Bedside Clinical Guidelines Partnership

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Paediatric Guidelines

2025–28

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CONTENTS

PREFACE ● 1/2

This book has been compiled as an aide-memoire for all staff concerned with the management of general medical paediatric patients, especially those who present as emergencies.

Guidelines on the management of common medical conditions
No guideline will apply to every patient, even where the diagnosis is clear-cut; there will always be exceptions. These guidelines are not intended as a substitute for logical thought and must be tempered by clinical judgement in the individual patient.

The guidelines are advisory, NOT mandatory

Prescribing regimens and nomograms
The administration of certain drugs, especially those given intravenously, requires great care if hazardous errors are to be avoided. These guidelines do not include all guidance on the indications, contraindications, dosage and administration for all drugs. Please refer to the British National Formulary for Children (BNFc).

Antibiotics
Recommendations are based on national guidance reflecting a balance between common antibiotic sensitivities and the narrowest appropriate spectrum to avoid resistance but local policies may reflect frequently encountered sensitivity patterns in individual local patient groups.

Antimicrobials
Recommendations are generic. Please check your local microbiology advice.

Practical procedures
DO NOT attempt to carry out any of these practical procedures unless you have been trained to do so and have demonstrated your competence.

National guidelines
Where there are different recommendations the following order of prioritisation is followed:
NICE > NPSA > SIGN > RCPCH > National specialist society > BNFc > Cochrane > Meta-analysis > systematic review > RCT > other peer review research > review > local practice.

Evidence base
These have been written with reference to published medical literature and amended after extensive consultation. Wherever possible, the recommendations made are evidence based. Where no clear evidence has been identified from published literature the advice given represents a consensus of the expert authors and their peers and is based on their practical experience.

Supporting information
Where supporting evidence has been identified it is graded 1 to 5 according to standard criteria of validity and methodological quality as detailed in the table below. A summary of the evidence supporting each statement is available, with the original sources referenced. The evidence summaries are being developed on a rolling programme which will be updated as each guideline is reviewed.

PREFACE ● 2/2

Level	Treatment benefits	Treatment harms	Prognosis	Diagnosis
1	Systematic review of randomized trials or n-of-1 trials	Systematic review of randomized trials, systematic review of nested case-control studies, n-of-1 trial with the patient you are raising the question about, or observational study with dramatic effect	Systematic review of inception cohort studies	Systematic review of cross sectional studies with consistently applied reference standard and blinding
2	Randomized trial or observational study with dramatic effect	Individual randomized trial or (exceptionally) observational study with dramatic effect	Inception cohort studies	Individual cross sectional studies with consistently applied reference standard and blinding
3	Non-randomized controlled cohort/follow-up study	Non-randomized controlled cohort/follow-up study provided there are sufficient numbers to rule out a common harm	Cohort study or control arm of randomized trial	Non-consecutive studies, or studies without consistently applied reference standards
4	Case-series, case-control studies, or historically controlled studies	Case-series, case-control, or historically controlled studies	Case-series or case-control studies, or poor quality prognostic cohort study	Case-control studies, or poor or non-independent reference standard
5	Mechanism-based reasoning	Mechanism-based reasoning	n/a	Mechanism-based reasoning

Excerpt from: OCEBM Levels of Evidence Working Group. The Oxford Levels of Evidence 2. Oxford Centre for Evidence-Based Medicine. 2009. http://www.cebm.net/index.aspx?o=5653

Feedback

Evaluating the evidence-base of these guidelines involves continuous review of both new and existing literature. The editors encourage you to challenge the evidence provided in this document. If you know of evidence that contradicts, or additional evidence in support of the advice given in these guidelines please contact us.

The accuracy of the detailed advice given has been subject to exhaustive checks. However, if any errors or omissions become apparent contact us so these can be amended in the next review, or, if necessary, be brought to the urgent attention of users. Constructive comments or suggestions would also be welcome.

Contact

Partners in Paediatrics, via http://www.partnersinpaediatrics.org/, or Bedside Clinical Guidelines Partnership via e-mail: bedsideclinicalguidelines@uhnm.nhs.uk

ACKNOWLEDGEMENTS • 1/1

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RECOGNITION AND ASSESSMENT

Symptoms and signs

- Pain – may be localised or generalised
- Vomiting
- Anorexia
- Weight loss
- Fever
- Crying and irritability
- Character of the pain:
- colicky (spasmodic/comes in waves) or
- constant, sharp

Remember to examine inguinal canals (and genitalia in boys) as part of abdominal examination
In adolescent girls, consider possible pregnancy

Typical features of some important causes of acute abdominal pain in children

Appendicitis

- History of localised pain with increased severity
- On examination:
- low grade fever
- mid-abdominal pain migrating to RIF
- guarding and rebound tenderness
- pain on percussion
- Young children may not have typical features e.g. irritability, grunting, diarrhoea, vomiting, limp, right hip pain

Intussusception

- Typical age at presentation: 2 months–2 yr
- History of intermittent colicky abdominal pain 2–3 times/hr initially with increasing frequency
- Looks pale with pain
- Lethargic between episodes of pain
- Vomiting prominent feature
- Diarrhoea common
- Passage of blood and/or mucus *per rectum* (redcurrant jelly stools) late sign
- Follows respiratory or diarrhoeal illness
- Clinical features of intestinal obstruction
- On examination:
- a sausage-shaped mass crossing midline in the right upper quadrant, epigastrium or behind umbilicus may be palpable
- may be associated with Henoch-Schönlein purpura (children can be aged >2 yr)
- abdominal distension and hypovolaemic shock are late signs

Pneumonia and empyema

- History of fever and cough
- On examination:
- tachypnoea
- recession +/- focal signs at one base
- decreased breath sounds and dullness to percussion

Other differential diagnoses

Surgical problems

- Intestinal obstruction
- Torsion of ovary or testis
- Meckel's diverticulitis
- Renal pelvis-ureteric junction obstruction
- Renal or biliary calculus
- Enterocolitis secondary to Hirschprung's disease

Medical problems – relatively common

- Mesenteric adenitis (history of sore throat)
- Constipation

- Gastroenteritis
- Inflammatory bowel disease
- Lower lobe pneumonia
- Acute pyelonephritis
- Henoch-Schönlein purpura
- Hepatitis
- Acute cholecystitis
- Gastritis/peptic ulcer
- Coeliac disease (chronic history)
- Recurrent functional abdominal pain (affects 10–20%)
- Irritable bowel syndrome

Medical problems – rare but important
- Lead poisoning
- Diabetes
- Sickle cell crisis
- Acute porphyria
- Pancreatitis
- Primary peritonitis
- Non-accidental injury

Gynaecological problems
- Ectopic pregnancy
- Torsion of ovarian cyst
- Miscarriage
- Pelvic inflammatory disease (PID)
- Mittelschmerz pain (mid menstrual cycle)
- Imperforate hymen

Chronic abdominal pain red flag symptoms
Note – consider referral to paediatric gastroenterologist
- Persistent vomiting
- Family history of:
  - inflammatory bowel disease
  - coeliac disease
  - peptic ulcer disease
- Dysphagia
- Pain on swallowing
- GI blood loss
- Nocturnal diarrhoea
- Arthritis
- Perianal disease
- Weight loss or reduced linear growth velocity
- Fever

INVESTIGATIONS

Only urinalysis is essential, other tests as appropriate for differentials above:
- Urine testing and analysis
- FBC, ESR
- Blood and stool culture
- CRP, U&E, amylase, glucose, LFT
- If chronic history, tTG and IgA
- If at high risk of blood loss, consider group and save
- In adolescent females, consider pregnancy test (inform patient)
- Normal WBC and CRP do not rule out appendicitis

Imaging
- Abdominal X-ray
  - only if bowel obstruction or perforation suspected
- Abdominal ultrasound scan

- if child stable and appendicitis is suspected
- intussusception
- torsion of ovary or testis
- renal problems
- pancreatitis
- cholecystitis
- MRI abdomen and pelvis or CT
- If ultrasound normal and there is persisting pain, discuss MRI with paediatric radiologist during working hours only. Out-of-hours if skilled operator not available CT abdomen can be useful for same conditions, but involves radiation
- useful to rule out appendicitis and avoid hospital admission
- imaging should be considered with the surgical team and in light of other investigations
- If respiratory symptoms, **CXR**
- If acute surgical problem suspected (e.g. torsion of testis, intussusception), do not delay surgical review whilst awaiting scans

MANAGEMENT

- If hypotensive or shocked, treat with fluid bolus
- If surgical problem suspected, stop feeding
- If appendicitis suspected, clear fluids whilst awaiting surgical review
- If clinical peritonitis, keep nil-by-mouth
- If surgical cause likely, establish IV access
- If bowel obstruction, insert nasogastric tube on free drainage
- If suspected bowel perforation, IV antibiotics (e.g. cefuroxime and metronidazole as per Trust guidelines)

Indications for surgical review

- Localised RIF pain
- Rebound tenderness/pain on percussion
- Migration of pain
- Redcurrant jelly stools and bleeding *per rectum* (in the absence of constipation)
- Bile-stained vomiting
- Marked abdominal distension
- Inguino-scrotal pain or swelling
- Increasing abdominal pain with progressive signs of deterioration
- If in doubt, discuss with senior colleague and refer to surgical paediatric abdominal pain pathway

Recurrent abdominal pain

- If due to constipation, prescribe laxatives (e.g. laxido) and advise increased fibre in diet
- Probiotics may be of benefit (parents can purchase)
- Little evidence for benefit of any medications
- Hypnotherapy and psychological therapies are interventions most likely to provide benefit
- Little evidence dietary modification is helpful

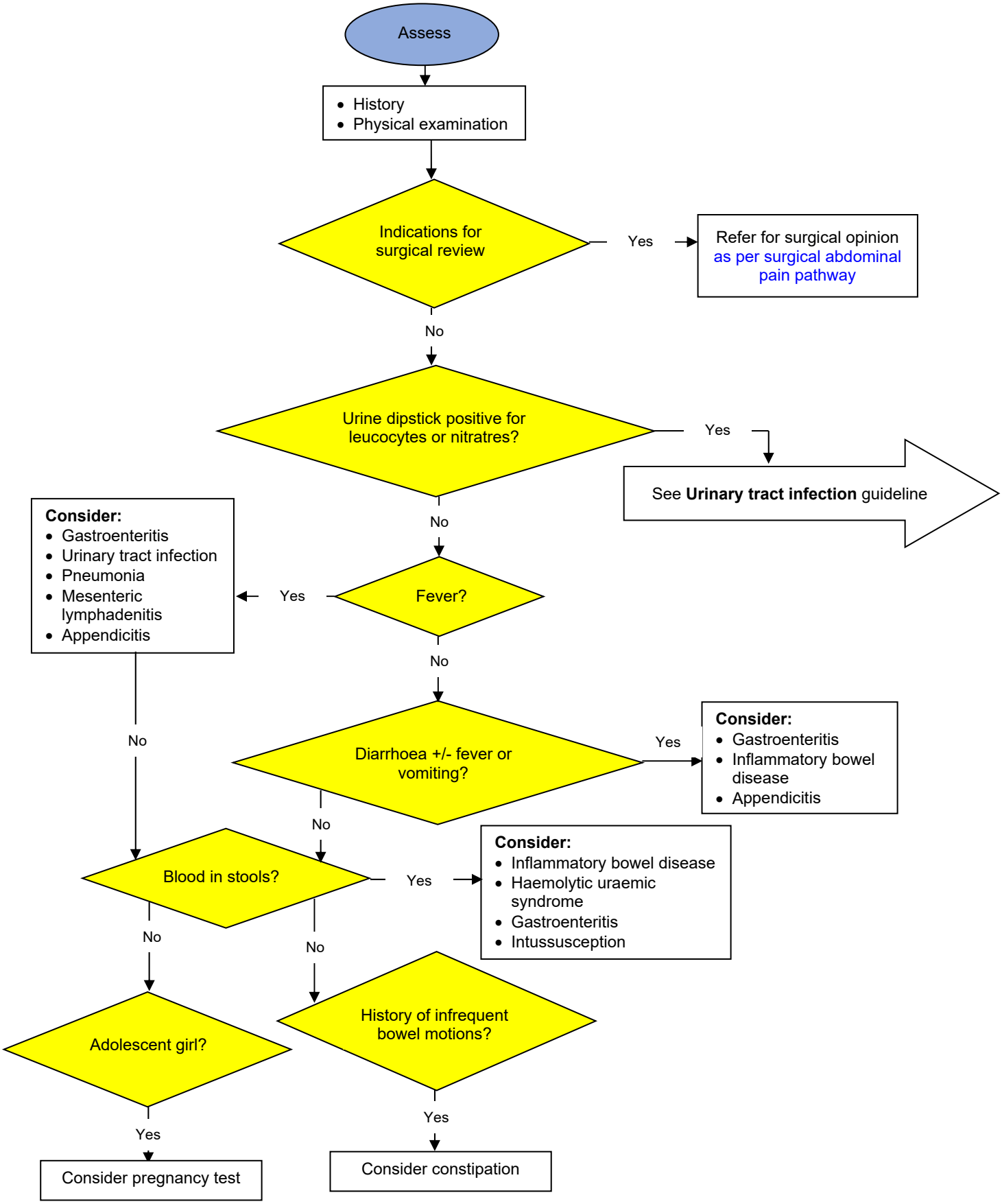
Observation

- If stable, period of observation may be useful to make diagnosis

Analgesia

- Do not withhold analgesia pending surgical review: opioids may be necessary (see **Analgesia** guideline)

Management of acute abdominal pain



SURGICAL ABDOMINAL PAIN PATHWAY

- Discuss with surgeons all surgical patients who re-present
- If appendicitis suspected, calculate appendicitis inflammatory response (AIR) score see https://www.mdcalc.com/calc/3984/appendicitis-inflammatory-response-air-score
- if score <4, appendicitis unlikely and no surgical input required
- if score ≥5, refer to surgeons
  - patients should be seen within 2 hr

DISCHARGE AND FOLLOW-UP

- Discharge usually within 24 hr of symptoms improving (e.g. fever, abdominal pain)
- Follow-up usually appropriate in primary care/GP

ACUTE KIDNEY INJURY ● 1/4

RECOGNITION AND ASSESSMENT

Definition

- Sudden reduction in renal function associated with retention of nitrogenous waste and acute disturbance of water and electrolyte balance

Presentation

- Poor/absent urine output (oliguria) with/without puffiness/oedema:
- <0.5 mL/kg/hr

Causes

Pre-renal

- Secondary to hypotension (e.g. hypovolaemia from gastroenteritis or septicaemia)
- urine osmolality >300 mOsm/kg
- urine:plasma urea ratio >5
- urine sodium <20 mmol/L

Renal

- Haemolytic uraemic syndrome (see **Haemolytic uraemic syndrome** guideline)
- Acute nephritis (see **Glomerulonephritis** guideline)
- Acute tubular necrosis or renal vein thrombosis
- Unrecognised chronic renal failure (oliguria usually not a feature)
- Acute-on-chronic renal failure (e.g. dehydration or infection in a child with chronic kidney disease)

Post-renal

- Urinary tract obstruction (rare)

Assessment

- Hydration (under/over)
- Weight (compare with previous if available)
- Skin (turgor/oedema)
- Ascites
- BP/capillary refill
- Jugular venous pressure (JVP), heart sounds
- Urine output

Immediate investigations

- See separate **guidelines for specific causes**
- Blood
- U&E, creatinine, calcium, phosphate, LDH (if considering haemolytic uraemic syndrome)
- FBC and film (if considering haemolytic uraemic syndrome)
- venous blood gas, lactate and glucose levels
- Urine
- urinalysis for blood, protein, nitrites and leucocytes
- If pyonephrosis suspected, renal ultrasound scan within 6 hr of assessment
- size and appearance of kidneys, perfusion
- swelling
- evidence of obstruction

IMMEDIATE TREATMENT

- Correct volume status and maintain fluid and electrolyte balance
- Prevent hyperkalaemia
- Treat underlying cause where appropriate
- Maintain adequate nutrition
- Review prescription to exclude or modify dose of nephrotoxic drugs

Fluid and sodium balance

Initial correction

- Dehydration
- for shock, give sodium chloride 0.9% 10 mL/kg immediately
- for correction of dehydration (see **Diarrhoea and vomiting** guideline)

- Volume overload/hypertension
- low plasma sodium usually indicates fluid overload
- furosemide (commence at 2 mg/kg and adjust to response) 2–4 mg/kg IV over 1 hr (maximum rate 4 mg/min), repeated 6-hrly if response obtained
- if furosemide ineffective, discuss dialysis with PICU/regional paediatric renal centre

Metabolic acidosis

- Sodium bicarbonate may be required – discuss with on-call consultant

Potassium

- Hyperkalaemia can lead to cardiac arrest or serious arrhythmias
- severely restrict potassium intake by introducing low potassium diet and avoiding potassium in IV fluids unless plasma potassium <3.5 mmol/L or there are ongoing losses
- If potassium >6.0 mmol/L, ECG monitoring essential, discuss with on-call consultant
- watch for development of prolonged P-R interval and/or peaked T wave
- as toxicity worsens, P wave is lost, QRS widens and S-T depression develops
- Once toxicity develops, the following (see **Table 1**) are holding measures whilst dialysis is set up
- give salbutamol IV or by nebuliser if no IV access as first-line emergency treatment, followed by oral/rectal calcium polystyrene sulphonate (even if salbutamol effective) to start to reduce potassium load
- if ECG still unstable, give calcium gluconate by slow IV injection
- if patient acidotic pH <7.30, give sodium bicarbonate to correct fully (base deficit × weight × 0.6)
- if further reduction required after other measures implemented, use insulin and glucose
- After starting treatment discuss with on-call consultant

Table 1: Emergency treatment of hyperkalaemia

Treatment	Dose	Onset	Mode of action
Salbutamol nebuliser	2.5–5 mg	5 min Lasts up to 2 hr; repeat as necessary	Shifts potassium into cells
Salbutamol IV	4 microgram/kg over 5 min repeat as necessary. Limited by tachycardia	Immediate Effect maximal at 60 min	Shifts potassium into cells
Calcium gluconate 10%	0.11 mmol/kg (0.5 mL/kg) IV [max 4.5 mmol (20 mL)] over 5–10 min. Monitor ECG Do not administer through same line as bicarbonate	1 min Repeat after 5 min if ECG changes persist	Antagonises effect of high potassium
Sodium bicarbonate 4.2% infusion (only if patient acidotic)	1 mmol/kg IV over 15 min (2 mL/kg of 4.2% diluted 1 in 5 with sodium chloride 0.9%) Do not administer through same line as calcium	1 hr Effect may last 2 hr	Shifts potassium into cells
Glucose/insulin infusion	Glucose 10% 0.5 g/kg/hr (5 mL/kg/hr) and when blood glucose >10 mmol/L infuse insulin 0.1 unit/kg/hr (50 units insulin in 50 mL sodium chloride 0.9%). Stop glucose and insulin when potassium falls by 0.5 mmol/L	15 min Effect may last several hours Frequent glucose stick checks	Shifts potassium into cells
Furosemide	1 mg/kg IV over 5 min	May not be effective in chronic renal failure	Potassium excreted in urine
Polystyrene sulphonate resins	Calcium polystyrene sulphonate: aged 1 month – 18 yr 125–250 mg/kg (max 15 g) oral 3–4 times daily. Discuss with nephrology team before starting it	Administer in water or as paste Do not give with fruit squash − high potassium content	Removes potassium from body

- Hypokalaemia is also dangerous
- if patient becomes potassium depleted from heavy ongoing losses (fistula or diuretic phase), it is most important that replacement is given
- amount and rate of replacement depend on estimation of losses and response to initial supplementation. If in doubt, discuss with on-call consultant

SUBSEQUENT MANAGEMENT

Fluid and sodium balance

- Discuss with consultant short-term bladder catheterisation to measure urine flow accurately
- Once normal hydration restored, aim to replace insensible loss (300 mL/m^2/day) + urine output + other losses
- In anuric patients (as opposed to oliguric), give oral fluids that are free of electrolytes to compensate for insensible loss; anuric patients having IV fluids should be prescribed, glucose 5%/sodium chloride 0.45%
- Replace sodium losses in urine and in other fluids (diarrhoea, gastric aspirate, fistula)
- in most patients dietary sodium will suffice
- in those with large fluid losses, consider IV sodium to match losses

Nutrition

- Involve paediatric dietitian

- A low-protein high-energy diet is ideal. Optimise nutritional intake in accordance with blood results and renal function
- Avoid foods high in potassium and phosphate
- Be realistic about what a child will take

Indications for discussion with renal unit

- Anuric patient
- Fluid overload unresponsive to diuretics
- Fluid overload with uncontrolled hypertension (for height-related 97th centiles – see **Hypertension** guideline)
- Potassium toxicity (as indicated by features listed previously)
- Metabolic acidosis (pH <7.2) unresponsive to base supplementation
- Seizures (secondary to hypertension or hyponatraemia)
- Loss of general well being +/- alteration in conscious level (see **Glasgow coma score** guideline)
- Blood product requirement
- AKI + multisystem disease
- Spontaneous resumption of renal function likely to be delayed
- acute-on-chronic renal failure
- haemolytic uraemic syndrome
- Following recovery from AKI if there is hypertension, impaired renal function (including if eGFR remains <80 mL/min/1.73 m^2) or ≥1+ proteinuria on early morning dipstick sample

MONITORING TREATMENT

- Accurate fluid balance – maintain strict input-output chart
- Re-assess fluid intake at least 12-hrly
- Record weight twice daily
- Check potassium hourly if >6 or <3 mmol/L
- Check U&E 12-hrly if potassium 3–6 mmol/L in renal failure
- Respond promptly to increase in urine volume, fall in serum creatinine and increase in urine osmolality by increasing fluid intake
- Once diuresis begins, increase electrolyte replacement, including potassium
- once stable, reduce fluid intake gradually to avoid prolonged diuretic phase

USEFUL INFORMATION

http://www.thinkkidneys.nhs.uk/aki/guidance-clinicians-managing-children-risk-acute-kidney-injury/

ACUTE PSYCHOSIS • 1/3

DEFINITION

- Mental state in which appreciation of reality is lost
- may range from hallucinations to delusions and self-neglect

CAUSES

Infectious diseases

Viral

- HSV
- Arbovirus
- Measles encephalitis

Bacterial

- Meningitis
- Cat scratch disease
- Urinary tract infections

Risckettsial and parasitic

- Lyme disease
- Malaria

Autoimmune diseases

- Acute disseminated encephalomyelitis
- Autoimmune neuropsychiatric disorders associated with streptococcal infections
- Systemic lupus erythematosus
- Reye syndrome
- Autoimmune hepatitis
- Immune mediated encephalitis (e.g. anti-NMDA receptor encephalitis, paraneoplastic limbic encephalitis)
- Hashimoto's encephalopathy

Metabolic conditions

- Hypoglycaemia
- Hyponatraemia
- Wilson's disease
- Acute intermittent porphyria
- Urea cycle defects
- Other more complex metabolic disorders e.g. homocysteine remethylation (discuss with metabolic team)

Systemic diseases

- Renal: uraemic encephalopathy
- Hepatic encephalopathy
- Endocrine
- adrenal
- thyroid

Toxins

- Substance abuse e.g. opioids and non-opioids
- Drug
- immunosuppressive
- anti-epileptics
- steroids
- Toxins
- Drug withdrawal e.g. benzodiazepines

Central nervous system abnormalities

- Seizure disorder
- Central nervous system
- mass lesion
- system vasculitis
- Intracranial injury

Migraine
- Acute confusional

Psychiatric disease
- Childhood-onset schizophrenia
- Brief reactive psychosis
- Bipolar disorder

HISTORY
- Drug overdose
- Recreational drugs
- Fever
- Trauma
- Seizures, headache, vomiting, history suggesting neurological deficit
- Rash, mucosal ulcers, joint pains suggesting SLE
- Episodes of worsening behaviour with intercurrent illness
- History of premorbid state, similar episodes in past, history of chronic kidney or liver disease
- Family history of neurological, behavioural or metabolic disorders
- Social history, including issues e.g. school bullying

EXAMINATION
- Focal neurological findings indicating intracranial space occupying lesion, stroke or trauma
- Papilloedema: raised intracranial pressure (trauma/infection/space occupying lesion)
- Irritability or signs of meningeal irritation – infective meningoencephalitis
- Body rash
- Eye examination for:
- Kayser Fleischer rings – suggests Wilson's disease
- dilated pupils – suggests sympathomimetic or anticholinergic drugs
- congestion – marijuana
- nystagmus – ketamine

INVESTIGATIONS
First line
- FBC, ESR
- U&Es, bone profile, Mg
- LFTs, blood glucose, TFT
- Coeliac screen
- Copper, caeruloplasmin
- Ferritin, vitamin B12, folate
- Ammonia
- Lactate
- Cranial CT/MRI
- EEG
- LP (e.g. in cases of suspected CNS infection such as bacterial meningitis and HSV encephalitis, after excluding contraindications)
- Toxicology screen

Second line investigations
- EEG
- Urine for porphyrins
- Anti-NMDA receptor (NMDAR) antibodies
- Anti-VGKC (LGI1 and CASPR2 antibodies)
- Anti-TPO antibodies
- Plasma amino acids
- Plasma carnitine and acylcarnitine
- Plasma homocysteine
- Urine organic acids
- Urine oligosaccharides and MPS screen
- Autoimmune screen (ANA, ANCA, ds-DNA, anti-CCP, antiphospholipid/cardiolipin antibodies)
- Haemoglobinopathy screen

- Viral PCR screen
  - if febrile, HSV
- HIV antibody
- Hepatitis B and C screen
  - if raised, ALT
- White cell enzymes
- Very long chain fatty acids
- LP (if not done as part of first line investigations), include:
  - CSF cell count
  - virology (in suspected meningoencephalitis) protein
  - glucose/lactate (paired with plasma)
  - amino acids (paired with plasma)

MANAGEMENT

- Stabilisation
  - ABCDE of resuscitation (if required)
- Treat underlying cause
- Management of agitation benzodiazepines, haloperidol (following review by psychiatrist)
- Discuss with neurologist, psychiatrist and other relevant specialist

ADRENAL INSUFFIENCY ● 1/6

- Adrenal insufficiency (AI) is characterised by lack of cortisol production from adrenal glands
- can be a primary adrenal disorder or secondary to adrenocorticotropic hormone (ACTH) deficiency, or suppression from exogenous glucocorticoids

