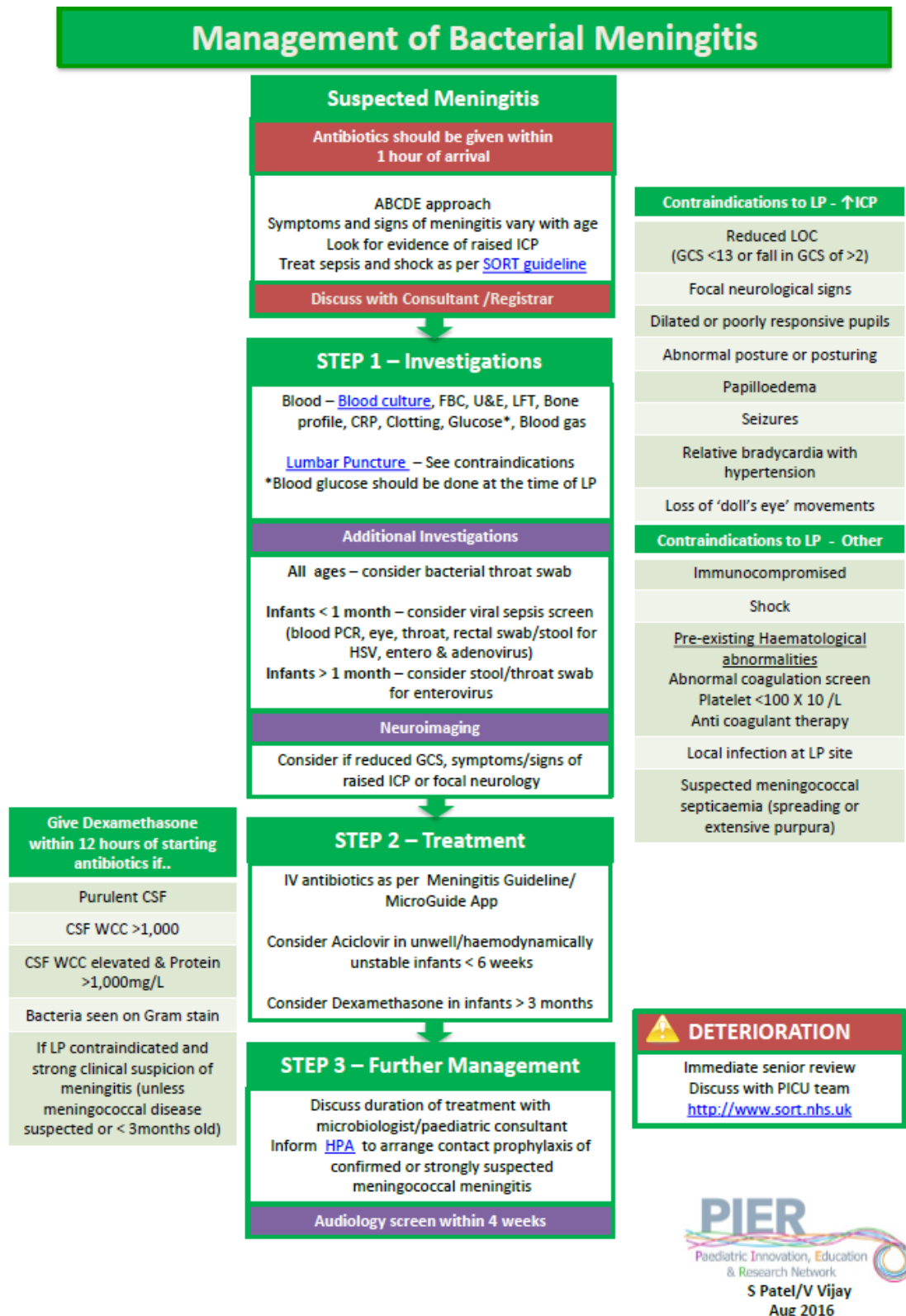


Management of suspected meningitis guideline

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Executive Summary



1.1 Introduction

This guideline aims to assist in patient management of suspected bacterial meningitis. If you have any doubts or concerns please discuss with a senior colleague.

Delays in recognition and treatment of bacterial meningitis can be fatal or result in neurological damage. Suspected infective meningitis should always be considered as a medical emergency. If meningitis is strongly suspected, antibiotics should be commenced within 1 hour of arrival.

Even when meningitis is diagnosed early and adequate therapy instituted, 5% to 10% of patients die, typically within 24-48 hours of onset of symptoms. Bacterial meningitis may result in hearing loss, physical or learning disability in 10 to 20% of survivors.

