriginal health outcomes.

Clinicians can secure positive long term health and wellbeing outcomes by making well informed clinical decisions based on cultural considerations.

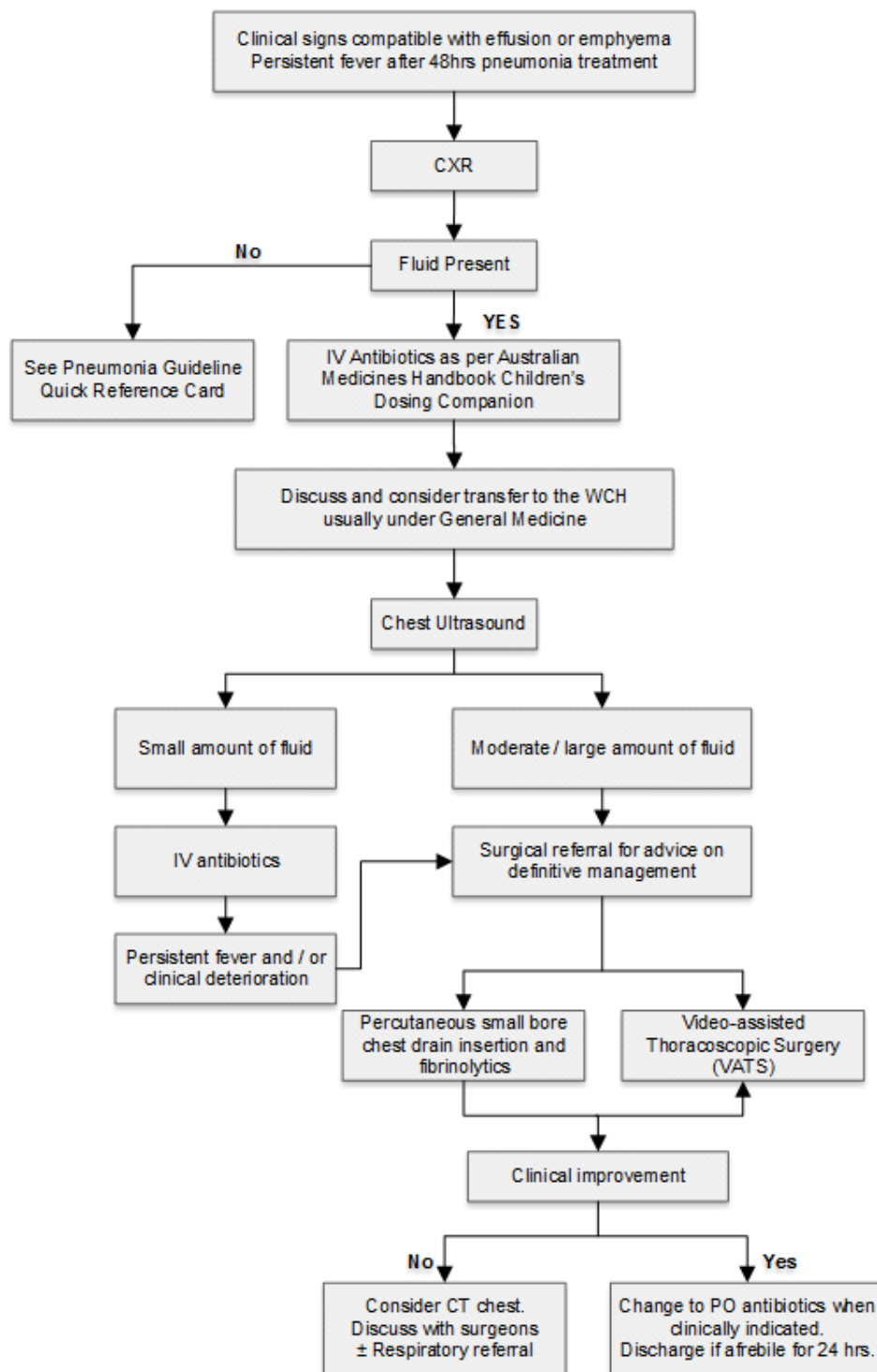
The term 'Aboriginal' is used to refer to people who identify as Aboriginal, Torres Strait Islanders, or both Aboriginal and Torres Strait Islander. This is done because the people indigenous to South Australia are Aboriginal and we respect that many Aboriginal people prefer the term 'Aboriginal'. We also acknowledge and respect that many Aboriginal South Australians prefer to be known by their specific language group(s).

