Queensland Paediatric Guideline

Emergency

Meningitis – Emergency management in children

Purpose

This document provides clinical guidance for all staff involved in the care and management of a child presenting to an Emergency Department (ED) with suspected acute meningitis in Queensland.

It has been developed by senior ED clinicians and Paediatricians across Queensland and endorsed for use across Queensland by the Queensland Emergency Care of Children Working Group in partnership with the Queensland Emergency Department Strategic Advisory Panel and the Healthcare Improvement Unit, Clinical Excellence Queensland.

Key points

- Children with meningitis often present with nonspecific symptoms and not the classic triad of fever, headache and nuchal rigidity.
- Bacterial meningitis is less common than viral meningitis but is a more serious disease that can result in neurological sequelae or even death.
- Laboratory testing (blood and CSF) is required to definitively differentiate between viral and bacterial meningitis.
- If meningitis is clinically suspected and lumbar puncture is contraindicated, or delayed for more than 30 minutes, administer empiric antimicrobial therapy IV.

Introduction

Meningitis is a rare but serious paediatric ED presentation in which the membranes that surround the brain and spinal cord become inflamed. A variety of different microorganisms, including both viruses and bacteria can cause meningitis.[1]

Bacterial meningitis

The mortality rate from bacterial meningitis ranges from 2% in children to 20% in neonates with up to a third of survivors experiencing transient or permanent neurological sequelae.[2] Approximately 90% of bacterial meningitis occurs in children less than five years of age.[2]

Bacterial infection in infants up to three months of age (corrected for prematurity) is typically acquired during birth through aspiration of intestinal and genital tract secretions from the mother (vertical transmission).[3] Group B streptococci (subtype III), gram-negative enteric bacilli (*Eschericha coli*, *Klebsiella* and *Enterobacter*), and *Listeria monocytogenes* (serotype IVb) are the most common causes of bacterial meningitis in this age group.

In the older child, the rates of meningitis are much lower with an estimated incidence of 1 per 5,901 febrile children aged 2 to 24 months.[4] In older infants and children, bacterial meningitis usually develops after encapsulated bacteria (that have colonised the nasopharynx) are disseminated in the blood stream. The most common pathogens in children aged over three months are *Streptococcus pneumoniae* and *Neisseria meningitidis*. The incidence of bacterial meningitis has markedly declined in Australia with the introduction of the Hib and pneumococcal vaccines in the National Immunisation Program.[5-7]

Viral meningitis

Viral meningitis is usually diagnosed following exclusion of bacterial meningitis, with enterovirus and coxsackie virus being the major causes.[3] Parechovirus is also common in infants less than three months of age.

Herpes simplex virus meningitis without encephalitis is an infrequent cause of viral meningitis in children and usually has an excellent outcome even without antiviral therapy. HSV encephalitis however, is a particularly devastating form of herpes infection (especially in neonates) with significant morbidity and mortality if not treated appropriately. Patients may have a history of HSV in close contacts.

Patients with HSV meningoencephalitis can have disseminated disease, but specific features include:

- focal neurological signs e.g. dysphasia or hemiparesis
- focal seizures
- predominance of lymphocytes in the CSF
- skin lesions (may not be present)

Assessment

The aim of the assessment (history and clinical examination) is to identify children with meningitis promptly to enable appropriate management. Distinguishing between viral and bacterial meningitis on initial assessment can be difficult. Given the importance of early antibiotic treatment, it is safest to assume a bacterial cause until proven otherwise, especially in children less than five years.

Consider seeking senior emergency/paediatric advice as per local practice if meningitis is suspected

Seek urgent senior emergency/paediatric advice as per local practice for a child with suspected meningitis who is unstable/toxic

History

The clinical presentation of bacterial meningitis may be acute (hours to 1 - 2 days) or insidious (over a few days). A preceding upper respiratory tract infection is reported in up to 75% of patients.[8] Apparent improvement with Paracetamol should not be used to exclude the diagnosis.