SYMPTOMS

- May initially be non-specific and include:
- faltering growth
- lethargy
- poor feeding
- abdominal pains
- vomiting and lingering illnesses

TREATMENT

- Treat with replacement doses of hydrocortisone
- At times of physiological stress e.g. illness, trauma or surgery requirement for exogenous glucocorticoids increases – if untreated can lead to adrenal crisis and death

ADRENAL CRISIS

- See https://www.bsped.org.uk/adrenal-insufficiency#collapse44be1f43-cbd5-48f6-bb3d-f3184b779427
- If adrenal crisis suspected, e.g. acutely unwell with any of the following not attributable to another illness:
- tachycardia
- hypotension
- hypoglycaemia
- hyponatraemia
- hyperkalaemia
- treat immediately with glucocorticoids without delay +/- additional fluids – see **Table 1** and **2**

Emergency management
Community
Table 1: Intramuscular (IM) hydrocortisone doses/initial IV dose

Age	IM hydrocortisone dose	Indications
<1 yr	25 mg	• Acutely unwell and unable to obtain IV access • Acutely unwell with diarrhoea and vomiting and unable to tolerate oral treatment • Reduced responsiveness or loss of consciousness • Hypoglycaemic or new onset seizure in known or suspected adrenal insufficiency
1–5 yr	50 mg	
≥6 yr	100 mg	

Hospital

Table 2: Hydrocortisone dose and frequency

Age	Severe illness	Stable and improving	Stable and tolerating drinks/diet
≥28 days	• Age based doses given IM/IV ◦ aged <1 yr: 25 mg ◦ aged 1–5 yr: 50 mg ◦ aged ≥6 yr: 100 mg • Subsequent doses as below **OR** • 2 mg/kg (max 100 mg) IV bolus initially **then** • Bolus dose 6-hrly [*can give 4-hrly or as an infusion (see **Major surgery**)]	• 1 mg/kg (max 50 mg) IV 6-hrly [can give 4-hrly or as an infusion (see **Major surgery**)]	• Oral sick day steroids: 30 mg/m^2/day in 4 equally divided doses • If indicated restart fludrocortisone
<28 days	• 4 mg/kg IV initially 6-hrly [*can give 4-hrly or as an infusion (see **Major surgery**)]	• 2 mg/kg IV 6-hrly [can give 4-hrly or as an infusion (see **Major surgery**)]	• Oral sick day steroids: 30 mg/m^2/day in 4 equally divided doses • If indicated restart fludrocortisone

**If small or failure to thrive, discuss using neonatal doses with consultant*

Table 3: Fluid type and volume

Blood glucose <3 mmol/L	• 2 mL/kg glucose 10% IV bolus • Recheck blood glucose after 15 min and repeat bolus if necessary
Shock or moderate to severe dehydration	• Give sodium chloride 0.9% 10 mL/kg as bolus and repeat if necessary • Check electrolytes immediately at presentation to inform fluid usage (see **Fluid and electrolyte management**)
Maintenance fluids type and amount	• Sodium chloride 0.9%/glucose 5% usually appropriate starting point: ◦ 1st 10 kg: 100 mL/kg/day ◦ 2nd 10 kg: 50 mL/kg/day ◦ >20 kg: 20 mL/kg/day • Do not exceed daily adult dose i.e.: ◦ adult males: 2.5 L/day (104 mL/hr) ◦ adult females: 2 L/day (83 mL/hr)

PERI- AND POST-OPERATIVE MANAGEMENT

Major surgery

- See British society for paediatric endocrinology and diabetes (BSPED) https://www.bsped.org.uk/
- https://www.bsped.org.uk/clinical-resources/bsped-adrenal-insufficiency-consensus-guidelines/
- Defined as any procedure lasting >90 min with variable recovery periods and an expected delay in restarting oral intake
- In all cases, initial bolus of hydrocortisone given at induction, followed by either a hydrocortisone infusion **or** regular bolus doses (as preferred)

Table 4: Continuous IV infusion hydrocortisone doses

<table>
<tr><td>Induction</td><td colspan="3">Hydrocortisone 2 mg/kg IV bolus (max 100 mg)
(premature infants and neonates <28 days' corrected gestational age: 4 mg/kg)</td></tr>
<tr><td rowspan="8">Intra-operative</td><td colspan="3">IV hydrocortisone infusion</td></tr>
<tr><td>Weight (kg)</td><td>Total dose in 24 hr</td><td>Infusion rate (50 mg hydrocortisone in 50 mL sodium chloride 0.9%)</td><td>Additional consideration</td></tr>
<tr><td><10</td><td>25 mg</td><td>1 mL/hr</td><td rowspan="5">• More concentrated infusion in those requiring fluid restriction (e.g. 100 mg hydrocortisone in 50 mL sodium chloride 0.9%)
• Hydrocortisone infusion can run alongside sodium chloride 0.9%, glucose 5% and Plasma-Lyte solutions</td></tr>
<tr><td>>10–20</td><td>50 mg</td><td>2 mL/hr</td></tr>
<tr><td>>20–40</td><td>100 mg</td><td>4 mL/hr</td></tr>
<tr><td>>40–70</td><td>150 mg</td><td>6 mL/hr</td></tr>
<tr><td>>70</td><td>200 mg</td><td>8 mL/hr</td></tr>
<tr><td>Post-operative</td><td colspan="2">• Continue hydrocortisone infusion
• Change to oral sick day hydrocortisone when stable and tolerating oral fluids/diet</td><td></td></tr>
</table>

Table 5: Child >28 days corrected gestational age with IV hydrocortisone boluses

	Hydrocortisone bolus dose	Frequency	Additional considerations
Induction	2 mg/kg (max 100 mg)		• Neonatal doses for infants who are significantly small for gestational age or with faltering growth
Intra-operative	2 mg/kg (max 100 mg)	• Given at 6 hr IV	• Infusion for prolonged procedures • 4-hrly if unstable
Post-operative	1 mg/kg (max 50 mg)	• Every 6 hr IV • Change to oral sick day hydrocortisone when stable and tolerating oral fluids/diet	• In severe obesity substituting 50 mg hydrocortisone with 100 mg hydrocortisone

Tables 6: Premature infants and neonates (<28 days' corrected gestational age) with IV hydrocortisone boluses

	Hydrocortisone bolus dose	Frequency	Additional considerations
Induction	4 mg/kg		
Intra-operative	2 mg/kg	• Given at 6 hr IV	• Infusion for prolonged procedures • 4 mg/kg if unstable or can give 4-hrly doses (discuss with consultant)
Post-operative	2 mg/kg	• Every 6 hr IV • Change to oral sick day steroids when stable and tolerating oral feeds	• Oral dose can be given IV if not tolerating feeds

Minor procedures

- See https://www.bsped.org.uk/clinical-resources/bsped-adrenal-insufficiency-consensus-guidelines/
- Defined as any procedure lasting <90 min and patient expected to be eating and drinking by next meal e.g.
  - MRI scans
  - endoscopies
  - dental extractions under general anaesthetic/sedation
- If procedure >90 min proceed management as per major surgery, with a further bolus hydrocortisone IV given 4–6 hr after initial dose

Table 7: Procedures requiring general anaesthesia

	Hydrocortisone bolus dose	Post-operative
Induction	2 mg/kg (max 100 mg) * (4 mg/kg in neonates)	Oral sick day steroid doses for 24 hr
*Use neonatal dosing for infants significantly small for gestational age or failing to thrive (whilst not neonates, are neonatal size)		

Table 8: Procedures NOT requiring general anaesthesia

Medical procedures (local anaesthetic/sedation)	Oral hydrocortisone dose
• Minor procedure – local anaesthetic (e.g. skin biopsy) • Minor dental procedures e.g. filling, tooth extraction	• Give oral sick day steroid dose before procedure • If in pain/unwell – continue for up to 24 hr
• MRI scans (using sedation) • Non-anaesthetic sedation (e.g. chloral hydrate) does not merit use of hydrocortisone IV – sick day dosing with hydrocortisone oral is sufficient	• Give oral sick day steroid dose before to procedure and continue for the day

SICK DAY RULES AND DOSE

Indication

- Moderate to severe illness
- Too unwell to go to school

- Diarrhoea and vomiting
- Minor procedure

- If oral sick day dose not tolerated give hydrocortisone IM as above

Dose

- Total daily hydrocortisone dose of approximately 30 mg/m^2/day given as 4 evenly spaced doses recommended
- see **BNFc** for body surface area calculation or latest clinic letter for sick day dose (if available)

FLUID AND ELECTROLYTE MANAGEMENT

- See https://www.bsped.org.uk/
- https://www.bsped.org.uk/clinical-resources/bsped-adrenal-insufficiency-consensus-guidelines/

Table 9

	Primary adrenal insufficiency (elevated ACTH levels)	Secondary adrenal insufficiency (suppressed ACTH)
Glucocorticoid treatment	• Usually hydrocortisone	• Usually hydrocortisone (or prednisolone)
Mineralocorticoid treatment	• Fludrocortisone • Acute illness (primary AI)	• Not required • Acute illness (secondary AI)
Possible abnormality of sodium and potassium	• May have hyponatraemia and hyperkalaemia • Dehydration due to mineralocorticoid deficiency causing salt and water loss	• ACTH and hence cortisol deficiency associated with inability to excrete water load • If hyponatraemia present may be due to excess water • Potassium usually normal – may not be significantly fluid deplete
Other possible electrolyte abnormalities	• Hypoglycaemia • Hypercalcaemia • Metabolic acidosis	• Hypoglycaemia
Treatment	• Correct hypoglycaemia • Glucocorticoids in stress doses have some mineralocorticoid action • Sick day oral hydrocortisone or hydrocortisone IV with sodium chloride 0.9% IV will usually result in resolution of biochemical abnormality • In some cases, specific treatment for hyperkalaemia required (see below)	• Correct hypoglycaemia • May need to adapt volume and type of IV fluid individual circumstance – may include checking adequate glucocorticoids have been provided (see below)

Hyponatraemia

Features warranting slow or particularly careful rehydration

- Rapid correction of acute and chronic hyponatraemia can be associated with significant risk of cerebral oedema and/or osmotic demyelination syndrome
- Substantial risk of seizures with plasma Na <110 mmol/L
- If plasma Na concentration <105 mmol/L elevated risk of osmotic demyelination syndrome
- Careful approach to rehydration required with:
- severe hyponatraemia; plasma sodium <120 mmol/L
- reduced consciousness, seizures or other signs compatible with cerebral oedema
- diabetes insipidus

- when duration of illness or being unwell >1 day

Key considerations in severe hyponatraemia

- Avoid increasing plasma Na concentration by >10 mmol/L/day (approximately 0.5 mmol/L/hr)
- normal sodium chloride 0.9% with stress doses of glucocorticoid can increase sodium concentrations more rapidly
- IV fluid may need to be changed to one containing less sodium
- Slow, measured, increase in serum sodium can be achieved by linking sodium input (fluid) to output (urine) (i.e. giving little more sodium than that present in urine)
- In patients in adrenal crisis careful monitoring of electrolytes required
- particularly important when hydrocortisone treatment started in addition to mineralocorticoid action, hydrocortisone will also switch off ADH secretion leading to a diuresis and potentially rapid rise in plasma sodium concentration
- Sodium chloride 3% 1 mL/kg will increase plasma Na concentration by approximately 1 mmol/L
- can be considered especially in context of abnormal neurology or ongoing severe symptomatic hyponatraemia
- may need to repeat bolus
- close supervision and regular clinical assessment and monitoring of electrolytes is required
- Discuss admission to PHDU/PICU with consultant
- Rate of correction of hyponatraemia may be dependent on underlying aetiology
- sodium should not rise >10 mmol/L in 24 hr

Hyperkalaemia treatment

- Rehydration with sodium chloride and administration of hydrocortisone are key measures that will reduce potassium in the context of adrenal insufficiency
- If plasma potassium >7.0 nmol/L or ECG changes
- calcium gluconate 10% IV: 0.5 mL/kg (0.11 mmol/kg) slow IV administration over 10 min with ECG monitoring to stabilise myocardium – maximum single dose 4.5 mmol (20 mL)
- nebulised salbutamol – quick and readily available treatment that drives potassium into cells
  - aged 0–5 yr: 2.5 mg
  - aged >5 yr: 5 mg (3 doses back-to-back)
- If persistent hyperkalaemia:
- insulin and glucose – short-acting insulin (Actrapid® or NovoRapid®): 0.1 units/kg in 5–10 mL/kg glucose 10% IV over 30 min
- If significant metabolic acidosis, consider sodium bicarbonate 1 mmol/kg IV over 30 min
- Cation exchange resins – calcium or sodium polystyrene sulfonate (resonium): 125–250 mg/kg 6-hrly oral or PR in neonates
- Discuss admission to PHDU/PICU with consultant
- Check potassium levels within 15 min after initial treatment and recheck after 1–2 hr to decide about further treatment

FURTHER INFORMATION

- See Adrenal Insufficiency Guideline of the British Society for Paediatric Endocrinology and Diabetes (BSPED) (https://www.bsped.org.uk)
- https://www.bsped.org.uk/clinical-resources/bsped-adrenal-insufficiency-consensus-guidelines/

- For combination of analgesics to use, see **Analgesic ladder** in **Pain assessment** guideline

TOPICAL AND DISTRACTION TECHNIQUES

Age group	Preparation	Time to onset	Comments
<1 month	Sucrose 24% oral solution on dummy	During procedure	For venepuncture or cannulation
>1 month	Lidocaine 4% LMX4® local anaesthetic cream	30–60 min	Wait 5 min after removing cream before cannulation
	Lidocaine 2.5% with prilocaine 2.5% EMLA® **or** Denela® local anaesthetic cream (5 g tube)	30–60 min. Remove after 1 hr	• Aged <3 months: apply no later than 1 hr before procedure • Aged 3 months–1 yr: max 2 doses in 24 hr, 4 hr before procedure • Aged >1–18 yr: 1–5 hr before procedure, max 2 doses in 24 hr
>5 yr	Ethyl chloride spray (i.e. Cryogesic®)	Immediately	If cannot wait for cream

MILD PAIN – not impacting on activities (pain score 1–3)

Drug and preparation	Dose	Maximum dose in 24 hours	Comments
Paracetamol [oral/nasogastric (NG)] • Suspensions: ◦ 120 mg/5 mL ◦ 250 mg/5 mL • Tablets/soluble 500 mg	• Aged 1 month (born term) – 12 yr or ≤50 kg: 15 mg/kg 4–6 hrly max QDS • For obese patients use ideal body weight • Aged 12–18 yr **and** >50 kg: 500 mg–1 g 4–6 hrly max QDS • For TTO see **BNFc** banded doses	• Aged <1 month [>32 weeks corrected gestational age (CGA)]: 60 mg/kg/day • Aged ≥1 month (born term) –18 yr: 75 mg/kg/day (max 4 g/day)	• For mild pain • Increase dose interval in renal impairment • Avoid large doses in dehydration, malnutrition, hepatic impairment • Review need for paracetamol at day 3
Paracetamol (rectal) • Suppositories: ◦ 60 mg ◦ 125 mg ◦ 250 mg ◦ 500 mg ◦ 1 g	• Aged 1–3 months: 30–60 mg 8-hrly • Aged 3–12 months: 60–125 mg 4–6 hrly • Aged 1–5 yr: 125–250 mg 4–6 hrly • Aged 5–12 yr: 250–500 mg 4–6 hrly • Aged 12–18 yr: 500 mg –1 g 4–6 hrly	• **Max total dose in 24 hr:** ◦ aged 1–3 months: 60 mg/kg daily in divided doses (8-hrly ◦ aged 3–12 months: 4 doses (4–6 hrly) ◦ aged 1–5 yr: 4 doses (4–6 hrly) ◦ aged 5–12 yr: 4 doses (4–6 hrly) ◦ aged >12 yr: 4 doses (4–6 hrly)	• As for oral paracetamol • For mild pain when oral/NG route not possible
Paracetamol (IV) 10 mg/mL (<33 kg use 50 mL vial via burette or in syringe) Prescribe in mg (not mL)	• <10 kg: 7.5 mg/kg 6-hrly • 10–50 kg: 15 mg/kg 6-hrly • >50 kg: 1 g 6-hrly • If obese, use ideal body weight	• <10 kg: max 30 mg/kg/day • 10–50 kg: max 60 mg/kg/day • >50 kg: max 4 g/day	• As for oral paracetamol • For mild pain when oral/NG/PR route not possible • Give over 15 min

MODERATE PAIN – some interference with activities (pain score 4–7)

Drug and preparation	Dose	Maximum dose in 24 hr	Comments
Ibuprofen • Liquid 100 mg/5 mL • Tablets 200 mg and 400 mg	• Aged 3 months–12 yr: 5 mg/kg 6–8 hrly • Aged ≥12 yr: 200–400 mg 6–8 hrly • See **BNFc** for banded doses for TTO	• Aged <12 yr: max 30 mg/kg/day in 3–4 divided doses • Aged ≥12 yr: 400 mg 3–4 times per day	• If aged <3 months or <5 kg use only if recommended by consultant • Avoid in renal dysfunction/impairment • Contraindications: ◦ shock ◦ bleeding disorders ◦ hypersensitivity to aspirin or other NSAID • Can be given to asthmatics if no history of NSAID-induced wheeze and chest clear on auscultation • Caution in hypertension, heart failure
Diclofenac sodium • Tablets: ◦ enteric coated 25 mg and 50 mg • Suppositories 12.5 mg, 25 mg, 50 mg and 100 mg	• Aged >6 months: 300 microgram –1 mg/kg 8-hrly	• Max 1 mg/kg up to 50 mg 8-hrly (max 150 mg/day)	• As ibuprofen • Second line NSAID – consultant led use only • If liquid dose form required for chronic pain aged >6 yr, consider piroxicam
• **Morphine** sulfate oral solution	• Oral 50–100 microgram/kg 4–6 hrly (max 5 mg depending on weight)		• Respiratory rate, maintain: ◦ aged 1–2 yr: >16 breaths/min ◦ aged 2–9 yr: >14 breaths/min ◦ aged 10–16 yr: >12 breaths/min • If rate reduced, contact medical staff

SEVERE PAIN IN CHILDREN AGED >1 YR – unable to perform activities (pain score 8–10)

In head injuries/respiratory difficulties/upper airway obstruction/ex-premature infant, use opioids only with consultant advice. Monitor children needing oxygen and parenteral opioids with SpO_2 +/- $TcCO_2$ in an HDU setting

ANALGESIA • 3/4

Analgesic method and technique	Dose	Monitoring
Oral morphine sulfate • Single dose before painful procedure may be useful • Use if no IV access or for weaning from IV opioid • If to be taken regularly consider use of prophylactic laxative	• 200–300 microgram/kg 2–4 hrly PRN then review • If weight >50 kg:10–15 mg 2–4 hrly PRN then review	• Respiratory rate, maintain: ◦ aged 1–2 yr: >16 breaths/min ◦ aged 2–9 yr: >14 breaths/min ◦ aged 10–16 yr: >12 breaths/min ◦ if rate reduced, contact medical staff
IV morphine sulfate patient/nurse-controlled analgesia (PCA/NCA) • PCA suitable for children aged >5 yr (understand and will press button); NCA otherwise • Nurses must be certified competent in use of PCA/NCA • Use anti-reflux valve unless dedicated cannula • Use morphine 1 mg/kg made up to 50 mL with sodium chloride 0.9% ◦ max of 50 mg/50 mL (i.e. cap at 50 kg)	• If loading dose required: ◦ **experienced staff only** ◦ 50–100 microgram/kg over 5 min (max 5 mg) – PCA: 1 mL bolus, 5 min lockout, no background infusion – NCA: 1 mL bolus, 20 min lockout, +/- background infusion as per each individual infusion pump protocol	Hourly observations • Pain score • Sedation score • Pump displays • Syringe movement • Respiratory rate • SpO_2 if needed • $TcCO_2$ if needed 4-hrly observations • Vomiting/itching • Urinary retention • Inspection of IV site
IV morphine sulfate infusion (PICU only) • Use for severe pain when unable to use PCA/NCA • Use anti-reflux valve unless dedicated cannula • Use anti-siphon valve on line • Use morphine 1 mg/kg made up to 50 mL with sodium chloride 0.9% ◦ max of 50 mg/50 mL (i.e cap at 50 kg, even for patients >50 kg)	• Loading dose of 100 microgram/kg given over 5 min (max 5 mg) • Continuous infusion of 10–40 microgram/kg/hr (cap at 50 kg) • Start at 20 microgram/kg/hr except after major surgery when start at 30 microgram/kg/hr and adjust according to pain and sedation scores	Hourly observations • Pain score • Sedation score • Respiratory rate (as above) • SpO_2 monitoring • Syringe movement • IV site for infection • Urinary retention
IV intermittent morphine sulfate • Infusion preferable	• Give slowly over 5 min ◦ 100 microgram/kg 4 hrly (max 5 mg)	Hourly observations • Pain score • Sedation score • Respiratory rate (as above) • SpO_2 monitoring
SC intermittent opioid • IV preferable • Site 22/24 G SC cannula at time of surgery or using local anaesthetic cream ◦ suitable sites: uppermost arm, abdominal skin	• Flush with sodium chloride 0.9% 0.3 mL • Prime cannula with morphine solution • Morphine sulfate: ◦ 100–200 microgram/kg 4-hrly ◦ max 6 times in 24 hr (for aged ≥6 months)	Hourly observations • Pain score • Sedation score • Respiratory rate (as above)

SEVERE PAIN IN CHILDREN AGED <1 YR (pain score 8–10)

In head injuries/respiratory difficulties/upper airway obstruction/ex-premature infant, only use opioids with consultant advice. Monitor children requiring oxygen and parenteral opioids with SpO_2 +/- $TcCO_2$ in an HDU setting

Analgesic method and technique	Dose	Monitoring
Oral morphine sulfate • Use if no IV access or for weaning from IV opiate	• Aged 1–6 months: 50–100 microgram/kg 6-hrly • Aged 6–12 months: 100–200 microgram/kg 4-hrly	• Pain score • Sedation score • **Respiratory rate**, maintain: ◦ if aged <6 months, >20 breaths/min ◦ if aged ≥6 months, >16 breaths/min ◦ if rate reduced, contact medical staff • SpO_2
Morphine sulfate infusion (PICU only) • Use anti-reflux valve unless dedicated cannula • Use anti-siphon valve on line • Use morphine 1 mg/kg made up to 50 mL with sodium chloride 0.9% ◦ thus 1 mL/hr = 20 microgram/kg/hr	• Aged <1 month: 50 microgram/kg over 5 min then 5–20 microgram/kg/hr • Aged 1–12 months: 100 microgram/kg over 5 min then 10–40 microgram/kg/hr • Adjust in increments of 5 microgram/kg/hr according to response	Hourly observations • Pain score • Sedation score • Respiratory rate (as above) • SpO_2 monitoring • Syringe movement • Site for infection • Urinary retention
IV intermittent morphine sulfate • Infusion preferable	• Aged <1 month: 50 microgram/kg 6-hrly • Aged 1–6 months: 100 microgram/kg 6-hrly • Aged 6–12 months: 100 microgram/kg 4-hrly	Hourly observations • Pain score • Sedation score • Respiratory rate (as above) • SpO_2 monitoring
SC intermittent morphine sulfate • IV preferable • Site 24 G SC cannula at time of surgery or using local anaesthetic cream ◦ suitable sites: uppermost arm, abdominal skin	• Flush with sodium chloride 0.9% 0.3 mL • Morphine: ◦ aged <1 month: 100 microgram/kg 6-hrly ◦ aged 1–6 months: 100–200 microgram/kg 6-hrly (aged ≥6 months 4–6 hrly)	Hourly observations • Pain score • Sedation score • Respiratory rate (as above) • SpO_2

ANAPHYLAXIS ● 1/4

DEFINITION

- Sudden onset systemic life-threatening hypersensitivity reaction
- Acute-onset illness (from minutes to several hours) involving:
  - respiratory compromise
  - reduced blood pressure or symptoms of end organ dysfunction
  - infants and children: low systolic pressure according to age-related values or decrease in 30% of systolic pressure
  - teenagers: systolic pressure <90 or decrease >30% of baseline
  - often (but not always) involves skin and/or mucosal tissue

TRIGGERS

- Food
- Drugs
  - antibiotics
  - non-steroidal anti-inflammatorie (NSAIDs)
  - chemotherapy
  - contrast material
  - anaesthetic agents
- Insect sting
- Latex

SYMPTOMS AND SIGNS

Table 1: Allergy vs anaphylaxis

Allergy	Anaphylaxis (To diagnose anaphylaxis ≥1 of the below must be present)		
	Airway	**Breathing**	**Circulation**
• Swollen lips, face or eyes • Itchy/tingling mouth • Hives/itchy skin rash • Abdominal pain/ vomiting • Sudden change in behaviour	• Persistent cough • Hoarse voice • Difficulty swallowing • Swollen tongue	• Difficulty breathing • Noisy breathing • Wheeze • Persistent cough	• Persistent dizziness • Pale/floppy • Suddenly sleepy • Collapse/unconscious • Feeling of impending doom

IMMEDIATE TREATMENT

- See **Management of anaphylaxis** algorithm
- Remove allergen (if possible)
- Call for help

- Adrenaline **IM**: dose by age (see **Management of anaphylaxis** algorithm) or 10 microgram/kg: 0.01 mL/kg of 1:1000 (maximum 0.5 mL = 0.5 mg)
  - give in mid-outer thigh
  - auto-injectors (EpiPen® or Jext ®) may be used:
    - weight <15 kg: 150 microgram IM
    - weight 15–<25 kg: 150 microgram IM (then 150 micrograms after 5 min as required)
    - weight ≥25 kg: 500 microgram IM (if not available use 300 microgram IM)
- Do not give adrenaline for widespread facial or peripheral oedema and rash in absence of other systemic symptoms

- If no response after 5 min, repeat adrenaline IMIf no response after 5 min to second dose IM, see **Refractory anaphylaxis**. Seek critical care support (PICU)

- ABCDE approach: provide advanced paediatric life support (APLS) as needed
  - facial oedema should prompt careful, urgent review of airway
  - if airway oedema, call anaesthetist for potential difficult airway intubation
  - treat stridor with nebulised adrenaline 1:1000 (1 mg/mL) 400 microgram/kg (maximum 5 mg)
  - treat wheeze with nebulised salbutamol (Aged 1–4 yr: 2.5 mg via oxygen driven nebuliser, if possible, aged 5–17 yr 5 mg via oxygen driven nebuliser if possible. Repeat every 20–30 min as needed)

