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GUIDELINES

Meningitis (bacterial) and meningococcal disease: recognition, diagnosis and management—summary of updated NICE guidance

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What you need to know

- Identification of red flag combinations of symptoms and signs should raise the index of suspicion of bacterial meningitis or meningococcal disease
- A senior clinical decision maker should perform an initial assessment and ensure that antibiotics start within 1 hour of the person arriving at hospital
- Review people who have had bacterial meningitis or meningococcal disease within 4-6 weeks after discharge from hospital

Bacterial meningitis and meningococcal disease are uncommon but life-threatening conditions. Early recognition is important but difficult because of the non-specific ways in which individuals present. The National Institute for Health and Care Excellence (NICE) initially published guidance on the conditions in 2010 and, after a surveillance review in 2018, updated it following changes in guideline development methodology and to reflect recent developments in vaccination.[1] The 2024 guidance also extends the population of the original guideline from children only to including recommendations for adults.[1]

The term "bacterial meningitis" includes meningococcal meningitis without meningococcal sepsis and meningitis caused by other bacteria, while the term "meningococcal disease" includes meningococcal sepsis with or without meningococcal meningitis. Evidence for the two conditions was reviewed separately but considered in parallel. Whether separate recommendations were needed for each condition was decided based on the evidence and Guideline Committee's experience. In this article, we summarise selected recommendations related to early recognition of these conditions, timing of investigations, initiating antibiotic therapy, and follow-up.

Recommendations

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

GRADE Working Group grades of evidence

- *High certainty*—we are very confident that the true effect lies close to that of the estimate of the effect
- *Moderate certainty*—we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different
- *Low certainty*—our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect
- *Very low certainty*—we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect

Recognition

In these new recommendations, most of the symptoms and signs identified were at least moderately (≥50%) or highly (≥90%) sensitive or specific for a diagnosis of bacterial meningitis or meningococcal disease (infographic and tables 1-3). However, the evidence appraised was mostly based on individual symptoms and signs, as limited data were available for the diagnostic accuracy of combinations, and from adult populations. The presence of these individual symptoms or signs alone may not be sufficient to make a diagnosis because of the substantial overlap with other conditions that present similarly.

This is a summary of selected recommendations from NICE guideline NG240: Meningitis (bacterial) and meningococcal disease: recognition, diagnosis and management.

Table 1 | Symptoms and signs that may indicate 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 (including confusion or delirium)	Fever and neck stiffness are less common in babies. Headache and neck stiffness are harder to identify in babies and young children.
Appearance	
Bulging fontanelle	In babies and young children with an open fontanelle. Moderately to highly specific but not sensitive
Fever	Fever, headache, neck stiffness and altered level of consciousness or cognition are the red flag combination for bacterial meningitis. Fever is less common in babies. Ask the child or young person (or their family members or carers) if they have taken antipyretics, because this may make fever harder to identify. For other possible causes of fever in under 5 year olds, see table 3 in the NICE guideline on fever in under 5s.[2] For children under 6 months, see recommendation 1.2.11 in the NICE guideline on fever in under 5s.[2] Moderately to highly specific but not sensitive
Ill appearance	Ask the child or young person (or their family members or carers) if they have taken antipyretics, because this may make ill appearance harder to identify. Highly specific but not sensitive
Non-blanching petechial or purpuric rash	Mainly in meningococcal disease (with or without meningococcal meningitis) (table 3). Check all over the body and look for petechiae in the conjunctivae. May be difficult to see on brown, black, or tanned skin. Highly specific but not sensitive
Pale, mottled skin or cyanosis	May be difficult to see on brown, black or tanned skin. Highly specific but not sensitive
Behaviour	
Irritability	Common in babies and young children. Moderately to highly specific, but not sensitive
Lethargy	Common in babies and young children. Moderate to highly specific and moderately to highly sensitive
Reduced feeding	In babies. Moderately specific but not sensitive
Unusual behaviour	For example, the person may be agitated, aggressive or subdued. Ask family members or carers about changes in the child or young person's behaviour. For more guidance on identifying changes in babies, children and young people who do not communicate verbally, see recommendation 1.2.14 in the NICE guideline on babies, children and young people's experience of care.[3]
Weak, high-pitched or continuous cry	In babies.
Cardiovascular	
Early signs of sepsis Signs of shock	See table 3. For more guidance on assessing for sepsis, see the sections on evaluating risk in the NICE guideline on suspected sepsis.[4] Highly specific but not sensitive
Neurological	
Altered level of consciousness or altered cognition (including confusion or delirium)	Fever, headache, neck stiffness, and altered level of consciousness or cognition are the red flag combination for bacterial meningitis. Not specific to highly specific and moderately to highly sensitive
Focal neurological deficits	Highly specific but not sensitive
Headache	Fever, headache, neck stiffness and altered level of consciousness or cognition are the red flag combination for bacterial meningitis. Babies and children and young people with cognitive impairment or communication difficulties may not be able to report headache. Not specific to moderately specific and not sensitive to moderately sensitive
Neck stiffness, including more subtle discomfort or reluctance to move the neck	Fever, headache, neck stiffness and altered level of consciousness or cognition are the red flag combination for bacterial meningitis. Neck stiffness is less likely and harder to identify in babies. Neck stiffness is harder to identify in children and young people with cognitive impairment or communication difficulties. Moderately specific and sensitive
Photophobia	Harder to identify in babies. Highly specific but not sensitive
Seizures	Highly specific but not sensitive
Respiratory	
Tachypnoea, apnoea, and grunting	Non-specific signs of illness, including sepsis and meningitis in babies. Moderately to highly specific and not sensitive to moderately sensitive

