NATIONAL INSTITUTE FOR HEALTH AND CARE EXCELLENCE

Guideline

Meningitis (bacterial) and meningococcal disease: recognition, diagnosis and management

Draft for consultation, September 2023

This guideline covers recognising, diagnosing and managing bacterial meningitis and meningococcal disease in babies, children, young people and adults. It aims to reduce death and disability by helping healthcare professionals recognise meningitis and treat it quickly and effectively.

This guideline will update NICE guideline CG102 (published June 2010).

Who is it for?

- Healthcare professionals
- Commissioners and providers
- People with bacterial meningitis or meningococcal disease, their families and carers

What does it include?

This draft guideline contains:

- the draft recommendations
- recommendations for research
- rationale and impact sections that explain why the committee made the recommendations and how they might affect practice
- the guideline context.

Information about how the guideline was developed is on the guideline's webpage. This includes the evidence reviews, the scope, details of the committee and any declarations of interest.

Who is not covered by this guideline?

People with:

- known immunodeficiency
- brain tumours, pre-existing hydrocephalus, intracranial shunts, previous neurosurgical procedures, or known cranial or spinal anomalies that increase the risk of bacterial meningitis
- confirmed viral meningitis or viral encephalitis
- confirmed tuberculous meningitis
- confirmed fungal meningitis.

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Recommendations

People have the right to be involved in discussions and make informed decisions about their care, as described in NICE's information on making decisions about your care.

Making decisions using NICE guidelines explains how we use words to show the strength (or certainty) of our recommendations, and has information about prescribing medicines (including off-label use), professional guidelines, standards and laws (including on consent and mental capacity), and safeguarding.

Recommendations are for babies (over 28 days), children, young people and adults unless otherwise stated. Some recommendations also cover newborn babies, including babies who may be in neonatal units. Recommendations that cover newborn babies are listed at the start of the relevant sections. For all other recommendations on treating bacterial meningitis in newborn babies in hospital, see the NICE guideline on neonatal infection.

Recommendations on bacterial meningitis also cover meningococcal meningitis without meningococcal sepsis. Recommendations on meningococcal disease cover meningococcal sepsis with or without meningococcal meningitis.

For more guidance on recognising, diagnosing and managing sepsis (including for newborn babies), see the NICE guideline on sepsis.

1.1 Recognising bacterial meningitis and meningococcal disease

1.1.1 When considering a diagnosis of bacterial meningitis or meningococcal disease, be aware that these:

- are rapidly evolving conditions
- can occur at the same time, particularly in people with a rash

- can present with non-specific symptoms and signs (with none of the red flag symptoms in recommendations 1.1.3 and 1.1.5), particularly in young babies and older adults
- may be difficult to distinguish from other infections with similar symptoms and signs.

1.1.2 Complete an assessment of signs, symptoms and risk factors using:

- the red flag symptoms and combination in recommendations 1.1.3 and 1.1.5, and
- the section on symptoms, signs and risk factors of bacterial meningitis and
- the section on symptoms, signs and risk factors of meningococcal disease.

1.1.3 Strongly suspect bacterial meningitis in people with a combination of fever, headache, neck stiffness, and altered level of consciousness or cognition (the red flag combination).

1.1.4 Do not rule out bacterial meningitis just because a person does not have one or more of the symptoms in the red flag combination.

1.1.5 Strongly suspect meningococcal disease in people with any of these red flag symptoms:

- haemorrhagic, non-blanching rash with lesions larger than 2 mm (purpura)
- rapidly progressive and/or spreading non-blanching rash
- any symptoms and signs of bacterial meningitis (see tables 1 and 2), when combined with a non-blanching rash.

1.1.6 Do not rule out meningococcal disease just because a person does not have a rash.

1.1.7 When looking for a rash:

- check all over the body (including nappy areas), and check for petechiae in the conjunctivae
- note that rashes can be harder to detect on brown, black or tanned skin
- tell the person and their family members or carers to look out for any changes in the rash, because it can change from blanching to non-blanching.

1.1.8 Bacterial meningitis or meningococcal disease can be strongly suspected based on clinical assessment, even in people who do not have the red flag combination (for bacterial meningitis) or any of the red flag symptoms (for meningococcal disease).

1.1.9 If you suspect or strongly suspect bacterial meningitis or meningococcal disease, transfer the person to hospital as an emergency (see the recommendations on transfer to hospital).

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on recognition.

Full details of the evidence and the committee's discussion are in evidence review A1: Symptoms and signs of bacterial meningitis. and evidence review A3: Symptoms and signs of meningococcal disease.

Symptoms, signs and risk factors of bacterial meningitis

Symptoms and signs

1.1.10 Assess for the symptoms and signs of bacterial meningitis in table 1 (babies, children and young people) and table 2 (adults).

- Bacterial meningitis can present with any of these symptoms and signs.
- The more symptoms and signs present, the more likely it is that the person has bacterial meningitis.

Table 1 Symptoms and signs of bacterial meningitis in babies, children and young people

Symptoms and signs in babies, children and young people	Notes
Red flag combination	
Fever, headache, neck stiffness, and altered level of consciousness or cognition	Fever and neck stiffness is less common in babies. Headache and neck stiffness are harder to identify in babies and young children.
Appearance	
Fever	Fever, headache, neck stiffness and altered level of consciousness or cognition is the red flag combination for bacterial meningitis. Fever is less common in babies. For other possible causes of fever in under 5s, see table 3 in the NICE guideline on fever in under 5s. For children under 6 months, see recommendation 1.2.11 in the NICE guideline on fever in under 5s.
Non-blanching rash	Mainly in meningococcal disease (with or without meningococcal meningitis). May be difficult to see on brown, black or tanned skin. Look for petechiae in the conjunctivae.
Pale, mottled skin or cyanosis	May be difficult to see on brown, black or tanned skin.
Ill appearance	
Bulging fontanelle	In babies and young children with an open fontanelle.
Behaviour	
Altered behaviour (for example unusually aggressive or subdued)	
Lethargy	Common in babies and young children.
Irritability	Common in babies and young children.
High-pitched cry	In babies.
Reduced feeding	In babies.
Cardiovascular	
Cardiovascular indications of shock, such as cold hands and feet or other early signs of sepsis	
Neurological	
Headache	Fever, headache, neck stiffness and altered level of consciousness or cognition is the red flag combination for bacterial meningitis.

	Headache cannot be reported by babies and young children or by children and young people with cognitive impairment.
Neck stiffness, including more subtle discomfort or reluctance to move the neck	Fever, headache, neck stiffness and altered level of consciousness or cognition is the red flag combination for bacterial meningitis. Neck stiffness is less likely and harder to identify in babies.
Altered level of consciousness or altered cognition (including confusion or delirium)	Fever, headache, neck stiffness and altered level of consciousness or cognition is the red flag combination for bacterial meningitis.
Photophobia	Harder to identify in babies.
Focal neurological deficits	
Seizures	
Respiratory	
Tachypnoea, apnoea, and grunting	Non-specific signs of both sepsis and meningitis in babies.
Other	
Vomiting	
Unexplained body pain, including limb, back and abdominal pain	

Table 2 Symptoms and signs of bacterial meningitis in adults

Symptoms and signs in adults	Notes
Red flag combination	
Fever, headache, neck stiffness, and altered level of consciousness or cognition	Fever is less common in older adults. Headache and neck stiffness are harder to identify in adults with cognitive impairment. Neck stiffness is harder to identify in adults with dementia or arthritis Altered level of consciousness or cognition may be missed in young adults and older adults.
Appearance	
Fever	Fever, headache, neck stiffness and altered level of consciousness or cognition is the red flag combination for bacterial meningitis. Fever is less common in older adults.
Non-blanching rash	Mainly in meningococcal meningitis and meningococcal disease (with or without meningococcal meningitis). May be difficult to see on brown, black or tanned skin. Look for petechiae in the conjunctivae.
Pale, mottled skin or cyanosis	May be difficult to see on brown, black or tanned skin.
Ill appearance	

Behaviour	
Altered level of consciousness or altered cognition (including confusion or delirium)	Fever, headache, neck stiffness and altered level of consciousness or cognition is the red flag combination for bacterial meningitis. Bacterial meningitis may be missed in older adults with delirium or altered consciousness. In young people and young adults, altered level of consciousness may be assumed to be caused by alcohol or substance misuse, and bacterial meningitis can be missed as a result.
Altered behaviour (for example unusually aggressive or subdued)	Bacterial meningitis may be missed in older adults with delirium or altered consciousness. In young people and young adults, altered behaviour may be assumed to be caused by alcohol or substance misuse, and bacterial meningitis can be missed as a result.
Lethargy	Common in older adults.
Irritability	
Cardiovascular	
Cardiovascular indications of shock, such as cold hands and feet or other early signs of sepsis	
Neurological	
Headache	Fever, headache, neck stiffness and altered level of consciousness or cognition is the red flag combination for bacterial meningitis. Headache cannot be reported by adults with cognitive impairment.
Neck stiffness, including more subtle discomfort or reluctance to move the neck	Fever, headache, neck stiffness and altered level of consciousness or cognition is the red flag combination for bacterial meningitis. Neck stiffness is less likely and harder to identify in older adults. Neck stiffness is harder to identify in adults with cognitive impairment, dementia or arthritis.
Photophobia	
Focal neurological deficits	
Seizures	
Other	
Vomiting	
Unexplained body pain, including limb, back and abdominal pain	

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1.1.11 For people with reduced consciousness or communication difficulties, ask family members or carers about recent changes in symptoms.

Risk factors

1.1.12 Be on heightened alert to the possibility of bacterial meningitis (including meningococcal meningitis) in people with any of these risk factors:

- missed relevant immunisations, such as meningococcal, *Haemophilus influenzae* type b (Hib) or pneumococcal vaccines
- reduced or absent spleen function
- congenital complement deficiency or acquired inhibition
- they are a student in further or higher education, particularly if they are in large shared accommodation (such as halls of residence)
- a family history of meningococcal disease
- they have been in contact with someone with Hib disease or meningococcal disease, or have been in an area with an outbreak of meningococcal disease
- a previous episode of bacterial meningitis or meningococcal disease
- a cerebrospinal fluid leak
- a cochlear implant.

For newborn babies, see the risk factors for neonatal infection (not specific to meningitis) in the NICE guideline on neonatal infection:

- risk factors for and clinical indicators of possible early-onset neonatal infection
- risk factors for and clinical indicators of possible late-onset neonatal infection.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on recognising bacterial meningitis and meningococcal disease.

Full details of the evidence and the committee's discussion are in evidence review A1: Symptoms and signs of bacterial meningitis and evidence review A2: Risk factors of bacterial meningitis.

1 Symptoms, signs and risk factors of meningococcal disease

2 Symptoms and signs

3 1.1.13 While you should strongly suspect meningococcal disease in people with
4 any one of the red flag symptoms, be aware that meningococcal disease
5 can present with any combination of these non-specific moderate- to high-
6 risk symptoms and signs of severe illness.