Meningitis can be accompanied by systemic sepsis (also known as septicaemia), characterised by a purpuric or petechial rash and rapid circulatory collapse. This is most often seen in meningococcal infection. If meningococcal sepsis is suspected refer to the meningococcal sepsis protocol

(<http://www.meningitis.org/assets/x/50150>)

Vaccination does **not** exclude meningitis because it does not protect against all organisms that cause meningitis.

1.2 Definitions

Meningitis is the inflammation of the meninges. The term is usually used to mean infection of the meninges which can be caused by bacteria, viruses, fungi and amoeba.

2 Symptoms and Signs

Meningism is the classical clinical sign associated with inflammation of the meninges, and the word describes the triad of headache, neck stiffness and photophobia. Meningism may be present in older children but is **rarely seen** in younger ones.

When pyrexia is present without an identifiable focus meningitis must **always** be considered.

Typical findings are fever with vomiting, headache and altered interaction. A child may be irritable and inconsolable, listless and difficult to rouse, or confused and aggressive. A fluctuating or depressed level of consciousness occurs in the advanced clinical course.

2.1 Infants

May present with non-specific signs, eg poor feeding, temperature instability, listlessness, and being 'generally unwell'. They may have a vacant staring expression. A tense / bulging fontanelle may be seen but is not a reliable finding, and is generally considered a late sign.

Any child aged 3 months or less with a fever of 38°C or above must be considered to have bacterial meningitis until proven otherwise.

2.2 Toddlers and Young Children

Pyrexia without an established focus must always be considered to be potential meningitis.

Signs and symptoms may include fever, vomiting, irritability, drowsiness / listlessness or decreased level of consciousness.

2.3 Teenagers

Are more likely to have classical meningism with fever: headache, photophobia, vomiting and neck stiffness. They may also be confused, aggressive or have a fluctuating level of consciousness.

3 Signs of Raised Intracranial Pressure (ICP) In Acute Meningitis

- Decreased or fluctuating level of consciousness
- Hypertension with bradycardia indicates raised ICP
A febrile /septic child would be expected to be *tachycardic* – so be alert to a relative bradycardia even if not an absolute bradycardia. Note that bradycardia may be intermittent.
- Unequal, dilated or poorly reacting pupils
- False localising signs such as a 6th cranial nerve palsy
- Any abnormal brain stem signs (Cheyne-Stokes breathing, doll's eyes movement)
- Abnormal posturing (including opisthotonus, severe hyperextension and arching)
- Focal neurological signs or focal / prolonged seizures may or may not indicate raised ICP but always represent a serious clinical concern in a child with suspected meningitis

- Papilloedema may not be present acutely so normal fundi do not exclude raised ICP

4 Investigations and Management

4.1 Blood Tests

- Venous blood gas (will help decide if shocked (base deficit / lactate / chloride)
- FBC
- U&E, Bone, LFT, CRP
- Glucose – *immediately prior to LP*
- Clotting screen
- Blood culture (>0.5ml if age <1 month, >1ml if age 1/12 to 3 years and 4ml if age > 3years)
- Blood for meningococcal PCR if CSF cell count suggestive of bacterial meningitis.

Delaying an LP after starting antibiotics will reduce the chance of identifying a causative organism. A precise diagnosis is important for management, prognosis and contact tracing. However, cell count abnormalities persist for a number of days after antibiotics have been started.

It is **usually safe** to perform a lumbar puncture, and **it is expected that every child with suspected meningitis will have a lumbar puncture on admission before starting IV antibiotics unless one of the following relative contraindications are present** (APLS guidelines, see flowchart):

- suspected raised intracranial pressure (altered level of consciousness - GCS <13 or fall in GCS of >2), focal neurological signs including unequal/dilated/poorly responsive pupils, decorticate/decerebrate posturing, papilloedema) – see section 8.
- cardiorespiratory instability
- coagulopathy, petechiae/purpura
- focal or prolonged seizure.

Suggested volume of CSF (see Table 1) :-

Age < 5 years 2 ml

Age ≥ 5 years 4 ml

If in doubt discuss whether to perform LP with a senior colleague. If there are any contraindications you must inform your consultant on call and PICU as

contraindications to LP are indicative of a very ill child. Delaying an LP should not delay the administration of IV antibiotics.