History should include specific information on:

- immunisations (reduces but not eliminates risk of infection)
- prior use of oral antibiotics (may modify clinical features and CSF findings resulting in a delay in diagnosis)[9]
- risk factors for infection

Risk factors for meningitis:

- recent contact with a case of bacterial meningitis (especially in family)
- recent contact with HSV "cold sores" or confirmed enterovirus infection (risk for HSV or EV71 encephalitis)
- recent overseas travel
- maternal GBS colonisation (in infants less than three months)
- immunocompromised (if so consider cryptococci and mycobacteria)
- recent history of neurosurgical procedure or penetrating head injury
- VP shunt
- cochlear implant

Examination

While the classic triad of fever, neck stiffness and headache is suggestive of meningitis, it is found in less than 50% of cases in older children and adolescents.[3,10] Older children may present with any combination of these and/or other symptoms including rash, upper or lower respiratory tract symptoms, myalgia and abdominal pain. In preverbal children, symptoms are even more nonspecific, and a high index of suspicion is required to avoid missing cases.[7] A collection of nonspecific symptoms that include fever, neck stiffness and headache are more common in viral meningitis while neurological complications (including seizures and coma) are rare.[11]

The presence of an apparent explanation for fever such as pharyngitis, UTI or otitis media does not rule out diagnosis.[12]

A high index of suspicion for meningitis is required for:

- all sick, febrile or hypothermic neonates (with or without the features described)
- all children presenting with fever and convulsions especially if aged less than two years.

Whilst the presentation varies with age, bacterial meningitis should be considered for any child with the clinical features outlined in the table below.

Fever and rash

The presence of a rash in a febrile child is often nonspecific and more likely to be caused by a viral illness than acute bacterial meningitis. Clinical judgement and decision making should be based on the entire clinical presentation and not just the rash. The rash associated with meningococcal disease may be maculopapular (in the earlier stages), petechial, or purpuric. Refer to Fever guideline.

Clinical features suggestive of bacterial meningitis	
ANY of the following clinical features	**Common features in infants under three months***
• fever • vomiting and/or nausea • lethargy or irritability • photophobia and/or headaches • anorexia • nuchal rigidity (often not present, especially in young children and infants) • positive Kernig's or Brudzinski's sign • altered mental status • shock • seizures • focal neurological deficit • petechial rash (an erythematous maculopapular eruption may be present initially) (see above)	• bulging fontanelle • high pitched cry • poor feeding • apnoea • seizures • vomiting • hypothermia or temperature instability • fever in neonate (age less than 29 days)

*May also occur in infants greater than three months.

Adapted from van de Beek et al[10] and Oostenbrink et al[13] and Feigin et al[14]

Differential diagnoses

- viral encephalitis
- viremia
- sepsis
- intracranial collections e.g. subdural empyema and brain abscess
- eosinophilic meningitis
- acute disseminated encephalomyelitis
- other infectious diseases e.g. pneumonia, otitis media, gastroenteritis, sinusitis and pharyngitis

Investigations

The definitive diagnosis of acute bacterial or viral meningitis is made on analysis of cerebrospinal fluid (CSF) obtained via lumbar puncture (LP). Where a LP is contraindicated or clinically unsafe (see box below), investigations such as blood cultures and PCR testing on blood may be useful to diagnose meningococcal, pneumococcal or Hib infection.

Consider a clotting profile prior to LP if any clinical concerns around pre-existing coagulopathy e.g. sepsis, thrombocytopenia.

Investigations for suspected meningitis	
Investigation	**Notes**
CSF analysis	• Positive CSF gram stain and culture results seen in 70 - 80% of untreated acute bacterial meningitis cases. • CSF cell count, protein and glucose do not change appreciably with antibiotics.[3,15] • Meningococcus PCR has 89% sensitivity and 100% specificity[16] • Meningococcus or pneumococcus PCR may be positive despite antibiotic treatment. • Viral PCR will guide treatment if clinical picture or CSF cell count suggests a viral aetiology.
Blood cultures	• Especially valuable if LP not done. • Positive in 74% of untreated acute bacterial meningitis cases and less than 50% of treated patients.
Biochemistry	• Serum electrolytes - seizures may be secondary to low sodium, calcium or magnesium; hyponatraemia in SIADH. • BGL – check for hypoglycaemia especially in infants aged less than three months. • UEC, LFT and VBG may suggest sepsis. • CRP – may be high in bacterial meningitis but is nonspecific.
Full blood count	• May be high in bacterial meningitis but is nonspecific.
Serum for bacterial PCR (Whole blood - EDTA sample)	• Consider collection with initial venepuncture and bloods. Seek senior advice prior to request. • Meningococcal PCR has a high sensitivity and specificity. • Pneumococcal PCR may be performed at some laboratories. • Sensitivity higher with earlier time of collection but may remain positive up to 72 hours post antimicrobial therapy.[17]
CT scan	• Carefully consider in child with suspected raised ICP or focal neurological signs. • Neither the absence of papilloedema or presence of a normal head CT scan rules out raised ICP (and the associated risk of subsequent brain herniation). • CT scan rarely changes initial management and transportation out of ED for radiological investigations may put the unstable child at greater risk.[18]