7 Table 3 Symptoms and signs that indicate meningococcal disease for babies, 8 children, young people and adults

Symptom or sign	Notes
Red flags	
Haemorrhagic, non-blanching rash with lesions larger than 2 mm (purpura) Rapidly progressive and/or spreading non-blanching rash Any symptoms and signs of bacterial meningitis (see tables 1 and 2), when combined with a non-blanching rash	Rashes may be difficult to see on brown, black or tanned skin. Look for petechiae in the conjunctivae.
Non-specific symptom or sign	
Appearance	
Pale, mottled skin or cyanosis	May be difficult to see on brown, black or tanned skin.
Ill appearance	
Parent or carer concern	
Behaviour	
Altered level of consciousness or altered cognition (including confusion or delirium)	Meningococcal disease may be missed in older adults with delirium or altered consciousness. In young people and young adults, altered level of consciousness may be assumed to be caused by alcohol or substance misuse, and meningococcal disease can be missed as a result.
Altered behaviour (for example unusually aggressive or subdued or no response to social cues)	Meningococcal disease may be missed in older adults with delirium or altered consciousness. In young people and young adults, altered behaviour may be assumed to be caused by

	alcohol or substance misuse, and meningococcal disease can be missed as a result.
Lethargy, does not wake or if roused does not stay awake	Common in babies, young children and older adults.
Weak, high-pitched or continuous cry	In babies.
Cardiovascular	
Cold hands and feet	
High age-specific heart rate	For age-specific heart rates, see the section on risk stratification in the NICE guideline on sepsis.
Heart rate less than 60 beats per minute	In babies and children under 12 years
Low age-specific blood pressure	For age-specific blood pressures, see the section on risk stratification in the NICE guideline on sepsis.
Hydration	
Capillary refill time of 3 seconds or longer	
Reduced urine output	
Respiratory	
Grunting	In babies and children.
High age-specific respiratory rate	For age-specific respiratory rates, see the section on risk stratification in the NICE guideline on sepsis.
Temperature	
Fever	39°C or higher in children aged 3 to 6 months 38°C or higher in children younger than 3 months.
Temperature less than 36°C	
Other	
Leg pain	
Abdominal pain	
Diarrhoea	

Risk factors

1.1.14 Be on heightened alert to the possibility of meningococcal disease in people with any of these risk factors:

- missed meningococcal vaccinations
- reduced or absent spleen function
- complement deficiency or inhibition
- they are a student in further or higher education, particularly if they are in large shared accommodation (such as halls of residence)

- a family history of meningococcal disease
- they have been in contact with someone with meningococcal disease, or have been in an area with an outbreak
- a previous episode of meningococcal disease.

1.1.15 For people who have had a previous episode of meningococcal disease, also check for risk factors for recurrent bacterial meningitis and meningococcal disease.

For newborn babies, see the risk factors for neonatal infection (not specific to meningococcal disease) in the NICE guideline on neonatal infection:

- risk factors for and clinical indicators of possible early-onset neonatal infection
- risk factors for and clinical indicators of possible late-onset neonatal infection.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on symptoms and signs of meningococcal disease.

Full details of the evidence and the committee's discussion are in evidence review A3: Symptoms and signs of meningococcal disease and evidence review A4: Risk factors of meningococcal disease.

Safety netting

1.1.16 If you send a person home after clinical assessment for bacterial meningitis and meningococcal disease:

- consider a safety netting arrangement
- tell them what to do if they develop new symptoms, if a rash changes from blanching to non-blanching, or if existing symptoms get worse (for example, ask them to return to the GP or ring NHS 111 or 999).

Alternative causes

1.1.17 Be aware that many of the symptoms and signs of bacterial meningitis and meningococcal disease are also indicators of many other serious conditions in babies, children, young people and adults (for example other forms of sepsis, intracranial bleed or ischaemia, and pneumonia).

For guidance on assessing for sepsis, see the NICE guideline on sepsis:

- identifying people with suspected sepsis
- risk factors for sepsis
- face-to-face assessment of people with suspected sepsis
- stratifying risk of severe illness or death from sepsis.

For guidance on assessing fever in children under 5, see the section on clinical assessment of children with fever in the NICE guideline on fever in under 5s.

For guidance on diagnosing and managing stroke and transient ischaemic attack in over 16s, see the NICE guideline on stroke.

For guidance on diagnosing and managing pneumonia in adults, see the NICE guideline on pneumonia.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on safety netting and alternative causes.

Full details of the evidence and the committee's discussion are in evidence review A1: Symptoms & signs for bacterial meningitis and evidence review A3: Symptoms & signs for meningococcal disease.

1.2 Transfer to hospital and antibiotics outside of hospital

1.2.1 Transfer people with suspected bacterial meningitis or meningococcal disease to hospital as an emergency.

1.2.2 Tell the hospital that a person with suspected bacterial meningitis or meningococcal disease is being transferred and that they will need assessment by a senior clinical decision maker.

1.2.3 For people with strongly suspected bacterial meningitis, give intravenous or intramuscular ceftriaxone or benzylpenicillin outside of hospital if there is likely to be a clinically significant delay in transfer to hospital.

1.2.4 For people with strongly suspected meningococcal disease, give intravenous or intramuscular ceftriaxone or benzylpenicillin as soon as possible outside of hospital.

1.2.5 Do not delay transfer to hospital to give antibiotics to people with suspected or strongly suspected bacterial meningitis or meningococcal disease.

See the recommendation on penicillin allergy for alternative antibiotics.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on transfer to hospital and antibiotics outside of hospital.

Full details of the evidence and the committee's discussion are in:

- evidence review A1: Symptoms & signs of bacterial meningitis
- evidence review A3: Symptoms & signs of meningococcal disease
- evidence review C1: Optimal timing of antibiotic administration for those with suspected bacterial meningitis
- evidence review C2: Optimal timing of antibiotic administration for those with suspected meningococcal disease.

1.3 Information and support for people with suspected bacterial meningitis or meningococcal disease

1.3.1 Discuss the following with people who are in hospital with suspected bacterial meningitis or meningococcal disease and their family members and carers:

- the reasons for their suspected diagnosis, and any uncertainty about their initial diagnosis
- when they can expect to know more
- the need for investigations (including lumbar puncture for bacterial meningitis)
- the timing of investigations and antibiotics.

1.3.2 For people who are unlikely to have meningitis or meningococcal disease, but who are sent home from hospital with an unconfirmed diagnosis:

- explain which symptoms and signs to look out for, and what changes should prompt them to return to hospital
- direct them to sources of online information.

For more guidance on providing information to adults, see the NICE guideline on patient experience in adult NHS services. In particular, see the sections on:

- knowing the patient as an individual
- communication
- information.

For more guidance on providing information to babies, children and young people, see the NICE guideline on babies, children and young people's experience of healthcare. In particular, see the sections on:

- communication by healthcare staff
- providing information.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on information and support for people with suspected bacterial meningitis

Full details of the evidence and the committee's discussion are in evidence review K1: Information for those with suspected bacterial meningitis or meningococcal disease and evidence review K2: Support for those with suspected bacterial meningitis or meningococcal disease.

1.4 Investigating suspected bacterial meningitis in hospital

Timing of investigations and antibiotics

1.4.1 A senior clinical decision maker should perform an initial assessment and ensure that:

- antibiotics start within 1 hour of the person with suspected bacterial meningitis arriving at hospital, and in line with the section on antibiotics for bacterial meningitis in hospital
- blood tests and lumbar puncture are performed before starting antibiotics, and in line with the sections on blood tests and lumbar puncture.

1.4.2 Confirm a diagnosis of bacterial meningitis based on:

- clinical features and
- blood test results and
- lumbar puncture results.

Bacterial throat swab

1.4.3 For people with suspected bacterial meningitis, perform a bacterial throat swab for meningococcal culture, preferably before starting antibiotics. Indicate on the request form that this is specifically for meningococcal culture.

Blood tests

1.4.4 Perform the following blood tests for people with suspected bacterial meningitis:

- blood culture (before the first dose of antibiotics is given)
- white blood cell count (including neutrophils)
- blood C-reactive protein (CRP), or procalcitonin (PCT) if CRP is not available
- blood glucose
- whole-blood diagnostic polymerase chain reaction (PCR).

1.4.5 Request that serum is saved for use in possible future tests.

1.4.6 Do not rule out bacterial meningitis based only on a normal CRP, PCT, or white blood cell count.

For guidance on blood tests for sepsis, see the section on managing and treating suspected sepsis in acute hospital settings, in the NICE guideline on sepsis.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on bacterial throat swabs and blood tests for bacterial meningitis, and timings of investigations and antibiotics.

Full details of the evidence and the committee's discussion are in evidence review B1: Blood and urine investigations for suspected bacterial meningitis and evidence review C1: Timing of antibiotics for bacterial meningitis.

Neuroimaging before lumbar puncture

1.4.7 Do not routinely perform neuroimaging before lumbar puncture.

1.4.8 Consider neuroimaging before lumbar puncture if the person has any of the following features of brain herniation:

- focal neurological features (including seizures or posturing)

- abnormal pupillary reactions
- a rapidly deteriorating level of consciousness.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on neuroimaging before lumbar puncture.

Full details of the evidence and the committee's discussion are in evidence review B4: Factors associated with brain herniation and evidence review B5: Neuroimaging prior to lumbar puncture.

Lumbar puncture

1.4.9 Perform the lumbar puncture before starting antibiotics, unless it will cause a clinically significant delay to starting antibiotics.

The following recommendations cover newborn babies. For further information about investigations and when to perform a lumbar puncture in newborn babies with suspected meningitis, see the NICE guideline on neonatal infection:

- investigations before starting antibiotics in babies who may have early-onset infection
- investigations during antibiotic treatment for early-onset neonatal infection
- investigations before starting antibiotics in babies who may have late-onset infection
- investigations during antibiotic treatment for late-onset neonatal infection

1.4.10 Perform a lumbar puncture urgently for people with suspected bacterial meningitis.

1.4.11 Treat and stabilise any of the following before performing a lumbar puncture:

- unprotected airway
- respiratory compromise

- shock
- uncontrolled seizures
- bleeding risk.

1.4.12 Do not perform lumbar puncture if there is:

- extensive or rapidly spreading purpura
- infection at the lumbar puncture site.

1.4.13 If the person has started on antibiotics before having a lumbar puncture, perform a lumbar puncture as soon as possible.

1.4.14 Measure blood glucose in people immediately before lumbar puncture, so that the cerebrospinal fluid to blood glucose ratio can be calculated.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on lumbar puncture.

Full details of the evidence and the committee's discussion are in evidence review B3: Investigating and diagnosing suspected bacterial meningitis with cerebrospinal fluid parameters and evidence review C1: Timing of antibiotics for bacterial meningitis.

Cerebrospinal fluid investigations

All recommendations in this section cover newborn babies.