- treat shock with sodium chloride 0.9% 10 mL/kg bolus initially
- NB: children with anaphylaxis are likely to need more than 1 fluid bolus and so prompt reassessment and further fluid bolus(es) should be given as needed
- monitor
  - SpO_2
  - non-invasive blood pressure
  - ECG

REFRACTORY ANAPHYLAXIS

- Further rapid fluid bolus of 10 mL/kg and commence adrenaline infusion IV/IO following local protocol **or** adrenaline 1 mg [1 mL of 1 mg/mL (1:1000)] in 100 mL of sodium chloride 0.9%. Start at 0.5–1 mL/kg/hr and titrate according to response
- Whilst waiting for infusion to be prepared, give IM adrenaline every 5 min
- If shock is refractory to adrenaline infusion, discuss second vasopressor (e.g. noradrenaline, vasopressin or metaraminol) with pediatric intensive care specialist
- corticosteroids are still recommended for refractory reactions - use in acute phase limited as onset of action is too delayed to be of benefit in first hour

Do not give adrenaline intravenously except in cardiorespiratory arrest or resistant shock (no response to 2 IM doses)

Table 2:

Drugs in anaphylaxis	Dosage by age			
	<6 months	**6 month–5 yr**	**6–12 yr**	**>12 yr**
Adrenaline IM: 0.01 mL/kg: 1 in 1000 (10 microgram/kg)	100–150 microgram (0.1–0.15 mL)	150 microgram (0.15 mL)	300 microgram (0.3 mL)	500 microgram (0.5 mL)
Crystalloid (sodium chloride 0.9%)	10 mL/kg			
Adrenaline IV	As per local policy, **or** 1 mg [1 mL of 1 mg/mL (1:1000)] adrenaline in 100 mL of sodium chloride (0.9%). Start at 0.5–1 mL/kg/hr and titrate according to response			
Hydrocortisone (IM/slow IV) – for refractory anaphylaxis only	25 mg	50 mg	100 mg	200 mg
Cetirizine – give post stabilisation	Not to be used	• 1–2 yr: 250 microgram/kg 12-hrly • >2 yr: 2.5 mg 12-hrly	5 mg 12-hrly	10 mg daily

SUBSEQUENT MANAGEMENT

- **Admit for minimum of 6 hr** to detect potential biphasic reactions and usually for 24 hr, especially in the following situations:
- severe reactions with slow onset caused by idiopathic anaphylaxis
- reactions in individuals with severe asthma or with a severe asthmatic component
- reactions with possibility of continuing absorption of allergen
- previous history of biphasic reactions
- presenting in evening or at night, or those who may not be able to respond to any deterioration
- in areas where access to emergency care is difficult
- Consider sending mast cell tryptase – serum sample (clotted blood – must get to immunology immediately) at following times:
- immediately after reaction
- 1–2 hr after symptoms started when levels peak
- >24 hr after exposure or in convalescence for baseline
- If trigger unclear, then mast cell tryptase MUST be sent

- If patient presenting late, take as many of these samples as time since presentation allows
- Please discuss with a consultant paediatrician with an interest in allergy if the patient has required adrenaline and the trigger is not clear, as the differential diagnosis could be bradykinin disease

FOLLOW-UP

- Give following to patient, or as appropriate their parent and/or carer:
- information about anaphylaxis, including signs and symptoms of anaphylactic reaction
- information about risk of biphasic reaction
- information on what to do if anaphylactic reaction occurs (use adrenaline injector and call emergency services)
- demonstration of correct use of the adrenaline injector and when to use it
- advice about how to avoid suspected trigger (if known)
- information about need for referral to a specialist allergy service and the referral process
- information about patient support groups

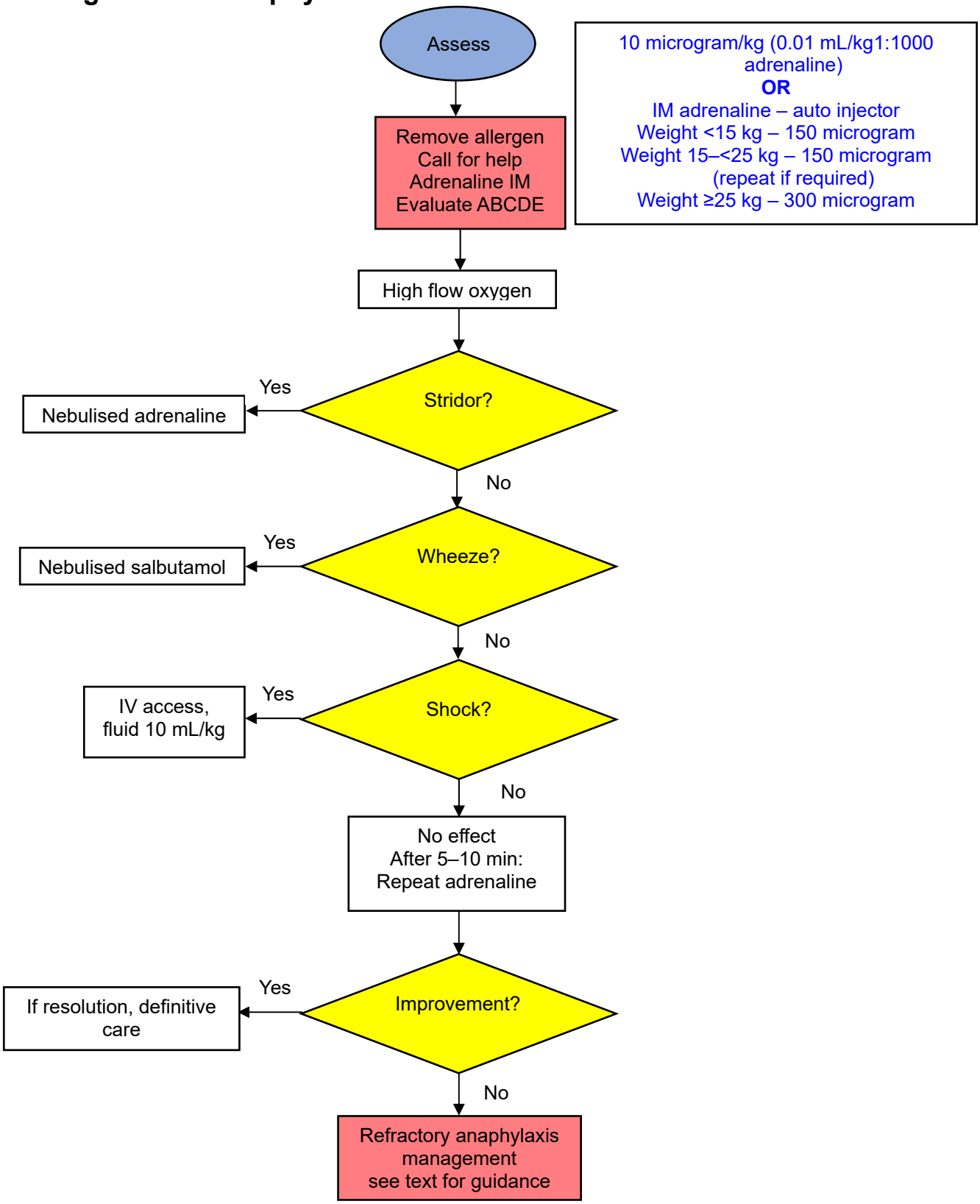
Further useful information

- Families/children on allergy UK website – https://www.allergyuk.org/allergyuk-resources/?conditions=15

DISCHARGE

- Discharge with a personalised allergy action plan and adrenaline auto-injector(s) (number as per local policy) after appropriate training:
- see https://www.bsaci.org/resources/resources/paediatric-action-plans/
- see https://www.itchysneezywheezy.co.uk/FoodAnaVideos.html (training videos)
- If still symptomatic give oral antihistamines for up to 3 days
- Refer as outpatient to consultant paediatrician with an interest in allergy

Management of anaphylaxis



ANTIBIOTICS ● 1/1

Always check local guidelines

NATIONAL GUIDELINES

- UK Paediatric Antimicrobial Stewardship (UKPAS) https://uk-pas.co.uk
- British Society for Antimicrobial Chemotherapy https://bsac.org.uk/paediatrics
- Eolas Medical https://app.eolasmedical.com
- Microguide: Antibiotic Paediatric National Guide UK-PAS https://uk-pas.co.uk/Antimicrobial-Paediatric-Summary-UKPAS.pdf
  - for all ages on paediatric wards (not neonatal units)
  - recommendations based on evidence hierarchy of: National guidelines > RCTs > local practice
  - adjust if high local resistance rates, patient's previous and current culture results
- See https://bsac.org.uk/paediatrics/ for indications, investigations and other management
- See **BNFc** for doses, contraindications, interactions etc.

GENERAL ADVICE

- Collect all specimen(s) for culture before commencing antibiotics
- Once organism identified, change antibiotic to narrowest spectrum appropriate for site of infection
- Give oral**,** unless only IV available or specifically stipulated
- Consider IV to oral switch
- At 48 hr review consider whether to:
  - stop
  - switch to oral
  - change
  - continue
  - give paediatric outpatient parenteral antibiotic therapy

MANAGEMENT

- Stimulate patient to assess for signs of life and call for help
- Establish basic life support: Airway – Breathing – Circulation
- Connect ECG monitor: identify rhythm and follow **Algorithm**
- Control airway and ventilation: preferably intubate
- Obtain vascular access, peripheral or intraosseous (IO)
- Change person performing chest compressions every few minutes

Airway (A)

- Inspect mouth: apply suction if necessary
- Use either head tilt and chin lift or jaw thrust
- Oro- or nasopharyngeal airway
- If patent airway not achieved, consider intubation, laryngeal mask or cricothyroidotomy

Breathing (B)

- Self-inflating bag and mask with 100% oxygen
- Ventilation rate
- unintubated: 2 inflations for every 15 compressions
- intubated: 10–12/min, with continuous compressions
- Consider foreign body or pneumothorax

Circulation (C)

- Cardiac compression rate: 100–120/min
- depress lower half of sternum by at least one third: push hard, push fast
- Peripheral venous access: 1–2 attempts (<30 sec)
- IO access: 2–3 cm below tibial tuberosity (see **Intraosseous infusion** guideline)
- Use ECG monitor to decide between:
- a non-shockable rhythm: asystole or pulseless electrical activity (PEA) **OR**
- a shockable rhythm: ventricular fibrillation or pulseless ventricular tachycardia

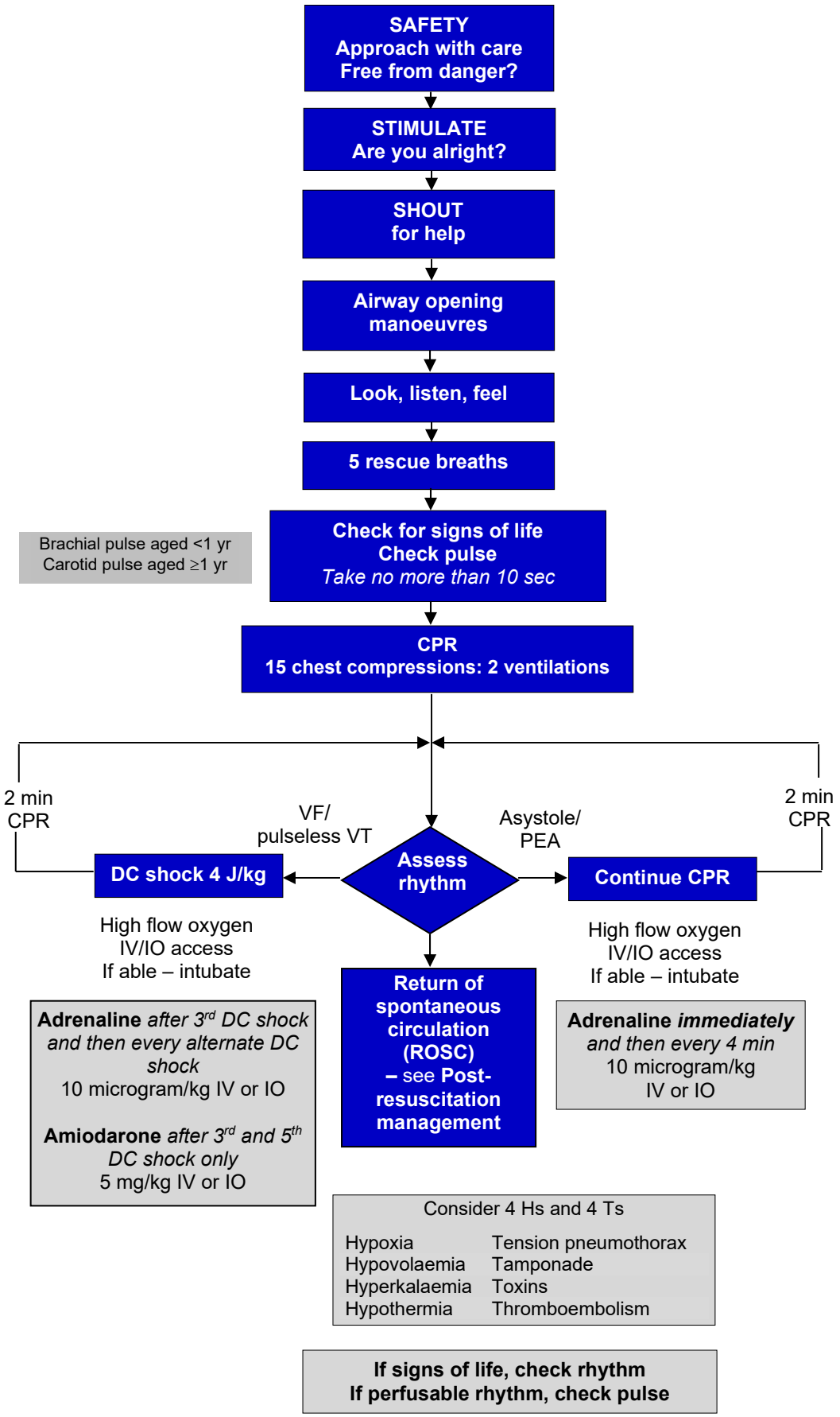
Algorithm for managing these rhythms follows:

- If arrest rhythm changes, restart **Algorithm**
- If organised electrical activity seen, check pulse and for signs of circulation

Adrenaline doses for asystole

Route	Aged <12 yr	Aged 12 yr–adult	Notes	
IV rapid bolus/ IO	10 microgram/kg (0.1 mL/kg of 1:10,000)	1 mg (10 mL of 1:10,000 **OR** 1 mL of 1:1000)	Initial and usual subsequent dose	If given by IO route, flush with sodium chloride 0.9%

APLS – CARDIORESPIRATORY ARREST ● 2/3



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Defibrillation

- Use hands-free paediatric pads in children, may be used anteriorly and posteriorly
- Resume 2 min of cardiac compressions immediately after giving DC shock, without checking monitor or feeling for pulse
- Briefly check monitor for rhythm before next shock: if rhythm changed, check pulse
- Adrenaline and amiodarone are given after the 3rd and 5th DC shock, and then adrenaline only every other DC shock
- Automatic external defibrillators (AEDs) do not easily detect tachyarrythmias in infants but may be used at all ages, ideally with paediatric pads, which attenuate the dose to 50–80 J

PARENTAL PRESENCE

- Evidence suggests that presence at their child's side during resuscitation enables parents to gain a realistic understanding of efforts made to save their child. They may subsequently show less anxiety and depression
- Designate 1 staff member to support parents and explain all actions
- Team leader, not parents, must decide when it is appropriate to stop resuscitation

WHEN TO STOP RESUSCITATION

- No time limit is given to duration of CPR
- no predictors sufficiently robust to indicate when attempts no longer appropriate
- cases should be managed on individual basis dependent on circumstances
- Prolonged resuscitation has been successful in:
- hypothermia (<32°C)
- overdoses of cerebral depressant drugs (e.g. intact neurology after 24 hr CPR)
- Discuss difficult cases with consultant before abandoning resuscitation

POST-RESUSCITATION MANAGEMENT

Identify and treat underlying cause

Monitor

- Heart rate and rhythm
- Oxygen saturation
- CO_2 monitoring
- Core and skin temperatures
- BP
- Urine output
- Arterial blood gases and lactate
- Central venous pressure

Request

- CXR
- Arterial and central venous gases
- Haemoglobin and platelets
- Group and save serum for crossmatch
- Sodium, potassium, U&E
- Clotting screen
- Blood glucose
- LFTs
- 12-lead ECG
- Referral for advice and support may offer some paediatricians help
- Hold team debriefing session to reflect on practice

APLS – RECOGNITION AND ASSESSMENT OF THE SICK CHILD ● 1/5

RAPID CLINICAL ASSESSMENT

Airway (A) and Breathing (B)

- Effort of breathing
  - respiratory rate
  - recession
  - use of accessory muscles
  - additional sounds: stridor, wheeze, grunting
  - flaring of nostrils
- Efficacy of breathing
  - chest movement and symmetry
  - breath sounds
  - SpO_2 in air

Circulation (C)

- Heart rate
- Pulse volume
  - peripheral
  - central (carotid/femoral)
- Blood pressure
- Capillary refill time
- Skin colour and temperature

Disability (D)

- Conscious level – **A**wake, **V**erbal, **P**ain, **U**nresponsive (AVPU)
- Posture
- Pupils

Exposure (E)

- Fever
- Skin rashes, bruising

Don't Ever Forget Glucose (DEFG)

- BM stick

Actions

- Complete assessment should take <1 min
- Treat as problems are found
- Once airway (A), breathing (B) and circulation (C) are clearly recognised as being stable or have been stabilised, definitive management of underlying condition can proceed
- Reassessment of ABCDE at frequent intervals necessary to assess progress and detect deterioration
- Hypoglycaemia: glucose 10% 3 mL/kg followed by IV glucose infusion

CHILD AND PARENTS

- Give clear explanations to parents and child
- Allow and encourage parents to remain with child at all times

STRUCTURED APPROACH TO THE SERIOUSLY ILL CHILD

Airway

Primary assessment of airway

- Vocalisations (e.g. crying or talking) indicate ventilation and some degree of airway patency
- Assess patency by:
  - **looking** for chest and/or abdominal movement
  - **listening** for breath sounds
  - **feeling** for expired air

Re-assess after any airway opening manoeuvres

- Infants: a neutral head position; other children: 'sniffing the morning air'
- Other signs that may suggest upper airway obstruction:
  - stridor

- intercostal/subcostal/sternal recession

Breathing

Primary assessment of breathing

- Assess
- effort of breathing
- efficacy of breathing
- effects of respiratory failure

Effort of breathing

- Respiratory rates 'at rest' at different ages (see **Table 1**)
- Respiratory rate:
- tachypnoea: from either lung or airway disease or metabolic acidosis
- bradypnoea: due to fatigue, raised intracranial pressure, or pre-terminal
- Recession:
- intercostal, subcostal or sternal recession shows increased effort of breathing
- degree of recession indicates severity of respiratory difficulty
- in child with exhaustion, chest movement and recession will decrease
- Inspiratory or expiratory noises:
- stridor, usually inspiratory, indicates laryngeal or tracheal obstruction
- wheeze, predominantly expiratory, indicates lower airway obstruction
- volume of noise is not an indicator of severity (reduces with exhaustion)
- Grunting:
- sign of severe respiratory distress
- can also occur in intracranial and intra-abdominal emergencies
- Accessory muscle use
- Gasping (a sign of severe hypoxaemia and can be pre-terminal)
- Flaring of nostrils

Exceptions

- **Increased effort of breathing DOES NOT occur in these circumstances:**
- **exhaustion**
- **central respiratory depression** (e.g. raised intracranial pressure or poisoning)
- **neuromuscular disease** (e.g. spinal muscular atrophy, muscular dystrophy)

Efficacy of breathing

- Breath sounds on auscultation:
- reduced or absent
- bronchial
- symmetrical or asymmetric
- Chest expansion
- Pulse oximetry

Effects of respiratory failure on other physiology

- Heart rate:
- increased by hypoxia, fever or stress
- bradycardia is a pre-terminal sign
- Skin colour:
- hypoxia first causes vasoconstriction and pallor (via catecholamine release)
- cyanosis is a late and pre-terminal sign
- some children with congenital heart disease may be permanently cyanosed and oxygen may have little effect
- Mental status:
- hypoxic child will be restless or agitated first, then drowsy and unconscious
- pulse oximetry can be difficult to achieve in agitated child owing to movement artefact

Circulation

- Heart rates 'at rest' at different ages (see **Table 1**)

Pulse volume
- Absent peripheral pulses or reduced central pulses indicate shock

Capillary refill
- Pressure on centre of sternum or a digit for 5 sec should be followed by return of circulation in skin within 2–3 sec
- can be prolonged by shock or cold environmental temperatures
- neither a specific nor sensitive sign of shock
- should not be used alone as a guide to response to treatment

Blood pressure
- See **Table 1**
- Cuff bladder should cover >80% of length of upper arm
- Hypotension is a late and pre-terminal sign of circulatory failure

Effects of circulatory inadequacy on other organs/physiology
- Respiratory system:
- tachypnoea and hyperventilation occur with acidosis
- Skin:
- pale or mottled skin colour indicates poor perfusion
- Mental status:
- agitation, then drowsiness leading to unconsciousness
- Urinary output:
- <1 mL/kg/hr (<2 mL/kg/hr in infants) indicates inadequate renal perfusion

Features suggesting cardiac cause of respiratory inadequacy
- Cyanosis, not relieved by oxygen therapy
- Tachycardia out of proportion to respiratory difficulty
- Raised JVP
- Gallop rhythm/murmur
- Enlarged liver
- Absent femoral pulses

Disability

Primary assessment of disability
- Always assess and treat airway, breathing and circulatory problems before undertaking neurological assessment:
- respiratory and circulatory failure have central neurological effects
- central neurological conditions (e.g. meningitis, raised intracranial pressure, status epilepticus) have both respiratory and circulatory consequences

Neurological function
- Conscious level: **AVPU**; a painful stimulus may be applied by sternal pressure, squeezing trapezius muscle or Achilles tendon, or supra-orbital ridge pressure
- **A**lert
- **V**oice
- **P**ain (equivalent to GCS <8)
- **U**nresponsive
- Posture:
- hypotonia
- decorticate or decerebrate postures may only appear with a painful stimulus
- Pupils, look for:
- pupil size, reactivity and symmetry
- dilated, unreactive or unequal pupils indicate serious brain disorders

Signs of raised intracranial pressure (Cushing's triad)
- Respiratory:
- hyperventilation
- Cheyne-Stokes breathing
- slow, sighing respiration

- apnoea
- Systemic hypertension
- Sinus bradycardia

Table 1: APLS aide-memoire

Age	Guide Weight (kg)	A ET tube		C Joules	C Fluids	C Adrenaline	D Lorazepam	D Glucose	RR At rest Breaths/ min	HR	BP Systolic		
		Int diameter (mm)	Length (cm)	4 J/kg	10 mL/kg (mL)	0.1 mL/kg of 1:10,000 (mL)	0.1 mg/kg max 4 mg (mg)	3 mL/kg of glucose 10% (mL)	5th–95th centile	Beats/min 5th–95th centile	5th centile	50th centile	95th centile
Birth	3.5	3.0(or uncuffed 2.5–3.0)	9	20	35	0.4	0.4	10.5	25–50	120–170	65–75	80–90	105
1 month	4	3.0	9	20	40	0.4	0.4	12	25–50	120–170	65–75	80–90	105
3 months	5	3.0	10	30	50	0.5	0.5	15	25–45	115–160	65–75	80–90	105
6 months	8	3.5	12	30	80	0.8	0.8	24	20–40	110–160	65–75	80–90	105
12 months	10	3.5	13	40	100	1.0	1.0	30	20–40	110–160	70–75	85–95	105
2 yr	12	4	13	50	120	1.2	1.2	36	20–30	100–150	70–80	85–100	110
3 yr	14	4	14	60	140	1.4	1.4	42	20–30	90–140	70–80	85–100	110
4 yr	16	4.5	14	60	160	1.6	1.6	48	20–30	80–135	70–80	85–100	110
5 yr	18	4.5	14	80	180	1.8	1.8	54	20–30	80–135	80–90	90–110	110–120
6 yr	20	5	15	80	200	2	2	60	20–30	80–130	80–90	90–110	110–120
7 yr	23	5	15	100	230	2.3	2.3	69	20–30	80–130	80–90	90–110	110–120
8 yr	24	5.5	16	100	240	2.4	2.4	72	15–25	70–120	80–90	90–110	110–120
9 yr	28	5.5	16	120	280	2.8	2.8	84	15–25	70–120	80–90	90–110	110–120
10 yr	30	6	17	120	300	3	3	90	15–25	70–120	80–90	90–110	110–120
11 yr	35	6	17	140	350	3.5	3.5	100	15–25	70–120	80–90	90–110	110–120
12 yr	40	6.5	18	150	400	4	4.0	100	12–24	65–115	90–105	100–120	125–140
14 yr	50	7	21	150	500	5.0	4.0	100	12–24	60–110	90–105	100–120	125–140
Adult	70	8	24	120–150 Joules biphasic	500	10 mL (i.e. 1 mg)	4 mg	100 mL	12–24	60–110	90–105	100–120	125–140

TIP: if a child is particularly big go up 1 or 2 yr; particularly small go down 1 or 2 yr

The final responsibility for delivery of the correct dose remains that of the physician prescribing and administering the drug

RECOGNITION AND ASSESSMENT

Definition

- Acute, chronic (≥6 weeks) or recurrent inflammation of joint(s)

Acute arthritis associated with fever requires urgent assessment to rule out septic arthritis/osteomyelitis (see Osteomyelitis and septic arthritis guideline)

Symptoms and signs

- Swollen joint(s), which may be:
- warm
- stiff +/- restricted range of movement
- tender

Differential diagnosis

Trauma

- History of previous injury
- If minor injury and significant swelling consider haemophilia

Acute septic arthritis

- See **Osteomyelitis and septic arthritis** guideline

Malignancy

- Malignancy – a swollen joint may be the only clinical finding
- Associated features may include:
- lymphadenopathy
- bleeding
- bruising
- hepatosplenomegaly

Non-accidental injury

- See **Child protection** guideline

Reactive arthritis

- 7–14 days following acute infection
- gastroenteritis
- post streptococcal
- tonsillitis
- viral illness
- Usually monoarthritis
- Self-limiting