Lumbar puncture

Reasons for delaying a LP

- patient instability such as respiratory or cardiovascular compromise
- persistently reduced level of consciousness
- continuing seizures
- suspicion of space-occupying lesion or raised ICP (i.e. Cushing sign, focal seizures, focal neurological defect, irregular breathing and papilloedema; relative bradycardia and hypertension)
- skin infection at the LP site
- coagulopathy/thrombocytopenia

Do NOT delay antibiotics. Continue treatment until clinical improvement is evident, at which time a LP may be safely performed.

Laboratory request

Request urgent CSF microscopy (includes Gram stain, WCC and differential), CSF protein and glucose, culture & sensitivity and PCR studies. In addition, if suspect viral aetiology, request viral PCR for enterovirus (and parechovirus if less than three months) and HSV plus VZV PCR (if varicella zoster virus is suspected).

CSF analysis

Consider seeking senior emergency/paediatric advice as per local practice if unsure of CSF interpretation

No single CSF test parameter reliably identifies bacterial meningitis. Very rarely, culture proven bacterial meningitis can occur in a child with normal CSF findings. Always correlate CSF results with clinical findings.

Normal CSF values				
	White cell count		Biochemistry	
	Neutrophils ($\times 10^6$ /L)	Lymphocytes ($\times 10^6$/L)	Protein (g/L)	Glucose (CSF:blood ratio)
Normal (more than 1 month of age)	0	≤ 5	< 0.4	≥ 0.6 (or ≥ 2.5 mmol/L)
Normal neonate (less than 1 month of age)	0	< 20	<1.0	≥ 0.6 (or ≥ 2.5 mmol/L)

Traumatic tap

Some guidelines suggest that in traumatic taps you can allow 1 white blood cell for every 500 to 700 red blood cells and 0.01g/L protein for every 1000 red cells. However, rules based on a 'predicted' white cell count in the CSF are not reliable.

In order not to miss any meningitis cases, decision making regarding treatment should be conservative. The safest interpretation of a traumatic tap is to **count the total number of white cells and disregard the**

red cell count. If there are more white cells than the normal range for age, then the safest option is to treat.

Taken from The Royal Children's Hospital, Melbourne, Australia, Clinical Practice Guideline on *CSF Interpretation*, [Internet; cited June 18], Available from: https://wwww.rch.org.au/clinicalguide/

Management

Refer to Appendix 1 for a summary of the recommended emergency management and medications for children with suspected meningitis.

Consider seeking senior emergency/paediatric advice as per local practice if meningitis is suspected

Seek urgent senior emergency/paediatric assistance as per local practice for a child with suspected meningitis who is unstable or toxic. Consider critical care.

Seek urgent paediatric critical care advice (onsite or via Retrieval Services Queensland (RSQ)) for the following children:

- in shock and not responding to initial treatment
- suspected raised ICP
- seizure

The absence of early appropriate senior input (including the absence of consultant supervision) during the first 24 hours in hospital is an independent risk factor for death.[19]

The initial management for a child suspected of having meningitis is the same as for any serious illness. The assessment and management should be performed simultaneously, and the child moved into the resuscitation area for stabilisation of airway, breathing, circulation, and disability (seizures/ hypoglycaemia). This assessment and stabilisation should be prioritised above any illness-specific diagnostic assessment or treatment.

Antibiotic therapy

ALERT – If meningitis is clinically suspected, but LP cannot be done within 30 minutes, administer antibiotics IV.

Early use of appropriate antibiotics IV (and antivirals where HSV meningoencephalitis is considered, especially in neonates) has been shown to improve outcome. Empiric antibiotic therapy regimens are selected to cover the most likely pathogens for the selected age group.

Clinicians working in Townsville, Cairns and Gold Coast Hospital and Health Services should follow their local paediatric empirical antibiotic guidelines. Clinicians elsewhere in Queensland should follow the Children's Health Queensland paediatric empirical antibiotic prescribing guidelines.