1.4.15 Perform the following cerebrospinal fluid investigations in people with suspected bacterial meningitis:

- white blood cell count and cell type (including differential white cell count)
- total protein
- glucose concentration (to calculate cerebrospinal fluid to blood glucose ratio)
- microscopy for bacteria (using gram stain)

- microbiological culture and sensitivities
- PCR for relevant pathogens.

1.4.16 Store the remaining cerebrospinal fluid in case more tests are needed.

1.4.17 When interpreting the results of cerebrospinal fluid investigations, take into account:

- red cells in the sample, which may suggest blood contamination or a different diagnosis
- whether earlier antibiotics may have reduced the diagnostic reliability of these investigations
- that the normal thresholds for white cell count and protein may be higher in babies under 3 months.

1.4.18 Interpret cerebrospinal fluid results using standard age-appropriate threshold values (taking into account factors such as earlier antibiotic use or suspected immunodeficiency).

1.4.19 Interpret cerebrospinal fluid results in newborn babies alongside the clinical presentation and maternal history.

1.4.20 If cerebrospinal fluid results are abnormal, consider alternative viral, mycobacterial, fungal or non-infectious causes as well as bacterial meningitis.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on cerebrospinal fluid investigations.

Full details of the evidence and the committee's discussion are in evidence review B3: Investigating and diagnosing suspected bacterial meningitis with cerebrospinal fluid parameters.

1.5 Investigating suspected meningococcal disease in hospital

Timing of investigations and antibiotics

1.5.1 A senior clinical decision maker should perform an initial assessment and ensure that:

- antibiotics start within 1 hour of the person with suspected meningococcal disease arriving at hospital, and in line with the section on antibiotics for meningococcal disease in hospital.
- blood tests are performed before starting antibiotics, and in line with the section on blood tests.

Bacterial throat swab

1.5.2 For people with suspected meningococcal disease, perform a bacterial throat swab for meningococcal culture, preferably before starting antibiotics. Indicate on the request form that this is specifically for meningococcal culture.

Blood tests

1.5.3 Perform the following blood tests for people with suspected meningococcal disease:

- blood culture (before the first dose of antibiotics is given)
- white blood cell count (including neutrophils)
- blood C-reactive protein (CRP), or procalcitonin (PCT) if CRP is not available
- lactate
- whole-blood diagnostic polymerase chain reaction (PCR).

1.5.4 Request that serum is saved for use in possible future tests.

1.5.5 Do not rule out meningococcal disease based only on a normal CRP, PCT or white blood cell count.

1.5.6 Confirm a diagnosis of meningococcal disease based on the blood test results and clinical features.

For guidance on blood tests for sepsis, see the section on managing and treating suspected sepsis in acute hospital settings, in the NICE guideline on sepsis.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on investigating suspected meningococcal disease in hospital.

Full details of the evidence and the committee's discussion are in evidence review B2: Blood and urine investigations for suspected meningococcal disease and evidence review C2: Timing of antibiotics for meningococcal disease.

1.6 Antibiotics for bacterial meningitis in hospital

February 2024: when using ceftriaxone, follow the MHRA safety advice that ceftriaxone is incompatible with solutions containing calcium.

1.6.1 Take blood samples before giving antibiotics (see the section on blood tests).

1.6.2 If it is safe to do so, take cerebrospinal fluid samples for culture and other diagnostic tests before giving antibiotics (see the section on cerebrospinal fluid investigations).

1.6.3 Give intravenous antibiotics as soon as bacterial meningitis is suspected, within one hour of arrival in hospital (after taking blood samples and performing a lumbar puncture).

1.6.4 Get infection specialist advice for:

- people who have recently travelled outside of the UK and may be at risk of antimicrobial resistance
- people who are colonised with cephalosporin-resistant gram-negative bacteria.

See the recommendation on penicillin allergy for alternative antibiotics for each causative organism.

For guidance on antibiotics for newborn babies, see:

- the section on early- and late-onset meningitis in the NICE guideline on neonatal infection
- recommendation 1.7.12 in the NICE guideline on sepsis.

Before the causative organism is known, or when it cannot be identified

1.6.5 For suspected bacterial meningitis when the causative organism has not been identified:

- give ceftriaxone
- if ceftriaxone is contraindicated, consider cefotaxime (see the BNFC for contraindications to ceftriaxone for pre-term babies under 41 weeks corrected gestational age).

1.6.6 Give intravenous amoxicillin in addition to ceftriaxone or cefotaxime for people with risk factors for Listeria monocytogenes.

1.6.7 Do not routinely give intravenous aciclovir unless herpes simplex encephalitis is strongly suspected.

1.6.8 Continue initial antibiotic treatment until the results of confirmatory tests suggest an alternative treatment is needed or there is an alternative diagnosis.

1.6.9 If the cerebrospinal fluid results suggest bacterial meningitis, but the blood culture and whole-blood diagnostic polymerase chain reaction are negative:

- continue antibiotics for 10 days
- after 10 days, stop antibiotics if the person has recovered, and get advice from an infection specialist if they have not.

For guidance on antibiotics for suspected herpes simplex encephalitis in newborn babies, see recommendation 1.5.20 in the NICE guideline on fever in under 5s.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on antibiotics for bacterial meningitis in hospital.

Full details of the evidence and the committee's discussion are in the following evidence reviews:

- evidence review C1: Timing of antibiotics for bacterial meningitis
- evidence review D1: Antibiotics for bacterial meningitis before or in the absence of identifying causative organism in younger infants
- evidence review D2: Antibiotics for bacterial meningitis before or in the absence of identifying causative organism in older infants and children
- evidence review D3: Antibiotics for bacterial meningitis before or in the absence of identifying causative organism in adults
- evidence review E1: Antibiotics for bacterial meningitis caused by Streptococcus pneumoniae
- evidence review E2: Antibiotics for bacterial meningitis caused by Haemophilus influenzae
- evidence review E3: Antibiotics for bacterial meningitis caused by group B streptococcus
- evidence review E4: Antibiotics for bacterial meningitis caused by gram negative bacilli
- evidence review E6: Antibiotics for bacterial meningitis caused by Neisseria meningitidis

When the causative organism is known

Streptococcus pneumoniae

1.6.10 For *Streptococcus pneumoniae* meningitis:

- give ceftriaxone

- if ceftriaxone is contraindicated, consider cefotaxime (see the BNFC for contraindications to ceftriaxone for pre-term babies under 41 weeks corrected gestational age)
- after 10 days, stop antibiotics if the person has recovered, and get advice from an infection specialist if they have not.

Haemophilus influenzae type b

1.6.11 For *Haemophilus influenzae* type b meningitis:

- give ceftriaxone
- if ceftriaxone is contraindicated, consider cefotaxime (see the BNFC for contraindications to ceftriaxone for pre-term babies under 41 weeks corrected gestational age)
- get advice from an infection specialist
- after 7 days, stop antibiotics if the person has recovered, or continue for a total of 10 days if they have not
- get further advice from an infection specialist if the person has not recovered after 10 days.

Group B streptococcal meningitis

1.6.12 For group B streptococcal meningitis:

- give ceftriaxone
- if ceftriaxone is contraindicated, consider cefotaxime (see the BNFC for contraindications to ceftriaxone for pre-term babies under 41 weeks corrected gestational age)
- get advice from an infection specialist
- continue antibiotics for at least 14 days.

Gram-negative bacteria

1.6.13 For meningitis caused by gram-negative bacteria:

- give ceftriaxone

- if ceftriaxone is contraindicated, consider cefotaxime (see the BNFC for contraindications to ceftriaxone for pre-term babies under 41 weeks corrected gestational age)
- get advice from an infection specialist
- continue treatment for at least 21 days.

Listeria monocytogenes

1.6.14 For meningitis caused by *Listeria monocytogenes*:

- give intravenous amoxicillin or ampicillin for 21 days
- get advice from an infection specialist on adding intravenous gentamicin or co-trimoxazole for the first 7 days.

In January 2024, this was an off-label use of co-trimoxazole. See NICE's information on prescribing medicines.

Neisseria meningitidis

1.6.15 For *Neisseria meningitidis*:

- give ceftriaxone
- if ceftriaxone is contraindicated, consider cefotaxime (see the BNFC for contraindications to ceftriaxone for pre-term babies under 41 weeks corrected gestational age)
- after 5 days, stop antibiotics if the person has recovered, or continue for a total of 7 days if they have not.

Tuberculous meningitis

For guidance on risk factors, identification and treatment for tuberculous meningitis, see the NICE guideline on tuberculosis.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on antibiotics for bacterial meningitis in hospital when the causative organism is known.

Full details of the evidence and the committee's discussion are in the following evidence reviews:

- evidence review D1: Antibiotics for bacterial meningitis before or in the absence of identifying causative organism in younger infants
- evidence review D2: Antibiotics for bacterial meningitis before or in the absence of identifying causative organism in older infants and children
- evidence review D3: Antibiotics for bacterial meningitis before or in the absence of identifying causative organism in adults
- evidence review E1: Antibiotics for bacterial meningitis caused by Streptococcus pneumoniae
- evidence review E2: Antibiotics for bacterial meningitis caused by Haemophilus influenzae
- evidence review E3: Antibiotics for bacterial meningitis caused by group B streptococcus
- evidence review E4: Antibiotics for bacterial meningitis caused by gram negative bacilli
- evidence review E5: Antibiotics for bacterial meningitis caused by Listeria monocytogenes
- evidence review E6: Antibiotics for bacterial meningitis caused by Neisseria meningitidis

Penicillin allergy with bacterial meningitis

1.6.16 In people with a penicillin allergy:

- ask about the reaction they get
- get advice from an infection specialist
- if their reaction was not anaphylaxis or severe allergy, consider:
  - ceftriaxone or cefotaxime for suspected or confirmed *Streptococcus pneumoniae*, *Haemophilus influenzae* type b, group B streptococcus, gram-negative bacteria, *Neisseria meningitidis*, and meningitis with an unknown cause

  - co-trimoxazole, and either ceftriaxone or cefotaxime for people with risk factors for *suspected Listeria monocytogenes*
- if their reaction was anaphylaxis or severe allergy, consider:
  - co-trimoxazole and chloramphenicol for people with risk factors for suspected *Listeria monocytogenes*
  - chloramphenicol for other causative organisms and for meningitis with an unknown cause.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on penicillin allergy.

Full details of the evidence and the committee's discussion are in the following evidence reviews:

- evidence review D1: Antibiotics for bacterial meningitis before or in the absence of identifying causative organism in younger infants
- evidence review D2: Antibiotics for bacterial meningitis before or in the absence of identifying causative organism in older infants and children
- evidence review D3: Antibiotics for bacterial meningitis before or in the absence of identifying causative organism in adults
- evidence review E1: Antibiotics for bacterial meningitis caused by Streptococcus pneumoniae
- evidence review E2: Antibiotics for bacterial meningitis caused by Haemophilus influenzae
- evidence review E3: Antibiotics for bacterial meningitis caused by group B streptococcus
- evidence review E4: Antibiotics for bacterial meningitis caused by gram negative bacilli
- evidence review E5: Antibiotics for bacterial meningitis caused by Listeria monocytogenes
- evidence review E6: Antibiotics for bacterial meningitis caused by Neisseria meningitidis

1.7 Antibiotics for meningococcal disease in hospital

February 2024: when using ceftriaxone, follow the MHRA safety advice that ceftriaxone is incompatible with solutions containing calcium.