Inflammatory bowel disease (IBD) associated arthritis

- Monoarthritis in a large joint or peripheral arthritis. Arthritis improves as IBD improves associated with disease activity

Juvenile idiopathic arthritis (JIA)

- Arthritis of unknown aetiology before aged 16 yr (peak aged 1–5 yr)
- More common in females
- Persisting for ≥6 weeks
- Affects joint(s)
- Stiffness especially after rest (e.g. mornings)
- Pain
- May be associated with systemic signs – fever, fatigue

Systemic rheumatic diseases

- Juvenile systemic lupus erythematosus (SLE), juvenile dermatomyositis
- Vasculitis, including Henoch-Schönlein purpura and Kawasaki disease (see **Henoch-Schönlein** guideline and **Kawasaki disease** guideline)

MANAGEMENT

- If septic arthritis suspected, refer to orthopaedic team for aspiration and IV antibiotics

ARTHRITIS ● 2/2

Analgesia

- Ibuprofen 30−40 mg/kg/day in 3−4 divided doses or piroxicam (weight dependent – see **BNFc.** If 8-hrly maximum 800 mg per dose, if 6-hrly maximum 600 mg per dose)

Investigations

- If fracture or metabolic disorder suspected – X-ray
- Bloods
- FBC and film
- ESR
- CRP (to exclude malignancy and infection)
- coagulation studies (if bleeding disorder suspected)
- Further imaging e.g. US/MRI may be indicated (seek advice from paediatric rheumatology/orthopaedics)

Referral

- If ≥6 weeks or concerned regarding systemic or other connective tissue disorders, refer to paediatric rheumatology

Rheumatology

- Assessment and diagnosis of arthritis
- Urgent referral to paediatric ophthalmology for assessment of uveitis
- Optimise medical treatment – anti-inflammatories, steroid injections, disease modifying agents (methotrexate), biological therapies
- Physiotherapy and occupational therapy

ASTHMA – ACUTE MANAGEMENT ● 1/6

RECOGNITION AND ASSESSMENT

Definition

- Chronic inflammatory disorder of airways with reversible obstruction

In children aged <2 yr who have an initial poor response to β_2 agonists administered with adequate technique, continue treatment if severe (see definition below), but consider alternative diagnosis and other treatment options

Symptoms and signs

- Breathlessness
- Wheeze
- Cough
- Nocturnal cough
- Tight chest

- Symptoms and signs tend to be:
- variable
- intermittent
- worse at night
- provoked by triggers, including exercise

Mild/moderate

- Normal vital signs
- Mild wheeze
- Speaks in complete sentences or feeding
- No clinical features of severe asthma
- SpO_2 >92% in air
- Peak expiratory flow rate (PEFR) >50% in patient aged ≥5 yr

Severe

- Too breathless to talk/feed/eat
- Tachypnoea
- aged <5 yr: >40 breaths/min
- aged 5–11 yr: >30 breaths/min
- aged 12–18 yr: >25 breaths/min
- Tachycardia
- aged <5 yr: >140 beats/min
- aged 5–11 yr: >125 beats/min
- aged 12–18 yr: >110 beats/min
- Use of accessory muscles, recession subcostal and intercostal, flaring of alae nasi
- SpO_2 <92% in air
- 30–50% predicted/best peak expiratory flow rate (PEFR) aged ≥5 yr

Life-threatening

- SpO_2<92% in air AND/OR: Cyanosis/pallor
- Decreased air entry/silent chest
- Poor respiratory effort
- Altered conscious level
- Irritable/exhausted
- ≤30% predicted/best PEFR aged ≥5 yr

Patients with severe or life-threatening attacks may not be distressed and may not have all these abnormalities. Presence of any one of these should alert doctor

Differential diagnosis

- Inhaled foreign body
- Pneumonia
- Pneumothorax
- Aspiration
- Cystic fibrosis

- Tracheobronchomalacia
- Gastro-oesophageal reflux
- Hyperventilation

Assessment
- Record:
- respiratory rate and effort
- recession
- heart rate
- air entry
- oxygen saturation in air
- if ≥5 yr, PEF
- conscious level
- CXR if severe and life-threatening sign/symptoms do not improve with medical management

Routine CXR is unnecessary in child with asthma. Diagnosis is clinical. Only perform blood gas if it is likely to change management

IMMEDIATE TREATMENT

- Follow algorithm **Management of acute wheezing in children**
- Prescribe oxygen on drug chart if required and maintain oxygen saturations between 94−98%

Senior assessment
If you are worried about child's conscious level or there is no response to nebulised salbutamol or poor respiratory effort:
- Call senior doctor for further assessment
- Site an IV line

First line IV bronchodilator therapy
- Magnesium sulfate IV injection over 20 min (aged 2–17 yr): 40 mg/kg single dose (maximum 2 g)
- use 50% injection and dilute to 10% concentration by diluting required volume with 4x volume of sodium chloride 0.9% with cardiac monitoring and close monitoring of blood pressure

If not responding within 15 min of completion of magnesium sulfate, discuss with on-call paediatric consultant and move to second line treatment

Second line IV bronchodilator therapy
EITHER
- Initial bolus dose of salbutamol IV over 5 min
- aged <2 yr: 5 microgram/kg (maximum 250 microgram)
- aged ≥2 yr: 15 microgram/kg (maximum 250 microgram)
- Using 500 microgram/mL injection preparation dilute to a concentrate of 50 microgram/mL with sodium chloride 0.9%
- e.g. withdraw 250 microgram = 0.5 mL and make up to total volume of 5 mL using sodium chloride 0.9% = 250 microgram in 5 mL

OR
IV Aminophylline loading dose followed by maintenance infusion

If child on regular Theophylline', do not give loading dose and send sample for aminophylline levels

- Loading dose: 5 mg/kg (maximum per dose 500 mg)
- Maintenance infusion:
- aged 1month–11 yr: 1 mg/kg/hr (adjusted according to plasma-theophylline concentration)
- aged 12–17 yr: 500–700 micrograms/kg/hr (adjusted according to plasma-theophylline concentration)

NOTE: This is often a high proportion of child's daily fluid requirements, so adjust maintenance fluids accordingly to avoid fluid overload

Not responding to second line IV bronchodilator therapy
- Discuss with on-call paediatric consultant and involve PICU consultant/KIDS team early

Third line:

- Consider alternative bronchodilator as above depending on which is used 2nd line
- Salbutamol bolus can then be followed by Salbutamol infusion:
- use 1 mg/mL solution for IV infusion, take 10 mg (10 mL) and make up to 50 mL with sodium chloride 0.9% giving a concentration of 200 microgram/mL
- salbutamol 1–2 microgram/kg/min continuous infusion (use 50 kg as maximum weight)
- if weight >50 kg, contact PICU for dosing advice
- if not responding, increase up to 5 microgram/kg/min for 1 hr then reduce back to 2 microgram/kg/min
- Continue with oxygen and continuous salbutamol nebuliser whilst waiting for infusion to be made up
- Consider repeating dose of magnesium sulfate with cardiac monitoring and close monitoring of blood pressure (discuss with on call paediatrician/PICU consultant/KIDS)

Drug doses

- Salbutamol nebulised, driven by 6–8 L/min oxygen:
- aged <5 yr: 2.5 mg
- aged 5–11 yr: 2.5–5 mg
- aged ≥12 yr: 5 mg

- Ipratropium bromide (Atrovent®) nebulised:
- aged <12 yr: 250 microgram, maximum 1 mg per day
- aged ≥12 yr: 500 microgram, maximum 2 mg per day

- Prednisolone 1 mg/kg oral (round up to nearest 5 mg):
- aged <2 yr: maximum 10 mg once daily
- aged 2–5 yr: maximum 20 mg once daily
- aged >5 yr: maximum 30 mg once daily
- aged ≥12 yr: maximum 40 mg once daily
- if already on maintenance oral corticosteroids prednisolone 1–2 mg/kg (maximum 60 mg) and discuss weaning plan with respiratory consultant
- consider if weaning plan required
- Hydrocortisone [preferably sodium succinate (until conversion to oral prednisolone possible)] slow IV injection
- **EITHER:**
- 4 mg/kg 6-hrly (maximum per dose 100 mg)
- **OR:**
- aged 1 month–1 yr: 25 mg 6-hrly
- aged 2–4 yr: 50 mg 6-hrly
- aged 5–18 yr: 100 mg 6-hrly
- Do not give antibiotics routinely
- If high prevalence of influenza with fever, coryza, generalised symptoms (headache, malaise, myalgia, arthralgia) give oseltamivir

Monitoring

If treated with IV bronchodilator therapies:

- Record heart rate and respiratory rate every 15–30 min until patient stabilised
- Continuous SpO_2 monitoring
- Continuous cardiac monitoring
- Baseline U&E
- Capillary blood gas and lactate
- Regular capillary gas for electrolyte and lactate (at least 12-hrly)

Specific requirements:

- Magnesium sulfate
- risk of hypotension - blood pressure monitoring every 5 min during infusion
- risk of arrhythmia - cardiac monitoring
- Salbutamol
- tachycardia, hypokalaemia and lactic acidosis – monitor electrolytes and lactate
- Aminophylline
- tachycardia, flushing, nausea and vomiting – cardiac monitoring
- if already on theophylline monitor aminophylline levels

Aim to wean IV bronchodilator therapies at the earliest opportunity to minimise risk of side effects

SUBSEQUENT MANAGEMENT

Follow algorithm **Management of acute wheezing in children**

Previous history

- When recovering, ask about:
  - previous episodes of wheeze, similar episodes
  - triggering factors, seasonal variation
  - nocturnal cough
  - family history of asthma, hay fever, eczema, other atopy
  - smokers or vapers in the family (including child)
  - mould/damp in house
  - pets
  - days off school because of asthma
  - number of courses of prednisolone used in last year
  - number of salbutamol inhalers prescribed in last year
  - drug history (device and dose) especially any bronchodilators/inhaled corticosteroids and their effect, particularly need to use beta-agonists
  - review electronic prescription issue of preventer and reliever if available

DISCHARGE AND FOLLOW-UP

Discharge criteria

- SpO_2 in air ≥94%
- Respiratory rate:
  - aged <5 yr: <40 breaths/min
  - aged 5–11 yr: <30 breaths/min
  - aged 12–18 yr: <25 breaths/min
- Heart rate:
  - aged <5 yr: <140 beats/min
  - aged 5–11 yr: <125 beats/min
  - aged 12–18 yr: <110 beats/min
- Peak flow: ≥75% predicted/best (aged >5 yr)
- Stable on 4-hrly treatment

Discharge home if:

- Child has made significant improvement and has remained stable for 4 hr
- Parents:
  - understand use of inhalers
  - have a written personal asthma action plan (PAAP)
  - have a written discharge/weaning salbutamol information leaflet
  - know how to recognise signs of deterioration and the actions to take
  - complete asthma discharge bundle

Discharge treatment

- Prescribe beta-agonist with spacer
  - aged ≤5 yr with mask
  - aged >5 yr without mask (e.g. volumatic/aerochamber)
- Give prednisolone daily for 3–5 days (if already on oral prednisolone maintenance therapy speak to respiratory consultant/nurse and discuss weaning plan)
- If aged ≥5 yr educate on use of PEF meter
- Prescribe preventer as appropriate – see **Chronic management**
- Inhaled corticosteroids generally not required for recurrent viral induced wheeze
- Discuss follow-up in either community, nurse-led asthma clinic or consultant clinic
- If there have been life-threatening features refer to paediatric respiratory specialist
- Advise follow-up with GP within 2 working days
- Refer smokers to smoking cessation services
- Identify trigger of acute attack and discuss future management plan for exposure

ASTHMA – ACUTE MANAGEMENT ● 5/6

Chronic management

- Commence regular inhaled prevention treatment or escalate preventer treatment if any of following:
  - frequent episodes
  - bronchodilators used most days (>3 days/week)
  - nocturnal and/or exercise-induced symptoms
  - other atopic symptoms and strong family history of atopy
- If recurrent upper respiratory tract problems or allergic rhinitis triggering attacks, give oral antihistamines +/- steroid nasal spray

ASTHMA – ACUTE MANAGEMENT ● 6/6

Algorithm: Management of acute wheezing in children

Assessment

MILD/MODERATE

Normal vital signs
Mild wheeze
Speaking in complete sentences or feeding normally
SpO_2 >92% in air

Salbutamol MDI 2–10 puffs (200–1000 microgram) via large volume spacer (LVS) +/- face mask
Oxygen if SpO_2 <92% in air
Once daily oral prednisolone, if on maintenance therapy, discuss with respiratory consultant/nurse
- Aged <2 yr = max 10 mg once daily
- Aged 2–5 yr = max 20 mg once daily
- Aged >5 yr = max 30 mg once daily
- Aged ≥12yr: max 40 mg once daily

RE-ASSESS EVERY 15–30 MIN

DISCHARGE CRITERIA MET

SpO_2 ≥94% in air

Age	Respiratory rate	Heart rate
<5 yr:	<40 breaths/min	<140 beats/min
5–12 yr:	<30 breaths/min	<125 beats/min
12–18 yr:	<25 breaths/min	<110 beats/min

Peak flow ≥75% predicted/best
Stable on 4-hrly inhaled treatment

NO

YES

DISCHARGE HOME
Continue once daily oral prednisolone, complete a 3–5 day course
Review long-term asthma control + treatment
- Check inhaler technique
- Provide PAAP
- Agree follow-up plan
- Complete respiratory discharge letter

DISCHARGE

SEVERE

Too breathless to talk/feed
SpO_2 <92% in air
Use of accessory muscles

Age	Respiratory rate	Heart rate
<5 yr:	>40 breaths/min	>140 beats/min
5–11 yr:	>30 breaths/min	>125 beats/min
12–18 yr:	>25 breaths/min	>110 beats/min

Peak flow 30-50% in those aged ≥5 yr

Oxygen via mask or nasal cannula
Salbutamol MDI 10 puffs (1000 microgram) via large volume spacer +/- face mask, or:
Salbutamol nebulised, driven by 6–8 L/min oxygen:
- Aged <5 yr: 2.5 mg
- Aged 5–11 yr: 2.5–5 mg
- Aged >12 yr: 5 mg

If poor response, give ipratropium bromide nebulised
- aged <12 yr: 250 microgram (max. 1mg / day)
- aged ≥12 yr:500 microgram (max. 2mg / day)

Once daily oral prednisolone, if on maintenance therapy, discuss with respiratory consultant/nurse
- Aged <2 yr: max 10 mg once daily
- Aged 2–5 yr: max 20 mg once daily
- Aged >5 yr: max 30 mg once daily
- Aged ≥12yr: max 40 mg once daily

If oral steroids not tolerated give hydrocortisone by slow IV injection aged ≥1 month 4 mg/kg 6-hrly (max per dose 100 mg) **or**:
aged 1 month–1 yr: 25 mg 6-hrly
aged 2–4 yr: 50 mg 6-hrly
aged 5–18 yr: 100 mg 6-hrly

YES

DISCHARGE CRITERIA MET

NO

ADMIT
Continue oxygen via mask/nasal cannula
Nebulised salbutamol ¼–4 hrly
Repeat nebulised ipratropium bromide. If poor response, give every 20–30 min for first 2 hr

RE-ASSESS FREQUENCY OF BRONCHODILATOR THERAPY

SYMPTOMS IMPROVING

LIFE-THREATENING

SpO_2 <92% in air AND/OR
Cyanosis/pallor
Silent chest
Poor respiratory effort
Altered consciousness
Irritable/exhausted
If aged≥ 5 yr, PEF ≤30%

Inform on-call consultant and PICU
Oxygen via mask/nasal cannula
Continuous salbutamol nebulised, driven by 6–8 L/min oxygen
- Ipratropium bromide nebulised every 20-30 mins for 1st 2 hr
- Hydrocortisone by slow IV injection
- If signs of shock, give 10mls/kg balanced cystalloid. Consider anaphylaxis as an alternative diagnosis

RESPONSE

SYMPTOMS IMPROVING

NO CHANGE /WORSENING

NO IMPROVEMENT

Continuous nebulised salbutamol
Repeat ipratropium bromide. If poor response, give every 20–30 min for first 2 hr

YES

SYMPTOMS IMPROVING

Check

Has patient received:
- Continuous salbutamol nebulised?
- Ipratropium bromide nebulised?
- Hydrocortisone IV?

Is patient still not improving/worsening and meets severe/life threatening criteria?

YES

MAGNESIUM SULFATE IV BOLUS (aged 2–17 yr)
- Magnesium sulfate IV injection over 20 min : 40 mg/kg single dose (max 2 g)

MONITORING
- Record heart rate and respiratory rate every 5 min
- Record blood pressure every 5 min
- Continuous SpO_2 and CO_2 monitoring

YES

RESPONSE

NO

SALBUTAMOL IV BOLUS
- Aged 1 month–2 yr: 5 microgram/kg
- Aged 2–18 yr: 15 microgram/kg (max 250 microgram)

MONITORING
- Record heart rate and respiratory rate every 10 min
- Continuous SpO_2 and CO_2 monitoring
- ECG monitoring
- Baseline U&E (capillary blood gas for potassium)

OR

AMINOPHYLLINE IV LOADING THEN MAINTENANCE
- Loading: 5mg/kg (max per dose 500mg)
- Maintenance infusion:
- 1 month-11 yr: 1mg/kg/hr
- 12-17 yr: 500-700 micrograms/kg/hr

YES

RESPONSE

NO

SALBUTAMOL INFUSION
Infuse at 60–300 microgram/kg/hr (use 50 kg as max weight) = 0.3–1.5 mL/kg/hr when using 200 microgram/mL solution (max 75 mL/hr)
- If >2 microgram/kg/min, give in in PICU

MONITORING
- Continuous SpO_2 and CO_2 monitoring
- ECG monitoring
- Repeat bloods at 2 hr, 4 hr, then 4-hrly

BLEEDING DISORDERS IN CHILDREN ● 1/4

INTRODUCTION

- All patients with a bleeding disorder must have open access and possess a medical card identifying their condition. Conditions include:
- haemophilia A (Factor VIII deficiency)
- haemophilia B (Factor IX deficiency)
- von Willebrand's (vW) disease
- platelet defects
- deficiency of other coagulation factors (rare)

Definitions

- Normal levels of Factor VIII and IX = 50–150%
- Mild haemophilia >5% – muscle and joint bleeds, usually following trauma
- Moderate haemophilia 1–5% – muscle and joint bleeds, usually following trauma
- Severe haemophilia <1% – spontaneous joint and muscle bleeds

If major trauma or major head injury, should attend A&E
Otherwise patient to attend children's assessment unit (CAU) and be treated within 30 min of arrival.
Open access plans to CAU on Iportal with patient details of condition and treatment

Presentation

- **Minor bleeds** usually present with pain and slight restriction of movement, with minimal or no joint swelling
- **Major bleeds** present with severe pain/tenderness with marked swelling and restricted movement of joint

Do not request inappropriate blood tests, venepuncture can cause bleeding. FBC only if large bleed, coagulation screen not required on a known patient. Discuss with consultant whether pre and post treatment factor levels required (ensure coagulation laboratory informed of any urgent samples)
Patients presenting will be registered with the local designated haemophilia unit
If condition severe, patient may be registered locally, and also with comprehensive care centre

INDICATIONS FOR ADMISSION

- Bleeding in mouth, neck, respiratory passages or gastro-intestinal tract
- Suspected internal bleeding (intracranial, intra-thoracic or intra-abdominal)
- Haemorrhage endangering a nerve (e.g. carpal tunnel – median nerve, iliopsoas – femoral nerve) or other vital structure
- Requiring surgical treatment, including dental surgery
- Haemarthrosis, especially weight bearing joints (e.g. hips and knees)
- Any lesion requiring 12-hrly or more frequent replacement therapy

MANAGEMENT OF ACUTE BLEEDING

- Patients present for treatment, particularly when developing a haemarthrosis before any physical signs are present
- If suspected intracranial bleed: arrange scans **but treat IMMEDIATELY – do not wait for results**
- Give **IMMEDIATE** replacement therapy for joint bleeds as haemarthroses are very painful and any delay may increase severity of bleed and risk of joint damage **– do not wait for results**
- When requesting any factor inform blood bank that it is required immediately; (use same brand factor named in each child's open access information)
- Prescribe analgesia (do not use ibuprofen or other NSAID – risk of bleeding), do not administer IM medications
- Contact haemophilia nurse (Mon–Fri) or out-of-hours on-call paediatric consultant requesting they liaise with haematologist (e.g. via Birmingham Children's Hospital)

Replacement therapy dosage

- When deciding dose, consider:
- type of bleed
- time of onset of symptoms
- factor level required to sustain haemostasis
- patient weight
- half-life of therapy (varies with each concentrate)

Type of bleed	Level of factor desired
• Uncomplicated bleeding into joints and muscles	• Non weight bearing joint 30% • Weight bearing joint 80- 100%
• Haematoma in potentially serious situations: • bleeding in mouth • neck • respiratory passages • endangering nerves	• 50-80%
• Pre-dental extraction	• 50%
• Major surgery • Serious accident • Head injury	• 80–100%

Calculation of replacement factor

- Give patient same brand of concentrate each time treatment is required

Step 1 Calculate factor (%)

Increase required = desired factor percentage – baseline factor percentage of patient

Step 2 Calculate dose of specific factor required

a) For Factor VIII concentrate (Advate®, Elocta®): dose required (units) = body weight (kg) × factor (%) increase required divided by 2

b) For Factor IX concentrate (Alprolix™): dose required (units) = body weight (kg) × factor (%) increase required × 1.2

c) For vW factor concentrate (Voncento®, plasma derived, available from blood bank); dose required (units) = weight (kg) × Ricof/vW factor (%) increase required divided by 3

- For any other factor concentrate, contact on-call haematologist to discuss treatment and ascertain correct recovery constant

Other treatment

- On advice of consultant haematologist for those with inhibitors to Factors VIII or IX
- Factor VIIa (recombinant: NovoSeven®) or FEIBA (Factor VIII inhibitor bypass agent)

DO NOT USE FEIBA FOR ANY PATIENT ON EMICIZUMAB

- **Emicizumab (Hemlibra®) – new treatment for severe haemophilia A**
- monoclonal modified immunoglobulin antibody
- give SC once a week or every 2 weeks
- discuss use of Factor VIII concentrate in trauma/surgery with consultant haematologist
- used for both inhibitor and non-inhibitor patients

Administration of factor concentrate

- **Always wear gloves**
- Most factor concentrates are provided in packs with concentrate, diluent in syringe, vial adapter for transfer, infusion set
- Read instructions carefully (picture guides included in each pack) before reconstituting factor - incorrect reconstitution may result in wastage of expensive concentrate. If in doubt seek advice from haemophilia nurse or haematology consultant on-call
- Transfer the diluent into the dried concentrate vial via a needleless adapter
- Give intravenously, via butterfly if 1 dose required; if admitting for several doses, use cannula. Rate to be given by slow bolus at no more than 3 mL per min – or as specified
- Factor IX infusion may cause reaction; observe patient carefully post infusion
- Vials available in 250–3000 units for Factor VIII and IX
- adverse reactions rare but include anaphylactic shock
- During prolonged treatment screen for inhibitors every 5 doses
- Half-life of Factor VIII varies from 12 hr for the extended half-life , half-life of Factor IX is 18 hr (maybe

shorter in young children). Initial levels can be assessed 15 min post infusion, blood tests to assess factor level are advisable post infusion under guidance of haematologist

Duration of treatment

- Decided by local on-call haematologist or designated tertiary haemophilia unit (on-call haematologist). **If in doubt, ask**

DESMOPRESSIN IN MILD HAEMOPHILIA A AND VON WILLEBRAND'S DISEASE

- SC or IV
- may be used to raise Factor VIII and vW factor levels
- response usually 4-fold rise (IV/SC) in Factor VIII and vW antigen concentration – peak response is seen approximately 30–60 min after administration SC/IV

Patient selection

- Consider **only** in mild (**NOT** severe) haemophilia A
- **Not** appropriate in Factor IX deficiency (haemophilia B)
- Check notes for outcome of previous desmopressin challenge
- **Do not use in**:
- aged <2 yr
- cardiac conditions
- epilepsy
- renal impairment
- diabetes insipidus

Administration of desmopressin

- Desmopressin SC/IV, **be vigilant with dose prescribing and preparation choice**
- **SC**: 0.3 microgram/kg (vials of 1 mL = 15 microgram/mL) or, less preferably
- **IV**: 0.4 microgram/kg IV in sodium chloride 0.9% 30–50 mL over 20 min. 4 microgram vials for IV only
- May be repeated after 12 hr
- **Side effects** include hypertension, headache, flushed face, nausea
- measure pulse and BP every 5 min during IV infusion. If either rises unacceptably, reduce rate of infusion
- If requested by consultant, blood samples may be taken before and after infusion to measure Factor VIII/vW level and ensure therapeutic level reached
- tachyphylaxis can occur with depletion of stored Factor VIII with consecutive days. After 3 days there may be an inadequate rise of Factor VIII
- Monitor patient's fluid intake over the following 24 hr; ensure no excessive oral intake, due to risk of hyponatremia

VON WILLEBRAND'S DISEASE

- More common than haemophilia
- caused by deficiency (qualitative or quantitative) of vWF protein, which binds to Factor VIII (prolonging half-life) and platelets
- Can present with acute episodes of mucosal bleeding, helping to form initial clot
- Before treatment, consider:
- von Willebrand's disease (vWD) subtype
- bleeding history, including previous response to any treatment
- nature of haemostatic challenge
- Treatment is often a combination of tranexamic acid and desmopressin or vWF concentrate (available from blood bank with consultant guidance)

Tranexamic acid

- Anti-fibrinolytic agent
- Contraindicated in presence of frank haematuria (>2+ blood)
- Decrease dose in mild renal impairment
- Oral tranexamic acid alone can be used to treat minor problems such as recurrent epistaxis, but main use is in combination with desmopressin if appropriate
- oral dose 15–25 mg/kg 8-hrly (maximum dose 1.5 g 8-hrly) for maximum 5 days (oral suspension available but pharmacy may need to order in or manufacture on site)