Links:

- Cairns (access via QH intranet)
- Children's Health Queensland
- Gold Coast
- Townsville (access via QH intranet)

The child should be admitted, and empiric antibiotic therapy continued until culture results are known to be negative or an organism and its sensitivity pattern are identified. Although *Streptococcus pneumoniae* penicillin resistance remains low in Queensland, in some countries the incidence of multi-resistant *Streptococcus pneumoniae* is on the rise and many are also resistant to the third-generation cephalosporins.[20,21] In critically ill children with suspected Streptococcus pneumoniae and children with gram positive cocci in CSF (depending on age and illness severity) add Vancomycin to empiric antibiotics. Consider consulting Infectious diseases physician for advice.

Antivirals

Aciclovir is not routinely required in children with meningitis. It is recommended for all children with suspected encephalitis and may be considered in other children if a viral aetiology is suspected. For antiviral dosages refer to the relevant antimicrobial guidelines for your site (see above).

Corticosteroids

Corticosteroids should be considered in all suspected bacterial meningitis cases over three months of age, with administration ideally prior to or immediately following the first antibiotic IV dose.

Corticosteroids potentially improve patient outcome in acute bacterial meningitis by modulating the response to inflammatory mediators. The inflammatory response may be initiated in response to lysis of bacterial cell walls after the first antibiotic dose. However, there is no evidence of benefit in viral meningitis, neonatal bacterial meningitis, Gram-negative bacterial meningitis, or in children already on antibiotics (partially-treated meningitis).[22]

A Cochrane review concluded that corticosteroids (used in conjunction with antibiotic therapy) significantly reduces hearing loss (but not overall mortality) in children with acute bacterial meningitis.[23]

Dexamethasone IV dosing for the treatment for meningitis in children aged over 3 months	
Dexamethasone (IV)	For children greater than three months of age: 0.15 mg/kg/dose (maximum 10 mg/dose), every six hours for four days if able to start **prior** to or **within one hour** of first antibiotic IV dose. If not available, do not delay antibiotics.

Fluid management

Initial fluid resuscitation is recommended as clinically indicated. Careful fluid management and electrolyte balance is important. Children with meningitis are at high risk of developing hyponatraemia associated with increased secretion of ADH.[3] Fluid restriction is not recommended in the first 48 hours. It has not been shown to reduce the incidence of cerebral oedema in children with bacterial meningitis.[1]

Fluid resuscitation (IV) for the management of shocked children	
Bolus dose	Sodium Chloride 0.9% administered in 20 mL/kg bolus. Repeat in 20 mL/kg boluses as clinically indicated.
Maintenance	Sodium Chloride 0.9% + Glucose 5% preferred

Infection control measures

Standard precautions and droplet precautions should be observed during the care of a child with suspected or confirmed acute bacterial meningitis. Appropriate personal protective equipment must be worn when undertaking any procedure where there is a risk of exposure to blood or body fluids. All cases of suspected

bacterial meningitis should be initially isolated in a single room until cleared or confirmed and ongoing isolation requirements discussed with the local hospital infection control team.

Public health notification

Under the *Public Health Act 2005 (Qld)* a provisional diagnosis (i.e. prior to laboratory confirmation) of *N. meningitidis* or Hib meningitis requires urgent notification to your local Public Health Unit to enable timely chemoprophylaxis for identified contacts.

Chemoprophylaxis

Chemoprophylaxis aims to eradicate asymptomatic carriage in contacts so that susceptible members of the group do not acquire the organism from the original carrier and develop an invasive infection. In meningococcal meningitis and Hib cases, chemoprophylaxis is offered to close (usually household) contacts of the primary index case.[24] Despite prophylaxis, disease may still occur. Advise contacts of the need for frequent, careful observation and to seek medical attention at the first signs of any unexplained illness.

Prophylaxis for health care workers is not routinely recommended. It is limited to staff in direct contact with the nasopharyngeal secretions of a child with suspected (or proven) meningococcal meningitis (where appropriate PPE was not used e.g. intubation or mouth-to-mouth resuscitation) or those who have had close contact nursing a child for more than six hours.[24]

Escalation and advice outside of ED

Clinicians can contact the services below if escalation of care outside of senior clinicians within the ED is needed, as per local practices. Transfer is recommended if the child requires a higher level of care.