1.7.1 Give intravenous ceftriaxone for suspected or confirmed meningococcal disease in hospital.

1.7.2 Stop antibiotic treatment at:

- 5 days, for people who have recovered
- 7 days, for people who have not recovered after 5 days.

1.7.3 In people with a penicillin allergy:

- ask about the reaction they get
- give ceftriaxone if their reaction was not anaphylaxis or severe allergy
- if their reaction was anaphylaxis or severe allergy, get advice from an infection specialist and consider chloramphenicol.

For guidance on antibiotics for newborn babies, see:

- the section on early- and late-onset meningitis in the NICE guideline on neonatal infection
- recommendation 1.7.12 in the NICE guideline on sepsis.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on antibiotics for meningococcal disease in hospital settings.

Full details of the evidence and the committee's discussion are in evidence review F1: Antibiotics for meningococcal disease.

1.8 Fluid restriction, osmotic agents and intracranial pressure monitoring for confirmed bacterial meningitis

Fluid restriction

Both recommendations in this section cover newborn babies.

1.8.1 Do not routinely restrict fluid intake to below routine maintenance needs in people with bacterial meningitis.

1.8.2 Give maintenance fluids orally or by enteral tube, if tolerated.

For more guidance on fluid therapy, see the NICE guidelines on intravenous fluid therapy in adults and intravenous fluid therapy in children and young people.

Osmotic agents

1.8.3 Do not use glycerol in the management of bacterial meningitis in babies, children, young people and adults.

1.8.4 Do not routinely use other osmotic agents (such as mannitol or hypertonic sodium chloride) in the management of bacterial meningitis in babies, children, young people and adults.

1.8.5 If there are signs of brain herniation:

- consider osmotic agents (but not glycerol) as a temporary measure to reduce intracranial pressure
- get urgent advice from critical care.

Intracranial pressure monitoring

1.8.6 Do not routinely use invasive intracranial pressure monitoring in the management of bacterial meningitis in babies, children, young people and adults.

1.8.7 Get specialist advice on intracranial pressure monitoring, if there are features of raised intracranial pressure or hydrocephalus.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on fluid restriction, osmotic agents and intracranial pressure monitoring.

Full details of the evidence and the committee's discussion are in the following evidence reviews:

- evidence review G1: Fluid restriction in bacterial meningitis
- evidence review G2: Osmotic agents in bacterial meningitis
- evidence review G3: Intracranial pressure monitoring in bacterial meningitis.

1.9 Corticosteroids for bacterial meningitis and meningococcal disease

Bacterial meningitis

1.9.1 For people with strongly suspected or confirmed bacterial meningitis, give intravenous dexamethasone.

1.9.2 Stop dexamethasone if the causative organism is not pneumococcal. If no causative organism is found, get advice from an infection specialist on whether or not to continue dexamethasone.

1.9.3 For people receiving dexamethasone:

- give the first dose with or before the first dose of antibiotics if possible
- however, do not delay antibiotics to wait for dexamethasone to be started
- if dexamethasone is delayed for less than 12 hours after the start of antibiotics, give dexamethasone as soon as possible
- if dexamethasone is delayed for more than 12 hours after the start of antibiotics, get advice from an infection specialist and decide whether dexamethasone is still likely to provide benefit.

In January 2024, this was an off-label use of dexamethasone. See NICE's information on prescribing medicines.

Meningococcal disease

1.9.4 Do not routinely give corticosteroids to people with meningococcal disease.

1.9.5 Consider low-dose replacement corticosteroids for people with meningococcal septic shock who are not responding to high-dose vasoactive agents.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on corticosteroids.

Full details of the evidence and the committee's discussion are in evidence review G4: Corticosteroids for treatment of bacterial meningitis and evidence review H: Corticosteroids for treatment of meningococcal disease.

1.10 Management after bacterial meningitis or meningococcal disease

All recommendations in this section cover newborn babies, apart from 1.10.1 and 1.10.2.

1.10.1 Test for HIV in adults with bacterial meningitis or meningococcal disease.

1.10.2 Consider testing for HIV in babies, children and young people with bacterial meningitis or meningococcal disease, if they have signs of immunodeficiency or risk factors for HIV.

1.10.3 Refer babies, children and young people with pneumococcal meningitis to a paediatric immunology and infectious disease specialist to assess for primary immunodeficiency.

1.10.4 For babies and young children with bacterial meningitis, examine their back and scalp for signs of a sinus tract.

1.10.5 For babies, children, young people and adults with bacterial meningitis or meningococcal disease, take a history of:

- head trauma, surgery or cerebrospinal fluid leak
- immunisations
- medicines, including drugs that suppress the immune system (such as complement inhibitors).

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on management after bacterial meningitis or meningococcal disease.

Full details of the evidence and the committee's discussion are in evidence review J1: Factors associated with an increased risk of recurrent bacterial meningitis and evidence review J2: Factors associated with an increased risk of recurrent meningococcal disease.

1.11 Information and support after diagnosis

All recommendations in this section cover newborn babies.

1.11.1 Early in the management of confirmed bacterial meningitis or meningococcal disease, discuss the following with people and their family members or carers:

- what might happen during the course of the disease
- the uncertainty about their initial prognosis, and when they can expect to know more
- the risk of passing on the infection
- whether their close contacts need to take any preventative measures (for meningococcal meningitis or meningococcal disease)
- visible effects (such as drips and other invasive devices), swelling (for people receiving fluid resuscitation), and how rashes can spread and turn purple
- effects of sedative withdrawal, such as agitation or abnormal neurological behaviour

- the potential short and long-term outcomes, taking account of the severity of their illness and their need for critical care.

1.11.2 Repeat information over time and check the person understands, as they may be distressed and unable to ask questions when they are first diagnosed.

For more guidance on providing information, see the NICE guidelines on:

- patient experience in adult NHS services
- babies, children and young people's experience of healthcare.

1.11.3 Provide emotional and pastoral support for people and their family members and carers during hospitalisation.

1.11.4 Consider referral for psychological interventions, for people with bacterial meningitis or meningococcal disease who are in distress and who need more specialist psychological support.

1.11.5 Before discharge from hospital, explain to the person and their family members or carers:

- how to access support, including contact details of meningitis charities
- what assessments, aftercare and follow-up they will receive (now and long-term)
- any uncertainties about what long-term effects they might experience.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on information and support after diagnosis.

Full details of the evidence and the committee's discussion are in evidence review K3: Information for those with confirmed bacterial meningitis or meningococcal disease and evidence review K4: Support for those with confirmed bacterial meningitis or meningococcal disease.

1.12 Preparing for hospital discharge

All recommendations in this section cover newborn babies.

Identifying and managing complications

1.12.1 Identify follow-up needs for people who have had bacterial meningitis or meningococcal disease, taking into account potential cognitive, developmental, orthopaedic, skin, sensory, psychosocial, education, and renal complications.

Cognitive and developmental complications

1.12.2 Refer babies, children and young people for community neurodevelopmental follow-up.

1.12.3 Refer children, young people and adults to psychological services for cognitive and psychological support if follow-up needs have been identified.

1.12.4 For people who are taking anti-epileptic drugs, refer for a medicines review 3 months after hospital discharge, with a clinician with an interest in epilepsy, an epilepsy specialist nurse, or a neurologist.

Orthopaedic and skin complications

1.12.5 For people with acute orthopaedic complications (such as amputation):

- arrange follow-up with an orthopaedic surgeon after discharge
- consider referral to psychological services.

1.12.6 For people with orthopaedic and skin complications:

- coordinate management with tissue viability and community nursing services
- refer to rehabilitation services for assessment as needed.

Hearing problems

1.12.7 Offer a hearing assessment within 4 weeks of the person being well enough for testing (and preferably before discharge).

1.12.8 Offer children, young people and adults with severe or profound deafness an urgent assessment for cochlear implants as soon as they are well enough for testing.

For further guidance on cochlear implants, see the NICE technology appraisal guidance on cochlear implants for children and adults with severe to profound deafness.

> For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on identifying and managing complications.
>
> Full details of the evidence and the committee's discussion are in evidence review I1: Long-term complications of bacterial meningitis and evidence review I2: Long term complications of meningococcal disease.

Planning for care after discharge

All recommendations in this section cover newborn babies.

1.12.9 For people who have had bacterial meningitis or meningococcal disease, tell their GP (and health visitor and school nurse if relevant), and explain any follow-up plans.

1.12.10 Tell the person and their family members and carers who their main point of contact will be after discharge.

1.12.11 Document the follow-up plan for managing complications in the discharge summary.

1.12.12 The hospital team should coordinate with the following professionals for care after discharge:

- tertiary and primary care and other specialists

- allied professionals and community teams that will be involved in follow-up (for example audiology and speech and language therapy departments).

Providing information

1.12.13 Tell people who have had bacterial meningitis or meningococcal disease:

- when they are likely to be able to resume:
  - driving and travel
  - work and education
  - exercise and sports
- that these timings may change, based on the results of their follow-up assessments.

Psychosocial support

1.12.14 Consider referral to psychosocial support for people who have had bacterial meningitis or meningococcal disease and their family members and carers. Arrange this after discharge if needed.

Education support

1.12.15 Think about the need for education support for children and young people who have had bacterial meningitis or meningococcal disease. Discuss with their GP, and if needed their school.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on planning for care after hospital discharge.

Full details of the evidence and the committee's discussion are in the following evidence reviews:

- evidence review I1: Risk of long-term complications in bacterial meningitis
- evidence review I2: Risk of long-term complications in meningococcal disease
- evidence review K3: Information for those with confirmed bacterial meningitis or meningococcal disease

- evidence review K4: Support for those with confirmed bacterial meningitis or meningococcal disease.

1.13 Care after hospital discharge

First review

Recommendation 1.13.1 covers newborn babies.

1.13.1 For babies, children and young people who have had bacterial meningitis or meningococcal disease, arrange for a review with a paediatrician at 4 to 6 weeks after discharge from hospital. As part of this review, cover:

- the results of their hearing test, and whether cochlear implants are needed
- damage to bones and joints
- skin complications (including scarring from necrosis)
- psychosocial problems (if relevant, see the NICE guideline on post-traumatic stress disorder)
- neurological and developmental problems, in liaison with community child development services.

1.13.2 For adults who have had bacterial meningitis or meningococcal disease, arrange for a review at 4 to 6 weeks after discharge from hospital. As part of this review, cover:

- the results of their hearing test (if available at this time), and whether cochlear implants are needed
- damage to bones and joints
- skin complications (including scarring from necrosis)
- psychosocial problems (if relevant, see the NICE guideline on post-traumatic stress disorder)
- neurological problems
- care needs.