Table 1 | Symptoms and signs that may indicate bacterial meningitis in babies, children, and young people *(Continued)*

Symptoms and signs in babies, children, and young people	Notes
Other	
Unexplained body pain, including limb, back or abdominal pain	Moderately specific but not sensitive (based on data from an undefined age range)
Vomiting	Not specific to moderately specific and not sensitive to moderately sensitive

Information on the sensitivity and specificity of individual symptoms or signs provided for which evidence was available

Table 2 | Symptoms and signs that may indicate bacterial meningitis in adults

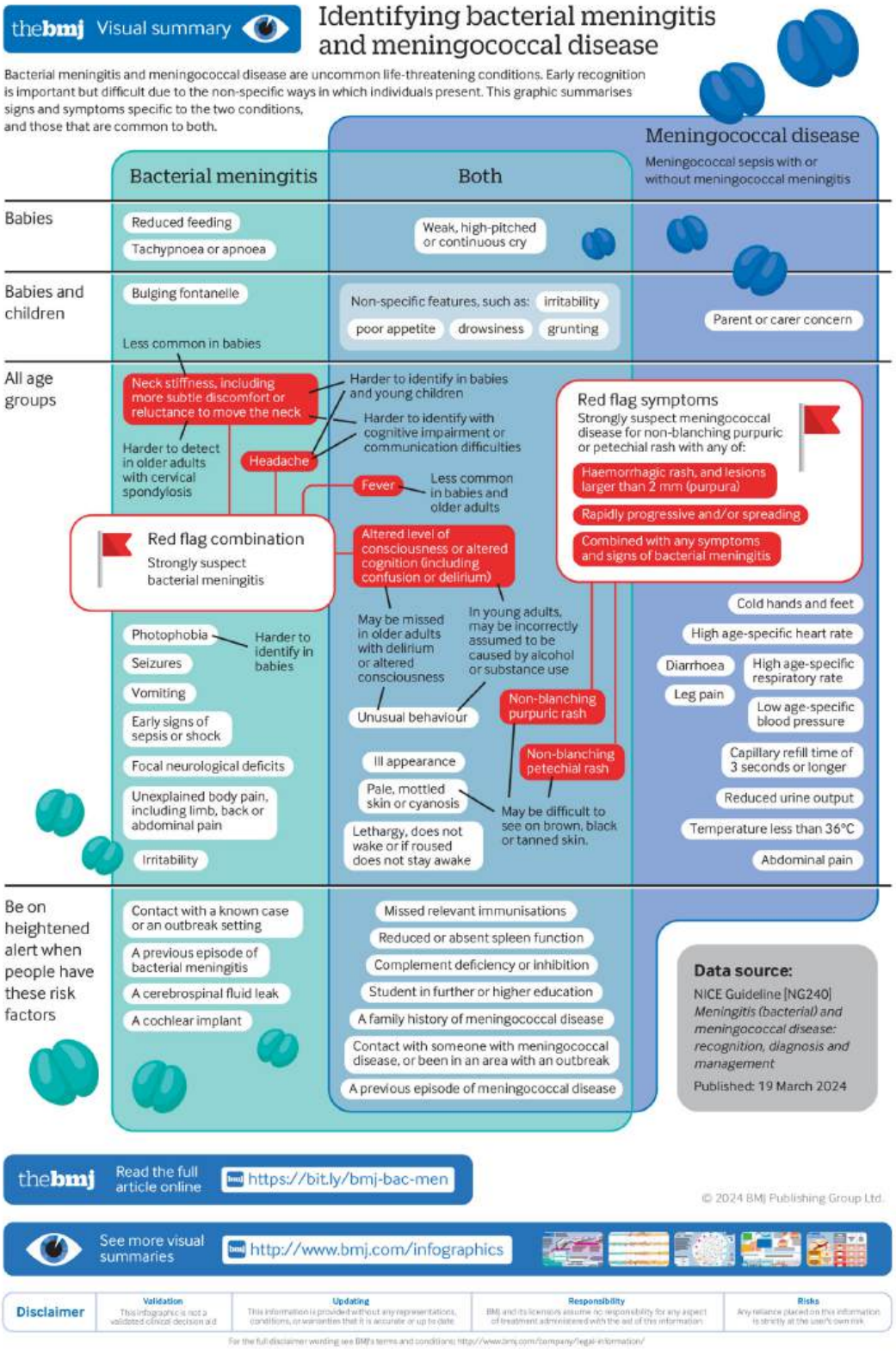
Symptoms and signs in adults	Notes
Red flag combination	
Fever, headache, neck stiffness, and altered level of consciousness or cognition (including confusion or delirium)	Fever is less common in older adults. Headache and neck stiffness are harder to identify in adults with cognitive impairment. Neck 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 are the red flag combination for bacterial meningitis. Ask the person (or their family members or carers) if they have taken antipyretics, because this may make fever harder to identify. Fever is less common in older adults. Moderately to highly sensitive and not specific to moderately specific (including data from older children)
Ill appearance	Ask the person (or their family members or carers) if they have taken antipyretics, because this may make ill appearance harder to identify.
Non-blanching petechial or purpuric rash	Mainly in meningococcal meningitis and meningococcal disease (with or without meningococcal meningitis) (table 3) Check all over the body and look for petechiae in the conjunctivae. May be difficult to see on brown, black, or tanned skin. Moderately sensitive and specific (based on data from an undefined age range)
Pale, mottled skin or cyanosis	May be difficult to see on brown, black, or tanned skin. Highly specific but not sensitive (based on data from an undefined age range)
Behaviour	