Child is critically unwell or rapidly deteriorating

Includes the following children (as a guide):

- suspected sepsis (see Sepsis guideline)
- suspected raised ICP
- shock
- recent seizure
- physiological triggers based on age (see below)

Less than 1 year	1-4 years	5-11 years	Over 12 years
• RR >50 • HR <90 or >170 • sBP <65 • SpO2 <93% in oxygen or <85% in air • GCS ≤12	• RR >40 • HR <80 or >160 • sBP <70 • SpO2 <93% in oxygen or <85% in air • GCS ≤12	• RR >40 • HR <70 or >150 • sBP <75 • SpO2 <93% in oxygen or <85% in air • GCS ≤12	• RR >30 • HR <50 or >130 • sBP <85 • SpO2 <93% in oxygen or <85% in air • GCS ≤12

Reason for contact	Who to contact
For immediate onsite assistance including airway management	The most senior resources available onsite at the time as per local practices. Options may include: • paediatric critical care • critical care • anaesthetics • paediatrics • Senior Medical Officer (or similar)
Paediatric critical care advice and assistance	Onsite or via Retrieval Services Queensland (RSQ). If no onsite paediatric critical care service contact RSQ on **1300 799 127**: • for access to paediatric critical care telephone advice • to coordinate the retrieval of a critically unwell child RSQ (access via QH intranet) **Notify early of child potentially requiring transfer.** **Consider early involvement of local paediatric/critical care service.** In the event of retrieval, inform your local paediatric service.

Non-critical child

Advice may be needed regarding:
• timing of lumbar puncture • antimicrobial therapy following lumbar puncture • interpretation of CSF microscopy • management and disposition of unwell child with a normal CSF

Reason for contact	Who to contact
Advice	Options: • onsite/local paediatric service • Queensland Children's Hospital experts via Children's Advice and Transport Coordination Hub (CATCH) on 13 CATCH (13 22 82) (24-hour service) • local and regional paediatric videoconference support via Telehealth Emergency Management Support Unit TEMSU (access via QH intranet) on 1800 11 44 14 (24-hour service)
Referral	First point of call is the onsite/local paediatric service

Inter-hospital transfers

Do I need a critical transfer?	• discuss with onsite/local paediatric service • view Queensland Paediatric Transport Triage Tool
Request a non-critical inter-hospital transfer	• contact onsite/local paediatric service • contact RSQ on 1300 799 127 for aeromedical transfers • contact Children's Advice and Transport Coordination Hub (CATCH) on 13 CATCH (13 22 82) for transfers to Queensland Children's Hospital

Non-critical transfer forms	• QH Inter-hospital transfer request form (access via QH intranet)
	• aeromedical stepdown (access via QH intranet)
	• commercial aeromedical transfers:
	  ○ Qantas
	  ○ Virgin
	  ○ Jetstar

Disposition

Admission is required for:

- children with confirmed meningitis
- children in whom meningitis is suspected and unable to be excluded (due to delay in LP).

Ensure urgent notification to your local Public Health Unit as appropriate.

Children who have meningitis excluded on CSF but had received empiric antibiotic therapy IV will usually require a period of inpatient observation. **Always** seek senior emergency/paediatric advice on management and disposition of these children.

Consider admission for children with a previous diagnosis of viral meningitis and who represent with symptoms within 24 hours of discharge.

Following the exclusion of meningitis, discharge may be considered providing ALL of the following criteria are met:

- symptoms such as pain and vomiting are controlled
- clear alternative diagnosis which does not require inpatient management
- can be safely managed at home and return in event of deterioration (consider time of day, parent/carers comprehension and compliance, access to transport and distance to local hospital)

On discharge:

- advise parent/caregiver to seek medical attention if any concerns prior to scheduled review appointment
- provide parent/caregiver with a Fever factsheet