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Purpose and Scope of PCPG

This paediatric empyema excluding neonate's guideline is primarily aimed at medical staff working in any of primary care or hospitals. It may however assist the care provided by other clinicians such as nurses. The information is current at the time of publication and provides a minimum standard for the assessment (including investigations) and management of empyema; it does not replace or remove clinical judgement or the professional care and duty necessary for each specific case.

Acute Management Flowchart



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Summary of Practice Recommendations

Key Priorities

- > Empyema should be suspected in patients with pneumonia who do not respond to standard antibiotic therapy after 48-72 hours.
- > **Paediatric patients < 16 years of age with symptomatic pleural effusions require multi-disciplinary paediatric specialist input and are usually best managed at the WCH.**
- > High-dose, intravenous, antibiotics are indicated
- > Paediatric patients with an empyema usually require drainage either surgically or via interventional radiology. Fibrinolytics may also be used.

Preamble

Empyema refers to the presence of pus within the pleural space, most often in association with an underlying pneumonia, and may result in sepsis and impaired respiratory function. While the prognosis in appropriately treated children is very good, with complete recovery and restoration of normal lung function, care is potentially complex and requires close attention to detail.

Empyema develops in a continuum, however three stages are described:

- > Exudative – a simple parapneumonic effusion arising from inflamed pleura.
- > Fibrinopurulent – frank pus and fibrin deposition within the pleural space leads to septation and loculation (complicated parapneumonic effusion / empyema).
- > Organised – fibroblast infiltration leads to the formation of a thick non-elastic peel.

Causative Organisms

Streptococcus pneumoniae is the most common pathogen. However, *Staphylococcus aureus*, including methicillin-resistant Staph aureus (MRSA) and *Streptococcus pyogenes* are also seen.

Consider other organisms, e.g. anaerobes in those who may aspirate. *Mycoplasma pneumoniae* is an unusual cause of empyema. *Mycobacterium tuberculosis* is uncommonly seen as a cause of empyema in South Australia.

While this guideline focuses on management of the empyema, the underlying pneumonia may be the most concerning component of the child's illness.

Where progress is poor, fever persists or respiratory function is severely compromised, consider the role of the pneumonia as well as the empyema.

Abbreviations

Nil	
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Definitions

PHDU/PICU	Paediatric High Dependency Unit / Paediatric Intensive Care Unit
WCH	Women's and Children's Hospital
DGM	Department of General Medicine



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Assessment

Clinical Features

Children with empyema present in a similar fashion to those with pneumonia but may:

- > be more unwell than expected
- > have pleuritic chest pain and/or prefer to lie on the affected side
- > often evolves after treatment for pneumonia has commenced

Pleural effusion is suggested on examination by:

- > unilaterally decreased breath sounds and chest expansion
- > dullness to percussion
- > functional scoliosis (concave towards affected side)

Empyema should be suspected in any child who has persistent (>48-72hr) fever on IV antibiotics.

Children with apparent non-infective pleural effusions (e.g. malignancy) require different investigations and management and this guideline should not be used.

Management of children with parapneumonic effusions or empyema:

- > All patients should be admitted to hospital for intravenous antibiotics and appropriate supportive care.
- > Further management will depend on the size of effusion, response to antibiotics and degree of respiratory compromise.