Further reviews for babies (including newborn babies), children and young people

All recommendations in this section cover newborn babies.

1.13.3 For babies under 12 months who have had meningitis or meningococcal disease, arrange a review for 1 year after discharge. At this review, assess for possible late-onset neurodevelopmental, orthopaedic, sensory and psychosocial complications.

1.13.4 Healthcare professionals (such as school nurses, health visitors and GPs) with responsibility for monitoring the health and wellbeing of babies, children and young people should be alert for late-onset complications of bacterial meningitis or meningococcal disease.

1.13.5 Be aware that late-onset complications may not be apparent until transition points (such as starting nursery or school).

1.13.6 For babies, children and young people, community child development services should follow up and assess the risk of long-term neurodevelopmental complications for at least 2 years after discharge.

1.13.7 If a neurodevelopmental deficit is identified, refer to the appropriate services (for example neurodisability services) and agree with them who will be responsible for follow-up, to ensure that nobody misses out on care.

1.13.8 Staff working in education and early years services should:

- keep records of past episodes of meningitis for children and young people in their care
- regularly review and discuss educational outcomes and learning needs with these children and young people and their parents and carers, even when there have been no known complications.

Return to education or work for adults

1.13.9 Advise adults that they may need to arrange a phased return to education or employment.

1.13.10 Refer for assessments for special needs (including driving) if needed.

For guidance on helping people return to work, see the NICE guideline on workplace health: long-term sickness absence and capability to work.

For guidance on rehabilitation for adults, see the NICE guideline on rehabilitation after critical illness in adults.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on care after hospital discharge.

Full details of the evidence and the committee's discussion are in the following evidence reviews:

- evidence review I1: Risk of long-term complications in bacterial meningitis
- evidence review I2: Risk of long-term complications in meningococcal disease
- evidence review K4: Support for those with confirmed bacterial meningitis or meningococcal disease.

1.14 Recurrent bacterial meningitis and meningococcal disease

All recommendations in this section cover newborn babies except rec 1.14.4.

Risk factors

1.14.1 Risk factors for recurrent bacterial meningitis are:

- primary or secondary immunodeficiency, including:
  - HIV
  - congenital complement deficiency or acquired inhibition
  - reduced or absent spleen function
  - hypogammaglobulinaemia

- communication between the cerebrospinal fluid and external surface, for example caused by:
  - prior trauma or surgery
  - a congenital anomaly.

1.14.2 The risk factor for recurrent meningococcal disease is primary or secondary immunodeficiency, including:

- HIV
- congenital complement deficiency or acquired inhibition
- reduced or absent spleen function.

Management

1.14.3 For people who have had a recurrent episode of bacterial meningitis or meningococcal disease:

- review with a paediatric immunology and infectious disease specialist or an adult infection specialist or immunologist (as appropriate) and
- discuss what tests, investigations, vaccines and other interventions are needed to prevent re-occurrence.

1.14.4 Test for HIV in babies, children, young people and adults with recurrent bacterial meningitis or meningococcal disease.

1.14.5 For babies and young children with bacterial meningitis, examine their back and scalp for signs of a sinus tract.

1.14.6 For people with recurrent bacterial meningitis, get specialist radiological advice on investigations for a cerebrospinal fluid leak.

1.14.7 For people with recurrent bacterial meningitis or meningococcal disease, take an immunisation and medicine history, including for drugs that suppress the immune system (such as complement inhibitors).

1.14.8 In people with recurrent meningitis with unconfirmed bacterial cause, consider other causes (for example Mollaret's lymphocytic meningitis) and get advice from an infection specialist.

For a short explanation of why the committee made these recommendations and how they might affect practice, see the rationale and impact section on recurrent bacterial meningitis and meningococcal disease.

Full details of the evidence and the committee's discussion are in evidence review J1: Factors associated with an increased risk of recurrent bacterial meningitis and evidence review J2: Factors associated with an increased risk of recurrent meningococcal disease.

Terms used in this guideline

This section defines terms that have been used in a particular way for this guideline.

Adults

18 and over.

Babies

29 days to 1 year (adjusted for gestational age from their due birth date).

Children

1 to 18 years.

Infection specialist

Microbiologist or infectious diseases specialist.

Newborn babies

28 days or younger (adjusted for gestational age from due birth date).

For more guidance on recognising and treating bacterial meningitis in babies aged 28 days or younger in hospital, see the NICE guideline on neonatal infection.

Older adults

Over 65.

Senior clinical decision maker

A 'senior clinical decision maker' for people under 18 is a paediatric or emergency care qualified doctor of grade ST4 or above or equivalent.

A 'senior clinical decision maker' for people aged 18 years or over should be a clinician with core competencies in the care of acutely ill patients.

Severe penicillin allergy

A history of allergy to penicillin with effects that are clearly likely to be allergic in nature such as anaphylaxis, respiratory distress, angioedema or urticaria.

Strongly suspected

Bacterial meningitis can be strongly suspected:

- if the person has the red flag combination of symptoms (see recommendation 1.1.3) or
- using clinical judgement, based on the symptoms and signs and risk factors present, for people who do not have the red flag combination.

Meningococcal disease can be strongly suspected:

- if the person has any of the red flag symptoms (see recommendation 1.1.5) or
- using clinical judgement, based on the symptoms and signs and risk factors present, for people who do not have any of the red flag symptoms.

Young adults

18 to 25.

Young babies

29 days to 3 months (adjusted for gestational age from their due birth date).

Young children

Over 1 year up to 5 years (adjusted for gestational age from their due birth date for children up to 2 years).

Young people

12 to 18.

Recommendations for research

The guideline committee has made the following recommendations for research.

1 Long-term outcomes of bacterial meningitis

What are the long-term outcomes after bacterial meningitis in infancy?

> For a short explanation of why the committee made this recommendation and how they might affect practice, see the rationale and impact section for identifying and managing complications.
>
> Full details of the evidence and the committee's discussion are in evidence review I1: Long term complications of bacterial meningitis.

2 Novel diagnostic techniques applied to blood or cerebrospinal fluid

Can novel host biomarker or metagenomic techniques applied to blood or cerebrospinal fluid be used to diagnose bacterial meningitis?

> For a short explanation of why the committee made this recommendation and how it might affect practice, see the rationale and impact section on cerebrospinal fluid investigations.
>
> Full details of the evidence and the committee's discussion are in evidence review B3: Cerebrospinal fluid parameters.

3 Duration of antibiotic treatment for meningitis caused by gram-negative bacteria

What is the effectiveness of shorter courses of antibiotics (compared with standard duration courses) for treating bacterial meningitis caused by gram-negative bacilli, particularly in newborn babies?

For a short explanation of why the committee made this recommendation and how it might affect practice, see the rationale and impact section on antibiotics for bacterial meningitis in hospital when the causative organism is known.

Full details of the evidence and the committee's discussion are in evidence review E4: antibiotics for bacterial meningitis caused by gram-negative bacilli.

4 Intracranial pressure monitoring

In people with bacterial meningitis and impaired consciousness, are clinical outcomes improved if invasive and non-invasive intracranial pressure monitoring is used to guide treatment decisions?

For a short explanation of why the committee made this recommendation and how it might affect practice, see the rationale and impact section on fluid restriction, osmotic agents and intracranial pressure monitoring for confirmed bacterial meningitis.

Full details of the evidence and the committee's discussion are in evidence review G3: Intracranial pressure monitoring in bacterial meningitis.

5 Corticosteroids for newborn babies with bacterial meningitis

What is the effectiveness of corticosteroids as an adjunct to antibiotic treatment in newborn babies with suspected or confirmed bacterial meningitis?

For a short explanation of why the committee made this recommendation and how they might affect practice, see the rationale and impact section on corticosteroids for bacterial meningitis and meningococcal disease.

Full details of the evidence and the committee's discussion are in evidence review G4: Corticosteroids for treatment of bacterial meningitis.

Rationale and impact

These sections briefly explain why the committee made the recommendations and how they might affect practice.

Recognising bacterial meningitis and meningococcal disease

Recommendations 1.1.1 to 1.1.9

Why the committee made the recommendations

Bacterial meningitis and meningococcal disease can be fatal if treatment is delayed. They are also difficult to diagnose, as they can present with non-specific symptoms and signs, and can be difficult to distinguish from other infections. The committee used their expertise and the available evidence to highlight the most important risk factors and specific and non-specific symptoms and signs to take into account when considering a diagnosis, to help reduce the chance that bacterial meningitis and meningococcal disease are missed.

Evidence showed that the following symptoms all had at least moderate sensitivity and specificity for a diagnosis of bacterial meningitis:

- fever
- headache
- neck stiffness
- altered level of consciousness or cognition.

In the committee's experience, people with all of these symptoms and signs together are highly likely to have bacterial meningitis. However, the committee emphasised that bacterial meningitis should not be ruled out just because a person does not have one or more of these signs or symptoms. Meningitis can present with non-specific symptoms and signs, and some symptoms are less common or harder to identify in babies.

Evidence showed that these symptoms both had at least moderate sensitivity and specificity for a diagnosis of meningococcal disease:

- a haemorrhagic, non-blanching rash with lesions larger than 2 mm (purpura)

- a rapidly progressive and/or spreading rash.

There was also evidence that some symptoms and signs of meningitis (including neck pain or stiffness, photophobia, and a composite clinical factor of signs or symptoms of meningism) were also moderately or highly specific for a diagnosis of meningococcal disease. In the committee's experience, when a person has symptoms and signs that could indicate meningitis or meningococcal disease, they are more likely to have meningococcal disease if they also have a non-blanching rash.

While a non-blanching rash is a commonly known sign of meningococcal disease (and this is supported by the evidence), the committee were aware based on their clinical knowledge and expertise that not everyone with meningococcal disease will have a rash. They highlighted this issue to avoid people being misdiagnosed and to avoid delays to treatment.

The committee gave advice on finding rashes, because in their experience not all healthcare professionals are aware of these issues.

How the recommendations might affect practice

The recommendations are in line with current practice and they should not have a significant resource impact. The recommendations will help healthcare professionals recognise and diagnose bacterial meningitis and meningococcal disease earlier, and earlier treatment will lead to reduced costs.

Return to recommendations

Symptoms, signs and risk factors of bacterial meningitis

Recommendations 1.1.10 to 1.1.12

Why the committee made the recommendations

The symptoms and signs listed are based on the evidence and the committee's knowledge and experience. In the committee's experience, the more symptoms and signs present, the more likely it is that the person has bacterial meningitis.

The evidence on risk factors was limited, because it came from a single study and was restricted to a comparison against viral meningitis only. There were no significant associations between maternal and perinatal risk factors and a diagnosis of bacterial meningitis (relative to viral meningitis).

Based on their clinical knowledge and experience, and extrapolating from evidence reviewed for meningococcal disease, the committee highlighted groups who might be more at risk of developing bacterial meningitis. Some of the risk factors are also indirect indicators of potential immune deficiency (including family history and a previous episode of meningitis or meningococcal disease).