NOTE: Always perform formal lab sugar (fluoride sample) (not bedside BM) immediately prior to LP

Table 1. CSF samples to be obtained during lumbar puncture

Bottle	Lab	Test
Number 1	Virology	Virology sample (1ml minimum) – saved sample can be sent initially and PCRs (HSV and enterovirus) or meningococcal PCR requested on basis of CSF white cell count.
Number 2	Chem	Protein (0.4ml)
Number 3	Micro	M, C & S (0.5ml)
Yellow / Grey (Fluoride)	Chem	Glucose (0.1ml)

4.2 Interpretation of CSF findings

Condition	CSF pressure	WBCs (μ l)	Protein (g/litre)	Glucose (CSF MUST BE COMPARED TO FORMAL LAB PLASMA GLUCOSE)
Normal child 0-30 days	50–80 mm H ₂ O young children	<20	up to 1.15	60-75% blood glucose
Normal Child > 1 months	50–80 mm H ₂ O young children, up to 200mm H ₂ O >8yrs	< 5 75% lymphocytes	0.2–0.45	60-75% blood glucose
Bacterial meningitis	Increased 200-500 mm H ₂ O	↑↑↑	↑↑↑	↓
Tuberculous meningitis	Increased	↑↑neutrophils early in disease, later mainly lymphocytes	↑↑↑	↓
Fungal meningitis	Increased	↑mainly lymphocytes	↑↑	↓
Viral meningitis	Normal or increased	↑mainly mononuclear cells May be polymorphonuclear (neutrophil) predominance especially in enteroviral infection	N/↑	↓/N
Herpes simplex encephalitis	Increased	Lymphocytes and RBCs increased	Increased	Normal

4.3 Other Investigations

For infants < 1 months of age

Consider neonatal viral 'sepsis' screen. Request HSV, adenovirus and enterovirus PCRs on eye swab, throat swab, rectal swab (samples in viral transport media), and EDTA blood for PCR.

For infants > 1 months of age

Consider sending viral throat swabs for respiratory virus PCR (see figure 2) and stool for enterovirus PCR.

All children

Consider throat swabs (see figure 2)

Bacterial M,C&S

Viral For enterovirus

5 Imaging

Any child ill enough to justify emergency imaging must be discussed with the general paediatric consultant on call. Imaging must not delay urgent acute management.

Urgent imaging is usually indicated to detect an alternative intracranial pathology if unexplained decreased LOC, focal neurological concerns (including focal seizures), prolonged seizure with incomplete recovery or clinical symptoms / signs indicating raised ICP. Imaging may demonstrate an acute focal lesion, such as a brain abscess or infarct, venous sinus thrombosis, cerebral oedema/midline shift.

A normal CT does not exclude raised ICP: the decision to LP following imaging should be discussed with a senior colleague. If in doubt and no senior help is available then defer LP.

6 Urgent Treatment

6.1 First Line Antibiotics (treat without delay if strong suspicion of bacterial meningitis)

6.1a < 1 month of age

IV Cefotaxime 50 mg / kg

- Neonate <7 days: 12 hourly (b.d.)

- Neonate 7-21 days: 8 hourly (t.d.s.)
- >21 days: 6 hourly (q.d.s.)

Amoxicillin to cover for *Listeria monocytogenes* (60 mg/kg (increase to 100mg/kg if proven *Listeria meningitis*)

- Neonate <7 days: 12 hourly (b.d.)
- Neonate 7-28 days: 8 hourly (t.d.s.)

Amoxicillin should be stopped if negative CSF and blood cultures at 48 hours.

In infants <6 weeks - if CSF WBC above normal range OR the infant appears sick / is haemodynamically unstable or deranged clotting/LFTs :-
→ start iv aciclovir 20 mg / kg 8 hourly (t.d.s.).

Ensure that HSV PCR is requested on CSF and blood (EDTA sample) and swabs (eye, mouth, rectum) are sent for HSV PCR.

Consider adding Rifampicin 10 mg/kg BD oral or NG if moribund (all PICU), recent foreign travel or suspected pneumococcal resistance (resistance is rare and rifampicin should not be routinely started unless child is intubated on PICU) – needs discussion with paediatric ID team or on-call microbiology consultant.