- IV tranexamic acid 10 mg/kg (maximum 1 g) 8-hrly over 10 min

Desmopressin

- Treatment of choice in responsive patients for spontaneous bleeding, trauma and minor surgery
- For administration, see **Administration of desmopressin**

vWD Type	Advice
Type 1	• Most patients responsive
Type 2A	• Some patients responsive • ask about previous challenge
Type 2B	• DO NOT GIVE desmopressin • it causes platelet agglutination and thrombocytopenia
Type 3	• Not all responsive and some can be severe • ask about previous challenge

vWF Voncento® (blood product)

- Avoid if at all possible
- Use in patients not responsive to, or unsuitable for, desmopressin (e.g. aged <2 yr)

BLOOD AND PLATELET TRANSFUSIONS ● 1/2

Always check front sheet in oncology patient notes before prescribing any blood product

PRE-TRANSFUSION

- Explain indications for blood products to parents and, if appropriate, the child
- Document indications and verbal consent
- If previous reactions to blood products have occurred, pre-medicate with chlorphenamine (oral or IV), if severe with hydrocortisone 4 mg/kg IV (maximum 200 mg)

BLOOD TRANSFUSION

When to transfuse

Oncology children

- If Hb ≤70 g/L or if >70 g/L and symptomatic or unstable, transfuse
- If having radiotherapy, transfuse if Hb <110 g/L
- If oncology patient has potential to require a bone marrow transplant (BMT) give hepatitis E -ve leucodepleted blood, unless already identified as requiring irradiated products

PICU patients

- Hb transfusion trigger of ≤70 g/L in stable critically ill children
- If symptomatic anaemia or impaired cardiorespiratory function, transfuse at higher threshold

Non-oncology children

- Consider transfusion if Hb <60 g/L or >60 g/L and symptomatic

Target Hb and volume to be transfused

- Aim for target Hb of 120 g/L or for 100 g/L if initial Hb <60 g/L
- In newly diagnosed patients with leukaemia/profound anaemia, aim for target Hb 80–90 g/L
- Calculate volume to be given as: (round to nearest unit)

  [Target Hb - actual Hb (g/L)] × weight (kg) × 0.4 mL
- **Total volume should not exceed 20 mL/kg**

Rate of infusion

- Give **total** over 3–4 hr. **Maximum rate 5 mL/kg/hr**
- If Hb <60 g/L, give blood over 4–8 hr (each unit must be used **within 4 hr** once removed from fridge)
- If concerns regarding fluid overload, give furosemide 1 mg/kg half way through, either oral (if tolerated) or IV

Use irradiated blood if

- Allogenic BMT from start of conditioning regimen
- Allogenic BMT donors
- If <7 days pre-harvest for autologous BMT and stem cell transplant patients (e.g. stage IV neuroblastoma)
- Hodgkin's disease or if patient has received fludarabine
- Children with severe immunodeficiency (e.g. SCID)
- HLA-matched platelets
- For high risk neonates e.g. post intrauterine transfusion

Leucodepleted and CMV negative blood

- All the packed cells are leucodepleted and therefore presumed CMV negative
- For neonates aged <28 days post expected date of delivery and for intrauterine transfusions, CMV serology negative blood requested

PLATELET TRANSFUSION IN ONCOLOGY CHILDREN

Transfuse platelets if platelet level

- $<10 \times 10^9$/L oncology children except brain tumour
- $<20 \times 10^9$/L oncology children except brain tumour and unwell
- $<30 \times 10^9$/L brain tumour
- $<50 \times 10^9$/L brain tumour and unwell
- $<40 \times 10^9$/L for lumbar puncture

Dosage and rate

- <15 kg: 15 mL/kg (round off the nearest unit)

- ≥15 kg: 1 pack
- Transfuse within 15–30 min

Immune thrombocytopenic purpura (ITP) – transfuse platelets only if bleeding and see* Immune thrombocytopenic purpura (ITP) *guideline

FRESH FROZEN PLASMA

- For bleeding in disseminated intravascular coagulopathy (DIC) when INR >1.7
- 15 mL/kg over 30 min

CRYOPRECIPITATE

- For significant bleeding and fibrinogen <1.5 g/L
- 5–10 mL/kg, over 30–60 min. Maximum up to 2 pool

PROTHROMBIN COMPLEX CONCENTRATE (PCC)

- Offer immediate prothrombin complex concentrate transfusions for the emergency reversal of warfarin anticoagulation in patients with either:
- severe bleeding (WHO grade 3&4) or head injury with suspected intracerebral haemorrhage or having emergency surgery
- seek advice form paediatric haematologist immediately for further advise

BRIEF RESOLVED UNEXPLAINED EPISODE (BRUE) ● 1/2

DEFINITION

This term has replaced apparent life threatening event (ALTE) and near-miss SIDS

- Refers to an episode in an infant aged <12 months which is:
  - <1 min duration (typically 20–30 sec)
  - accompanied by return to baseline state
  - not explained by identifiable medical conditions
  - characterised by ≥1 of the following:
    - central cyanosis or pallor
    - absent, decreased or irregular breathing
    - marked change in tone (hyper- or hypotonia)
    - altered level of consciousness

DIFFERENTIAL DIAGNOSIS

Physiological	Gagging, laryngospasm, neonatal periodic breathing
Cardiac	Congenital heart disease, arrhythmias, prolonged QT, vascular ring
Respiratory	Inhaled foreign body, airway obstruction from e.g. laryngomalacia, congenital malformation
Infection	Pertussis, pneumonia, URTI/LRTI (e.g. RSV), meningitis/encephalitis, UTI, septicaemia, gastroenteritis
CNS	Head injury, seizures, cerebral malformations, central hypoventilation syndrome
Non-accidental injury	Inflicted injury including drug ingestion, factitious illness (Munchhausen by proxy), suffocation
Gastrointestinal	Gastro-oesophageal reflux
Surgical	Intussusception, testicular torsion
Metabolic/toxins	Hypoglycaemia, hypocalcaemia, hypokalaemia, inborn error(s) of metabolism, intentional and non-intentional drug overdose

CLINICAL HISTORY AND EXAMINATION

- Full clinical examination including ABCDE
- Observations including temp, RR, HR, BP, AVPU and oxygen saturations
- Plot weight, length and head circumference
- Ensure no safeguarding concerns e.g.:
  - story changes or inconsistent with developmental stage
  - bruising or bleeding
  - subject to child protection plan

MANAGEMENT OF LOW RISK BRUE

- Low risk events are:
  - first events
  - full resolution
  - no medical condition identified
  - age >60 days
  - born ≥32 weeks' or ≥45 weeks' CGA
  - no CPR given
  - no concerns from history e.g. family history of cardiac conditions or similar events, social concerns, feeding concerns
- Low risk infants may be discharged home if parents are reassured and happy to care for child at home, and suitable safety netting can be arranged
- If discharge not possible, admit for period of observation and discuss with medical senior
- Consider Care of Next Infant (CONI) plus follow-up

BRIEF RESOLVED UNEXPLAINED EPISODE (BRUE) ● 2/2

INVESTIGATION OF HIGH RISK BRUE

If infant not fully recovered or not a low risk BRUE, perform the following investigations:

- Nasopharyngeal aspirate for virology
- Pernasal swab for pertussis
- FBC
- U&E, blood glucose
- Plasma lactate
- Blood gases
- Blood culture
- Urine microscopy and culture (microbiology)
- Urine biochemistry: store for possible further tests (see below)
- CXR
- ECG (looking for long QT)

FURTHER MANAGEMENT

- SpO_2 and ECG monitoring
- Liaise with health visitor (direct or via liaison health visitor on wards)
- Check if child known to local authority children's social care or is the subject of a child protection plan
- If events recur during admission, discuss further investigations with senior e.g.:
- MRI brain
- 24 hr ECG
- cardiorespiratory recordings
- skeletal survey
- toxicology
- All patients must have consultant review and be referred for CONI Plus programme if:
- parents remain concerned despite reassurance
- recurrent or severe events (e.g. needing CPR/PICU)
- <32 weeks' gestation at birth
- a sibling was either a sudden unexplained death (SUD) or had events
- family history of sudden death

BRONCHIOLITIS ● 1/3

RECOGNITION AND ASSESSMENT

Definition

- Acute viral inflammatory illness of small airways that occurs in winter epidemics and affects aged <2 yr, with peak incidence at around 6 months

Symptoms and signs

- Coryzal symptoms for 2–5 days before presentation
- Cough (sometimes paroxysmal)
- Intermittent wheeze
- Irritability and poor feeding
- Mild pyrexia – rarely >38.5°C
- Respiratory distress with progressive tachypnoea, flaring of alae nasi and intercostal recession
- Apnoea or hypoventilation
- Hyperinflated chest on examination
- Widespread fine crackles and wheeze over both lung fields

Differential diagnosis

- Recurrent viral-induced wheeze
- Early asthma
- Cystic fibrosis
- Pertussis
- Recurrent aspiration
- Foreign body in trachea
- Congenital lung anomaly

Investigations

- SpO_2 while breathing air
- Capillary blood gas if:
  - respiratory rate >80 breaths/min
  - transcutaneous PCO_2 >6 kPa
  - SpO_2 <92% in >50% inspired oxygen
  - severe respiratory distress
- Avoid tests that do not contribute to immediate management. Perform following only for specific indications:
  - viral nose swab for respiratory virus PCR
    - when flu prevalence high (if admission required, prescribe oseltamivir)
    - in severely immunocompromised patient to plan antiviral treatment
    - as per local guidelines for cohorting
  - CXR if there are localising signs, cardiac murmur or atypical presentation (e.g. aged >18 months)
  - U&E if there is plan for IV fluids
  - blood cultures if signs of sepsis or temperature >38.5°C

IMMEDIATE TREATMENT

- Nurse in cubicle, or in bay with children with same diagnosis
- Strict hand washing to support infection prevention and use apron for patient contact
- Nurse head up to reduce splinting of diaphragm
- Clear airway by careful suction of nares and mouth
- Use sodium chloride 0.9% nose drops before suction

Respiratory

- If oxygen saturation ≤90% in air and no comorbidities, prescribe oxygen via face mask with reservoir bag
  - if aged <3 months, or comorbidities, prescribe oxygen if saturation <92% in air
  - if mask not tolerated, use nasal prongs for oxygen flow up to 1 L/min in children ≤5 kg body weight, or up to 2 L/min in children >5 kg
  - use heated humidified oxygen if available
- Patients with impending respiratory failure: [SpO_2 <90% in >50% oxygen or in 2 L/min oxygen via nasal prongs, or cyanotic episodes despite supplemental oxygen (except cyanotic congenital heart disease)]
  - review hourly
  - give additional respiratory support with humidified high flow nasal cannula oxygen (2 L/kg/min, maximum 20 L/min)

- review <1 hr; treatment effective if heart and respiratory rate reduced
- Give additional respiratory support with CPAP if:
- no response to humidified high flow oxygen
- respiratory rate >60 breaths/min or bradypnoea
- severe intercostal recession
- rise in $PaCO_2$ (>3 kPa from baseline)
- respiratory acidosis (pH <7.20)

Circulation and hydration
- Assess circulation and treat shock if present
- Correct dehydration if present
- Use IV fluids if oral/NGT fluids not tolerated or significantly increased work of breathing
- restrict intake to 80% of estimated maintenance requirements (see **Intravenous fluid therapy** guideline) using sodium chloride 0.9% in glucose 5% with 10 mmol potassium chloride per 500 mL
- check U&E and blood glucose at least once every 24 hr while giving IV fluids (more frequently if abnormal), and adjust volume and potassium content accordingly

Feeds
- Normal feeds (breast, bottle, solids) if tolerated
- NG tube feeds if:
- oral intake by normal route insufficient **and**
- airway protective reflexes test normal on suctioning **and**
- patient well enough to tolerate NG feeds
- IV fluids (as above) if:
- persistent respiratory rate >80 breaths/min
- persistent vomiting
- oxygen saturation <92% despite supplemental oxygen
- deterioration of respiratory status during NG feeding
- marked increase in work of breathing with poor coordination of sucking, swallowing and breathing

Drug treatment
- In immunocompetent patients, drug treatment and physiotherapy (in acute phase) are ineffective. **Do not routinely prescribe** salbutamol, ipratropium bromide (Atrovent®), adrenaline, antibiotics or corticosteroids
- Aged <6 weeks or patients with temperature >39°C, discuss antibiotics with consultant
- If symptoms <48 hr and influenza test positive (or high prevalence influenza) and risk factors (chronic respiratory, renal, liver, neurological or cardiovascular disease, diabetic or immunocompromised) prescribe oseltamivir

Criteria for admission
Absolute
- Apnoea
- Underlying cardiac defects, especially large left-to-right shunt
- SpO_2 <90% for aged >6 weeks
- SpO_2 <92% in air for aged ≤6 weeks or any age with any underlying health conditions
- Inadequate feeding (<75% of normal)
- Dehydration
- Diagnostic uncertainty

Relative
- Re-attends A&E or CAU in <48 hr
- Aged <6 weeks (corrected gestational age)
- Difficult family circumstances and impaired ability to care for unwell child
- Younger children (i.e. aged <6 months), presenting earlier in illness (<3 days symptoms)
- Pre-existing lung disease, including chronic lung disease, ex-preterm, cystic fibrosis: inform speciality consultant
- Other pre-existing chronic disease (e.g. neurodegenerative, neuromuscular disorder, immunodeficiency, ex-preterm <32 weeks' gestation)

BRONCHIOLITIS ● 3/3

MONITORING TREATMENT

- Standard nursing observations
- Continuous oxygen saturation monitoring during escalation phase if patient requires supplemental oxygen
- Transcutaneous CO_2 monitoring (if available) if SpO_2 <90% in nasal prongs oxygen at 2 L/kg/min (approximately ≥60% oxygen), or has history of apnoea or colour changes
- Continuous heart and respiratory rate monitoring if patient requires additional respiratory support

SUBSEQUENT MANAGEMENT

- Fluid balance
- Oxygen support:
- test need for support 6-hrly
- keep oxygen saturation ≥90% in recovery phase
- wean from nasal prongs to air as tolerated

DISCHARGE AND FOLLOW-UP

- Discharge home when:
- fully fed orally
- SpO_2 >90% in air
- family to be educated on red flag symptoms to watch for:
  - apnoea
  - cyanosis
  - feeding <50% of usual
  - no wet nappy >12 hr
  - exhaustion
  - worsening of breathing
- avoid exposure to passive smoking in household
- educate family about RSV vaccination program for pregnant women over 28 weeks and elderly aged >75 yr
- Hospital follow-up if:
- ventilated on PICU
- consolidation on CXR (first reassess clinically, do not request 'routine' follow-up X-ray, but repeat if clinical examination at follow-up is abnormal)
- ex-preterm with chronic lung disease
- GP follow-up in all other cases

Divided by QRS rate and appearance in ECG into:
- Narrow QRS complex tachyarrhythmia
- Broad QRS complex tachyarrhythmia
- Bradyarrhythmia

NARROW COMPLEX TACHYARRHYTHMIA

Sinus tachycardia
- Rate can be >200 bpm particularly in infants. However, rates of 220–300 bpm most likely to be supraventricular tachycardia (SVT)

Supraventricular tachycardia
- Commonest tachyarrhythmia in infants and children

Symptoms and signs
- Episodes are usually recurrent and paroxysmal (rapid onset and offset)
- Presentation:
- infants
  - tachypnoea
  - poor feeding
  - pallor
  - occasionally rapid onset of heart failure
- toddlers
  - episodes of breathlessness, pallor, cold sweats
- older children/teenagers
  - palpitations, may be associated with dizziness, pallor

Diagnosis
12-lead ECG with rhythm strip
- During SVT
- regular narrow complex tachycardia
- rates 240 +/- 40 bpm
- P-waves usually **invisible** (if visible P-wave axis is abnormal and either precedes or follows QRS complex)
- rarely regular broad complex tachycardia if aberrant pathway present (if in doubt treat as VT)
- When in sinus rhythm
- Wolff-Parkinson-White (WPW) pre-excitation with short PR interval for age and delta-wave in 10−20% of children
- can be normal

Other investigations
- Blood gas for acid-base balance, lactate, electrolytes, ionised calcium
- Echocardiogram to assess structural anatomy and cardiac function

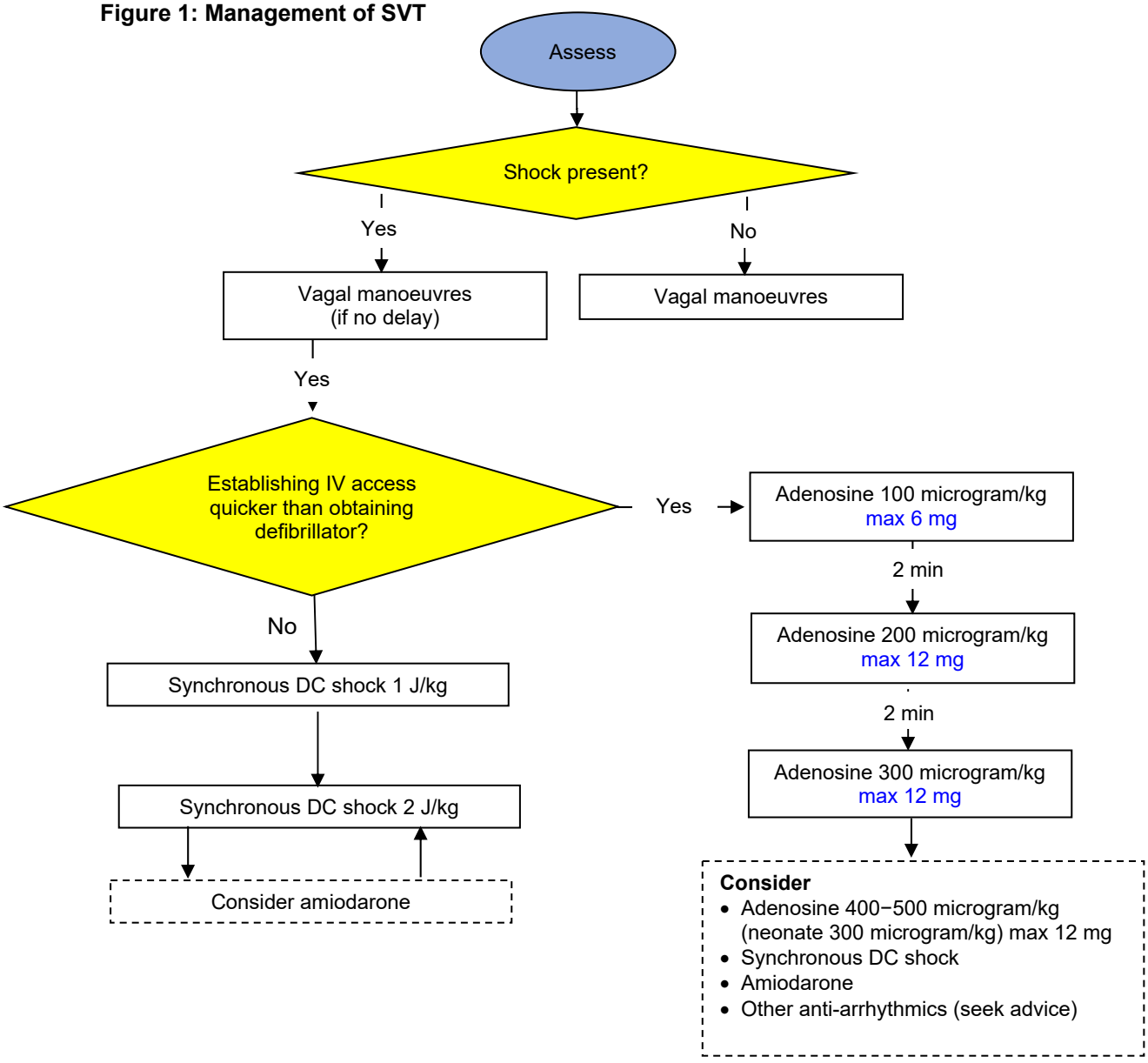
Treatment
- Resuscitate first (ABC approach). See **APLS – cardiorespiratory arrest** guideline
- Follow APLS protocol
- Continuous cardiac monitoring with ECG recording with each intervention
- Vagal manoeuvres
- diving reflex
  - use of ice bag over forehead and nasal bridge for 30 sec **OR**
  - wrapping infant in a towel and immersing face in iced water for 5 sec
- Valsalva manoeuvre (older children)
  - blowing into a 50 mL syringe for 15 sec whilst lying down
- **NOTE: Not recommended:**
  - ocular pressure (risk of injury)
  - carotid massage (deemed ineffective in children)
  - gag reflex using NGT

Adenosine IV
- Drug of choice, safe and effective
- Ideally administer via large cannula inserted in antecubital fossa

- Administration needs to be rapid to be effective (extremely short half-life 10−15 sec) − must get to the heart as quickly as possible
- Use 3-way tap with Luer-lock syringes; 1 syringe for adenosine and 1 for sodium chloride 0.9% flush
- Never test cannula by aspirating blood into syringe with adenosine before injection – will lead to breakdown of adenosine. Major route of elimination via active take-up by red blood cells and vascular endothelial cells where it is metabolised
- Intraosseous administration of adenosine is **ineffective** due to time taken for venous return
- Can be used in regular broad complex tachycardia of uncertain origin
- If SVT resistant to adenosine, seek advice from specialist paediatric cardiology centre

DO NOT USE adenosine in IRREGULAR broad complex tachycardia. Always seek advice from specialist paediatric cardiology centre

Figure 1: Management of SVT



DO NOT use verapamil and amiodarone in the same patient, as both have negative inotropic effects
DO NOT use verapamil in children aged <1 yr

Synchronous DC shock

- General anaesthetic must be given if responsive to pain

Subsequent management
- Admit to HDU
- Continuous cardiac monitoring
- Blood tests to check for electrolyte abnormalities (U&E, calcium and magnesium levels)
- Discuss with specialist paediatric cardiology centre
- All patients will require paediatric cardiology follow-up (local or tertiary)

Other uncommon narrow complex tachyarrhythmias

Ectopic atrial tachycardia
- Commonest cause of incessant tachycardia
- P-waves usually visible (but P-wave axis usually abnormal)
- Usually resistant to adenosine

Nodal or junctional ectopic tachycardias
- Usually in the early post-operative cardiac surgery period (otherwise rare)
- P-waves dissociated from QRS

Atrial flutter
- Can be seen in fetal/neonatal period (rates 200−400 bpm)
- 'Saw-tooth' flutter waves on ECG with variable degree heart block
- Adenosine resistant; but administration can help reveal flutter waves

Atrial fibrillation
- Extremely rare in childhood
- In teenagers with WPW, atrial fibrillation with a fast conducting pathway can result in ventricular fibrillation and carries a risk of sudden death

BROAD COMPLEX TACHYARRHYTHMIAS

Causes

Regular broad complex tachycardia
- Unifocal ventricular tachycardia (VT)
- ≥3 consecutive ventricular ectopic beats
- Sustained if continues >30 sec
- SVT with aberrant atrioventricular (AV) conduction

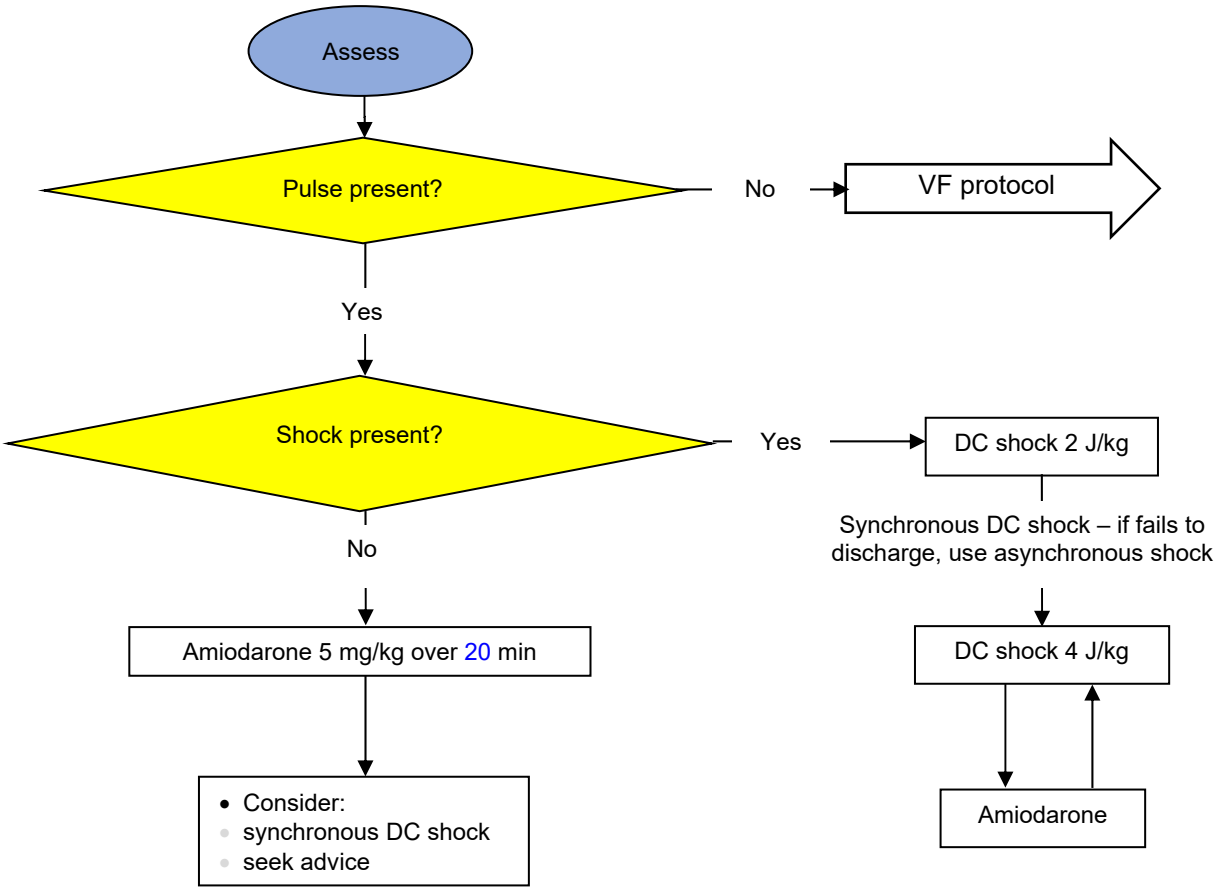
Irregular broad complex tachycardia
- Multifocal VT (long QT syndrome, Brugada syndrome, catecholaminergic polymorphic VT, arrhythmogenic right ventricular dysplasia)
- Atrial fibrillation with WPW