Admitting team:

- > **Patients with symptomatic effusions require multi-disciplinary paediatric specialist input and are usually best managed at the WCH.**
- > Most patients will be referred to and admitted under General Medicine at the WCH.
- > Patients with known or suspected complicating underlying lung disease (e.g. bronchiectasis) or significant co-morbidities (e.g. primary immunodeficiency) should be referred and admitted under the Respiratory Team.
- > If an operative procedure is to be undertaken or the child is to receive Alteplase delivered by the surgical team, the bed card will be transferred to Paediatric Surgery
- > All patients at the WCH should be referred to Infectious Diseases.
- > The admitting team is responsible for day to day care, communication and referrals.

Investigations

Baseline investigations

- > Full blood count
- > CRP, Procalcitonin (if available)
- > Electrolytes and renal function
- > Albumin
- > Blood culture
- > Blood Sterile site PCR (Pneumococcal)
- > NPA for viruses and mycoplasma
- > Sputum culture (if possible)
- > MRSA screen (nose, groin, axilla swabs)
- > Coagulation studies (perform in patients with known risk factors or suggestive history)

Correct abnormalities, where possible, before any surgical intervention.



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Chest ultrasound

The need and timing of chest ultrasound will vary and is dependent on diagnostic uncertainty and need for surgical intervention (e.g. small parapneumonic effusion responding well to intravenous antibiotics).

If ordering a chest ultrasound request a splenic ultrasound to check for the presence of a spleen, as this is a risk factor for invasive pneumococcal disease.

Routine bronchoscopy and/or CT are not usually required for empyema, although CT scans to define parenchymal disease to assist surgery may at times be warranted.

The decision regarding thoracentesis should be considered in conjunction with paediatric surgery.

Subsequent investigations

- > Pleural fluid (if obtained):
 - cytology, microscopy for malignant cells
 - M,C & S (consider microscopy and culture for mycobacteria only in correct clinical context)
 - PCR for *Streptococcus pneumoniae*
- > Consider investigations for underlying immunodeficiency if *Streptococcus pneumoniae* identified or clinical suspicion on history.

Management

Supportive care

- > Oxygen to maintain SpO₂ ≥93%
- > Analgesia for comfortable respiration and mobilisation. Use paracetamol and opioids but avoid non-steroidal anti-inflammatories if surgery is contemplated and whilst receiving vancomycin. Consider referral to the Acute Pain Service.
- > Antipyretics (paracetamol) if fever causes significant discomfort
- > Fluid and nutritional management
- > Mobilisation should be encouraged but there is otherwise no specific role for physiotherapy.
- > **Consider a dual lumen PICC line insertion early in treatment (particularly if a general anaesthetic is planned for drainage)**

Antibiotics

Intravenous

Initial empiric therapy:

Cefotaxime 50mg/kg/dose up to 2g IV 8-hourly

PLUS

Vancomycin 30mg/kg up to 1.5g IV 12-hourly

Consider addition of azithromycin 10mg/kg/dose up to 500mg IV daily if atypical pathogens suspected

Consider IV clindamycin if *Staph aureus* confirmed or highly likely, due to high risk of PVL toxin-producing strains. This should be in consultation with Infectious Diseases.

Once the causative pathogen has been identified, therapy should be modified according to the susceptibility test results (known or presumed).



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Oral

- > Children may be switched to oral antibiotics when all criteria below are met:
 - had any drains removed
 - been afebrile for ≥ 24 hours
 - are making good clinical progress
- > If causative pathogen known, oral antibiotic therapy should be directed and should be of narrowest possible spectrum
- > If no pathogen identified discuss oral stepdown therapy with Infectious Diseases
- > Oral therapy should be continued for a total antibiotic duration of 2-4weeks depending on the severity of disease, length of stay in hospital, complications and causative organism. If pulmonary abscess or lung necrosis present, duration may need to be increased to 6 weeks.