Irritability	–
Lethargy	Common in older adults.
Unusual behaviour	For example, the person may be agitated, 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 incorrectly assumed to be caused by alcohol or substance misuse, and bacterial meningitis can be missed as a result.
Cardiovascular	
Early signs of sepsis Signs of shock	See table 3. For more guidance on assessing for sepsis, see the sections on evaluating risk in the NICE guideline on suspected sepsis.[4] Highly specific and moderately sensitive
Neurological	
Altered level of consciousness or altered cognition (including confusion or delirium)	Fever, headache, neck stiffness, and altered level of consciousness or cognition are 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 incorrectly assumed to be caused by alcohol or substance misuse, and bacterial meningitis can be missed as a result. Not specific to highly specific and not sensitive to highly sensitive
Focal neurological deficits	Moderately to highly specific but not sensitive (including data from older children)
Headache	Fever, headache, neck stiffness, and altered level of consciousness or cognition are the red flag combination for bacterial meningitis. Adults with cognitive impairment or communication difficulties may not be able to report headache. Not specific or sensitive (including data from older children)
Neck stiffness, including more subtle discomfort or reluctance to move the neck	Fever, headache, neck stiffness, and altered level of consciousness or cognition are 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, communication difficulties, dementia, or arthritis. Moderately sensitive but not specific (including data from older children)
Photophobia	–
Seizures	Highly specific but not sensitive
Other	
Unexplained body pain, including limb, back or abdominal pain	Moderately specific but not sensitive (based on data from an undefined age range)
Vomiting	–

Information on the sensitivity and specificity of individual symptoms or signs provided for which evidence was available