6.1b > 1 month of age

IV Ceftriaxone 80 mg/kg (max 4g) daily (o.d.) – Infuse over 30 minutes

Consider adding Rifampicin 10 mg/kg BD oral or NG if moribund (all PICU), recent foreign travel or suspected pneumococcal resistance (resistance is rare and rifampicin should not be routinely started unless child is intubated on PICU) – needs discussion with paediatric ID team or on-call microbiology consultant. See encephalitis guideline if clinical features suggestive of infective encephalitis:-

- A. Fever > 38°C is usually but not invariably apparent at presentation
- B. Persistently altered level of consciousness (LOC) or change in personality or behaviour for >24 hours and one or more features in two or more of the following groups:-
 - 1) convulsions
emotional lability / psychiatric symptoms
focal neurology > 24 hours

- 2) CSF pleocytosis (>5 leucocytes/ μ L)
- 3) Characteristic neuroimaging findings (CT/MRI) associated with encephalitis such as changes in the cerebral cortex, or basal ganglia or at the grey-white matter junction, or, in ADEM, foci of demyelination in the white matter, basal ganglia and spinal cord. MRI may be insensitive for the detection of encephalitis early in the illness, especially in neonates.

6.2 Corticosteroids

Corticosteroids are **not** indicated in infants < 3 months of age.

Start dexamethasone if suspected bacterial meningitis. Indicators include :

- CSF frankly purulent
- CSF WBC > 1000
- CSF WBC elevated AND protein > 1000
- Bacteria / organisms are seen on Gram stain

If strong clinical suspicion of meningitis and LP contraindicated (unless meningococcal disease or child <3 months of age), start steroids.

Ideally start dexamethasone before antibiotics, but can be given at the same time or added later. Do not start dexamethasone more than 12 hours after starting antibiotics.

Dosing: dexamethasone 0.15 mg / kg 6 hourly (q.d.s.) for 4 days (max. per dose 10 mg).

7 Duration of antibiotic treatment

The duration of antibiotics will be tailored to individually to each patient according to clinical and laboratory findings. Discuss with microbiologist or clinical infectious diseases consultant for specific guidance.

General guidelines for duration according to the pathogen isolated are:

N. meningitidis: 7 days

S. pneumoniae and *H. influenzae*: minimum 14 days (increase if complicated)

L. monocytogenes and Group B streptococcus: 14 - 21 days

Gram-negative bacteria (e.g. *E. coli*): 21 days

8 Fluid Management When Bacterial Meningitis Is Suspected or Diagnosed

Do not start intravenous fluids if the child is well enough to feed (infants) or drink (older children). Do not restrict fluids unless there is evidence of: raised intracranial

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pressure, **or** increased antidiuretic hormone secretion (ie as indicated by low plasma sodium levels).

9 Prophylaxis of Household Contacts

Contact the local Public Health England centre (previously HPA) via switchboard to report the case of likely bacterial meningitis and discuss prophylaxis of contacts.

10 Audiology

Deafness is the commonest complication following bacterial meningitis. It is important that children should have an audiogram as soon as possible after the diagnosis of bacterial meningitis is made, irrespective of the clinical impression or parents' view of the hearing. This is because confirmed hearing loss may in some circumstances be treated with cochlear implants. The best outcome is obtained if surgery happens before fibrosis and ossification occurs and so children are fast tracked from audiology clinic to the audiology implant centre where necessary.

Telephone: X 2124 for urgent appointment. The NICE recommendations are "to offer a formal audiological assessment every child with confirmed bacterial meningitis as soon as possible, preferably before discharge, within 4 weeks of being fit to test."

Children with confirmed viral meningitis do not need routine audiology follow-up.

11 Follow-Up

Before discharge, families of children and young people with confirmed bacterial meningitis should be given information about potential long term side-effects and how to access further support (<https://www.meningitisnow.org/how-we-help/ways-we-can-help-you/about-our-services/recovery/>)

Regardless of other history or referring hospital, every child with confirmed meningitis needs a follow up appointment within 6 weeks of discharge:

- Under admitting consultant (unless discharged from PICU)

Both the vaccination history and past history of infections are important. These must be documented and correlated to the identified organism. If there is suggestion of vaccination failure, history of previous meningitis or frequent/unusual bacterial infections the child may need further immunological investigations. Consider follow up in Paediatric Immunology clinic (code SNFJC0) 6-8 weeks following discharge.

12 References

NICE guidelines: Bacterial meningitis and meningococcal septicaemia: Management of bacterial meningitis and meningococcal septicaemia in children and young people younger than 16 years in primary and secondary care. <http://www.nice.org.uk/guidance/cg102>

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13 Appendices

Figure 1. Swabs for microbiology and virology testing

- 1) Routine MC+S including MRSA screen



- 2) Routine virology including throat swabs for respiratory viral PCR