How the recommendations might affect practice

The recommendations are in line with current practice and they should not have a significant resource impact. The recommendations will help healthcare professionals recognise and diagnose bacterial meningitis earlier, and earlier treatment will lead to reduced costs.

Return to recommendations

Symptoms, signs and risk factors of meningococcal disease

Recommendations 1.1.13 to 1.1.15

Why the committee made the recommendations

The symptoms and signs listed are based on the evidence and the committee's knowledge and experience.

The risk factors listed are based on evidence and the committee's knowledge and experience. Some of the risk factors are also indirect indicators of potential immune deficiency (including family history and a previous episode of meningitis or meningococcal disease).

How the recommendations might affect practice

The recommendations are in line with current practice and they should not have a significant resource impact. The recommendations will help healthcare professionals

recognise and diagnose meningococcal disease earlier, and earlier treatment will lead to reduced costs.

Return to recommendations

Safety netting and alternative causes

Recommendations 1.1.16 to 1.1.17

Why the committee made the recommendations

Because bacterial meningitis and meningococcal disease are difficult to diagnose or distinguish from other conditions, the committee agreed that it is important to provide safety netting. Based on their knowledge and experience, they made recommendations to cover people when bacterial meningitis or meningococcal disease is not suspected, but when monitoring changes to symptoms is important. They also highlighted other serious conditions with similar symptoms and signs.

How the recommendations might affect practice

The recommendations are in line with current practice and they should not have a significant resource impact.

There will be a level of uncertainty even when bacterial meningitis and meningococcal disease are not suspected. Safety netting helps mitigate the potential harms and costs of missed infections, and harms and costs from other serious conditions with similar symptoms and signs.

Return to recommendations

Transfer to hospital and antibiotics outside of hospital

Recommendations 1.2.1 to 1.2.5

Why the committee made the recommendations

Delay to treatment for bacterial meningitis or meningococcal disease can be fatal, or cause serious complications. Because of this, the committee agreed (based on their knowledge and experience) that people with suspected or strongly suspected

bacterial meningitis or meningococcal disease should be transferred to hospital as an emergency.

For suspected bacterial meningitis, there is evidence showing no clear benefit from pre-hospital antibiotics (in terms of all-cause mortality, long-term neurological impairment, or functional impairment). Giving antibiotics before transfer to hospital would also affect the results of blood and cerebrospinal fluid tests. In line with this evidence, the committee agreed that antibiotics should not normally be given outside of hospital, unless there is a clinically significant delay in transfer to hospital.

Similarly, evidence for meningococcal disease did not suggest clear benefits from pre-hospital antibiotics, and giving antibiotics before hospital would also affect blood test results. However, given the rapid progression and seriousness of meningococcal disease, the committee agreed that pre-hospital antibiotics should be given as soon as possible when the disease is strongly suspected.

While the committee recommended antibiotics outside of hospital in some circumstances, they highlighted that the priority for both bacterial meningitis and meningococcal disease should be the transfer to hospital. This is so that urgent testing can be done to get a clear diagnosis and start the correct treatment as soon as possible.

How the recommendations might affect practice

The recommendations are in line with current practice. Ceftriaxone and benzylpenicillin are commonly available outside of hospital.

Return to recommendations

Information and support for people with suspected bacterial meningitis or meningococcal disease

Recommendations 1.3.1 to 1.3.2

Why the committee made the recommendations

The recommendations on what to discuss with people with suspected bacterial meningitis or meningococcal disease are based on evidence and the committee's knowledge of:

- the issues that matter most to people in this situation and
- what people need to know if they are sent home with an unconfirmed diagnosis.

There was evidence on accessible, person-centred communication and sharing information. However, this is covered by existing recommendations in the NICE guidelines on patient experience in the NHS.

This guideline also makes recommendations on information and support after diagnosis.

How the recommendations might affect practice

The recommendations are good practice, although they are not currently implemented everywhere. The list of issues to discuss is short and should not take up much time, as the focus at this stage is diagnosis and treatment.

Return to recommendations

Bacterial throat swabs and blood tests for bacterial meningitis, and timings of investigations and antibiotics

Recommendations 1.4.1 to 1.4.6

Why the committee made the recommendations

As suspected bacterial meningitis is a medical emergency, the committee agreed (based on their knowledge and experience) that a senior clinical decision maker should perform an initial assessment and ensure that investigations are done promptly. This will prevent unnecessary delays to the first dose of antibiotics (if this was not given before arrival at hospital).

Because of the issues with the diagnostic accuracy of blood tests, the committee recommended using them in combination with clinical features and lumbar puncture results to confirm a diagnosis of bacterial meningitis. A bacterial throat swab can

provide information about the strain of *Neisseria meningitidis*. The UK Health Security Agency guidance on managing meningococcal disease recommends taking a bacterial throat swab for suspected meningococcal disease for long-term monitoring purposes. The committee extended this to people with suspected bacterial meningitis because meningococcal disease cannot be ruled out at this stage.

Evidence showed that blood tests alone cannot be relied upon to accurately distinguish bacterial meningitis from other illnesses. However, blood tests are still an important tool for gathering information to inform the diagnosis, when used alongside clinical features and lumbar puncture results. The recommended blood tests are all simple, cheap, and widely used in current practice.

Both CRP and PCT were shown to be useful tests for bacterial meningitis. However, PCT is only recommended if CRP is not available, because PCT is more expensive and the evidence did not demonstrate a large difference in diagnostic accuracy.

Antibiotics can affect the results of blood tests, so blood from the initial sample (before the person has started antibiotics) needs to be saved for future diagnostic tests.

It is important not to rule out bacterial meningitis based on a normal CRP, PCT or white blood cell count alone, because these are non-specific tests that can indicate a problem without making it clear what the problem is. This is particularly true for babies, young children, older adults and people with immunodeficiencies, because the normal inflammatory responses are often absent in these groups.

How the recommendations might affect practice

Bacterial throat swab, CRP, PCT, white cell count, blood culture, and PCR are routinely used in current practice.

Return to recommendations

Neuroimaging before lumbar puncture

Recommendations 1.4.7 to 1.4.8

Why the committee made the recommendations

Evidence showed that performing a lumbar puncture without waiting for a CT scan led to people having their lumbar puncture sooner, and to more people receiving antibiotics within 1 or 2 hours of diagnosis. This led to lower rates of:

- mortality
- neurological and/or hearing problems
- functional impairment.

While most people with suspected meningitis should have a lumbar puncture before a CT scan, CT can still be important to identify people who are at risk of brain herniation because of raised intracranial pressure. The evidence showed that:

- seizures and reduced consciousness increased the risk of brain herniation
- abnormal pupillary reactions can indicate raised intracranial pressure and a risk of brain herniation.

The committee built on this evidence with their own experience and made a broader recommendation covering all focal neurological features.

How the recommendations might affect practice

These recommendations will result in less neuroimaging being performed.

Return to recommendations

Lumbar puncture

Recommendations 1.4.9 to 1.4.14

Why the committee made the recommendations

Lumbar puncture is the only test that can directly confirm a diagnosis of bacterial meningitis.

Antibiotics can affect the results of cerebrospinal fluid tests, so lumbar puncture needs to be performed before antibiotics when possible.

The committee used their experience to highlight situations that need treating or stabilising before a lumbar puncture, because these are potentially life-threatening and present a greater risk than delayed meningitis investigations.

How the recommendations might affect practice

Hospitals will need to be able to urgently transfer people out of the emergency department when bacterial meningitis is strongly suspected (following stabilisation), because lumbar punctures are not routinely performed in emergency departments.

Return to recommendations

Cerebrospinal fluid investigations

Recommendations 1.4.15 to 1.4.20

Why the committee made the recommendations

There was evidence on various cerebrospinal fluid investigations for diagnosing bacterial meningitis:

- white cell count was at least moderately sensitive and specific at most thresholds, and there was some evidence that it can be very specific and sensitive
- overall, the evidence showed that protein concentration was at least moderately sensitive and specific
- gram staining was very specific for identifying all causes of bacterial meningitis
- there was a large, consistent body of evidence showing that PCR was at least moderately sensitive and very specific for identifying particular causes of bacterial meningitis.

It is important to look at the whole clinical picture and take a full clinical history, including maternal history for babies aged 28 days or under. This is because there are factors that may reduce the reliability of cerebrospinal fluid investigations. Based on their knowledge and expertise the committee highlighted the most important of these factors.

Age-appropriate threshold values for cerebrospinal fluid should be used. Values for some parameters (such as protein and cell counts) are higher in newborn babies than in older children.

The committee highlighted the need to consider alternative diagnoses because there could be serious consequences if a potentially treatable alternative cause is missed.

There are new diagnostic techniques currently in development, such as host biomarker or metagenomic techniques. These may be able to address some of the problems with the current gold standards for diagnosing bacterial meningitis, including the time taken to receive results, the need to start antibiotic treatment before confirming a diagnosis, and the difficulties with differential diagnoses. As these techniques have not yet been sufficiently validated for clinical use, the committee made a recommendation for further research.

How the recommendations might affect practice

The recommendations largely support current practice, and they should not have a significant resource impact.

PCR was not included as part of cerebrospinal fluid investigations in the 2010 guideline, but it has since become standard practice in many hospitals.

Return to recommendations

Investigating suspected meningococcal disease in hospital

Recommendations 1.5.1 to 1.5.6

Why the committee made the recommendations

As suspected meningococcal disease is a medical emergency, the committee agreed (based on their knowledge and experience) that a senior clinical decision maker should perform an initial assessment and ensure that investigations are done promptly. This will prevent unnecessary delays to the first dose of antibiotics (if this was not given before arrival at hospital).

A bacterial throat swab can provide information about the strain of *Neisseria meningitidis*. The UK Health Security Agency guidance on managing meningococcal

disease recommends taking a bacterial throat swab for suspected meningococcal disease for long-term monitoring purposes.

Blood tests are the main way to diagnose meningococcal disease. The recommended tests are also all simple, cheap, and widely used in current practice.

PCT is only recommended if CRP is not available. This is because it is more expensive and the evidence did not demonstrate a large difference in diagnostic accuracy.

The evidence for whole-blood diagnostic PCR was not reviewed, because this test was used as a reference standard.

Antibiotics can affect the results of blood tests, so blood from the initial sample (before the person has started antibiotics) needs to be saved for future diagnostic tests.

How the recommendations might affect practice

CRP, PCT, white cell count, lactate, blood culture, and PCR are routinely used in current practice.

Return to recommendations

Antibiotics for bacterial meningitis in hospital

Recommendations 1.6.1 to 1.6.9

Why the committee made the recommendations

For adults in hospital, there was evidence that giving antibiotics as soon as bacterial meningitis is suspected reduces mortality, compared with giving antibiotics later. The evidence also showed that giving antibiotics early reduced functional impairment, but only when compared against delays of longer than 6 hours.

