

Sepsis, meningococcal septicaemia, and bacterial meningitis

(Adapted from NICE Guidelines June 2010 and June 2017, Meningitis Research Foundation algorithms and Sepsis Trust screening and action tools)

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Click to skip straight to [sepsis](#) or [meningitis](#) management pathways

See also:

- Early management of meningococcal sepsis in infants and children STRS guideline. Available at <https://www.evelinalondon.nhs.uk/resources/our-services/hospital/south-thames-retrieval-service/Sepsis.pdf>
- STRS Emergency drug calculator. Available at <https://www.evelinalondon.nhs.uk/resources/our-services/hospital/south-thames-retrieval-service/Drug-calculators/emergency-drug-calculator.pdf>

Background

Important updates (from 2017 guideline):

- Hartmann's solution is fluid of choice for resus (0.9% sodium chloride if no Hartmann's available)
- Fluids administered as 10mL/kg boluses (NOT 20mL/kg) with reassessment after each bolus
- Adrenaline now first line inotrope for septic shock – NOT dopamine

Meningococcal septicaemia should be managed as per the sepsis pathway.

Bacterial meningitis is managed differently – you should be able to recognise the different signs and symptoms and manage accordingly.

Assessment

All children should be assessed for signs of sepsis, shock and raised intracranial pressure. If a child presents unwell, or there is parental concern, think 'could this be sepsis'?

Risk factors for sepsis:

- Impaired immunity (IDDM, steroids, chemotherapy)
- Recent trauma, surgery, invasive procedure
- Central lines / broken skin

Sepsis screening tool – recognising sepsis and risk

Flags	Amber	Red
Colour		<ul style="list-style-type: none"> Non-blanching rash / mottled / ashen / cyanotic
Behaviour	<ul style="list-style-type: none"> Behaving abnormally / not wanting to play Not responding normally / no smile Reduced activity / very sleepy Parental or carer concern 	<ul style="list-style-type: none"> Objective evidence of new or altered mental state Doesn't wake when roused or won't stay awake Looks very unwell to healthcare professional Weak, high-pitched or continuous cry
Respiratory	<ul style="list-style-type: none"> Moderate tachypnoea (see chart) OR nasal flaring SpO2 < 92% in air or increased O2 requirement 	<ul style="list-style-type: none"> severe tachypnoea (see chart) Oxygen saturations < 90% in air OR increased oxygen requirements OR needs oxygen to keep sats ≥ 92%
Circulation & Hydration	<ul style="list-style-type: none"> Moderate tachycardia (see chart) OR new dysrhythmia Capillary refill time > 2 seconds Systolic BP 91 – 100 mmHg in > 12 years Reduced urine output (<1ml/kg/h if catheterised) 	<ul style="list-style-type: none"> Systolic BP ≤ 90 mmHg OR > 40 mmHg less than normal BP if ≥ 12 years Severe tachycardia (see chart) Bradycardia < 60 bpm in < 12 years Not passed urine in 18 hours (<0.5ml/kg/h if catheterised)
Other	<ul style="list-style-type: none"> Leg pain or refusal to use limb Temperature <36°C if > 5 years Immunocompromised / recent trauma, surgery or procedure OR clinical signs of wound infection 	<ul style="list-style-type: none"> Temperature <36°C if < 5 years or 38°+ if under 3 months

Age (years)	Tachypnoea (breaths / minute)		Tachycardia (beats / minute)	
	Severe	Moderate	Severe	Moderate
< 1	≥ 60	50 – 59	≥ 160	150 – 159
1 – 2	≥ 50	40 – 49	≥ 150	140 – 149
3 – 4	≥ 40	35- 39	≥ 140	130 – 139
5	≥ 29	24 – 28	≥ 130	120 – 129
6 – 7	≥ 27	24 – 26	≥ 120	110 – 119
8 – 11	≥ 25	22 – 24	≥ 115	105 – 114
≥ 12	≥ 25	21 – 24	> 130	91 – 130

Any **red** flags present? **Immediate review by 'senior clinical decision maker' (Paed ST4+ or equivalent)** to consider alternative diagnosis e.g. bronchiolitis
 Start sepsis pathway NOW! Click [here](#) to skip straight to pathway