Underlying conditions which can be associated with broad complex tachycardia
- Cardiomyopathy
- Myocarditis
- Post-cardiac surgery
- Known congenital heart disease
- Poisoning (tricyclic antidepressants, quinidine, procainamide, phenothiazines)
- Electrolyte disturbances (hyperkalemia, hypomagnesaemia)

Diagnosis
- Broad complex tachycardia is rare in childhood
- Differentiating between VT and SVT with aberrancy can be challenging even for experienced cardiologists

Management
- Follow APLS protocol (see below) − if in doubt treat as VT

Figure 2: Management of ventricular tachycardia



- Seek specialist advice early
- Amiodarone may cause hypotension − treat with volume expansion
- Use synchronous DC shock initially, as less likely to produce ventricular fibrillation. If synchronous shocks are ineffectual and child is profoundly hypotensive, subsequent shocks will have to be asynchronous
- Treatment of torsades de pointes VT is magnesium sulphate 25−50 mg/kg (maximum 2 g) IV diluted to 100 mg/mL (i.e.10%) in sodium chloride 0.9% and infused over 10−15 min

BRADYARRHYTHMIAS

Incidental bradycardia in an otherwise well child may be normal and does not require any treatment – seek senior advice

Causes that require urgent management

- Pre-terminal sign in hypoxia or shock
- Raised intracranial pressure
- Vagal stimulation

Other causes

- Congenital complete heart block
- Long QT syndrome
- Conduction pathway damage post cardiac surgery

Investigations

- 12-lead ECG
- 24 hr Holter monitor
  - check heart rate variability over 24 hr period
  - check for sinus pauses

CARDIAC ARRHYTHMIAS ● 5/5

Management
Treat only if child is in shock

- ABC approach: ensure adequate oxygenation and ventilation (APLS pathway)
- If above ineffective:
- adrenaline bolus 10 microgram/kg IV (maximum single dose 1 mg)
  - neonates may require higher doses on a microgram/kg basis as they are more resistant to atropine
- adrenaline infusion 0.05−1.5 microgram/kg/min infusion (if bolus ineffective)
- If vagal stimulation is cause
- atropine 20 microgram/kg IV/IO (maximum 1.2 mg per dose)
- can be repeated after 5 min [maximum total dose 1 mg in a child (up to aged 11 yr) and 2 mg in an adolescent (aged 12−17 yr)
- Contact specialist paediatric cardiology centre for advice (send 12-lead ECG)

CYSTIC FIBROSIS – ADMISSION ● 1/2

ARRANGING ADMISSION

- For elective admissions refer to admission plan in notes or clinic letter
- For acute admissions discuss with CF team
- Always admit to a cubicle

ADMISSION PROCEDURE

- Plot baseline weight, height
- Perform flow volume loop spirometry on admission day (aged ≥6 yr)
- Review medications with patient/parent/carer and last clinic letter
- Prescribe all medication
- Check whether annual bloods could conveniently be taken now (see **Annual bloods**)
- Ask nursing staff to inform physiotherapist and dietitian on day of admission
- Check specific aspects of management or investigations, as described by CF team
  - for IV antibiotics: see **Cystic fibrosis – Exacerbation** guideline
  - for bowel obstruction: see **Cystic fibrosis – Distal intestinal obstructive syndrome (DIOS)** guideline

INVESTIGATIONS

Bloods

- If child admitted for IV antibiotics, send bloods when the cannula/long line is inserted or port-a-cath accessed
- Send: FBC, U&E, CRP, LFT and blood cultures
- If allergic bronchopulmonary aspergillosis (ABPA) suspected, request total IgE, specific IgE to *Aspergillus* and *Aspergillus* precipitins

Microbiology

- On admission, request sputum/cough swab for MC&S
- If clinically indicated consider sending nose and throat viral swabs
- If non-tuberculous mycobacteria (NTM) infection suspected send sputum for NTM culture
- Repeat sputum/cough swabs for MC&S 1–2 x per week during admission (usually performed by physiotherapist but check this has been done)
- If new pathogen found, see **Cystic fibrosis – Microbiology** guideline

Chest X-ray

- If new clinical signs present when examining chest, order CXR
- Most children have CXR every 12 months, check when last one was performed; if in doubt, discuss with CF consultant
- If new CXR performed always compare with previous
- If recent CT performed review findings and discuss with CF consultant and radiologist

Lung function and oxygen saturation

- Perform spirometry on admission, then weekly on all children who blow reliably (usually aged ≥6 yr)
  - undertaken by physiotherapist or trained nurse. If evidence of airway obstruction repeat spirometry 15 min after inhalation of salbutamol MDI 4 puffs via spacer
- Monitor oxygen saturation overnight for first 2 nights after admission
  - if saturations <91%, prescribe oxygen via nasal cannulae or face mask

Screening for hyperglycaemia

Approximately 8% of children with CF develop diabetes after aged 10 yr, usually manifests as weight loss; ketoacidosis is rare

- If taking regular oral corticosteroids, screen for glucose intolerance at admission:
  - during first 24 hr after admission request fingerprick blood glucose before breakfast, 1–2 hr after every meal, and at 0200 hr if on overnight feeds
- If prednisolone started or dosage increased during admission, repeat fingerprick blood glucose
- If blood glucose elevated, discuss with CF team

Annual bloods

- All children attending CF clinics have annual blood screening
- Perform annual bloods if admission within a month of annual screening (usually at time of birthday) during insertion of a long line or port-a-cath needle, or when checking tobramycin level

CYSTIC FIBROSIS – ADMISSION ● 2/2

All ages
- FBC and film
- Vitamins A, D, E
- Parathyroid hormone
- U&E, CRP, LFTs, chloride, bone profile, magnesium, *Pseudomonas aeruginosa* antibodies
- Glucose
- Total IgE, specific IgE to *Aspergillus* and *Aspergillus* precipitins

If aged ≥10 yr
- Add glucose tolerance test (at 0, 60 and 120 min)

NUTRITION
- Always involve dietitians
- Weigh twice weekly, **in nightwear** and **before breakfast** (weigh babies naked if possible)
- Continue normal supplements

Pancreatic enzyme supplements
- Continue same type and dose of pancreatic supplement as already prescribed

Starting dosage for newly diagnosed child
- **Infants**
- **EITHER** Creon® Micro for children ½ scoop (2500 units lipase) to 1 scoop (5000 units lipase) per 120 mL milk or breast feed (mix with 5 mL of milk and administer via spoon – **do not** add to bottle)
- **OR** Creon® 10,000 ¼ (2500 units lipase) to ½ (5000 units lipase) per 120 mL milk or breast feed

- **Children**
- starting dose Creon® 10,000 – 2 capsules per meal, 1 capsule per snack
- Dose titrated with fat content of meals and snacks to control symptoms of malabsorption
- maximum 10,000 units lipase/kg/day, higher doses can result in colonic strictures

Signs of malabsorption
- Fatty pale stools, frequent, smelly, orange oil, excess flatulence, abdominal pains
- discuss with CF team

Proton pump inhibitor (PPI)
- If taking large doses of pancreatic enzymes (e.g. >10,000 units lipase), discuss with CF team need for concurrent PPI to reduce deactivation of pancreatin

Vitamins A, D and E
Starting dosage for newly-diagnosed
- **Infants**
- 0.6 mL Dalivit® and 0.5 mL (50 mg) alpha tocopheryl acetate (Vitamin E)
- **Children**
- **EITHER** 1 mL Dalivit® or 3 BPC multivitamin capsules and 100 mg (150 units) alpha tocopheryl acetate (Vitamin E) [x 2 50 mg (75 units) capsules]
- **OR** Paravit™-CF (contains vitamins A, D, E and K) x 2 capsules daily
- Vitamin levels are checked annually and dosage adjusted accordingly

Oral sodium chloride
- Only if prescribed by CF team
- Often needed in first year of life after diagnosis has been made

CYSTIC FIBROSIS – DISTAL INTESTINAL OBSTRUCTION SYNDROME ● 1/1

DEFINITION

- An acute complete or incomplete faecal obstruction in the ileocaecum
- in contrast, constipation is defined as gradual faecal impaction of the total colon

RECOGNITION AND ASSESSMENT

- Patients present with constipation, intermittent abdominal pain, abdominal distension and faecal masses
- Abdominal X-ray (AXR) may be performed to evaluate degree of bowel dilatation and obstruction
- If diagnostic doubt CT abdomen may be helpful – discuss with CF and radiology consultants

MANAGEMENT

- Manage medically with surgical intervention used only as a last resort. Discuss with CF team before making surgical referral
- If symptoms are mild, prescribe daily macrogol laxative (e.g. Movicol®) see **BNFc**, and encourage fluids
- Ensure adherence with pancreatic enzyme replacement therapy
- If unresponsive, or symptoms more severe:
- ensure adequate pre-hydration (low threshold for IV fluids and essential for all neonates and infants) and for ≥3 hr after administration of treatment. Monitor fluid balance and allow food
- Oral sodium amidotrizoate and meglumine amidotrizoate (Gastrografin®):
- aged 1 month–2 yr: 15–30 mL Gastrografin® diluted in 90 mL water/fruit juice
- 15–25 kg: 50 mL Gastrografin® diluted in 150 mL water/fruit juice
- >25 kg: 100 mL Gastrografin® diluted in 200 mL water/fruit juice
- Above can be given as single dose or 4 divided doses. If no effect after 24–48 hr or if patient deteriorates, bowel lavage with Moviprep® (usually requires NG tube)
- 10 mL/kg/hr for 30 min
- then if tolerated, 20 mL/kg/hr for 30 min
- if well tolerated can increase to 25 mL/kg/hr up to maximum total dose of 100 mL/kg or 4 L (whichever is smaller) over 4 hr
- if necessary, repeat 4 hr treatment
- Start early in the morning and continue until stools are yellow, watery and free of solid matter
- 2 L in first instance, increasing to 3 or 4 L depending on response, age and size of child (most children with DIOS will be teenagers)
- Withhold food but, if success not achieved after 12 hr, stop, give an evening meal and repeat following morning
- **DO NOT** give in the presence of bile-stained vomiting
- **DO NOT** give solid food for ≥2 hr before starting treatment
- **DO NOT** administer just before bedtime due to risk of aspiration
- Review after first 4 hr
- If not passing essentially clear fluid *per rectum* then further 4 hr treatment can be given
- Monitor for hypoglycaemia, which can occur CF with diabetics undergoing this regimen
- Monitor effectiveness with plain AXR before and after lavage
- If signs of complete intestinal obstruction, stop lavage, give IV fluids and discuss contrast enema with CF team

CYSTIC FIBROSIS – EXACERBATION ● 1/2

RESPIRATORY INFECTION/EXACERBATION

If unusual symptoms, e.g. haemoptysis, abdominal pain suggestive of distal intestinal obstruction syndrome, or bleeding varices, discuss urgently with CF team

Symptoms and signs

- Increasing cough and sputum production
- Increasing dyspnoea
- Weight loss with loss of appetite
- Thick, tenacious sputum
- Coarse crackles
- Haemoptysis

Investigations

- See investigations in **Cystic fibrosis – Admission** guideline

Differential diagnosis

- Non-CF bronchiectasis
- Chronic obliterative bronchiolitis

ADDITIONAL ADMISSION PROCEDURE

- Discuss all admissions with CF team
- Trained nursing staff needed to needle port-a-cath
- CXR not performed routinely – request if pneumothorax or lobar collapse suspected

IMMEDIATE TREATMENT

- Use IV antibiotic regimen suggested following discussion with CF team
- If no discussion possible, stop oral antibiotics and start same IV antibiotics used during last exacerbation
- If patient has never had IV antibiotics give first-line regimen (see below)
- Take into account any past allergic reactions

First-line regimen

- Sputum culture
- *Pseudomonas aeruginosa*: ceftazidime 50 mg/kg 8-hrly (maximum 3 g/dose) and tobramycin 10 mg/kg once daily (maximum 660 mg) given over 30 min; use ideal body weight for height to avoid overdose of tobramycin and monitor pre-dose (trough) levels for tobramycin (aim for <1 mg/L for once daily dosing)
- no *Pseudomonas aeruginosa*: cefuroxime 50 mg/kg 6-hrly (maximum single dose of 1.5 g)
- Courses usually last two weeks
- For cephalosporins (but not tobramycin), aim to use whole vials by rounding doses +/- 10% considering vial size

Nebulised antibiotics

- Prescribe child's routine nebulised antibiotics and administer as normal. Do not start new nebulised treatment without discussion with CF team

Oral antibiotics

Prescribe and administer children's routine prophylactic antibiotics as normal during an admission, even when receiving IV antibiotics

Bronchodilators

- Salbutamol by MDI and spacer may be used before nebulised treatments or physiotherapy, discuss with CF team

Inhaled corticosteroids

- There is no evidence these are of benefit. Discuss stopping with CF team

CYSTIC FIBROSIS – EXACERBATION ● 2/2

TOBRAMYCIN MONITORING

Once daily regimen:

- Trough (pre-dose) level immediately before 2nd and 8th doses
- Should be <1 mg/L
- Monitor urine output and serum creatinine
- **High levels need to be discussed with CF team**
- No need to determine peak (i.e. post-dose level) as once daily dosing
- **Always discuss dose or interval changes with CF team beforehand and ensure level taken at correct time**
- **DO NOT** check tobramycin level via port-a-cath or long line

SUBSEQUENT MANAGEMENT

- Do not change antibiotics before discussing with CF team
- If no chest improvement has occurred after 7day course of IV antibiotics – consider CXR

Oral corticosteroids

- If no chest improvement after 7 days of IV antibiotics, discuss with CF team about starting 7 day course of prednisolone 1 mg/kg/day rounded up to nearest 5 mg
- If already taking alternate-day prednisolone at lower dosage, review dosage needed at discharge
- For children with allergic bronchopulmonary aspergillosis (ABPA), continue prednisolone for longer (e.g. at least 1 month then wean) and add an anti-fungal agent

Nebulised mucolytics [dornase alfa (DNAse)/hypertonic saline]

- During admission prescribe patient's routine nebulised mucolytics and administer as normal
- If thick secretions are a particular problem a new nebulised mucolytic may be started or frequency of existing treatments increased. Discuss with CF team
- discuss timing of these treatments in relation to chest physiotherapy with CF team and patient
- Patient should bring their own nebuliser into hospital

DISCHARGE AND FOLLOW-UP

- On advice of CF team

Self-administration of IV antibiotics – home IV therapy

- It is appropriate in some patients for the IV antibiotic course to be completed at home
- Patients/families must receive appropriate training and achieve the necessary competences whilst on the ward
- Service managed by CF team in conjunction with hospital pharmacy
- Discuss fully with CF team before making any changes or arrangements

Criteria for home administration of IV antibiotics

Ensure that:

- CF team and ward staff happy for patient to be discharged
- Patient and parents **entirely happy, confident and competent** to administer IV antibiotics at home
- Patient/parent has been assessed before discharge by CF team
- Parents have written guidelines and **24 hr** contact numbers
- If patient considered responsible enough to self-administer IV antibiotics, important that parent/carer also has adequate instruction and guidance
- Anaphylaxis kit at home and family know how to use
- Notify CF team of any patient discharged on home antibiotic therapy so they can arrange support at home or at school if necessary
- CF team will visit patient at home during his/her course of IV therapy, to monitor progress
- Feedback any concerns to CF team

CYSTIC FIBROSIS – MICROBIOLOGY● 1/2

In addition to standard precautions and hand hygiene, the following precautions are required for patients infected with potentially transmissible pathogens

- Do not share equipment between patients
- Nurse children with CF in a cubicle
- Prevent contact between CF patients

PATIENT NEWLY DIAGNOSED WITH CF

- Prophylaxis with flucloxacillin 125 mg oral 12-hrly until aged 2 yr
- If newly diagnosed CF patient has chest infection requiring IV antibiotics:
- commence cefuroxime IV for two weeks
- Subsequent treatment depends on antibiotic sensitivities

PSEUDOMONAS AERUGINOSA

First isolation in sputum/cough swab

- If asymptomatic with first isolation from sputum/cough swab:
- ciprofloxacin: aged 1 month – 18 yr 20 mg/kg oral 12-hrly (maximum 750 mg per dose) for 6 weeks **and**
- colistimethate sodium (nebulised for 3 months):
  - aged <2 yr: 1 million units 12-hrly
  - aged ≥2 yr: 2 million units 12-hrly
- If symptomatic:
- tobramycin **and** ceftazidime IV for two weeks, followed by nebulised colistimethate sodium at doses listed above
- if organism is not successfully eradicated after 2 months of treatment consider 4 week course of nebulised tobramycin as directed by CF team

Chronic infection with *Pseudomonas aeruginosa*

- Defined as >50% of microbiology samples positive for *Pseudomonas aeruginosa* in previous 12 months (minimum of 4 samples)
- **Patients with chronic *Pseudomonas aeruginosa* to receive nebulised antibiotic prophylaxis; choice of agent (colistimethate sodium/tobramycin/aztreonam) will be decided by CF team according to clinical status and microbiology sensitivities**

BURKHOLDERIA CEPACIA COMPLEX (BCC)

First isolation in sputum/cough swab

- **Report new cases of BCC to CF team immediately**
- Eradication to be attempted using a regimen containing IV and nebulised antibiotics; choice of agent dependent on sensitivities

Chronic infection with BCC

- Defined as >50% of microbiology samples positive for BCC in previous 12 months (minimum of 4 samples)
- Children with chronic BCC to receive nebulised antibiotic prophylaxis; choice of agent (tobramycin/meropenem) will be decided by CF team according to clinical status, microbiology sensitivities and tolerability
- Children with transmissible strains of BCC need to be nursed in cubicle **on a separate ward** from other CF children

METHICILLIN RESISTENT *STAPHYLOCOCCUS AUREUS* (MRSA)

First isolation in sputum/cough swab

- **Report new cases to CF team immediately**
- If asymptomatic:
- attempt eradication using nebulised vancomycin for 5 days (as directed by CF team), followed by 2 or 3 oral antibiotics for 6 weeks (choice dependent on sensitivities)
- If symptomatic:
- eradication to also include 2 weeks IV antibiotics (choice dependent on sensitivities)

Chronic infection with MRSA

- Defined as >50% of microbiology samples positive for MRSA in previous 12 months (minimum of 4 samples)
- Use of nebulised or oral antibiotic prophylaxis to be discussed with CF Team

CYSTIC FIBROSIS – MICROBIOLOGY● 2/2

CHICKENPOX AND CF

- Varicella infection can have serious consequences in immunosuppressed children
- CF patients taking oral corticosteroids are at high risk
- If no history of chickenpox and no antibodies, vaccinate

Exposure

- Ask about exposure to a known case:
  - being in same room (e.g. in house, classroom or hall in school) for ≥15 min
  - face-to-face contact, e.g. whilst having a conversation
- If exposure significant, check notes to determine immune status (history of chickenpox or antibody status before corticosteroids)
- If non-immune and taking a high dose of oral corticosteroid (prednisolone 1 mg/kg/day for 1 month or 2 mg/kg/day for 1 week), and exposure occurred <96 hr earlier, request varicella-zoster immunoglobulin (VZIG) from microbiology
  - aged <6 yr: 250 mg
  - aged 6–10 yr: 500 mg
  - aged 11–14 yr: 750 mg
  - aged ≥15 yr: 1 g
- If non-immune and taking a modest dose of oral corticosteroid (prednisolone <1 mg/kg/day) or higher dose >96 hr since exposure, give oral aciclovir prophylaxis: 10 mg/kg (maximum single dose of 800 mg depending on weight), 6-hrly for seven days, starting from 7–14 days after exposure

Infected

- If chickenpox appears in a child not taking oral corticosteroid, give oral acyclovir:
  - aged <2 yr: 200 mg 6-hrly for 5 days
  - aged 2–5 yr: 400 mg 6-hrly for 5 days
  - aged 6–11 yr: 800 mg 6-hrly for 5 days
  - aged 12–17 yr: 800 mg 5 times/day for 7 days
- If taking steroids or chickenpox is severe, discuss VZIG with microbiology consultant

INFLUENZA AND PNEUMOCOCCAL VACCINE

- Influenza vaccine every October
- Administer conjugate pneumococcal vaccine (Prevenar13®) as part of standard childhood immunisation regimen
- Usually prescribed by patient's own GP but obtainable from pharmacy

PORT-A-CATH

- Use in children requiring frequent IV antibiotics
- Manufacturer's instructions found on ward
- Observe sterile precautions whenever port-a-cath accessed
- Accessed only by trained nursing staff

Routine flushing of port-a-cath (usually by nursing staff)

- Every four weeks (coincide with clinic appointment where possible)
- Use straight port-a-cath needle and 4 mL heparinised sodium chloride 0.9% 100 units/mL (e.g. Canusal®, not Hepsal®), withdrawing needle while injecting last mL

CHEST PAIN ● 1/2

Chest pain is a common complaint in children which can cause significant anxiety to patients and their families. Reassuringly an underlying cardiac cause is unusual (0.6–1%)

TRAFFIC LIGHT SYSTEM FOR ASSESSING CHEST PAIN

Red	
Recent cardiac surgery (<2 weeks)	• Pericarditis, post pericardiotomy syndrome • Pericardial effusion • Pleural effusion • Repair site complication (e.g. mediastinitis, wound infection) • Bacterial endocarditis • Pneumothorax
Known connective tissue disorder e.g. Marfan syndrome	• Aortic dissection/aortic aneurysm • Mitral valve prolapse • Pneumothorax
Known Kawasaki disease **with** coronary artery involvement	• Coronary artery thrombus
Hypercoagulable states e.g. obesity, oral contraceptive pill in females	• Pulmonary embolism
Amber	
Chest pain associated with exercise	• Myocardial ischaemia ◦ congenital heart disease [severe aortic stenosis (AS), severe pulmonary stenosis (PS), pulmonary hypertension] ◦ coronary artery disease (congenital anomalies, post Kawasaki, previous cardiac surgery involving coronaries) ◦ cardiomyopathy (dilated, hypertrophic)
Chest pain radiating to jaw/left arm	• Myocardial ischaemia (see above)
Chest pain radiating to left shoulder tip	• Pericarditis
Chest pain associated with palpitations	• Pathological arrhythmia [supraventricular tachycardia (SVT), frequent ventricular ectopics, ventricular tachycardia (VT)]
Chest pain associated with syncope	• Pathological arrhythmia or left heart obstruction (severe aortic stenosis and hypertrophic obstructive cardiomyopathy)
Known congenital or acquired heart disease/previous cardiac surgery or cardiac interventions	• Pathological arrhythmia (as above)
• Family history of: ◦ sudden death (aged <40 yr), cardiomyopathy ◦ conduction disorders (long QT syndrome, Brugada syndrome)	• Risk factor for sudden death
Green	
Chronic pain	• Less likely to be cardiac
Superficial reproducible chest wall tenderness	• Musculoskeletal/costochondritis
Worse with movement/deep breathing	• Musculoskeletal
Chest pain with cough/wheeze	• Respiratory causes
Chest pain with eating or posture	• Gastrointestinal causes
Anxiety trigger/hyperventilation	• Psychogenic

HISTORY

- Explore if in RED/AMBER category
- Well-localised and reproducible pain: usually musculoskeletal
- Crushing pain/heaviness associated with nausea, sweating or pallor: consider cardiac cause
- Past medical history

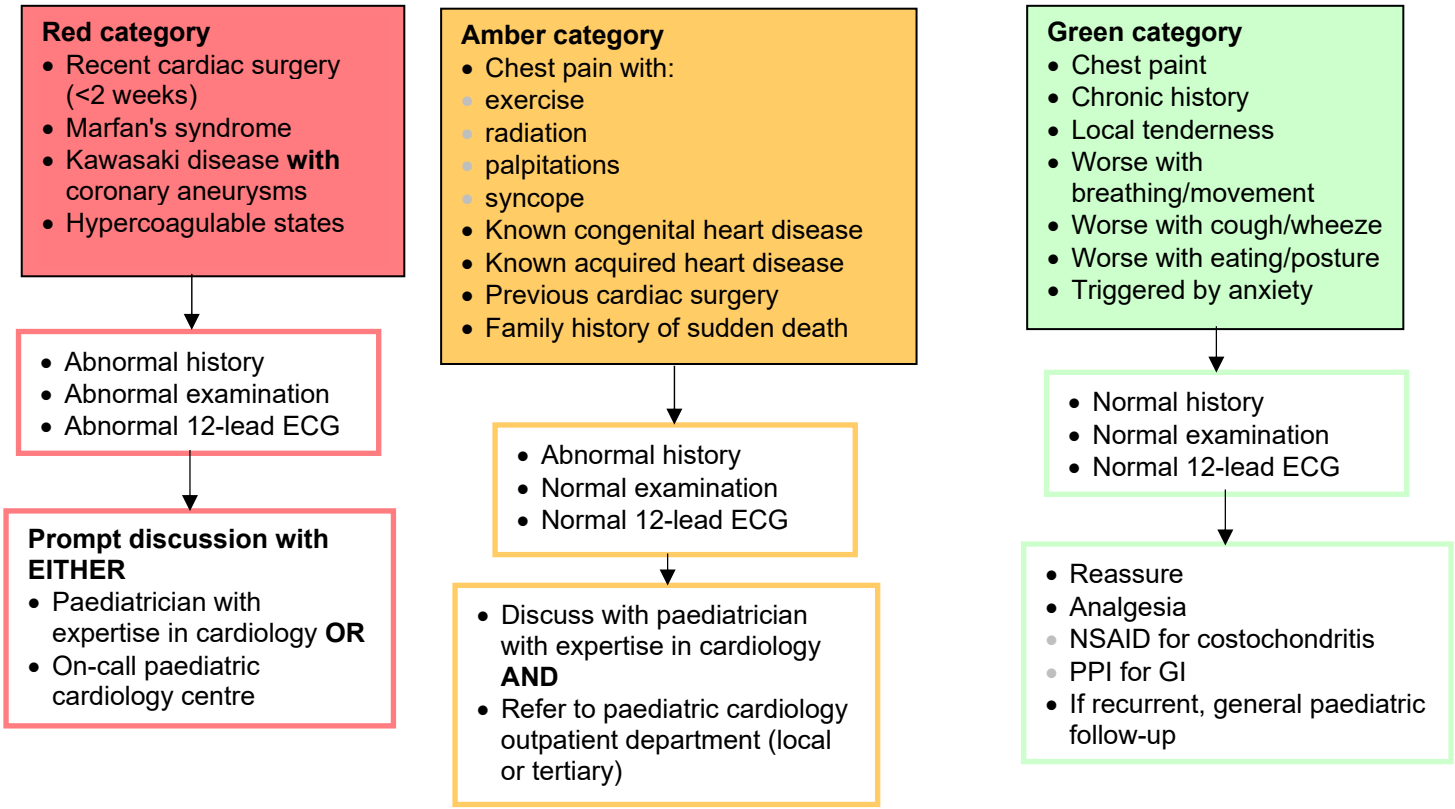
- asthma, acid reflux, sickle cell disease
- Kawasaki disease, known congenital heart disease, previous cardiac interventions/surgery
- drugs: recreational substances (cocaine), oral contraceptive pill
- Family history
- conduction disorders/arrhythmias (long QT syndrome, Brugada syndrome)
- cardiomyopathy
- sudden death in young relatives (aged <40 yr)
- connective tissue disorders

