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Practice Guidelines

Management of bacterial meningitis and meningococcal septicaemia in children and young people: summary of NICE guidance

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Bacterial meningitis and meningococcal septicaemia in children and young people are associated with considerable mortality and morbidity. Case fatality rates vary according to the causative organism and the age of the child or young person. In the United Kingdom they range from 2% to 11% and are especially high (about 10%) in neonates (children younger than 28 days). Survivors of bacterial meningitis and meningococcal septicaemia may experience serious long term morbidities (box 1). This article summarises the most recent recommendations from the National Institute for Health and Clinical Excellence (NICE) on the management of bacterial meningitis and meningococcal septicaemia in children and young people aged under 16 years in primary and secondary care.**1**

Box 1 Long term morbidities associated with bacterial meningitis and meningococcal septicaemia

- Hearing loss
- Orthopaedic complications (damage to bones and joints)
- Skin complications (including scarring from necrosis)
- Psychosocial problems
- Neurological and developmental problems
- Renal failure

Recommendations

NICE recommendations are based on systematic reviews of best available evidence and explicit consideration of cost effectiveness. When minimal evidence is available, recommendations are based on the Guideline Development Group's experience and opinion of what constitutes good practice. Evidence levels for the recommendations are given in italic in square brackets.

Symptoms and signs of bacterial meningitis and meningococcal septicaemia

- Consider bacterial meningitis and meningococcal septicaemia in children and young people who present with the symptoms and signs in the table⇓. [*Based on moderate quality evidence from a meta-analysis of cohort studies, further cohort studies and cross sectional studies, and case series*]

Symptom or sign	Bacterial meningitis (meningococcal meningitis and meningitis caused by other bacteria)	Meningococcal disease (meningococcal meningitis, meningococcal septicaemia, or both)	Meningococcal septicaemia
Common non-specific symptoms or signs			
Fever (not always present, especially in neonates)	Yes	Yes	Yes
Vomiting or nausea	Yes	Yes	Yes
Lethargy	Yes	Yes	Yes
Irritable or unsettled	Yes	Yes	Yes
Look ill	Yes	Yes	Yes
Refusing food or drink	Yes	Yes	Yes

Refusing food or drink	Yes	Yes	Yes
Headache	Yes	Yes	Yes
Muscle ache or joint pain	Yes	Yes	Yes
Respiratory symptoms or signs or breathing difficulty	Yes	Yes	Yes
Less common non-specific symptoms or signs			
Chills or shivering	Yes	Yes	Yes
Diarrhoea, abdominal pain, or distension	Yes	Yes	NK
Sore throat or coryza or other ear, nose, and throat symptoms or signs	Yes	Yes	NK
More specific symptoms or signs			
Non-blanching rash (may be less visible in darker skin tones—check soles of feet, palms of hands, and conjunctivas)	Yes	Yes	Yes
Stiff neck	Yes	Yes	NK
Altered mental state (includes confusion, delirium, drowsiness, and impaired consciousness)	Yes	Yes	Yes
Capillary refill time more than 2 seconds	NK	Yes	Yes
Unusual skin colour	NK	Yes	Yes
Shock	Yes	Yes	Yes
Hypotension	NK	Yes	Yes
Leg pain	NK	Yes	Yes
Cold hands or feet	NK	Yes	Yes
Back rigidity	Yes	Yes	NK
Bulging fontanelle (only relevant in children under 2 years)	Yes	Yes	NK
Photophobia	Yes	Yes	X
Kernig's sign*	Yes	Yes	X
Brudzinski's sign†	Yes	Yes	X
Unconsciousness	Yes	Yes	Yes
Toxic or moribund state	Yes	Yes	Yes
Paresis	Yes	Yes	X
Focal neurological deficit including cranial nerve involvement and abnormal pupils	Yes	Yes	X
Seizures	Yes	Yes	X

*With the patient lying flat on his or her back, inability to extend the knees beyond 135° without causing pain; †with the patient supine, one hand placed behind the patient's head and the other hand on the patient's chest, while the patient's head is raised, flexion of the patient's lower extremities (hips and knees) constitutes a positive sign.

Yes=symptom or sign present; X=symptom or sign not present; NK not known if a symptom or sign is present (not reported in the evidence).