Any **amber** flags present? **Needs senior review within 1 hour. Do bloods** (Blood culture, FBC, coagulation studies, group & save, U&E, calcium & magnesium, CRP, LFTs, blood gas lactate & glucose) **and review with results**

Signs and symptoms of septic shock:

- change in mental status (irritability, inappropriate crying, drowsiness / lethargy, confusion, unrousable)
- reduced urine output
- tachypnoea
- signs of warm or cold shock

Cold Shock	Warm Shock
Capillary refill > 3 secs	Flash capillary refill
Reduced peripheral pulses	Bounding peripheral pulses
Cool mottled extremities	Warm to edges
Core / peripheral temperature gap >3°C	Low diastolic BP
Narrow pulse pressure	Wide pulse pressure

Hypotension is a late sign suggesting decompensation.

Signs and symptoms of Meningitis:

➤ Bulging fontanelle	➤ Seizures
➤ Photophobia	➤ Paresis or focal neurological deficit
➤ Back rigidity	➤ Abnormal pupillary responses
➤ Positive Kernigs or Brudzinskis signs	

Note: Neck stiffness, headache, vomiting, lethargy, reduced consciousness and irritability are non-specific signs that may indicate sepsis or meningitis

Investigations in Sepsis, septicaemia and meningitis

All patients:

1. Blood cultures (peripheral + any indwelling lines)
2. Blood - FBC, coagulation studies, group & save, CRP, U&Es, LFT, bone profile & magnesium, blood glucose
3. Blood PCR (Meningococcal & Herpes Simplex as appropriate)
4. Urine culture (with dipstick)
5. Viral throat swab for respiratory viral screen, rash panel and COVID
6. Bacterial throat swab

Consider:

- Blood ammonia if reduced GCS
- Blood ASO titres and save serology
- CSF
 1. M,C&S +/- AFB's to micro lab and 'save CSF' to hold for PCR for N. Meningitides, S, pneumoniae +/- TB if CSF cultures negative
 2. protein & glucose to biochemistry
 3. PCR for all viruses to virology lab
- Sputum MC&S, including mycobacterial for TB
- Stool MC&S
- Pertussis screen
- CT head if suspected Meningitis with fluctuating or reduced Consciousness/ signs of raised ICP

1st hour pathway for child with sepsis		✓
<p>Call for help, move patient to resus, apply monitoring.</p> <p>Ensure Senior Clinician (ST4 level +) attends.</p> <p>Print STRS drug calculations for age / weight</p> <div style="border: 1px solid red; padding: 5px; margin: 5px 0;"> <p>Not all patients with red flags will need to follow the below pathway urgently. A senior decision maker may seek an alternative diagnosis or de-escalate care.</p> <p>All decisions must be documented in the notes.</p> </div>		
<p>Complete full ABCDE assessment</p> <p>If suspected meningitis & NO signs of shock or raised ICP, follow pathway for meningitis – click here to skip straight to meningitis management</p>		
<p>Establish patent airway.</p> <p>Start O₂ therapy if saturations < 92% or evidence of shock. Target sats 94-98%</p>		
<p>Obtain intravenous or intraosseous access x2 and take bloods – Blood culture 1st (aseptic ANNT), FBC, coagulation studies, group & save, U&E, calcium & magnesium, CRP, LFTs, blood gas lactate & glucose. Click here for full list of tests</p>		
<p>Administer intravenous / intraosseous antibiotics (Click here for full section on antimicrobials). See BNFC for doses – use severe infection / meningitis doses:</p> <p>< 1 month: Cefotaxime + amoxicillin +/- aciclovir. Stop amoxicillin if no listeria growth after 48 hours. Co-trimoxazole as alternative to amoxicillin in penicillin allergy.</p> <p>> 1 months old: Ceftriaxone +/- clindamycin +/- gentamicin</p> <p>History of cephalosporin anaphylaxis: Teicoplanin + ciprofloxacin, OR chloramphenicol +/- gentamicin</p>		
<p>Consider high dose Aciclovir if suspicion of HSV – coagulopathy, deranged LFTs, hypoglycaemia, localised or widespread vesicular rash or contact history of herpes</p>		
<p>Assess for and treat signs of shock or lactate > 2 mmol/L</p> <ul style="list-style-type: none"> Fluid resuscitate with Hartmann's solution (or 0.9% sodium chloride if Hartmann's not available) Administer as 10 mL/kg aliquots over 5 minutes or as rapid infusion / push Repeat up to 40-60 mL/kg in 1st hour. Fluid bolus in mL/kg should be dosed as ideal body weight 		
<p>Check blood glucose – if < 3 mmol/L: give 2 mL/kg 10% Glucose, recheck glucose & start maintenance</p>		
Ongoing care		✓
<p>Reassess ABCDE</p> <p>Consider BVM +/- airway adjunct & need for intubation if poor respiratory effort</p>		
<p>Assess response to fluids after every bolus:</p> <p>Check HR and BP, nature of peripheral pulses and CRT, colour and level of alertness</p> <p>If poor response, repeat 10mL/kg Hartmann's over 5 mins</p> <p>If >20mL/kg given, contact STRS early, and start preparing peripheral adrenaline (or noradrenaline if warm shock)</p>		
<p>Repeat blood gas to assess ventilation and lactate</p>		