Pleural Drainage

- > Antibiotics and supportive therapy are often all that is required for small parapneumonic effusions
- > In more severe cases, drainage of the pleural cavity hastens recovery and may reduce long term complications (lung entrapment)
- > Indications for intervention include:
 - Moderate to Large effusion / empyema with significant respiratory impairment (respiratory distress, hypoxia) and / or
 - Persistent fevers after 48hrs of IV antibiotics
 - The need for intervention should be made in consultation with the tertiary service and surgical team
- > SA experience suggests that drainage before 48 hrs markedly increases chance of isolation of pathogen.

Patients requiring invasive intervention should be discussed with the paediatric surgical team to determine the appropriateness, timing and method of intervention.

The surgical team will take responsibility for instillation of Alteplase if used.

Recommended pleural drainage options include

- > Chest drain with fibrinolytics (Alteplase) and negative pressure drainage.
- > Video-assisted Thoracoscopic Surgery (VATS)
- > Open thoracotomy
- > In cases requiring surgical intervention, care will be shared between the home and surgical teams from the point they are accepted for surgery until the last drain is removed, at which time they will be passed back to the primary medical team.
- > While they have drains in situ, they will generally be cared for in PICU/PHDU.

Refer to [Appendix 1 Drain management](#)

Refer to [Appendix 2: Alteplase instillation protocol in paediatric empyema](#)

Treatment failure and Complications

- > Persistent fever and/or persistently raised inflammatory markers may be an indication of:
 - severe inflammation
 - lung necrosis or abscess
 - poor antibiotic penetration
 - organism resistant to current antibiotic
- > In many cases, persevering with antibiotics may be the best course, especially if fever or inflammatory markers appear to be settling.
- > Consider chest x-ray, ultrasound and CT scan if progress is not as expected.
- > Persistent lobar collapse may be a sign of foreign body and bronchoscopy should be considered
- > Secondary scoliosis is common and usually transient. No specific treatment or



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investigation is necessary but resolution should be confirmed.

Discharge and follow up

- > Children may be discharged when:
 - they have minimal respiratory distress
 - they are eating, drinking and mobilising freely
 - they have a SpO₂ consistently $\geq 93\%$ in room air
 - they are afebrile for ≥ 24 hours
 - they had their last drain removed ≥ 12 hours ago, and
 - clinical staff are confident child is improving and that family are competent with child's ongoing care and have access to emergency services should symptoms reoccur.
- > If the child needs to fly this should be discussed with the surgeons.
- > Radiological resolution is not required (or anticipated) prior to discharge.
- > Patients should be advised about completing their course of oral antibiotics, reasons for return including fever and increased respiratory symptoms/signs.
- > Outpatient review should continue until the child has made a complete clinical recovery and has a near normal chest x-ray. Often clinic review 6 weeks post discharge with a repeat chest x-ray will satisfy these criteria.
- > Children with more severe disease will likely require longer follow up but nearly all chest x-rays are normal by 3-6 months.
- > Check that scoliosis (if present) has resolved.
- > Children with persistent signs, symptoms, and radiological abnormalities should be discussed early with the Respiratory team.

Special Considerations for Invasive Pneumococcal disease

- > Vaccinations – recommend 4th dose Prevenar 13 and PPV23 +/- Quadrivalent Meningococcal and Meningococcal B vaccines

Consider further investigation for a primary immunodeficiency as per WCHN procedure guideline

http://cger.cywhs.sa.gov.au/cgu/governing_docs/documents/invasive_pneumoccal_screen.pdf



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Appendices

Appendix 1: Drain management

Drain set-up

1. All chest drains require a unidirectional drainage system. At WCH this will generally be an Atrium system. Children <10kg should only be connected to a Paediatric Atrium System. (http://www.atriummed.com/en/chest_drainage/default.asp)
2. The drain should be clamped for 1 hour once 10 ml/kg is initially removed
3. Chest x-ray must be done following insertion to ensure appropriate placement.
4. Drains should usually be placed on controlled suction at the surgeon / intensivist's discretion.