Symptoms and signs of bacterial meningitis and meningococcal septicaemia

- Some children and young people will present with mostly non-specific symptoms or signs, and the conditions may be difficult to distinguish from other less important (viral) infections. [*Based on moderate quality evidence from a meta-analysis of cohort studies, further cohort studies and cross sectional studies, and case series*]
- Be aware that those with more specific symptoms and signs are more likely to have bacterial meningitis or meningococcal septicaemia, and that symptoms and signs may become more severe and more specific over time. [*Based on moderate quality evidence from a meta-analysis of cohort studies, further cohort studies and cross sectional studies, and case series*]

- Recognise shock (see box 2) and manage urgently in secondary care.
- Healthcare professionals should be trained in the recognition and management of meningococcal disease (bacterial meningitis and meningococcal septicaemia caused by *Neisseria meningitidis*). [*Based on the experience and opinion of the Guideline Development Group*]

Box 2 Signs of shock

Capillary refill time longer than 2 seconds

Unusual skin colour

Tachycardia or hypotension

Respiratory symptoms or breathing difficulty

Leg pain

Cold hands or feet

Toxic or moribund state

Altered mental state or decreased consciousness

Poor urine output

Management in the prehospital setting

- Primary care healthcare professionals should transfer children and young people with suspected bacterial meningitis or suspected meningococcal septicaemia to secondary care as an emergency by telephoning 999. [*Based on the experience and opinion of the Guideline Development Group*]
- Transfer those with suspected bacterial meningitis without non-blanching rash directly to secondary care without giving parenteral antibiotics. If urgent transfer to hospital is not possible (for example, in remote locations or adverse weather conditions), administer antibiotics to children and young people with suspected bacterial meningitis.
- In those with suspected meningococcal disease (meningitis with non-blanching rash or meningococcal septicaemia) give parenteral antibiotics (intramuscular or intravenous benzylpenicillin) at the earliest opportunity, either in primary or secondary care, but do not delay urgent transfer to hospital to give the parenteral antibiotics.

Diagnosis in secondary care
Investigation and management if petechial rash is present

- Give intravenous ceftriaxone immediately to those with a petechial rash and any of the signs in box 3 (because they are at high risk of having meningococcal disease). [*Based on high quality evidence from meta-analyses of randomised controlled trials, a further randomised controlled trial, and a health economic model developed for the guideline*]
- If a child or young person has an unexplained petechial rash and fever (or history of fever) carry out the following investigations: full blood count, measurement of C reactive protein, coagulation screen, blood culture, whole blood polymerase chain reaction for *N meningitidis*, blood glucose, and blood gas.
- In a child or young person with an unexplained petechial rash and fever (or history of fever) but none of the high risk clinical manifestations (box 3) manage as indicated in box 4.

Box 3 Signs indicating high risk of meningococcal disease in children and young people with a petechial rash

Petechiae start to spread

The rash becomes purpuric

Signs of bacterial meningitis or of meningococcal septicaemia (see table)

The child or young person appears ill to a healthcare professional

Box 4 Management of children and young people with unexplained petechial rash and fever (or history of fever) but without high risk clinical manifestations

Treat with intravenous ceftriaxone immediately if C reactive protein or white blood cell count (especially neutrophil count) is raised, either of which indicates an increased risk of meningococcal disease

Although a normal C reactive protein concentration and normal white blood cell count make meningococcal disease less likely, they do not rule it out. These measures may be normal or low even in severe meningococcal disease

Assess clinical progress by monitoring vital signs (respiratory rate, heart rate, blood pressure, level of consciousness, temperature), capillary refill time, and oxygen saturation; carry out observations at least hourly over the next four to six hours to determine the likelihood of the child or young person having meningococcal disease

If doubt remains, treat with antibiotics and admit to hospital

Polymerase chain reaction

- Perform whole blood real time polymerase chain reaction testing (EDTA sample) for *N meningitidis* to confirm a diagnosis of meningococcal disease. [*Based on moderate quality evidence from cohort studies and a health economic model developed for the guideline*]

Lumbar puncture

- In children or young people with suspected meningitis or suspected meningococcal disease, perform a lumbar puncture unless any of the contraindications listed in box

5 is present. [*Based on low quality evidence from case-control studies and case series*]

- In those with suspected bacterial meningitis use clinical assessment and not cranial computed tomography to decide whether it is safe to perform a lumbar puncture. Cranial computed tomography is not a reliable way to identify raised intracranial pressure.