Additional considerations

- Assess for signs of overload (lung crackles, enlarging liver, shortness of breath, gallop rhythm) – may indicate need for early vasoactive support
- Catheterise and strict input / output chart; Aim urine output > 0.5 – 1 mL/kg/hr
- Aim for **Hb** > 70 g/L (if SpO2 > 92%) or Hb > 100 g/L if SpO2 < 92% or haemodynamically unstable
- Replace **platelets** if < 20 (ideally aim for Platelets ≥ 50)
- Low **fibrinogen** suggests DIC - give 5 -10 mL/kg of Cryoprecipitate
- Consider 10 mL/kg of Fresh Frozen Plasma (**FFP**) if patient bleeding
- Give **Vitamin K (phytomenadione)** if **PT** prolonged – see dosing regime [here](#)
- **Aim for ionised Calcium** > 1.2 mmol/L – correct hypocalcaemia. Administer through different line to ceftriaxone as can precipitate
- Correct **hypomagnesaemia**. Caution – can cause hypotension, give slowly over 30 minutes with additional fluid bolus if necessary

See STRS emergencies calculator for doses and infusions

<https://www.evelinalondon.nhs.uk/our-services/hospital/south-thames-retrieval-service/clinical-guidelines.aspx>

First Hour Goals - aim to restore:

- Normal perfusion, warm extremities, CRT < 2 secs
- No difference in quality between central & peripheral pulses
- Normal mental status
- Urine output > 1 mL/kg/hr
- Serum lactate < 2 mmol/L
- Normal glucose & ionised calcium

Escalation: If at any point the child is deteriorating consider and prepare for intubation	✓
Anaesthetic team informed	
Optimise patient – fluids and peripheral inotropes	
Prepare intubation drugs (rocuronium and ketamine)	
Prepare dilute adrenaline and additional fluid boluses	
Assist Anaesthetists to prepare equipment for arterial line and central line	
Ensure STRS are aware	

Indications for Intubation:

- A- Poor airway reflexes
- B- Worsening tachypnoea or O₂ requirement
- C- Impending cardiovascular collapse i.e.:
Fluid and vasoactive refractory shock (≥ 40 mL/kg rapid fluid resuscitation)
- D- Depressed consciousness - GCS ≤ 8 or AVPU ≤ P, signs of raised ICP

STRS referral number: 020 7188 5000

VASOACTIVE SUPPORT (Refer to STRS drug calculator to prepare correct concentration)

NB. Dopamine is no longer used first line for septic shock

Drug	Adrenaline	Noradrenaline (warm shock)
Route	Peripheral or IO	CAN be given peripherally or via IO
Infusion rate	0.1mcg/kg/min up to 0.5mcg/kg/min.	0.1mcg/kg/min up to 0.5mcg/kg/min.