Table 3 | Symptoms and signs that may indicate meningococcal disease for babies, 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 petechial or purpuric rash Any symptoms and signs of bacterial meningitis (see tables 1 and 2) when combined with a non-blanching petechial or purpuric rash	Check all over the body and look for petechiae in the conjunctivae. Rashes may be difficult to see on brown, black, or tanned skin. Presence of any rash moderately specific and moderately sensitive; presence of haemorrhagic rash moderately to highly specific and not sensitive to moderately sensitive; purpura highly specific and moderately sensitive
Non-specific symptom or sign	
Appearance	
Ill appearance	Ask the person (or their family members or carers) if they have taken antipyretics because this may make ill appearance harder to identify. Moderately to highly specific and not sensitive to moderately sensitive
Pale, mottled skin or cyanosis	May be difficult to see on brown, black, or tanned skin. Moderately to highly specific but not sensitive
Parent or carer concern	–
Behaviour	
Lethargy, does not wake or if roused does not stay awake	Common in babies, young children and older adults. Moderately specific and moderately sensitive
Unusual behaviour	For example, the person may be agitated, aggressive, or subdued. Meningococcal disease may be missed in older adults with delirium or altered consciousness. In young people and young adults, altered behaviour may be incorrectly assumed to be caused by alcohol or substance misuse, and meningococcal disease can be missed as a result.
Weak, high pitched or continuous cry	In babies.
Cardiovascular	
Cold hands and feet	Moderately to highly specific but not sensitive
Heart rate <60 beats/minute	In babies and children <12 years old.
High age-specific heart rate	For age-specific heart rates, see sections on evaluating risk in the NICE guideline on suspected sepsis.[4] Moderately specific and moderately sensitive
Low age-specific blood pressure	- For age-specific blood pressures, see sections on evaluating risk in the NICE guideline on suspected sepsis.[4]
Hydration	
Capillary refill time of ≥3 seconds	Moderately specific and moderately sensitive
Reduced urine output	–
Neurological	
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 incorrectly assumed to be caused by alcohol or substance misuse, and meningococcal disease can be missed as a result. Highly specific and not sensitive to moderately sensitive
Respiratory	
Grunting	In babies and children.
High age-specific respiratory rate	For age-specific respiratory rates, see sections on evaluating risk in the NICE guideline on suspected sepsis.[4] Moderately specific and moderately sensitive
Temperature	
Fever	Ask the person (or their family members or carers) if they have taken antipyretics, because this may make fever harder to identify. Fever is a particular concern for babies at the levels specified in the NICE guideline on suspected sepsis: • ≥39°C in children aged 3-6 months • ≥38°C in children aged <3 months. Moderately specific and moderately sensitive
Temperature <36°C	–
Other	
Abdominal pain	Moderately specific but not sensitive
Diarrhoea	Moderately specific but not sensitive
Leg pain	Highly specific but not sensitive

Information on the sensitivity and specificity of individual symptoms or signs provided for which evidence was available



Therefore, the Guideline Committee considered the evidence along with their clinical knowledge and experience to identify combinations of symptoms and signs (red flag combinations) that should raise the index of suspicion or prompt an assessor to strongly suspect bacterial meningitis or meningococcal disease. Recommendations were classified as "strongly suspect" if there were the red flag combinations. However, they should not be used in isolation, and the guideline contains further information about when to suspect bacterial meningitis and meningococcal disease in the absence of these red flag symptoms and signs.

Evidence on risk factors that increase the likelihood of an individual having bacterial meningitis or meningococcal disease was also evaluated. Recommendations were classified as "be on heightened alert to the possibility of" if a risk ratio of >1.25 (moderate association) or >2.00 (strong association) was found between a risk factor and bacterial meningitis or meningococcal disease, or based on the Guideline Committee's experience. Being on heightened alert may prompt strong suspicions for bacterial meningitis or meningococcal disease in the absence of red flag combinations.

- Strongly suspect bacterial meningitis in people with all the symptoms in the red flag combination:
  - Fever
  - Headache
  - Neck stiffness
  - Altered level of consciousness or cognition (including confusion or delirium).
- 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
  - 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
  - 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.
- 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 petechial or purpuric rash
  - Any symptoms and signs of bacterial meningitis (see tables 1 and 2), when combined with a non-blanching petechial or purpuric rash.
- 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
  - 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
  - Have been in contact with someone with meningococcal disease, or have been in an area with an outbreak
  - A previous episode of meningococcal disease.
- If you send a person home after clinical assessment for bacterial meningitis and meningococcal disease:
  - Give safety netting advice (see recommendation 1.3.2 of full guideline)
  - Ask them to return for further assessment if they develop new symptoms, if a rash changes from blanching to non-blanching, or if existing symptoms get worse.