Box 5 Contraindications to lumbar puncture

Signs suggesting raised intracranial pressure:

- Reduced or fluctuating level of consciousness (Glasgow coma scale score <9 or a drop of 3 or more)

- Relative bradycardia and hypertension

- Focal neurological signs

- Abnormal posture or posturing

- Unequal, dilated, or poorly responsive pupils

- Papilloedema

- Abnormal “doll’s eye” movements

Shock (see box 2)

Extensive or spreading purpura

The child or young person has recently experienced convulsions and is not yet stabilised

Coagulation abnormalities:

- Coagulation results (if obtained) outside the normal range

- Platelet count below 100×10^{9}/l

- Receiving anticoagulants

Local superficial infection at the lumbar puncture site

Respiratory insufficiency

Management in secondary care

Antibiotics for suspected bacterial meningitis or meningococcal disease

- Treat children aged 3 months or more who have suspected bacterial meningitis without delay using intravenous ceftriaxone.
- Treat children younger than 3 months with suspected bacterial meningitis without delay using intravenous cefotaxime plus amoxicillin or ampicillin.
- Treat suspected meningococcal disease without delay using intravenous ceftriaxone.
- Treat those with suspected bacterial meningitis who have recently travelled outside the UK or have had prolonged or multiple exposure to antibiotics (within the past three months) with vancomycin in addition to the above antibiotics.
- Do not give ceftriaxone at the same time as calcium containing infusions.[2] Instead, use cefotaxime.

Fluids for bacterial meningitis

- Do not restrict fluids unless there is evidence of raised intracranial pressure (box 5) or increased secretion of antidiuretic hormone. [*Based on high quality evidence from a meta-analysis of randomised controlled trials and an observational study*]

Intravenous fluid resuscitation in meningococcal septicaemia

- In children with suspected or confirmed meningococcal septicaemia give fluids as indicated in box 6. [*Based on moderate quality evidence from randomised controlled trials, cohort studies, observational studies, case-control studies, and a health economic model developed for the guideline*]

Box 6 Intravenous fluid resuscitation in children and young people with suspected or confirmed meningococcal septicaemia

If there are signs of shock give an immediate fluid bolus of 20 ml/kg sodium chloride 0.9% over 5-10 minutes. Give the fluid intravenously or via an intraosseous route and reassess the child or young person immediately afterwards

If the signs of shock persist, immediately give a second bolus of 20 ml/kg of intravenous or intraosseous sodium chloride 0.9% or human albumin 4.5% solution over 5-10 minutes

If the signs of shock still persist after the first 40 ml/kg:

- Immediately give a third bolus of 20 ml/kg of intravenous or intraosseous sodium chloride 0.9% or human albumin 4.5% solution over 5-10 minutes

- Call for anaesthetic assistance for urgent tracheal intubation and mechanical ventilation

- Start treatment with vasoactive drugs

- Be aware that some children and young people may require large volumes of fluid over a short period of time to restore their circulating volume

- Consider giving further fluid boluses at 20 ml/kg of intravenous or intraosseous sodium chloride 0.9% or human albumin 4.5% solution over 5-10 minutes; base your decision on clinical signs and appropriate laboratory investigations including urea and electrolytes

Discuss further management with a paediatric intensivist

Corticosteroids

- Do not use corticosteroids in children younger than 3 months who have suspected or confirmed bacterial meningitis.
- Give dexamethasone (0.15 mg/kg to a maximum dose of 10 mg, four times daily for four days) for suspected or confirmed bacterial meningitis as soon as possible if lumbar puncture shows any of the following: frankly purulent cerebrospinal fluid, cerebrospinal fluid white blood cell count greater than 1000/µl, raised cerebrospinal fluid white blood cell count with protein concentration greater than 1 g/l, bacteria on Gram stain.

Monitoring deterioration

- Monitor children and young people with meningococcal disease closely after admission to hospital for signs of deterioration (monitor respiration, pulse, blood pressure, oxygen saturation, and Glasgow coma scale score).

Long term management
Long term effects of bacterial meningitis and meningococcal septicaemia

Offer children and young people with severe or profound deafness an urgent assessment for cochlear implants as soon as they are fit to undergo testing (see NICE guidelines for further guidance[3]). [*Based on moderate quality evidence from a meta-analysis of cohort studies and case series, plus further cohort studies and case series*]

Children and young people should be reviewed by a paediatrician four to six weeks after discharge from hospital to discuss morbidities (see box 1 for morbidities that should be specifically considered) and they should be offered referral to appropriate services. [*Based on the experience and opinion of the Guideline Development Group*]

Overcoming barriers

This guideline should give healthcare professionals in primary care settings, and families and carers of children and young people, the knowledge and confidence to recognise symptoms and signs of bacterial meningitis and meningococcal septicaemia and to seek appropriate clinical care. Training for healthcare professionals should emphasise the importance of ensuring prompt and appropriate emergency treatment in hospital because this will save lives and greatly reduce long term morbidities. Training should, however, reassure healthcare professionals that they can administer antibiotics to those with suspected bacterial meningitis without non-blanching rash if urgent transfer to hospital is not possible. Effective communication between healthcare professionals in different settings will be essential for implementation of the guideline (for example, to ensure that morbidities such as hearing loss are dealt with promptly after discharge from hospital).