Drug	Concentration	Diluent	Rate of Infusion
Adrenaline (peripheral)	< 5kg 1mg in 50mL	Sodium chloride 0.9% or glucose 5/10%	0.1microgram/kg/minute = 0.3mL/kg/h
	5-20kg 2mg in 50mL	Sodium chloride 0.9% or glucose 5/10%	0.1microgram/kg/minute = 0.15mL/kg/h
	> 20kg 4mg in 50mL	Sodium chloride 0.9% or glucose 5/10%	0.1microgram/kg/minute = 0.075mL/kg/h
Noradrenaline (peripheral)	< 5kg Not recommended		
	5-20kg 1.5mg in 50mL	Sodium chloride 0.9% or glucose 5/10% <i>(more stable in glucose and negates need for maintenance)</i>	0.1microgram/kg/minute = 0.2mL/kg/h
	> 20kg 7.5mg in 250mL	Sodium chloride 0.9% or glucose 5/10%	0.1microgram/kg/minute = 0.2mL/kg/h

Note on dilute adrenaline:

May be required to temporarily increase BP i.e., at induction of anaesthesia

1. Take 0.1 mL/kg (10 micrograms/kg) from minijet syringe 1:10,000 adrenaline (using a 3-way tap)
2. Make this up to 10 mL with 0.9% sodium chloride (MAX: 1mg in 10mL i.e., neat)
3. Use 0.5-2 mL bolus if ↓BP

Notes on Phytomenadione (Vitamin K)

IV or IM injection,

4 weeks - 12 months	1mg
1 - 4 years	3mg
5 - 12 years	5mg
Over 12 years	10mg

- IV injection can be diluted with 5% glucose
- Injection slowly over 5-10 minutes – rapid injection can cause peripheral vascular collapse, cyanosis, sweating and flushing

Notes on sepsis antimicrobial management (and special considerations)

Initial broad-spectrum antimicrobials should be administered within the first hour of presentation of sepsis. Give either IV or IO. See BNFC for doses – use ‘Severe’ dosing

< 1 month: Cefotaxime + amoxicillin +/- aciclovir. Stop amoxicillin if no listeria growth after 48 hours. Co-trimoxazole as alternative to amoxicillin in penicillin allergy.

> 1 months old: Ceftriaxone +/- clindamycin +/- gentamicin.

History of cephalosporin anaphylaxis: Teicoplanin and ciprofloxacin, OR chloramphenicol +/- gentamicin

Consider adding as per clinical assessment:

- **Gentamicin** if severe sepsis requiring inotropes / critical care, OR likely resistant organisms e.g., frequent or prolonged hospitalisation; >48 hours following admission; recent foreign travel
- **Clindamycin** if suspected staphylococcal or streptococcal toxic shock or necrotising fasciitis. Discuss possible IV immunoglobulin therapy with Paeds ID or Microbiology
- **Aciclovir** if < 2 months AND raised liver function test, coagulopathy, haemodynamically unstable, maternal primary herpes simplex, vesicles, seizure, OR suspected meningitis / encephalitis
- **Teicoplanin** if travel outside UK or prolonged antibiotic exposure in last 3 months or if previously MRSA positive or concern about infected prosthetic material e.g., VP shunt, Broviac or Hickman line, Portacath. Use Vancomycin for known resistant organisms.

Suspected surgical cause – discuss with paediatric surgeons and consider adding metronidazole if intra-abdominal focus

Immuno-suppression / neutropenia (even in absence of haem/onc diagnosis) – follow regional febrile neutropenia guidelines if neutropenic. Immunodeficiency / on biologics – consider unusual organisms / TB

Carriers of multi-resistant organisms – check previous sensitivities; follow local guidelines and discuss with microbiology team

Antimicrobial therapy duration in sepsis

Will be directed by organism and clinical response in consultation with microbiology.

Minimum 5 days, usual 7 – 10 days

- N. meningitidis 7 days
- S. pneumoniae 7 – 10 days
- Group B Strep: 7 days
- Gram negative: 10 days

Management of suspected meningitis pathway

Consider TB meningitis if raised CSF WBC and/or protein with or without risk factors for TB

1. If the child has signs of shock or raised ICP, **DO NOT perform LP** and follow pathway for sepsis. If no other contraindications, **perform LP** prior to administration of antibiotics.