[*Based on very low to high quality evidence and the experience and opinion of the Guideline Committee (GC)*]

Antibiotic therapy pre-hospital

These recommendations were updated, now including or amending suggestions of recommended antibiotic therapy pre-hospital. Following evidence review, administration of pre-hospital antibiotic therapy was not associated with improved clinical outcomes in patients with suspected bacterial meningitis and meningococcal disease.[5 6] However, in the real world setting, it remains difficult to distinguish bacterial meningitis from other conditions that do not require antibiotic therapy, patients who have meningococcal disease deteriorate rapidly, and there can be substantial delay in transferring patients to hospital. Therefore, pre-hospital antibiotic therapy should be given where meningococcal disease is strongly suspected unless it will delay transfer to hospital, or where transfer to hospital is likely to be significantly delayed for people with strongly suspected bacterial meningitis.

Ceftriaxone is the preferred option because it is a broad spectrum antibiotic, but it is less commonly available outside of hospital than benzylpenicillin. Administering the antibiotic intramuscularly, rather than intravenously, is more practical.

- If there is likely to be a clinically significant delay in transfer to hospital for people with strongly suspected bacterial meningitis, give intravenous or intramuscular ceftriaxone or benzylpenicillin outside of hospital.
- For people with strongly suspected meningococcal disease, give intravenous or intramuscular ceftriaxone or benzylpenicillin as soon as possible outside of hospital, unless this will delay transfer to hospital.
- Do not give antibiotics outside of hospital if the person has severe antibiotic allergy to either ceftriaxone or benzylpenicillin.

[*Based on very low to low quality evidence from observational studies and the experience and opinion of the GC*]

Timing of investigations and antibiotic therapy in-hospital

Initiation of antibiotic therapy for suspected bacterial meningitis or meningococcal disease before investigations may hinder diagnosis or lead to unnecessary antibiotic use if patients have a non-bacterial illness. Previous NICE guidance recommended giving antibiotics without delay and what investigations to perform, but did not comment on timeframes or sequencing.

Following evidence review, early (0 to 3 hours) compared with later (≥2 to >3 hours) in-hospital antibiotic administration for bacterial meningitis is associated with lower rates of mortality in adults,[7 8]

but there is limited evidence to inform a specific timeframe. For suspected meningococcal disease, there is no evidence comparing different timings of in-hospital antibiotic administration. The hour after arrival in hospital is widely regarded as the "golden hour" for people with life-threatening conditions and was considered enough time to stabilise a patient, take blood samples, and administer antibiotic therapy. When bacterial meningitis is suspected, it may not always be possible to perform a lumbar puncture, but doing so before starting antibiotic therapy should be the goal when this can be done within one hour.

- A senior clinical decision maker should perform an initial assessment and ensure that:
  - Antibiotics start within one hour of the person with suspected bacterial meningitis arriving at hospital, and in line with the section on antibiotics for bacterial meningitis in hospital [in the full guideline]
  - Blood tests and lumbar puncture are performed before starting antibiotics (if it is safe to do so and will not cause a clinically significant delay to starting antibiotics), and in line with the sections on blood tests and lumbar puncture [in the full guideline].
- A senior clinical decision maker should perform an initial assessment and ensure that:
  - Antibiotics start within one hour of the person with suspected meningococcal disease arriving at hospital, and in line with the section on antibiotics for meningococcal disease in hospital [in the full guideline]
  - Blood tests are performed before starting antibiotics, and in line with the section on blood tests [in the full guideline].

[*Based on low quality evidence from observational studies and the experience and opinion of the GC*]

Hospital discharge and post-discharge care

A wide range of long term complications are associated with bacterial meningitis and meningococcal disease, some of which may not be evident for several months or years.[9 10] Do not discharge people with bacterial meningitis and meningococcal disease from hospital until relevant assessments have taken place and an appropriate follow-up plan has been arranged.

The updated recommendations comment on timing of follow-up visits, how long people should be followed up for, and which assessments should be undertaken. Patients prefer written information, such as a detailed discharge summary, and think that it is helpful and informative.[11] A review at four to six weeks after discharge is newly recommended for all adults, in line with the existing recommendation for babies, children, and young people, to discuss any known complications and ensure any delayed complications are not missed. The Guideline Committee did not specify who should undertake this review because there could be variation in practice locally but acknowledged that such assessments are usually performed in secondary care.