Further information on the guidance

Background

Bacterial meningitis in children and young people is associated with case fatality rates of 2-11%, the rate being particularly high (10%) in neonates.[4] In neonates, bacterial meningitis is often caused by organisms acquired from the maternal genital tract and gastrointestinal tract around the time of birth. Such organisms include *Streptococcus agalactiae* (group B streptococcus), *Escherichia coli, Streptococcus pneumoniae*, and *Listeria monocytogenes*. In older children and young people, bacterial meningitis is usually caused by *N meningitidis* (meningococcus), *S pneumoniae* (pneumococcus), or *Haemophilus influenzae* type b, which often colonise the upper respiratory tract and can cause invasive disease when acquired by susceptible people.

Meningococcal disease is the leading infectious cause of death in early childhood,[5] making its control a priority for clinical management and public health surveillance and control. The disease can be fatal within hours of the first symptoms appearing, and the case fatality rate is about 10%.[6] The highest incidence of meningococcal disease occurs in children under 2 years, with further peaks in incidence occurring in adolescence and early adulthood.[7]

Under the Health Protection (Notification) Regulations 2010,[8] acute meningitis (including bacterial meningitis) and meningococcal septicaemia are notifiable diseases. Registered medical practitioners in England have a statutory duty to notify the proper officer of the local authority in which a patient lives when they have reasonable grounds for suspecting the patient has either condition. From October 2010, the regulations will also require diagnostic laboratories to notify the Health Protection Agency after identifying infection caused by specific organisms, including *N meningitidis*. The Department of Health has recently issued guidance explaining notification requirements to registered medical practitioners and diagnostic laboratories that test human samples.[9]

This guidance does not consider meningitis associated with tuberculosis because diagnosis and management of tuberculous meningitis is covered in other NICE guidance.[10] However some features of the presentation of tuberculous meningitis are indistinguishable from bacterial meningitis and this is highlighted in relevant guideline recommendations.

Methods

This guidance was developed by the National Collaborating Centre for Women's and Children's Health in accordance with NICE guideline development methods (www.nice.org.uk/guidelinesmanual). A guideline development group was established by the National Collaborating Centre for Women's and Children's Health, which incorporated healthcare professionals, parents of children and young people who have experienced bacterial meningitis or meningococcal septicaemia, employees of organisations that provide support for people with these conditions and their families or carers, and experts in guideline methodology. The Guideline Development Group identified relevant clinical questions, collected and appraised clinical evidence, and evaluated the cost effectiveness of proposed interventions where possible. The draft guideline underwent a rigorous review process where stakeholder organisations were invited to comment; all comments were taken into consideration when producing the final version of the guideline.

NICE has produced four different versions of the guideline: a full version containing all the evidence, the process undertaken to develop the recommendations, and all the recommendations; a quick reference guide; a version containing a list of all the recommendations, known as the "NICE guideline;" and a version for patients and the public. All these versions are available from the NICE website (www.nice.org.uk/CG102). Further updates of the guidance will be produced as part of the NICE guideline development

programme.

Future research

- What symptoms and signs of bacterial meningitis and meningococcal disease in children and young people differentiate between these conditions and minor self limiting infections (including those characterised by fever)?
- What are the normal ranges for blood and cerebrospinal fluid parameters in children and young people in the UK?
- How effective is albumin 4.5% solution compared with crystalloid saline 0.9% solution for fluid resuscitation in children and young people with septic shock?
- How effective are corticosteroids as an adjunct to antibiotic treatment in neonates with suspected or confirmed bacterial meningitis?
- How effective is steroid replacement treatment in children and young people with vasopressor unresponsive shock caused by septicaemia, including meningococcal septicaemia?

Notes

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Footnotes

- This is one of a series of *BMJ* summaries of new guidelines based on the best available evidence; they highlight important recommendations for clinical practice, especially where uncertainty or controversy exists.
- The members of the Guideline Development Group are Jay Banerjee (until March 2009), Angela Cloke, Linda Glennie, Caroline Haines, Paul Heath, Paul Jacklin, J Simon Kroll, Ian Maconochie, Sheila McQueen, Philip Monk, Moira Mugglestone (from April 2009), M Stephen Murphy (from December 2009), Simon Nadel, Nelly Ninis, Andrew Pollard (chair), Martin Richardson, Matthew Thompson, Alistair Thomson, and Roz Ullman (until June 2009)
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