Follow-up

- with General Practitioner within 24 – 48 hours

Related documents

Guidelines

- Febrile illness
- Sepsis

Factsheet

- Fever in children

References

1. Chavez-Bueno, S., McCracken, G.H. (2005), 'Bacterial meningitis in children', *Pediatric Clinics of North America,* **Vol. 52 (3):** pp. 795-810
2. Saez-Llorens, X., McCracken, G.H. (2003), 'Bacterial meningitis in children, *Lancet*, **Vol. 361 (9375):** pp. 2139-2148.
3. Strange, G.R., Ahrens, W.R. (2005), 'Meningitis: Evidence to guide an evolving standard of care', *Paediatric Emergency Medicine Practice,* **Vol. 2 (4):** pp. 1-24.
4. Alpern, E.R., Alessandrini, E.A., Bell, L.M., Shaw, K.N., McGowan, K.L. (2000), 'Occult bacteremia from a pediatric emergency department: Current prevalence, time to detection, and outcome', *Pediatrics,* **Vol.106 (3):** pp. 505-511.
5. Williams, S.R, Mernagh, P.J., Lee, M.H.T. et al. (2011), 'Changing epidemiology of invasive pneumococcal disease in Australian children after introduction of a 7-valent pneumococcal conjugate vaccine', *Medical Journal of Australia*, **Vol. 194 (3):** pp. 116-120.
6. Moore, H.C., Lehman, D. (2006), '(Letter) Decline in meningitis admission in young children: Vaccines make a difference', *Medical Journal of Australia*, **Vol. 185 (7):** p.404.
7. Miller, E., Andrews, N.J., Waight P.A., Slack M.P.E., George R.C. (2011) 'Effectiveness of the new serotypes in the 13-valent pneumococcal conjugate vaccine', *Vaccine*, **Vol. 29:** p.9127-9131.
8. Kipli T, Antilla M, Kallio MJ, Peltola H., Severity of childhood bacterial meningitis and duration of illness before diagnosis. Lancet 1991; **Vol. 338**:406-9.
9. Rothrock, S.G., Green, S.M., Wren, J., Letai, D., Daniel-Underwood, L., (1992), 'Pillar E. Paediatric bacterial meningitis: Is prior antibiotic therapy associated with an altered clinical presentation', *Annals of Emergency Medicine*, **Vol. 21(2):** pp.146-152.
10. van de Beek, D., de Gans, J., Spanjaard, L., Weisfelt, M., Reitsma, J.B., Vermeulen, M. (2004), 'Clinical features and prognostic factors in adults with bacterial meningitis', *The New England Journal of Medicine*, **Vol. 351 (18):** pp.1849-1859.
11. Rorabaugh, M.L., Berlin, L.E., Heldrich, F., Roberts, K., Rosenberg, L.A., Roberts, K., Modlin, J.F. (1992), 'Aseptic meningitis in infants younger than 2 years of age: Acute illness and neurologic complications', *Pediatrics*, **Vol. 92 (2):** pp. 206-211.
12. Kilpi, T., Anttila, M., Kallio, M.J., Peltola, H. (1991), 'Severity of childhood bacterial meningitis and duration of illness before diagnosis', *Lancet*, **Vol. 338 (8764):** pp. 406-409.
13. Oostenbrink, R., Moons, K.G., Theunissen, C.C., Derksen-Lubsen, G., Grobbee, D.E., Moll, H.A. (2001), 'Signs of meningeal irritation at the emergency department: How often bacterial meningitis?', *Pediatric Emergency Care,* Vol. 17 (3): pp.161-164.
14. Feigin R.D., McCracken G.H., Klein J.O. (1992) 'Diagnosis and Management of Meningitis', Pediatr Infect Dis J, Vol. 11: pp.785-814.
15. Kanegaye, J.T., Soliemanzadeh, P., Bradley, J.S. (2001), 'Lumbar puncture in pediatric bacterial meningitis: Defining the time interval for recovery of cerebrospinal fluid pathogens after parenteral antibiotic pretreatment', *Pediatrics*, Vol. 108 (5): pp.1169-1174.
16. Porritt, R.J., Mercer, J.L., Munro, R. (2000), 'Detection and serogroup determination of Neisseria meningitides in CSF by polymerase chain reaction', *Pathology*, Vol. 32 (1): pp.42-45.
17. Department of Health and Ageing, (Commonwealth of Australia). (2009), *Guidelines for the early and public health management of meningococcal disease in Australia*, [online] Available at: [internet]. http://www.health.gov.au/internet/main/publishing.nsf/Content/cda-pubs-other-mening-2007.htm [cited 25 Nov 2014]
18. Joffe, A.R. (2007), 'Lumbar puncture and brain herniation in acute bacterial meningitis: A review', *Journal of Intensive Care Medicine*, Vol. 22 (4): pp.194-207.
19. Ninis N., Phillips C., Bailey L., et al 'The role of healthcare delivery in the outcome of meningococcal disease in children: case-control study of fatal and non-fatal cases. BMJ 2005; Vol 330: 1475.
20. McCracken, G.H. (1995), 'Emergence of resistant Streptococcus pneumoniae: A problem in pediatrics', *Pediatric Infectious Disease Journal*, Vol. 14 (5): pp.424-428.
21. Quagliarello, V.J., Scheld, W.M. (1997), 'Treatment of bacterial meningitis', *New England Journal of Medicine,* Vol. 336 (10): pp. 708-716.
22. Schaad, U.B., Lips, U., Gnehm, H.E., Blumberg. A., Heinzer. I., Wedgwood. J. (1993), 'Dexamethasone therapy for bacterial meningitis in children. Swiss meningitis study group', *Lancet*, Vol. 342 (8869): pp.457-461.