EVALUATION

- Detailed history and examination
- Baseline observations, including blood pressure and oxygen saturations
- 12-lead ECG: assess rate, rhythm, signs of myocardial ischaemia, ventricular hypertrophy, corrected QT interval (see **ECG interpretation** guideline)
- Chest X-ray: consider if acute severe chest pain, associated with fever and cough, post chest trauma, abnormal respiratory examination, abnormal cardiovascular examination

MANAGEMENT

Flowchart: Management of chest pain



CHILD PROTECTION • 1/5

Always follow your local child safeguarding policies and procedures.
The safety of children is everyone's responsibility

More comprehensive guidance – the Child Protection Companion can be found on the RCPCH website: https://childprotection.rcpch.ac.uk/child-protection-companion/

- Four recognised categories of abuse (rarely seen in isolation)
- physical abuse (non-accidental injury)
- emotional abuse
- neglect
- sexual abuse

PHYSICAL ABUSE (NON-ACCIDENTAL INJURY)

Definition

Physical abuse may involve hitting, shaking, throwing, poisoning, burning or scalding, drowning, suffocating or otherwise causing physical harm to a child. Physical harm may also be caused when a parent fabricates the symptoms of, or deliberately induces, illness in a child

Recognition and assessment

Assessment of the child should be carried out by a paediatrician with Level 3 competences as per 'Safeguarding Children and Young people: Roles and Competencies for Healthcare Staff' – https://www.rcn.org.uk/professional-development/publications/pub-007366#:~:text=To%20protect%20children%20and%20young,as%20appropriate%20to%20their%20role. Where a trainee carries out the assessment, they should be supervised by a consultant or senior paediatrician

There may be direct information from the child or carer. The following presentations need to be considered:

- Delay in seeking medical attention following injury
- History incompatible with injury seen
- Numerous explanations suggested for injury
- Changes in the history
- Parents 'shopping around' for medical help (e.g. from GP, A&E, different hospitals)
- History of domestic violence
- Odd or aggressive parental behaviour
- Any fracture in an infant without a satisfactory explanation
- Any bruise on a child aged <6 months or pre-mobile
- Patterns of bruising, injury or explanation not compatible with child's development
- Recurrent injuries
- Evidence of other forms of abuse (e.g. failure to thrive, neglect)
- Previous evidence of injury or neglect (check if child known to local authority children's social care or is the subject of a child protection plan)

Referrals

- Most referrals for medical assessment will come through children's social care teams or the police
- Discuss referrals from GP with consultant before arranging medical assessment by on-call team
- consultant will review whether referral should be made to child protection agencies first/as well
- Referrals from A&E or surgical wards to be taken by registrar or above
- discuss with consultant first to determine who should carry out initial examination and whether social care or police should be present

Always discuss referrals with the on-call consultant for child protection duties and/or designated consultant for safeguarding

Immediate action

- If there is an urgent or life-threatening situation, start necessary emergency treatment
- Refer to your Trust on-call child protection arrangements
- if you suspect harm, refer to social care, and police if they are not already involved
- Keep any social worker or police officer involved informed
- Always consider potential risks to siblings or other children

History

- Where referral is made from social care and/or police, the child may have given a full history of events, often a visual recording
- ask for this information from social worker or police officer at beginning of examination. It may not be necessary to repeat this information unless further detail is required
- If child first presents in a health setting, registrar or consultant should take history and examine child before discussing with social care or police

How

- Record findings accurately during or immediately after examination, using a dedicated child protection proforma with body charts if available
- Complete and sign each page and include:
- full family history
- persons present at interview
- source of your information (including the child)
- person giving consent
- date and time of start and finish

Take care when talking to the child not to ask leading questions or make suggestions that could contaminate evidence in a subsequent trial, document clearly what is said in child's own words

Examination

- Ideally there should be only 1 examination. It can be useful to do further examinations as injuries such as bruises may evolve and the picture becomes clearer
- Keep your immediate senior informed
- All child protection examinations to be carried out within appropriate timescales, for physical abuse: within 24 hr

If this is a planned medical assessment at the request of child protection agencies, carers with parental responsibility and the child (depending on age and understanding) must give their consent (usually written) for examination to take place. If consent not forthcoming, social care may obtain a legal order giving permission for the child to be examined. This does not apply where a child needs urgent assessment and treatment

- Must include:
- state of child: cleanliness, appropriate clothing, etc.
- **all** body areas
- accurate description of all injuries (size, colour, position and pattern) on body charts
- mouth (torn frenulum of lip and tongue especially)
- fundi: look particularly for haemorrhages. With small children, especially where head injuries suspected, this is usually the role of the paediatric ophthalmologist
- note of any birth marks, scars etc.
- full paediatric systemic examination
- plotting height and weight and head circumference on growth charts – note centiles
- child's emotional state, demeanour and degree of co-operation
- a comment on the developmental state (or school progress)
- observations on relationships or behaviour between parents and child

Investigations

A selection of the following tests will usually be necessary; seek advice from consultant as to which are appropriate:

- If personal history of abnormal bleeding or concerning family history, discuss with paediatric haematologist first as other tests may be indicated
- Bone biochemistry [including vitamin D, PTH (EDTA specimen)] if there are unexplained fractures
- Investigations into other suspected abuse (e.g. failure to thrive)
- Skeletal survey in children aged <2 yr with unexplained injuries, repeat views after 11–14 days are required. Head CT scan in children aged <12 months and in older children if focal encephalopathic features, focal neurology or haemorrhagic retinopathy
- Further neuroimaging according to RCR/RCPCH guidelines
- Document in notes if decision made not to proceed with imaging
- Photographs (often a police photographer is used)

Haematological investigations
When a bleeding diathesis suspected or needs to be ruled out, perform following:
- Initial baseline investigations
- FBC and film (EDTA up to 1 mL)
- APTT and PT (not INR)
- thrombin time
- fibrinogen levels
- if thrombocytopenic, mean platelet volume
- von Willebrand Factor antigen and activity (ristocetin cofactor/RCoF)
- Factor VIII and IX assay if male
- blood group
- send 2 or 3 sodium citrate bottles, filled to appropriate fill line level

Subsequent investigations
- Identify all requests as non-accidental injury investigations
- Interpret all test results with age-appropriate reference values
- If significant bruises, before further investigations, discuss with paediatric haematologist:
- von Willebrand Factor antigen and activity
- Factor VIII, IX if not already done
- Factor XIII assay
- child aged <2 yr: platelet function assay

EMOTIONAL ABUSE

Recognition and assessment
Definition
- Habitual harassment of a child by disparagement, criticism, threat and ridicule
- Present in most cases of physical and sexual abuse, and neglect
- presents difficulties in definition, recognition and management
- long-term consequences upon social, emotional and cognitive development can be more harmful than other forms of abuse

Presentation
- Part of the differential diagnosis if a child presents with the following non-specific behaviours:
- unhappy
- disturbed
- poor concentration leading to learning difficulties/school failure
- poor social interactions
- unable to play
- problems with attachment to parents or caretakers
- behavioural difficulties
- over-friendly or craving affection from strangers

Assessment
- Assessment is complex; requires a multidisciplinary approach and may take some time – outcome may not be available immediately
- Social care take the investigative lead
- May need to rule out mental health difficulties
- if concerned about emerging or deteriorating mental health seek advice from CAMHS

NEGLECT

Neglect may not always be intentional (e.g. parental mental health problems)

Recognition and assessment
Definition
- Neglect is persistent failure to meet a child's physical and/or psychological needs
- Lack of care of physical needs that can result in failure to thrive
- important to eliminate organic causes
- neglect of physical care most likely to come to Child Health attention along with developmental delay

Presentation
- Child's appearance
  - note condition of clothing, hair, skin
- Growth
  - height, weight, serial measurements to check growth rate
  - head circumference
  - mid-upper arm circumference
- Non-attendance at (or repeat alterations of) appointments

Physical examination
- Signs of medical problem not appropriately treated
- Evidence of other forms of abuse
- Development
  - gross motor skills, fine motor skills, vision, hearing, language, behaviour, play

SEXUAL ABUSE

Recognition and assessment

Definition
- Forcing or enticing a child or young person to participate in sexual activities, whether or not the child is aware of what is happening
  - may involve physical contact, including penetrative (e.g. rape or buggery) or non-penetrative acts
  - may include non-contact activities (e.g. involving children in looking at, or in production of, pornographic material, watching sexual activities, or encouraging them to behave in sexually inappropriate ways)

Presentation
- Information given by child
- Symptoms resulting from local trauma or infection (e.g. bruises, bleeding, discharge)
- Symptoms resulting from emotional effects (e.g. behavioural changes, enuresis, encopresis, self-harming, eating disorders or psychosomatic symptoms)
- Sexualized behaviour or sexual knowledge inappropriate to age
- Under-age pregnancy
- Sexually transmitted infections

Referrals
- Referrals usually come from local authority children's social care or the police
  - refer to your departmental child protection rota

If a child presents in a medical setting and there are concerns about sexual abuse, call the on-call consultant for child protection immediately. Depending on any urgent medical needs, e.g. bleeding, child protection agencies may need to be involved before medical assessment

IMMEDIATE ACTION – HISTORY AND EXAMINATION

Preparation
- Where sexual abuse suspected, whoever examines the child **MUST** have training and experience in this field and the examination must take place in an appropriate location e.g. sexual assault referral centre (SARC)
- In exceptional cases, particularly where there is acute trauma and bleeding that may require surgical management, it may be appropriate for the examination to be carried out under anaesthetic by a gynaecologist/urologist after discussion with the forensic medical examiner (FME)

Examination
- Purpose of medical examination is to:
  - detect traumatic or infective conditions that may require treatment
  - evaluate the nature of any abuse
  - secure forensic evidence
  - reassure the child
  - start process of recovery

Initial management
- If penetration and/or passage of bodily fluids are suspected consider sexually transmitted diseases and, in girls, pregnancy
  - pregnancy test
  - if assault within 72 hr, offer post-coital contraception (ideally <12 hr) – usually levonorgestrel 1.5 mg stat dose
- Contact genito-urinary medicine department
- Post exposure prophylaxis should be started within 1 hr of assault if indicated (can be given up to 72 hr after assault). See **HIV and hepatitis B post-exposure prophylaxis (PEP)** guideline
- If ano-genital warts found, discuss with a senior/safeguarding lead (though usually spread non-sexually)

Investigations
- Mid-stream urine
- Forensic tests (FME to determine)
- Photos/video recordings obtained with a colposcope, stored in accordance with local policy

Always follow your local child safeguarding policy and procedures

SUBSEQUENT MANAGEMENT
- Majority of children seen will be allowed home if it is safe and after discussion with social care and police
  - some children who have been abused will be admitted while problems are investigated
- Always keep parents and children informed of concerns and what next actions will be
- Be open and honest with parents where possible unless this could put child (or others) at risk of further harm

Keeping children safe
- If there is clear evidence of child abuse and parents attempt to remove child there are 2 courses of action:
  - in an emergency, dial 999, the police can use police protection powers to keep child safe
  - if there is time, a social worker can obtain an Emergency Protection Order from Court (Section 44, Children Act 1989)
- Put the child's safety first
- Communicate with other staff involved (e.g. nursing staff) so that situation can be supervised
- Consider the safety of siblings
  - usual for siblings to be examined at same time as index child

DISCHARGE AND FOLLOW-UP

Only a consultant may allow child to go home

- Consultant should make decision regarding discharge, usually after discussion with the police and social care

Communication is vital

- Send written report to GP without delay, with a copy for social care and the police
- If child referred from A&E, send copy of report to them for feedback
- Ensure notes and dictation is available to secretary, marked 'for urgent attention'
  - type notes into iPortal/use digital dictation to provide typed notes immediately
- Ensure report is signed in a timely manner
- Complete ward discharge forms
- Check with consultant if follow-up is required

Child protection conference
- May be convened following a child protection investigation to consider whether child needs to be the subject of a child protection plan
- Medical and nursing staff will be expected to contribute invited if child has been admitted
  - usually in person, possibly by written report
  - ensure reports are available for future reference

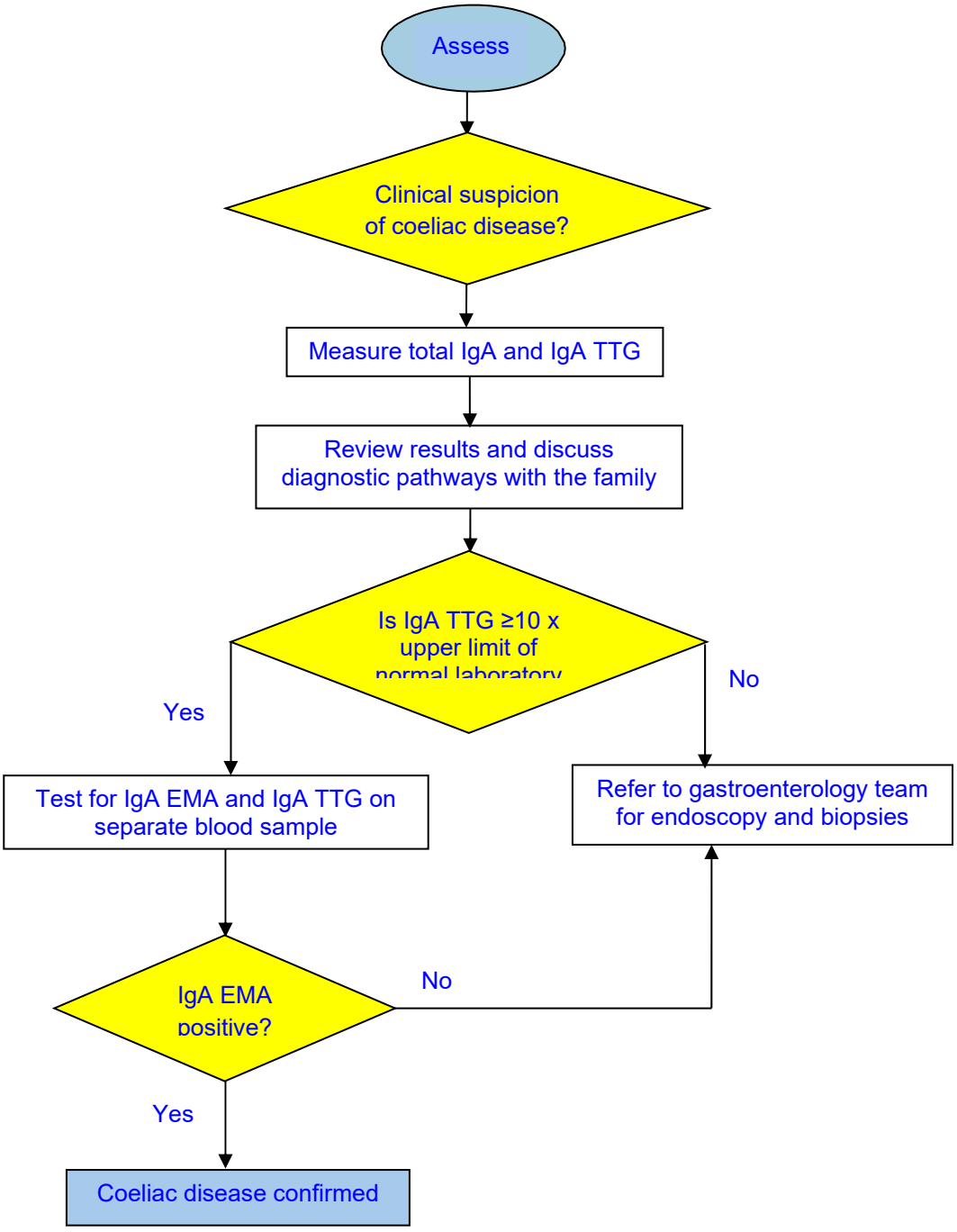
COELIAC DISEASE (CD) • 1/2

BACKGROUND

- ESPGHAN, NSPGHAN 2019, guidelines for CD diagnosis and management are aimed at simplifying and shortening diagnostic process in selected cases
- BSPGHAN recommends all patients with suspected CD to have diagnosis established by paediatric gastroenterologist with follow-up under care of paediatric gastroenterologist/paediatrician with special interest in CD, with access to appropriately skilled paediatric dietetic services

Algorithm

- All patients to continue normal gluten containing diet until diagnosis is established



Blood bottles:

- 2 x paediatric SST (orange tube) for IgA/IgA anti TTG/IgG anti TTG
- IgA EMA (endomysial antibodies) – 1 x paediatric SST (orange tube)

Note:

- Diagnosis of CD with/without biopsy requires lifelong gluten free diet
- If borderline TTG, confirm sufficient gluten intake and consider retesting IgA TTG and IgA EMA

COELIAC DISEASE (CD) ● 2/2

- Dermatitis herpetiformis – serology frequently negative

INVESTIGATIONS

- Ensure patient on normal gluten containing diet
- Request IgA and IgA TTG
- Request IgA EMA on separate sample
- If TTG and EMA done on same sample and both come back positive, send separate TTG on different date to ensure second TTG is also >10 x upper limit of normal laboratory value, to exclude any possibility of laboratory error
- If IgA deficiency it is not possible to interpret IgA TTG results
- Laboratory will automatically check for IgG TTG
- If IgG TTG positive refer to paediatric gastroenterology for endoscopy and biopsies

CONSTIPATION ● 1/5

RECOGNITION AND ASSESSMENT

Definition

- **Constipation:** infrequent bowel evacuation of hard faeces or difficult/painful defecation for ≥1 month
- **Faecal soiling** (overflow as a result of faecal impaction): passage of loose and offensive stools in child's underwear over which child has no control
- **Encopresis** (functional non-retentive soiling): inappropriate passage of normal stools in inappropriate places. Often associated with behavioural problems
- **Faecal incontinence**: soiling in the presence of an anatomical or organic lesion
- **Faecal impaction**: hard faecal mass in lower abdomen, a dilated rectum impacted with stool or excessive stool in the colon identified radiologically

KEY POINTS IN HISTORY

- Frequency, volume and type of stool using Bristol stool chart (see https://eric.org.uk/poo-checker)
- Overflow soiling in older children
- Distress and/or straining on opening bowels
- Holding behaviour (crossing legs, back arching or tiptoeing)
- Time of passing meconium after birth
- Bleeding *per rectum*
- Any trigger factors i.e. diet change, infection, potty training or starting nursery/school

KEY POINTS IN PHYSICAL EXAMINATION

- Weight and height
- Abdominal examination to look for abdominal distension, faecal loading
- Lower limb neuromuscular examination in long standing cases
- Spinal examination
- Inspection of perianal area for appearance, position of anus or evidence of streptococcal infections

Symptoms and signs suggestive of organic constipation (red flags)

- Early onset of constipation (first few weeks of life)
- Failure to thrive/growth failure
- Neuropathic bowel:
  - lack of lumbosacral curve
  - sacral agenesis
  - flat buttocks
  - patulous anus
  - absent cremasteric reflex/absent anal wink
  - decreased lower extremity tone and/or strength
  - absence or delay in relaxation phase of lower extremity deep tendon reflex
  - urinary symptoms
- Hirschsprung's disease
  - delayed passage of meconium for >24 hr after birth in a term baby
  - abdominal distension
  - tight empty rectum in presence of palpable faecal mass
  - gush of liquid stool and air from rectum on withdrawal of finger
  - rarely causes soiling
- Anteriorly displaced anus
- Anal stenosis:
  - tightness or stricture felt when *per rectum* digital examination done using lubricated 5th finger in newborn and infants up to 6 months
- Delayed cow's milk protein allergy in first 3 yr of life

DIFFERENTIAL DIAGNOSIS

- Idiopathic functional constipation (90–95%). Most common cause of constipation beyond neonatal period

Organic constipation (suspected in presence of red flags)

- Constipation secondary to anal anatomic malformation (anorectal examination required)
- Neurogenic constipation due to spinal cord anomalies or trauma, neurofibromatosis and tethered cord (lower limb neurological examination required)

- Constipation secondary to endocrine/metabolic disorders (hypothyroidism, hypercalcaemia, hypokalaemia, CF)
- Constipation induced by drugs (e.g. opioids)
- Coeliac disease

INVESTIGATIONS

- Most children with chronic constipation require minimal investigation:
  - careful history and physical examination will help determine appropriate investigation
- In cases of refractory constipation (consider earlier if faltering growth/short stature):
  - thyroid function tests
  - coeliac panel
- If delayed passage of meconium:
  - sweat test

Abdominal X-ray

- Not usually required, except for cases where history is suspicious but clinical examination difficult

When to consider referral for rectal biopsy

- History of delayed passage of meconium
- Constipation since neonatal period
- History of abdominal distension and vomiting
- Failure to thrive or faltering growth
- Family history of Hirschsprung's

MANAGEMENT OF FUNCTIONAL CONSTIPATION

- See **Algorithm: Constipation management**

Principles of treatment

- Education
- Diet and lifestyle
- Behavioural management
- Medication
- Supporting child and family

Education

- Give parents clear explanation of pathophysiology of constipation and soiling

Diet and lifestyle

- Use in combination with laxatives
- Ensure adequate fluid intake
- High fibre diet recommended
- Encourage physical activities

Behavioural management

- Use of behavioural management in combination with medications decreases time to remission
  - regular toileting – unhurried time on toilet after meals
  - correct toilet position
  - maintain diaries of stool frequency combined with reward system
  - regular review and positive reinforcement
  - discourage negative responses to soiling from family
  - encourage older children to take responsibility
- May need counselling or psychology referral in case of motivational or behavioural problems

Medication

- Disimpaction in the presence of impacted stools

DISIMPACTION

1. A macrogol laxative (e.g. Movicol® paediatric plain); faecal impaction dose, see below up to a maximum of 7 days
2. Use stimulant laxative, senna or sodium picosulfate (Picolax®) if no result with macrogol or if not tolerated

3. Review all children within/after 1 week of disimpaction (in hospital or by GP)

Disimpaction dosage

Age (yr)	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
	Number of macrogol 3350 PAEDIATRIC plain sachets daily divided into 2–3 doses*						
1–4	2	4	4	6	6	8	8
5–11	4	6	8	10	12	12	12
	Number of macrogol 3350 ADULT sachets for children aged >12 yr						
12–18	4	6	8	8	8	8	8

*Total daily dose to be taken over a 12 hr period

Rectal disimpaction (only if oral disimpaction fails)

- Sodium citrate micro-enemas
- Small volume sodium citrate enemas preferable to large volume phosphate enemas
- Phosphate enemas (only if oral medications and sodium citrate enemas failed). Use only under specialist supervision. Consider sedation if child is distressed

Manual evacuation

- If all above have failed, consider manual evacuation under general anaesthetic. Consult with paediatric gastroenterologist or paediatric surgeon

MAINTENANCE THERAPY

- After disimpaction, or if child had no impaction, focus treatment on prevention of recurrence and establishment of a regular bowel habit to allow bowel to regain normal tone and sensation
- Continue maintenance therapy for 4–6 months then reduce dosage gradually
- half the highest disimpaction dose of macrogol 3350 is a useful guide for initial maintenance dose. Total daily dose to be drunk within 6 hr period

Laxatives

- Use macrogols as first line maintenance treatment
- aged <1 yr: ½–1 paediatric sachet daily
- aged 1–5 yr: 1 paediatric sachet daily, adjust dose to produce regular soft stool (maximum 4/day)
- aged 6–11 yr: 2 paediatric sachets daily, adjust dose to produce regular soft stool (maximum 4/day)
- aged 12–18 yr: 1–2 adult sachets daily
- If not improved within 1 month or to prevent recurrence of impaction, add a stimulant laxative such as senna, or sodium picosulfate syrup. Using stimulants is recommended only for short periods of time and intermittently. Use with faecal softener e.g. sodium docusate and/or fibre
- Aim for soft/loose stools initially daily
- High doses (up to 4 sachets daily of macrogols) may be required and doses may need frequent adjustment by child and parent to maintain a regular bowel action. Advise parents to reduce doses gradually and to increase again if no bowel action in 3 days
- If macrogols not tolerated, use sodium docusate or lactulose
- Aged <6 months:
- give infant glycerol suppository (1 g glycerol) once/day
- change milk to hydrolysed formula if delayed cow's milk allergy suspected

Supporting child and family

- Organise review within 1 week then regular and frequent local contact and by telephone to prevent re-impaction
- Provide contact telephone number for parents if available
- Discuss timing of doses for convenience with bowel action
- Emphasise need for good compliance
- Use outreach nursing support if available
- Liaise with child's health visitor, community paediatric nurse and/or school nurse. Send copies of consultations with parental agreement to help provide a unified approach
- Child psychology support when available is invaluable