Drain Maintenance

1. An accurate record of the drain's status must be kept including whether it is static, swinging or bubbling and how much fluid is draining (usually an hourly record with tallies each morning).
2. Bubbling drains should never be clamped (or removed) and any clamped drain should be immediately unclamped if the patient develops breathlessness or signs of worsening respiration.
3. If a drain suddenly stops swinging or draining fluid the medical staff should be notified as it may be obstructed. The patient may need to be re-positioned, the drain uninked or the drain flushed (10-20mL 0.9% sodium chloride) to return it to patency. Once patency and position have been checked, non-functioning drains (neither swinging nor draining fluid) should be removed. Depending on the clinical setting the drain may need to be replaced or Alteplase instilled ([see contraindications below](#)). Discuss with the surgical team before removal.
4. For Alteplase instillation, [see Appendix 2](#).
5. For drain removal, [see Appendix 3](#).

Drain Removal

1. The last drain should be removed when less than 2mL/kg/day of fluid are draining (regardless of effusion size or clinical status). NB: A bubbling drain should not be removed.
2. [See Appendix 3](#) for drain removal procedure.
3. A chest x-ray should be performed within 4 hours of drain removal to check for pneumothorax. A small pneumothorax is not uncommon and will usually spontaneously reabsorb.



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Appendix 2: Alteplase instillation protocol in paediatric empyema

Procedure undertaken at direction of paediatric surgeon or cardiothoracic surgeon by consultant, registrar or resident of the surgical team

Contraindications

- > Neonates
- > Recent chest trauma
- > Systemic coagulopathy
- > Current air leak
- > Bleeding following drain insertion

Dose

- > Alteplase 0.1mg/kg (maximum 6mg) diluted in 1ml /kg of 0.9% sodium chloride
- > Can be followed by 10 ml saline drain flush
- > Can be repeated 8 to 12 hourly, maximum of 6 doses
- > Adding local anaesthetic agents to the mix is likely to offer little if any advantage and should only occur by consultant prescription

Procedure

- > Confirm safe position of the intra pleural catheter on X-ray
- > Note current clinical observations
- > IV access
- > Patient explanation / education
- > Supine position may facilitate distribution (pending on the target area & drain position)
- > Clamp the drain near patient if needing to disconnect to apply Alteplase syringe
- > Sterile gloves if disconnecting drain, placing the distal end on a sterile dressing pack
- > Consider placing 3 way tap system to facilitate future doses
- > Replace clamp once instillation complete for 30 mins only (Remove clamp immediately if increased respiratory distress)
- > Allow free drainage for 30 mins
- > Return to suction if appropriate
- > Measure drain output and note presence of frank blood or air leak
- > This output data and the child's clinical state are reviewed prior to decision to proceed with the next dose



Appendix 3: Chest drain removal protocol

Drain Removal

The last drain should be removed when less than 2ml/kg/day of fluid are draining (regardless of effusion size or clinical status).

NB: A bubbling drain should not be removed.

In brief:

1. Explain the procedure.
2. Ensure adequate analgesia is given.
3. A medical officer (or MET nurse) will remove the drain with nursing assistance
 - a. Position child as appropriate to provide good access to the drain
 - b. Stop suction and clamp drain
 - c. Instruct child (where possible) to take a deep breath in and push or blow out slowly (Valsalva) during the drain removal. If this isn't possible, ideally the drain should be removed during expiration.
 - d. While one person cuts the anchoring suture and pulls the drain out (brisk smooth motion), the second person presses (seals) the wound edges together, or a single person can withdraw the drain with one hand whilst sealing the edges with the other.
 - e. If there is a closing suture pull and knot this (not so tight as to pucker the edges).
 - f. Apply Steristrips as necessary to seal the wound
 - g. Apply an occlusive transparent sterile dressing
4. Ensure the child is comfortable and positioned for good chest expansion.
5. A chest x-ray should be performed within 4 hours of drain removal to check for pneumothorax. A small pneumothorax is not uncommon and will usually spontaneously reabsorb.
6. Nursing staff should assess respiratory status immediately following drain removal, hourly for four hours and four hourly thereafter.



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