23. Brouwer, M.C., McIntyre, P., de Gans, J., Prasad, K., van de Beek, D. (2010), 'Corticosteroids for acute bacterial meningitis', *Cochrane Database of Systematic Reviews*, Vol. Iss. 9, Art No.: CD004405.
24. Communicable Diseases Network Australia (CDNA). Invasive meningococcal disease: CDNA national guidelines for public health units. Canberra: Australian Government Department of Health, 2017. Available at: (www.health.gov.au/cdnasongs) (accessed July 2018).

Guideline approval

Document ID	CHQ-GDL-60008	**Version no.**	2.0	**Approval date**	30/09/2019
Executive sponsor	Executive Director Medical Services			**Effective date**	30/09/2019
Author/custodian	Queensland Emergency Care Children Working Group			**Review date**	30/09/2022
Supersedes	1.0				
Applicable to	Queensland Health medical and nursing staff				
Document source	Internal (QHEPS) + External				
Authorisation	Executive Director Clinical Services (QCH)				

Keywords	Paediatric, meningitis; bacterial, viral, guideline, emergency, children
Accreditation references	NSQHS Standard: 1, 3, 4, 8

Disclaimer

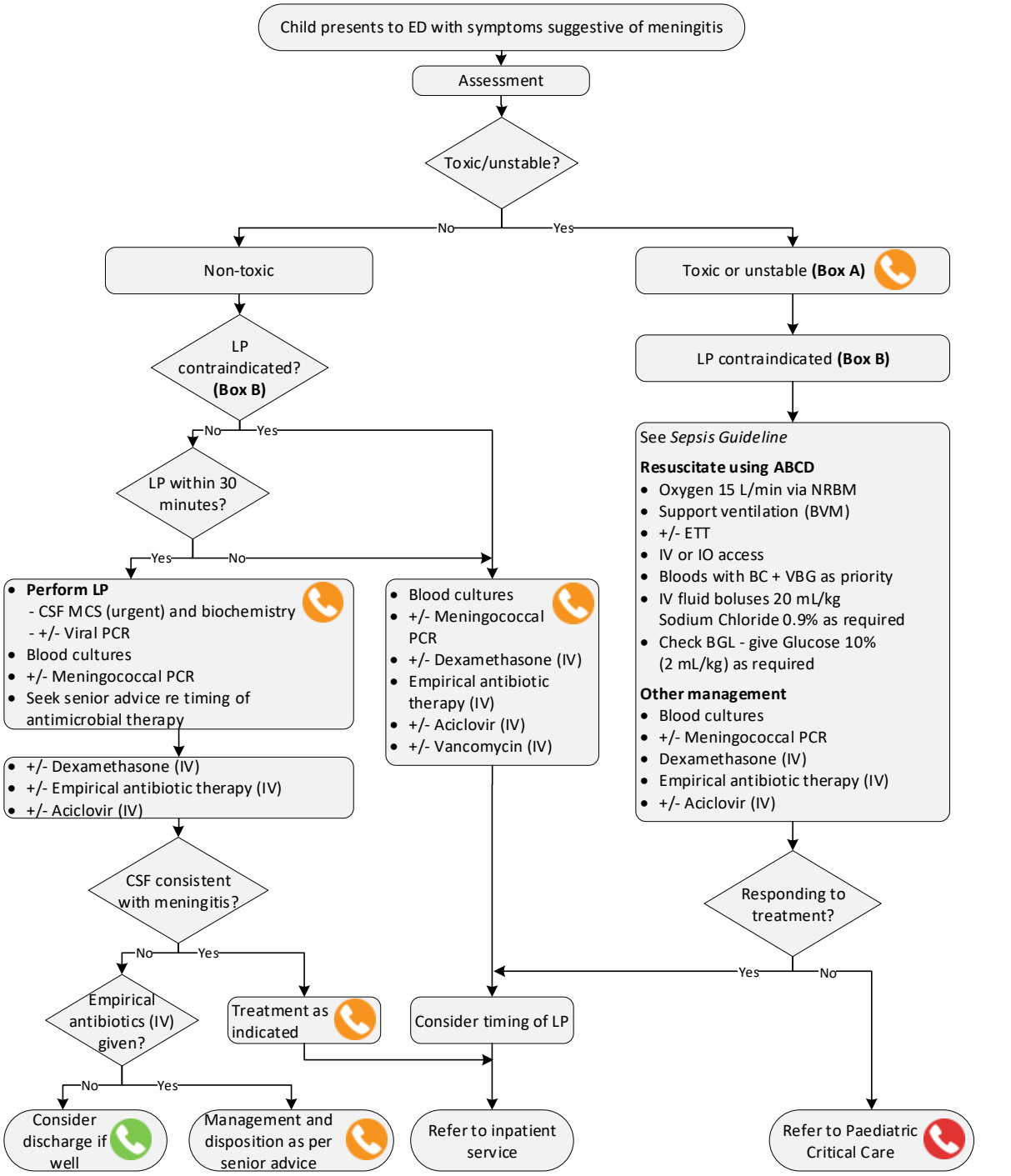
This guideline is intended as a guide and provided for information purposes only. The information has been prepared using a multidisciplinary approach with reference to the best information and evidence available at the time of preparation. No assurance is given that the information is entirely complete, current, or accurate in every respect. We recommend hospitals follow their usual practice for endorsement locally including presenting it to their local Medicines Advisory Committee (or equivalent) prior to use.