There was no evidence for babies, children, or young people, but the committee agreed, based on the evidence for adults as well as their clinical knowledge and expertise, that there were similar risks of adverse outcomes for these groups if antibiotics were delayed.

The 1-hour timeframe for starting antibiotics in hospital is based on the committee's expertise and the well-recognised principle of the 'golden hour' for optimal treatment of life-threatening emergencies such as meningitis. Blood tests and lumbar puncture should also be completed within this hour (when it is safe to do so), so that samples can be taken before antibiotics are started.

The committee recommended getting infection specialist advice for suspected or confirmed cephalosporin-resistant bacterial meningitis, because alternative antibiotics may be needed and there is no evidence for specific antibiotics in this situation.

Given the limitations of the evidence (for example low or very low quality evidence and small numbers of participants), the committee recommended intravenous ceftriaxone, based on their knowledge and experience. Ceftriaxone is a broad-spectrum antibiotic that can be used to treat the most common infective organisms. This treatment is in line with current practice and the BNF and BNFC. There are also potential practical and cost benefits with ceftriaxone, as it can be given once a day. Cefotaxime is recommended as an alternative because ceftriaxone is contraindicated in some circumstances for premature and newborn babies. This recommendation is also in line with the BNFC.

There was no evidence on the effectiveness of antibiotics for *Listeria monocytogenes*. Based on the committee's clinical knowledge and experience, listeria is not susceptible to ceftriaxone or cefotaxime. The committee recommended amoxicillin in this situation because amoxicillin is recommended by the BNF and the BNFC.

The committee were concerned about the overuse of aciclovir. In their experience it is routinely prescribed for suspected bacterial meningitis, but it is only beneficial for herpes simplex encephalitis. The committee agreed that aciclovir should only be given when herpes simplex encephalitis is strongly suspected.

The evidence showed no difference between short and long courses of ceftriaxone (4 days compared with 10 days, 7 days compared with 10 days, and 4 to 7 days compared with 8 to 14 days). In the committee's experience, the results of confirmatory tests could be available within 2 to 3 days and it is current practice to

continue empirical antibiotic treatment until the causative organism is identified or an alternative diagnosis is confirmed.

The recommendation on length of antibiotic course when the causative organism cannot be identified is based on current practice.

How the recommendations might affect practice

Giving early antibiotics is current practice for people with suspected bacterial meningitis.

Return to recommendations

Antibiotics for bacterial meningitis in hospital, when the causative organism is known

Recommendations 1.6.10 to 1.6.15

Why the committee made the recommendations

Given the limitations of the evidence (for example, very low quality evidence and small number of participants), the committee recommended intravenous ceftriaxone for most causative organisms, based on their knowledge and experience. Ceftriaxone is a broad-spectrum antibiotic that can be used to treat the most common infective organisms. This treatment is in line with current practice and the BNF and the BNFC. There are also practical and cost benefits with ceftriaxone, as it only needs to be given once a day. Cefotaxime is recommended as an alternative because ceftriaxone is contraindicated in some circumstances for premature and newborn babies. This recommendation is also in line with the BNFC.

On treatment length, the evidence showed no difference between short and long courses of ceftriaxone for *Haemophilus influenzae* type b meningitis or meningococcal meningitis (5 days compared with 10 days). There was no evidence for other organisms. Given the limitations of the evidence, the committee recommended treatment lengths based on their own experience and on current practice.

There was no evidence on antibiotics for *Listeria monocytogenes*. The committee recommended amoxicillin or ampicillin because these were recommended in the 2010 guideline (based on the knowledge and experience of the 2010 committee) and because the committee agreed this was still current practice. Gentamicin or co-trimoxazole are recommended (along with infection specialist advice) because in the committee's experience this can be beneficial, particularly with bacteraemic or septic illness.

Standard treatment duration for meningitis caused by gram-negative bacteria is at least 21 days. However, this is not evidence-based and may be based on the principle of providing 14 days of antibiotics after sterilisation of cerebrospinal fluid. As third-generation cephalosporins are associated with more rapid sterilisation, the committee made a recommendation for research on the effectiveness of shorter courses of antibiotics for meningitis caused by gram-negative bacteria.

How the recommendations might affect practice

The recommendations are in line with current practice.

Return to recommendations

Penicillin allergy with bacterial meningitis

Recommendation 1.6.16

Why the committee made the recommendations

There was no evidence on antibiotics for people with a penicillin allergy, so the committee made recommendations based on their knowledge and experience.

Ceftriaxone is still recommended for non-anaphylactic and non-severe allergies because cephalosporin-induced anaphylaxis is rare and ceftriaxone will have a better balance of benefits and risks than chloramphenicol for most people.

For people with risk factors for *Listeria monocytogenes* and a non-anaphylactic or non-severe allergy, the committee recommended co-trimoxazole in addition to ceftriaxone or cefotaxime, because this is in line with current practice. (Risk factors for *Listeria monocytogenes* include being very old or very young, pregnancy,

malignancy, kidney disease, liver disease, diabetes, alcohol misuse, and taking drugs that suppress the immune system.)

For people with an anaphylactic or severe allergic reaction, the committee recommended chloramphenicol for most causative organisms or when the cause is unknown, because this is in line with current practice. They specified co-trimoxazole and chloramphenicol for people with risk factors for *Listeria monocytogenes* because this is in line with current practice and the BNF.

How the recommendations might affect practice

The recommendations are in line with current practice, and they should not have a significant resource impact.

Return to recommendations

Antibiotics for meningococcal disease in hospital

Recommendations 1.7.1 to 1.7.3

Why the committee made the recommendations

Ceftriaxone is recommended for meningococcal disease because:

- evidence reviewed for the 2010 guideline showed that it was effective and
- evidence reviewed for the 2023 guideline showed that ceftriaxone may reduce necrotic skin lesions when compared with benzylpenicillin sodium.

There was no evidence on duration of antibiotics for meningococcal disease. The committee recommended treatment lengths based on their clinical knowledge and on current practice.

For penicillin allergy, there was no evidence so the committee made recommendations based on their knowledge and experience. Ceftriaxone is still recommended for non-anaphylactic and non-severe allergies because cephalosporin-induced anaphylaxis is rare and ceftriaxone will have a better balance of benefits and risks than chloramphenicol for most people. For people with an anaphylactic or severe allergic reaction, the committee recommended chloramphenicol because this is in line with current practice.

How the recommendations might affect practice

The recommendations are in line with current practice.

Return to recommendations

Fluid restriction, osmotic agents and intracranial pressure monitoring for confirmed bacterial meningitis

Recommendations 1.8.1 to 1.8.7

Why the committee made the recommendations

Fluid restriction for bacterial meningitis

For babies over 28 days, children and young people, there was a very small amount of evidence comparing fluid restriction with routine maintenance fluids. This evidence showed that fluid restriction reduces pulmonary and facial oedema. However, it also increases rates of neurological impairment and epilepsy. There was no evidence in newborn babies aged 28 days or under, or in adults. However, the committee extended the recommendations to cover these groups because they agreed the risks were likely to be the same, based on their knowledge and expertise.

The committee were particularly concerned about the increased rate of neurological impairment, as this could be the most important clinical outcome. Based on the evidence and their knowledge and experience, the committee agreed not to recommend routine fluid restriction for bacterial meningitis. They specified 'routine' because there are some relevant clinical conditions that do need fluid restriction, such as fluid overload.

There are potential complications to providing fluids intravenously, and in the committee's experience people with bacterial meningitis can often tolerate oral or enteral fluids. Because of this the committee recommended providing fluids orally or by enteral tube when possible.

Osmotic agents for bacterial meningitis

There was limited evidence in children and babies comparing osmotic agents with placebo or no intervention for raised intracranial pressure. There was no evidence for adults.

The committee were concerned that osmotic agents could cause increased mortality. This was based on uncertainty around the estimated effects on mortality in the studies they reviewed, and on the results of the Ajdukiewicz 2011 study showing a higher rate of mortality in adults who had glycerol compared with placebo.

The Ajdukiewicz study was not reviewed as part of the 2023 guideline update, because most of the study population were immunocompromised, and this guideline does not cover people with known immunodeficiency. However, despite the differences between the study population and the guideline population, the committee believed the study needed to be taken into account when making recommendations because any evidence of increased mortality is a serious concern.

Given this evidence, the committee recommended against any use of glycerol in the management of bacterial meningitis. They made a different recommendation for other osmotic agents because the evidence on mortality was less clear for these, and in the committee's experience osmotic agents can be useful when dealing with signs of brain herniation.

Intracranial pressure monitoring for bacterial meningitis

There was limited evidence in children, young people and adults comparing intracranial pressure monitoring with no intervention. This evidence showed that intracranial pressure monitoring reduced all-cause mortality in adults. However, the evidence was only indirectly applicable to the population of this guideline, as a high proportion of the study population was immunosuppressed.

In addition to the limitations of the evidence, intracranial pressure monitoring is an invasive procedure. Because of these factors, the committee recommended against its routine use for all people. They specified 'routine use', because intracranial pressure monitoring may still be beneficial for use in people with bacterial meningitis who have features of raised intracranial pressure or hydrocephalus.

The committee noted that the conventional methods for intracranial pressure monitoring are invasive, associated with important risks, costly, and usually only available in specialist hospitals. The committee made a recommendation for further research to assess the clinical and cost effectiveness of management guided by novel and non-invasive intracranial pressure monitoring.

How the recommendations might affect practice

Fluid restriction for bacterial meningitis

Fluid restriction is not part of routine practice, although it may be used for people with fluid overload.

Osmotic agents for bacterial meningitis

Osmotic agents are not part of routine practice, although they may be used in people with raised intracranial pressure.

Intracranial pressure monitoring for bacterial meningitis

Intracranial pressure monitoring is not part of routine practice, although it may be used for people with raised intracranial pressure or hydrocephalus.

Corticosteroids for bacterial meningitis and meningococcal disease

Recommendations 1.9.1 to 1.9.5

Why the committee made the recommendations

Corticosteroids for bacterial meningitis

There was evidence of benefit from high-dose dexamethasone:

- in adults, it reduced mortality and hearing impairment
- in babies over 28 days, children and young people, it reduced hearing impairment and persistent fever.

In most of the studies reviewed, corticosteroids were given before or with antibiotics. Nobody in the studies received corticosteroids more than 12 hours after antibiotics. The committee agreed with the timings used in the studies, but they highlighted that

antibiotics should not be delayed just so they can be given at the same time as corticosteroids.

In current practice, corticosteroids are not given to people who started antibiotics more than 12 hours earlier. However, there was no evidence for or against giving corticosteroids more than 12 hours after starting antibiotics, and in the committee's experience there are situations when this would be beneficial. Because there was no evidence, decisions would have to be made on an individual basis, and the committee recommended getting specialist advice to help with this.

The evidence for use of corticosteroids in newborn babies aged 28 days or under was limited and very low quality. The committee agreed that it was not appropriate to extrapolate from the evidence for older groups, because the range of causative organisms is different and the impact these have on the developing brain may not be the same. Therefore, the committee made a research recommendation to investigate the effectiveness of corticosteroids for newborn babies with suspected or confirmed bacterial meningitis.