- For people who are taking antiepileptic drugs, refer for a medicines review three months after hospital discharge with a clinician with an interest in epilepsy, an epilepsy specialist nurse, or a neurologist.
- Document the follow-up plan for managing complications in the discharge summary.
- For adults who have had bacterial meningitis or meningococcal disease, arrange for a review with a hospital doctor at four to six weeks after discharge from hospital. As part of this review, cover:
  - The results of their audiological assessment (if available at this time) and whether cochlear implants are needed
  - Damage to bones and joints
  - Skin complications (including scarring from necrosis)
  - Psychosocial problems
  - Neurological problems
  - Care needs.
- For babies under 12 months old who have had meningitis or meningococcal disease, arrange a review with a paediatrician for one year after discharge. At this review, assess for possible late-onset neurodevelopmental, orthopaedic, sensory, and psychosocial complications.
- 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 two years after discharge.

[*Based on very low to moderate quality evidence and the experience and opinion of the GC*]

Implementation

Real-world data demonstrate that the "golden hour" of commencing antibiotic therapy within one hour of arrival to hospital is often missed. In one retrospective case record study, median door-to-antibiotic time was 3.8 hours (interquartile range 1.4-6.1).[12] Existing secondary care pathways should be reviewed to ensure that there is timely assessment by a senior decision maker and that investigations and antibiotic therapy are not delayed.

Multiple recommendations related to follow-up after discharge may affect primary and secondary care resources to ensure complications of bacterial meningitis and meningococcal disease are detected and managed appropriately. Psychosocial and family support recommendations may be expensive to implement at an individual level; however, the overall population covered by the recommendations is relatively small. Therefore, implementation of the follow-up care is not anticipated to have a significant resource impact.

Future research

The Guideline Committee prioritised the following questions for further research:

- What are the long term outcomes after bacterial meningitis in infancy?
- Can novel host biomarker or metagenomic techniques applied to blood or cerebrospinal fluid be used to diagnose bacterial meningitis?
- What is the effectiveness of shorter courses of antibiotics (compared with standard duration courses) for treating bacterial meningitis caused by Enterobacterales (coliforms), particularly in newborn babies?
- 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?
- What is the effectiveness of corticosteroids as an adjunct to antibiotic treatment in newborn babies with suspected or confirmed bacterial meningitis?

Guidelines into practice

- Think about the last time you suspected someone to have bacterial meningitis and meningococcal disease. What symptoms and signs did you consider, and how did you provide timely management in your setting?
- When discharging patients with confirmed bacterial meningitis and meningococcal disease, what follow-up do you arrange routinely?

How patients were involved in the creation of this article

LG is a lay member of the Guideline Committee. Committee members involved in this guideline update included lay members who contributed to the formulation of the recommendations summarised here.

Further information on the guidance

This guidance was developed by NICE in accordance with NICE guideline methodology (https://www.nice.org.uk/media/default/about/what-we-do/our-programmes/developing-nice-guidelines-the-manual.pdf). A guideline committee (GC) was established by NICE, which incorporated healthcare and allied healthcare professionals (one consultant physician, one clinical associate professor and honorary consultant microbiologist, one professor or honorary consultant of paediatric immunology and infectious diseases, one consultant in paediatric accident and emergency medicine, one professor of infectious disease, one consultant in paediatric intensive care, one honorary consultant in neurointensive care, one portfolio general practitioner, one divisional lead pharmacist (women and children), one consultant nurse, one consultant geriatrician, one consultant diagnostic neuroradiologist, one honorary consultant in paediatric neurology, one consultant neonatologist, and one consultant in paediatric infectious diseases) and three lay members.

The guideline is available at https://www.nice.org.uk/guidance/ng240.

The GC identified relevant review questions and collected and appraised clinical and cost effectiveness evidence. Quality ratings of the evidence were based on GRADE methodology (www.gradeworkinggroup.org). These relate to the quality of the available evidence for assessed outcomes or themes rather than the quality of the study. The GC agreed recommendations for clinical practice based on the available evidence or, when evidence was not found, based on their experience and opinion using informal consensus methods. The scope and the draft of the guideline went through a rigorous reviewing process, in which stakeholder organisations were invited to comment; the GC took all comments into consideration when producing the final version of the guideline. NICE will conduct regular reviews after publication of the guidance, to determine whether the evidence base has progressed significantly enough to alter the current guideline recommendations and require an update.

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Other co-opted members (shown alphabetically): Debarata Bhattacharrya, Michael Griffiths, Paul Heath, Richard Tubman.

Resigned members (shown alphabetically): Tim Cook, Louisa Polak.

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