Confirmed meningitis is:

- CSF WBC > 5
- +/- raised CSF protein
- +/- raised CSF glucose

But if clinically suspicious, you do not need to wait for LP findings

Contraindications for LP:

- Clinical or radiological signs of raised ICP (reduced GCS (GCS <8 or drop of >3), bradycardia, and hypertension, altered neurology or abnormal posturing, unequal pupils or poorly responsive pupils, abnormal dolls eye movements, active seizures)
- Shock - increased work of breathing, unstable blood pressure or persistent tachycardia,
- coagulopathy or platelets < 50, patient on anticoagulant, spreading purpura
- local infection at LP site

2. Antibiotics for meningitis

Start within 1 hour of presentation, **AFTER LP** unless contra-indications

Give IV or IO

See BNFC for doses (**use Meningitis doses**)

< 1 months: Ceftriaxone (if contraindications Cefotaxime) + **amoxicillin +/- aciclovir**. Stop amoxicillin if no listeria growth after 48 hours.

>1 months: Ceftriaxone +/- aciclovir

+/- vancomycin

History of penicillin / cephalosporin anaphylaxis:

Ciprofloxacin + Vancomycin

+ co-trimoxazole in place of amoxicillin in < 1 month old

+/- aciclovir

See <https://uk-pas.co.uk/Antimicrobial-Paediatric-Summary-UKPAS.pdf> for organism specific guidance

Consider adding as per clinical assessment:

- **Aciclovir** if <2 months AND raised liver function test, coagulopathy, haemodynamically unstable, maternal primary herpes simplex, vesicles, seizure, OR suspected meningitis / encephalitis
- **Vancomycin** if recent travel outside UK or prolonged antibiotic exposure in last 3 months
- **Hospital acquired meningitis:** Meropenem

Antimicrobial therapy duration in meningitis

NB total course IV. No oral switch

- N. meningitidis 7 days
- S. pneumoniae 10-14 days
- H. influenzae 7-10 days
- E. coli 21 days

3. Give steroids if child > 3 months of age: Dexamethasone 0.15mg/kg to max dose of 10mg QDS for 4 days if ≤12h from first antibiotics **and** LP shows:

- Purulent CSF
- raised CSF WBC count with protein count > 1g/L
- CSF WBC count > 1000 µL
- Bacteria on gram stain
- And no meningococcal sepsis

4. Consider CT head

- The role of brain imaging is to identify complications of meningitis or to exclude focal brain pathology simulating meningitis.
- Indications for CT (or MRI) are:

Reduced GCS
Symptoms / signs of raised ICP
Focal neurology
Seizures
Increasing head circumference / evidence of continuing infection / recurrence of symptoms


- Brain imaging should not be undertaken until after administration of antimicrobial therapy, control of raised intracranial pressure, and, if necessary, intubation and ventilation.
- Consult with Paediatric Consultant and PICU prior to CT head and ensure child is stable prior to transfer.

NB. a normal CT head does NOT rule out raised ICP (and therefore guarantee safety when performing LP). Raised ICP should be assessed clinically.

Bacterial meningitis and meningococcal septicaemia long-term management checklist

All children will need assessment prior to discharge to consider potential complications i.e., hearing loss, orthopaedic complications, skin complications, psychological problems, neurological & developmental problems, renal failure. Arrange follow up with the relevant specialities as relevant.

(Please tick once complete or write N/A)

Long-term management task	
Formal audiological assessment booked as soon as possible for BACTERIAL meningitis, preferably before discharge, within 4 weeks of being fit to test. <u>Not</u> indicated for viral meningitis	
If profound deafness, referral for urgent ENT assessment	
Follow-up outpatient clinic booked with a paediatrician 4–6 weeks after discharge from hospital	
Speciality follow up i.e., renal / ortho / neuro / audiology / ID / immunology (KF)	
Testing for immunodeficiency done or booked for Dr Fidler clinic in 4 weeks from discharge if: <ul style="list-style-type: none"> • 1 episode of meningococcal disease or severe pneumococcal disease • Severe disease AND history of other recurrent serious bacterial infections • Family history of meningococcal disease/complement deficiency • Unusual infections e.g., severe staph aureus boils / Hib disease / liver abscess / unusual organism / recurrent shingles etc 	
Informed the child's or young person's GP / health visitor / school nurse of their bacterial meningitis or meningococcal septicaemia	
Notified Surrey and Sussex Health Protection Team – 0344 225 3861 (legal requirement). See govt website for notifiable disease or call Micro Registrar	
Considered prophylaxis of household contacts of patients – ciprofloxacin is available in the emergency drug cupboard at the RSCH (Site Manager can contact the Pharmacist on call if emergency supplies run out)	