The guideline is not a substitute for clinical judgement, knowledge and expertise, or medical advice. Variation from the guideline, taking into account individual circumstances may be appropriate.

This guideline does not address all elements of standard practice and accepts that individual clinicians are responsible for:

- Providing care within the context of locally available resources, expertise, and scope of practice
- Supporting consumer rights and informed decision making in partnership with healthcare practitioners including the right to decline intervention or ongoing management
- Advising consumers of their choices in an environment that is culturally appropriate and which enables comfortable and confidential discussion. This includes the use of interpreter services where necessary
- Ensuring informed consent is obtained prior to delivering care
- Meeting all legislative requirements and professional standards
- Applying standard precautions, and additional precautions as necessary, when delivering care
- Documenting all care in accordance with mandatory and local requirements

Children's Health Queensland disclaims, to the maximum extent permitted by law, all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages and costs incurred for any reason associated with the use of this guideline, including the materials within or referred to throughout this document being in any way inaccurate, out of context, incomplete or unavailable.



Box A: Toxic or unstable

- Altered level of consciousness or obtundation
- Signs of shock
- Coagulopathy
- Refractory seizures

Box B: Contraindications to lumbar puncture (LP)

- Focal neurological signs
- Signs of raised intracranial pressure
- Reduced level of consciousness
- Haemodynamic instability
- Respiratory compromise

Call Retrieval Services Queensland (RSQ) on 1300 799 127 if no paediatric critical care facility onsite

Seek senior emergency/paediatric advice as per local practices

Consider seeking senior emergency/paediatric advice as per local practices

CHQ-GDL-60008-Appendix 1 V2.0

Meningitis – Emergency management in children – Medications

Antimicrobial guidelines

Clinicians working in Townsville, Cairns and Gold Coast Hospital and Health Services should follow their local paediatric empirical antimicrobial therapy guidelines. Clinicians elsewhere in Queensland should follow the Children's Health Queensland paediatric antimicrobial prescribing guidelines until the results of microbiological investigations are available.

Links:

- Cairns (access via QH intranet)
- Children's Health Queensland
- Gold Coast
- Townsville (access via QH intranet)

Dexamethasone (IV) dosing for the treatment for meningitis in children over 3 months of age	
Dexamethasone (IV)	For children over 3 months of age: 0.15 mg/kg (maximum 10 mg/dose), every six hours for four days if able to start prior to or within one hour of first antibiotic IV dose. If not available, do not delay antibiotics.

Normal CSF values				
	White cell count		**Biochemistry**	
	Neutrophils (x 10^6 /L)	**Lymphocytes (x 10^6/L)**	**Protein (g/L)**	**Glucose (CSF:blood ratio)**
Normal (more than 1 month of age)	0	≤ 5	< 0.4	≥ 0.6 (or ≥ 2.5 mmol/L)
Normal neonate (less than 1 month of age)	0	< 20	<1.0	≥ 0.6 (or ≥ 2.5 mmol/L)

Taken from The Royal Children's Hospital, Melbourne, Australia, Clinical Practice Guideline on *CSF Interpretation*, [Internet; cited June 18], Available from: https://wwww.rch.org.au/clinicalguide/