Corticosteroids for meningococcal disease

There was evidence that high-dose dexamethasone increased the risk of mortality in babies over 28 days and children and young people with meningococcal disease. This evidence was limited and very low quality.

The committee agreed that corticosteroids (including dexamethasone) should not routinely be given to people with meningococcal disease. However, low-dose corticosteroids may still beneficial for people with meningococcal septic shock that are not responding to high-dose vasoactive agents.

There was no evidence in adults, but the committee agreed to extend the recommendation to cover this group, based on their clinical expertise and the evidence of increased risk of mortality for other groups.

How the recommendations might affect practice

Corticosteroids for bacterial meningitis

High-dose corticosteroids are part of routine practice for strongly suspected and confirmed bacterial meningitis. However, they are not currently started more than 12 hours after people have started taking antibiotics. As dexamethasone is the only recommended corticosteroid, there may be an increase in the use of dexamethasone and a decrease in the use of other corticosteroids.

Corticosteroids for meningococcal disease

The recommendations are in line with current practice.

Return to recommendations

Management after bacterial meningitis or meningococcal disease

Recommendations 1.10.1 to 1.10.5

Why the committee made the recommendations

The evidence looked at the risk of single episodes of bacterial meningitis, not recurrent bacterial meningitis. The committee were aware of additional evidence in this area which, together with their knowledge and expertise they used to inform the recommendations.

The committee agreed that:

- people with HIV have a higher risk of pneumococcal infections and invasive meningococcal disease
- the prevalence of HIV is higher in people with bacterial meningitis
- primary immunodeficiency is present in 8 to 26% of children with invasive meningococcal disease.

Based on this, the committee recommended HIV testing for adults. Many risk factors for HIV are less likely to be relevant to babies, children and young people, so they do not need to be routinely tested unless there are signs of immunodeficiency and other risk factors.

The committee agreed that referral to specialists was needed for babies (including newborn babies), children and young people with pneumococcal meningitis, because this disease may indicate a lack of immune response to pneumococcal vaccination and be associated with primary immune deficiencies. Adults were not included in this recommendation because the committee did not think there were increased rates of primary immunodeficiency in adults with invasive pneumococcal disease.

Some anatomical factors increase the risk of bacterial meningitis (see the explanation of the recommendations on risk factors). The committee agreed that people should be checked for these factors (including signs of a sinus tract), to assess whether they may need intervention to prevent future episodes.

Taking a detailed immunisation history will identify people who have not had routine vaccinations for relevant pathogens. Taking a medicine history will identify people taking drugs that suppress the immune system.

How the recommendations might affect practice

Testing for HIV in adults with a serious infection is in line with current practice. Testing for babies, children and young people is not, but the group who need testing is likely to be small so the resource impact will be minimal.

Other recommendations are in line with current practice.

Return to recommendations

Information and support after diagnosis

Recommendations 1.11.1 to 1.11.5

Why the committee made the recommendations

The committee made recommendations based on evidence on the views of parents and carers, and based on their own expertise. The themes in the evidence were consistent for both bacterial meningitis and for meningococcal disease, so the committee made recommendations that apply to both conditions.

The committee emphasised the need to discuss the issues covered in the recommendations with people with bacterial meningitis or meningococcal disease, to

give them the chance to ask questions, and to repeat information over time. This is because people may be distressed and unable to ask questions or understand information when they are first admitted to hospital.

Emotional and pastoral support is recommended because of the severe impact meningitis can have on a person. Likewise, some people will experience prolonged distress and would benefit from psychological interventions.

The committee also wanted to ensure that people knew how to get support after leaving hospital, because they will likely need follow-up assessments and aftercare for weeks or months after discharge.

How the recommendations might affect practice

The recommendations largely reflect current practice and they should not have a significant resource impact.

Return to recommendations

Identifying and managing complications

Recommendations 1.12.1 to 1.12.8

Why the committee made the recommendations

Evidence showed that meningitis can result in a range of long-term complications, such as:

- intellectual disability, which can lead to speech and language problems in babies, as well as poor educational attainment or the need for special educational assistance in babies and children
- long-term behavioural problems and problems with adjustment
- psychological distress
- acute orthopaedic and skin complications (with meningococcal disease)
- hearing problems, including acute deafness.

Most of the evidence concerned long-term complications for babies and children. However, the committee agreed that it was reasonable to extrapolate much of this

evidence to adults and newborn babies, because meningitis can have similar impacts on people regardless of age.

Based on this evidence, the committee agreed that people with bacterial meningitis or meningococcal disease should not be discharged from hospital until follow-up needs have been identified and planned for, and until certain assessments have been planned or completed. The committee did recognise that certain tests, like a hearing assessment, might not be possible until after discharge (although testing before discharge would be preferable).

The evidence for epilepsy as a long-term complication was mixed, and the committee were concerned about unnecessary long-term use of anti-epileptic drugs. They recommended a 3-month review to check whether the seizures were a short-term effect of the illness.

The evidence on long-term complications after bacterial meningitis in newborn babies was limited to a single, small study. The committee agreed that quantifying the long-term complications of bacterial meningitis is important, to allow follow-up to be arranged for those at risk and to help with prioritising treatment and prevention strategies. To address this, the committee made a research recommendation to investigate long-term outcomes after bacterial meningitis in infancy.

How the recommendations might affect practice

It is routine practice to identify possible follow-up needs before discharge and to make referrals when needed. There is some variation in follow-up for adults, but this should not have a significant resource impact given the small numbers of people affected.

Return to recommendations

Planning for care after discharge

Recommendations 1.12.9 to 1.12.15

Why the committee made the recommendations

There was evidence on the views and experiences of families and carers of people who have had meningitis. The committee built on this with their own expertise. They

recommended coordination with other professionals and services because this will ensure that follow-up care and support meets the person's needs, and will potentially reduce the impact of long-term complications.

Referral for psychosocial support is recommended because of the potential psychological impact of meningitis. It may need to be arranged after discharge because the impact may not be apparent immediately.

How the recommendations might affect practice

It is routine practice to make referrals and plan for care after discharge, and to inform GPs and other key professionals of any follow up needs. There is some variation in follow-up for adults, but this should not have a significant resource impact given the small numbers of people affected.

Return to recommendations

Care after hospital discharge

Recommendations 1.13.1 to 1.13.10

Why the committee made the recommendations

The committee agreed areas to cover in the post-discharge review based on the evidence of the long-term complications associated with meningitis (see the explanation of the recommendations on identifying and managing complications).

The review should happen at 4 to 6 weeks after discharge so that short-term effects of the illness can be ruled out and long-term issues can be identified early enough to make prompt referrals. The results of adult hearing tests may not be available at this point (for example, if illness interferes with the timing of the test), but the overall review should not be delayed if this is the case.

The evidence showed particular long-term complications for babies, children and young people. The committee used their own knowledge and experience to make recommendations on further tests and reviews for this group. These tests and reviews are important for identifying late-onset complications and developmental issues as children and young people grow up.

The tests and reviews recommended will involve staff working in multiple services, across health and education. The committee made a recommendation on coordinating follow-up, to avoid situations where professionals assume other services are responsible and people do not receive proper care as a result.

The evidence suggested that meningitis can increase the risk of poor educational outcomes and that the impact of long term complications may not always be apparent and that children and younger people who are seen to be underachieving, could be achieving more if they had more specific support. Therefore it was important for professionals in education and early years to regularly review learning needs as children and young people grow.

For adults, there was evidence that they may need a phased return to work. The committee recommended that healthcare professionals discuss this with people, so they could plan for their return to work.

How the recommendations might affect practice

It is routine practice to review people who have had meningitis or meningococcal disease for long-term complications after hospital discharge. There is some variation in follow-up for adults, but this should not have a significant resource impact given the small numbers of people affected.

Return to recommendations

Recurrent bacterial meningitis and meningococcal disease

Recommendations 1.14.1 to 1.14.8

Why the committee made the recommendations

Risk factors

Evidence showed that some anatomical factors increased the risk of recurrent bacterial meningitis (such as a cerebrospinal fluid leak). For most immunological factors, there was no evidence of an increased risk of recurrent bacterial meningitis.

The committee had concerns about the reliability of the anatomical and immunological evidence, because the studies only looked at a very small number of

people for some risk factors and for recurrent bacterial meningitis in general. Because of this, the committee made recommendations about the risk factors they believed to be most important, based on their clinical knowledge and expertise.

Management

There was no evidence, so the committee made recommendations based on their own knowledge and experience. They recommended a specialist review to decide which investigations, treatments and immunisations were needed to help prevent further recurrence.

The committee made recommendations on HIV testing, immunisation and medicine history, and sinus tract examination, in line with the recommendations for management after a first episode of meningitis or meningococcal disease (see the explanation of the recommendations on management after a first episode). They recommended HIV testing for babies, children and young people after a recurrent episode, because at this point there is an increased chance of immunodeficiency.

The committee also highlighted the possibility of other rare causes of recurrent meningitis.

How the recommendations might affect practice

Risk factors

The recommendations are largely in line with current practice. Healthcare professionals may have to change some of the risk factors they look for, but there should be no resource impact for services.

Management

Specialist review and prophylactic antibiotics are part of routine current practice for babies, children and young people with recurrent bacterial meningitis and meningococcal disease. Current practice varies for adults, but bacterial meningitis and meningococcal disease are very rare and the impact on services is likely to be small (both in terms of resources and antimicrobial resistance).

Return to recommendations

Context

This guideline is for healthcare professionals (including paramedics working in:

- primary and secondary care
- pre-hospital settings
- community settings.

Bacterial meningitis is an inflammation of the membranes that surround the brain and the spinal cord, caused by bacterial infection. We use the term 'meningococcal disease' to mean illness caused by an invasive meningococcal infection (including bloodstream infection and meningitis).

The main bacteria that cause meningitis in adults, children and babies over 3 months old are *Neisseria meningitidis* (meningococcus) and *Streptococcus pneumoniae* (pneumococcus). These two bacteria normally spread by person-to-person droplet transmission (for example sneezing). *Haemophilus influenzae* type b used to be another common cause, but since vaccination started it is now rare. In babies under 3 months old, Group B Streptococcus, *Escherichia coli* and other coliforms are common. *Listeria monocytogenes* is very rare, but occasionally causes meningitis in older people and in young children.

There are variations in clinical practice for bacterial meningitis and meningococcal disease, including in access to intensive care support for critically ill children and adults. There is also variation in follow-up and management for complications. This guideline aims to address these variations and promote effective, evidence-based care for people with bacterial meningitis and meningococcal disease.

Finding more information and committee details

To find NICE guidance on related topics, including guidance in development, see the NICE webpage on meningitis and meningococcal septicaemia.

For details of the guideline committee see the committee member list.

Update information

February 2024

This guideline is an update of NICE guideline CG102 (published June 2010) and will replace it.