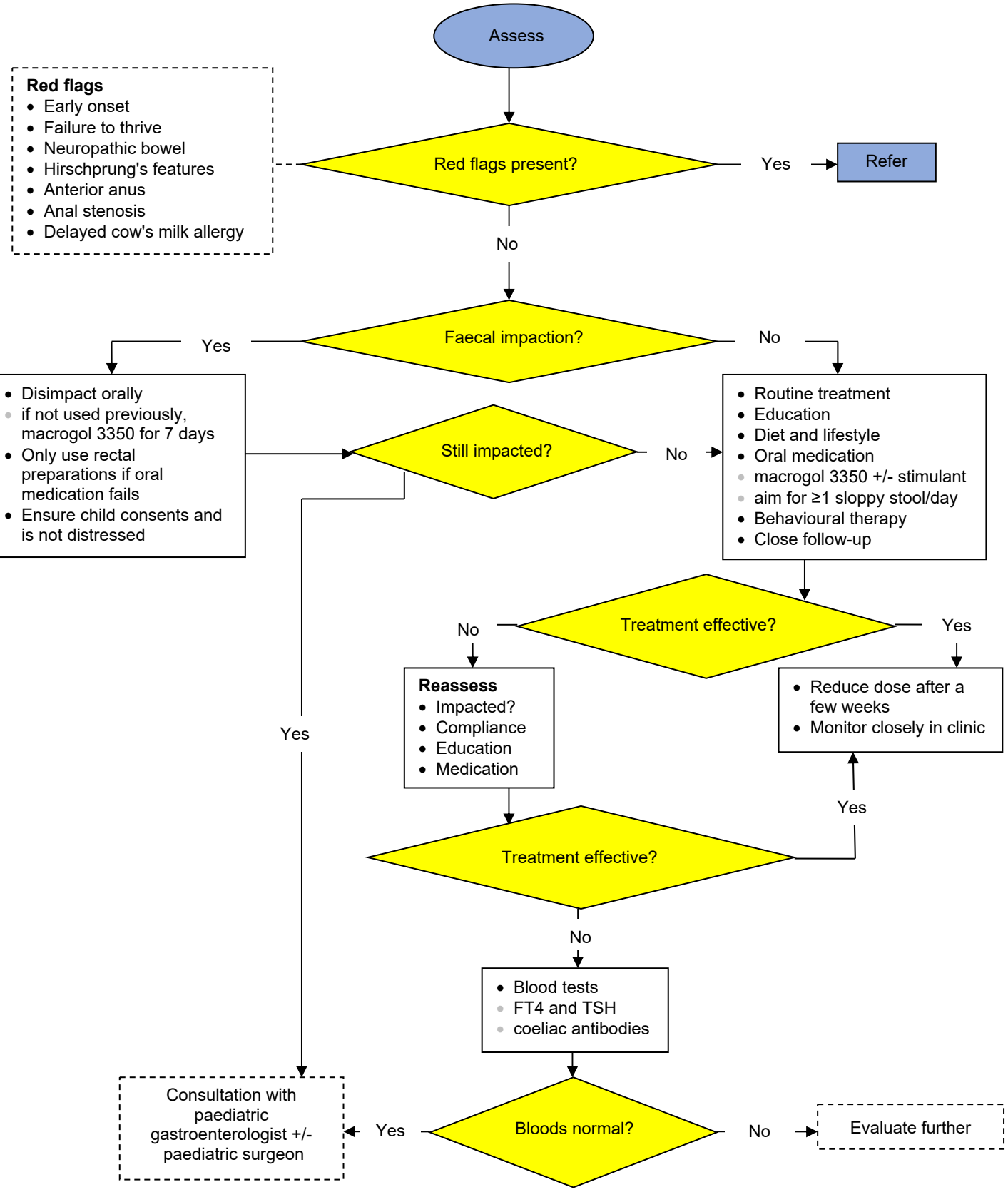
Withdrawal of laxatives

- Once regular bowel habit has been established for a few months, and child has good sensation of need to open bowels, gradually withdraw laxatives over a period of months

INDICATIONS FOR SEEKING ADVICE OF PAEDIATRIC GASTROENTEROLOGIST

- Organic cause of constipation suspected
- Disimpaction orally/rectally unsuccessful
- Soiling/abdominal pain continues despite treatment
- Children aged <1 yr with faecal impaction or not responding to maintenance therapy

Algorithm: Constipation management



DEFINITION

- Acute viral inflammation of upper airway causing oedema of larynx and trachea and presenting with barking cough, stridor and respiratory distress
- Causative agent: parainfluenza virus (sometimes influenza, respiratory syncytial virus, rhinovirus)

Aetiology

- Aged 6 months–6 yr (peak aged 2 yr)
- Seasonal peak: Spring and Autumn
- Transmission: usually by droplet spread
- Incubation period: 2–6 days

Differential diagnosis of stridor

Acute

- Croup
- Epiglottitis (rare since immunisation against *Haemophilus influenzae* type B)
- Bacterial tracheitis
- Foreign body

Chronic

- Allergic airways disease
- Congenital abnormality e.g. laryngeal haemangioma
- Laryngomalacia
- Foreign body
- Laryngeal papilloma

CROUP

Symptoms and signs

- Preceding coryzal illness
- Fever
- Harsh bark/seal-like cough
- Hoarse voice
- Inspiratory stridor
- Symptoms worse at night
- Child does not look toxic

Assessment

- Record croup severity:
  - C – Cyanosis
  - R – Recession of chest
  - O – Oxygen saturations (keep >92%)
  - UP – Upper airway obstruction e.g. stridor
- Respiratory rate
- Heart rate
- Level of consciousness
- **Do not examine throat as it may cause acute severe/total obstruction**
- Do not distress child
- Any clinical concerns call consultant paediatrician immediately

Severity

Mild croup

- Barking cough
- Mild stridor, but not usually at rest
- No recession
- No cyanosis

Moderate croup

- Intermittent stridor at rest
- Mild recession
- Alert and responsive

Severe croup
- Stridor at rest
- Cyanosis
- Oxygen saturation <92% in air
- Moderate to severe recession
- Apathetic/restless

Investigations
- No investigations necessary, do not attempt to take blood or put in cannula
- If diagnosis unclear, or child severely unwell, call consultant as an emergency measure

IMMEDIATE MANAGEMENT

Mild to moderate croup
- Analgesia e.g. paracetamol or ibuprofen for discomfort
- Adequate fluid intake
- Leaflet on croup and reassurance
- Oral dexamethasone 150 microgram/kg
- Admit/observe moderate croup for 4 hr and reassess
- Dexamethasone dose can be repeated after 12 hr or if well, patient can be discharged with a single dose of prednisolone 1 mg/kg rounded up to nearest 5 mg to take 12–24 hr later

If parents do not clearly understand what to do, do not discharge

Severe croup
- Keep child and parents calm – do not upset child e.g. by forcing oxygen mask onto face or examining throat; nurse on parent's lap and in position they find comfortable
- High flow oxygen 15 L/min via mask with reservoir bag, which must be prescribed
- Dexamethasone 150 microgram/kg oral (or if child refuses to swallow oral medication, nebulised budesonide 2 mg)
- Nebulised adrenaline 400 microgram/kg to maximum 5 mg (0.4 mL/kg to maximum 5 mL of 1:1000 injection) can be used to relieve symptoms whilst dexamethasone/budesonide starts to work
- short duration of action; can be repeated after 30 min
- if severe enough to require nebulised adrenaline likely to be admitted to ward; if considering discharge, ensure observed for ≥3 hr
- Contact on-call consultant paediatrician urgently to assess clinical situation
- discuss whether to involve on-call paediatric anaesthetist and ENT surgeon
- If no sustained improvement with adrenaline and dexamethasone:
- secure airway in theatre by experienced anaesthetist
- transfer to PICU

DISCHARGE AND FOLLOW-UP
- Leaflet on croup https://www.nhs.uk/conditions/croup/
- Antibiotics, antitussives and humidified air do not help
- Encourage oral fluid intake
- Advise parents to seek help urgently if any of the following are present:
- drooling
- laboured breathing
- persistent fever
- biphasic/worsening stridor
- cyanosis
- reduced level of consciousness/confusion
- No need for follow-up of croup

CUTS AND BITES ● 1/3

Prevention of infection after bites from humans and other animals

PROPHYLACTIC ANTIBIOTICS

Human bite

- Offer antibiotic prophylaxis if:
  - broken the skin and drawn blood
  - broken the skin of hands, feet, face, genitals, overlying cartilaginous structures or area of poor circulation
  - patient at risk of serious wound infection (e.g. immunosuppressed)
  - bite ≤72 hr old, even if no sign of infection

Cat bite

- Offer antibiotic prophylaxis if:
  - broken the skin and drawn blood
  - deep bite

Dog and other animal bites

- If wound ≤48 hr old, if broken the skin and drawn blood **AND** if:
  - bites to hand, foot, face or genitalia
  - puncture wounds
  - wounds requiring surgical debridement
  - crush wounds with devitalised tissue
  - wounds with associated oedema
  - wounds involving joints, tendons, ligaments, or suspected fractures
  - wounds that have undergone primary closure
  - patients at risk of serious wound infection (e.g. immunosuppressed)
  - asplenic patients, even after trivial animal bites
  - patients with prosthetic implants e.g. heart valve, VP shunt
- Co-amoxiclav 3 days prophylaxis, or 5 days treatment if appears infected
  - if unable to take orally give co-amoxiclav IV
- Penicillin allergy
  - aged ≥12 yr: doxycycline with metronidazole
  - aged <12 yr: co-trimoxazole
  - if unable to take oral antibiotics: cefuroxime **or** ceftriaxone with metronidazole
- Antibiotics not generally required if wound ≥2 days and no sign of local or systemic infection
- Advise patient and carers of signs of developing infection and to attend urgently for review should this happen
- Do not give prophylactic antibiotics for insect bites
- Send swab for bacterial culture and blood culture if systemically unwell

TETANUS-PRONE WOUND

- Wounds
  - that require surgical intervention that is delayed for >6 hr
  - that show a significant degree of devitalised tissue or a puncture-type injury particularly where there has been contact with soil or manure
  - containing foreign bodies
  - in patients who have systemic sepsis
- Compound fractures

Table 1: Bites and tetanus prophylaxis

Immunisation status	Immediate treatment		
	Clean wound	Tetanus-prone	High risk tetanus prone
• Aged ≤5 yr who have received adequate priming course • Aged 5–10 yr who have received priming course and pre-school booster • Aged ≥11 yr, who have received adequate priming course of tetanus vaccine with last dose within 10 yr	None required	None required	None required
• Aged 5–10 yr who have received adequate priming course but no pre-school booster • Received adequate priming course of tetanus vaccine but last dose ≥10 yr ago	None required (unless next dose due soon and convenient to give now)	Immediate reinforcing dose of vaccine	Immediate reinforcing dose of vaccine, one dose of human tetanus immunoglobulin in a different site
• Not received adequate priming course of tetanus vaccine	An immediate dose of vaccine followed, if records confirm the need, by completion of a full 5 dose course to ensure future immunity	Immediate reinforcing dose of vaccine, one dose of human tetanus immunoglobulin in a different site	Immediate reinforcing dose of vaccine, one dose of human tetanus immunoglobulin in a different site

* High risk: heavy contamination with material likely to contain tetanus spores and/or extensive devitalised tissue

- Clean wound defined as wounds ≤6 hr old, non-penetrating with negligible tissue damage
- ≤3 doses of tetanus vaccine
- this definition of adequate course is for risk assessment of tetanus-prone wounds only
- full UK schedule is 5 doses of tetanus containing vaccine at appropriate intervals
- If tetanus immunoglobulin (TIG) not available, human normal immunoglobulin (HNIG) may be used as an alternative

Tetanus vaccine [e.g. combined diphtheria (low dose), tetanus, and poliomyelitis] and immunoglobulin if indicated – see **Department of Health, Immunisation against infectious diseases**: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/148506/Green-Book-Chapter-30-dh_103982.pdf

RABIES

- Bat bites in UK
- Any animal bite overseas
- Take history of:
- patient name, date of birth, age and address
- date of exposure
- species and current health status of animal involved
- country of exposure
- type of exposure
- site of exposure
- any previous rabies vaccinations

- For vaccine, immunoglobulin and advice contact your local health protection team (https://www.gov.uk/health-protection-team)

CERVICAL LYMPHADENOPATHY ● 1/4

DEFINITION
Enlargement of cervical lymph nodes >2 cm

Acute lymphadenitis
- Short history (usually <2 weeks)
- Enlarged node with features of acute inflammation

Subacute lymphadenopathy
- History variable
- Often non-tender but with overlying erythema

Chronic lymphadenopathy
- Longer history (usually >6 weeks)
- No feature of acute inflammation

HISTORY
Symptoms
- Onset of symptoms (e.g. URTI, tonsillitis etc.)
- Duration
- Progression
- Fever
- Weight loss
- Night sweats
- Eczema/skin infection
- Bruising
- Pallor
- Bone pain
- Pruritis

Social
- Contact with TB or cats
- Travel or place of birth/parental origin

EXAMINATION
- Site of node(s)
- Size of node(s)
- ENT examination
- Skin – especially eczema
- Axillae, supraclavicular, suprasternal and groin for other nodes
- Abdomen for hepatosplenomegaly, and examine testes in boys

DIFFERENTIAL DIAGNOSIS
Acute unilateral
- Reactive
- URTI (*Strep. pneumoniae*)
- skin infection (*Group A Strep.*, *Staph. aureus*)
- dental infection (anaerobes)
- Kawasaki (see **Kawasaki disease** guideline)
- Cat scratch disease (*Bartonella*: tender, axillary lymphadenopathy)
- Kikuchi-Fujimoto disease (histiocytic necrotising lymphadenitis)

Acute bilateral
- Reactive
- viral URTI
- EBV, CMV (generalised lymphadenopathy, hepatosplenomegaly)

Subacute
- Non-tuberculous mycobacterial infection (aged <5 yr, unilateral, non-tender, purple, systemically well)
- *Mycobacterium tuberculosis* (history of contact or foreign travel)
- *Toxoplasma gondii* (generalised lymphadenopathy, fatigue, myalgia)

Chronic
- Reactive
- Neoplasia
  - lymphoma, leukaemia
  - soft tissue tumours
- Juvenile chronic arthritis, SLE

URGENT INVESTIGATION
If any of the following are noted:

Nodes:
- Supraclavicular or suprasternal or axillary – diagnostic of significant pathology
- Cervical nodes >2 cm at 4–6 weeks
- Growing in size for ≥2 weeks
- Not returned to base line (<1 cm) at 8–12 weeks

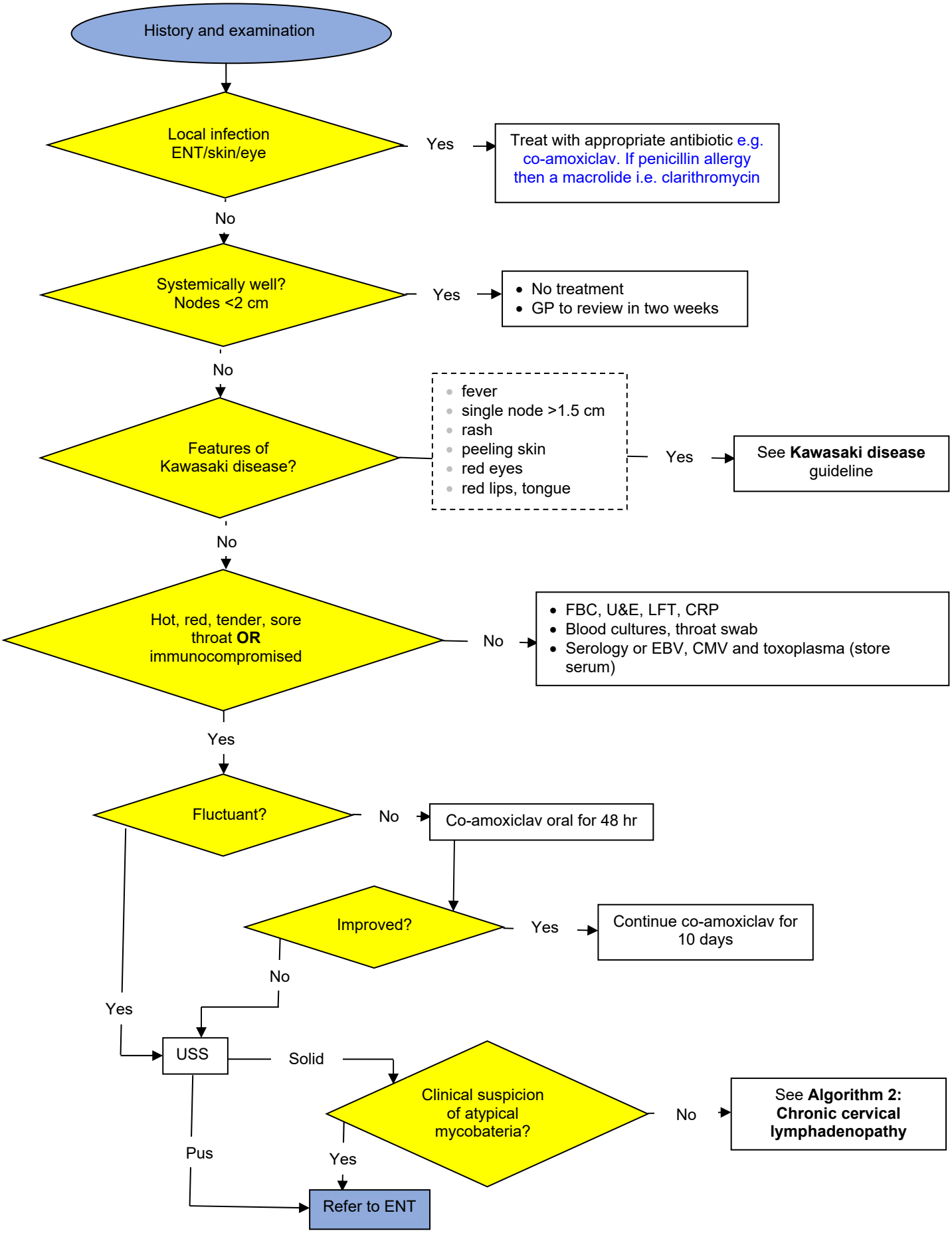
Signs and symptoms:
- Petechiae/purpura
- Respiratory compromise
- Dysphagia
- Hepatosplenomegaly – also need to exclude EBV
- Weight loss and night sweats – TB/malignancy, early investigation
- Persistent fever (>2 weeks)

INVESTIGATIONS
- See **Algorithm**
- To be done urgently:
  - FBC, film, ESR, CRP
  - CXR
    - hilar lymphadenopathy on CXR – refer for biopsy of suitable node
    - hilar lymphadenopathy significantly increases likelihood of neoplastic disease
  - ultrasound scan (USS)
    - high sensitivity and specificity for abscess formation in acute lymphadenitis
    - value in chronic lymphadenopathy for assessing size, architecture and vascularity
- LDH of limited diagnostic value: not to be done routinely
- LFTs: only if suspected viral infection
- Serology for *Toxoplasma*, CMV and EBV
- CT only if suspected deep neck space infection
- Discuss with ENT for biopsy

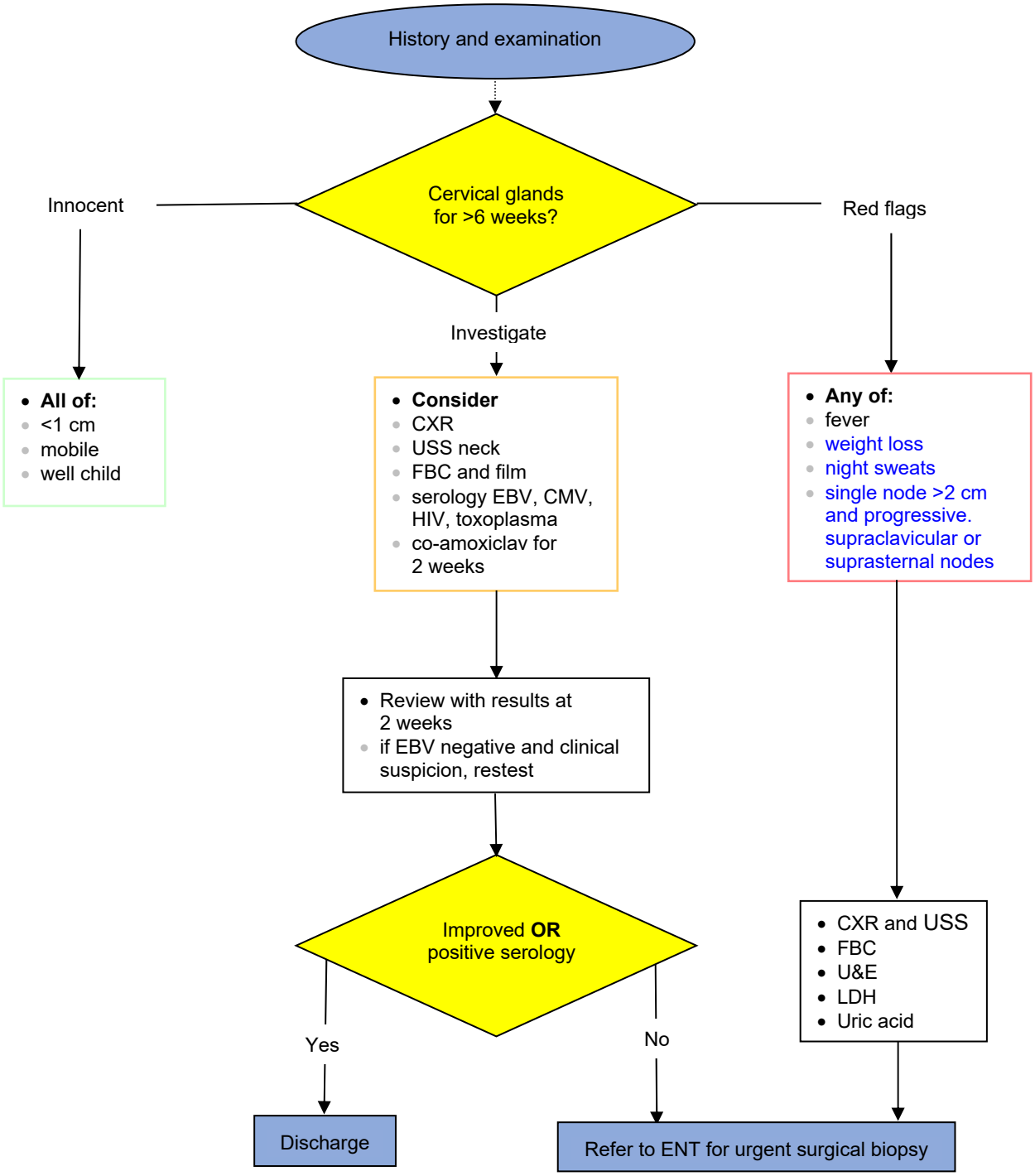
Surgical excision biopsy
- Atypical mycobacterial infection
- Features highly suggestive of neoplasia:
  - lymph nodes >2 cm diameter, progressive and not improving
  - all supraclavicular and suprasternal nodes
  - constitutional symptoms
  - hepatosplenomegaly
  - generalised lymphadenopathy
  - abnormal architecture on USS

Children undergoing surgical biopsy for suspected neoplastic disease
- FBC and film
- U&E, uric acid, LFTs
- CXR

Algorithm 1: Acute cervical lymphadenopathy



Algorithm 2: Chronic cervical lymphadenopathy



CONGENITAL HEART DISEASE: DUCT-DEPENDENT LESIONS [Including hypoplastic left heart syndrome (HLHS) and left-sided outflow tract obstructions] ● 1/4

INTRODUCTION

Ductal-dependent congenital heart lesions are dependent upon a patent ductus arteriosus (PDA) to supply pulmonary or systemic blood flow, or to allow adequate mixing between parallel circulations

Duct-dependent congenital heart disease can be broadly divided into 3 categories

1	Mixing lesions e.g. transposition of great arteries (TGA)	Usually presents as cyanosis ('blue baby')
2	Obstruction to pulmonary circulation e.g. pulmonary or tricuspid atresia, Fallot's tetralogy, critical pulmonary stenosis	Usually presents as cyanosis ('blue baby')
3	Obstruction to systemic circulation e.g. HLHS, critical aortic stenosis, coarctation of aorta, interrupted aortic arch	Usually presents as poor perfusion (shock)

Differential diagnosis of central cyanosis ('blue baby') or persistently low SpO_2 (<95%)

- Cyanosis is the abnormal blue discoloration of skin and mucous membranes

Without echocardiography, clinical distinction between significant persistent pulmonary hypertension (PPHN) and a duct-dependent pulmonary circulation can be extremely challenging. If cause in doubt and echocardiogram cannot be obtained, discuss starting prostaglandin urgently with on-call consultant, as can also be beneficial in PPHN

Cardiac causes of central cyanosis

- Duct-dependent lesions (see above)
- Other cardiac conditions e.g. anomalous pulmonary venous drainage, Fallot's tetralogy, truncus arteriosus etc.

Respiratory causes of central cyanosis

- Persistent pulmonary hypertension
- Other respiratory conditions, e.g. congenital pneumonia, pneumothorax, meconium aspiration, congenital diaphragmatic hernia, respiratory tract obstruction

Other rare causes of central cyanosis

- Methaemoglobinemia

Differential diagnosis of babies presenting with poor perfusion (shock)

Cardiac causes of shock

- Duct-dependent lesion (see above)
- Other cardiac causes e.g. arrhythmias (supraventricular/ventricular tachycardia), cardiomyopathy etc.

Other causes of shock

- Sepsis, bleeding, dehydration, metabolic

RECOGNITION AND ASSESSMENT OF DUCT-DEPENDENT LESIONS

In-utero (antenatal) diagnosis

- If diagnosed in-utero, see management plan in mother's healthcare record
- Deliver at local NNU or NICU equipped for the degree of congenital heart disease. Stabilise before non-urgent transfer to regional paediatric cardiac centre for full cardiology assessment
- For all antenatally diagnosed cases of TGA, antenatal care to be transferred to fetal medicine in a regional NICU attached to the tertiary cardiac centre (e.g. Birmingham Women's Hospital – refer to local pathway) with a plan to be delivered there (as may need atrial septostomy)
- if urgent septostomy indicated e.g. postnatally diagnosed TGA, contact KIDS NTS urgently (see **Transport and retrieval** guideline)
- Neonatal team meet parents pre-delivery
- In some cases of HLHS or complex congenital heart disease, comfort care plan may be in place antenatally – clarify with cardiac team and parents before delivery
- When delivery expected, notify on-call neonatal consultant, NNU and paediatric cardiology team at local referral centre

CONGENITAL HEART DISEASE: DUCT-DEPENDENT LESIONS [Including hypoplastic left heart syndrome (HLHS) and left-sided outflow tract obstructions] ● 2/4

Postnatal

- Some babies, particularly if left heart lesion developed later in gestation, will present when duct closes
  - can happen at any time during neonatal period and early infancy
  - baby often asymptomatic before duct closes

A baby presenting with cyanosis or shock is a neonatal emergency requiring consultant input. These babies can deteriorate very quickly

Signs of duct-dependent cardiac disease

- Central cyanosis and/or SpO_2 <95%
- Poor perfusion and shock
- Weak or absent femoral pulses
- Usually limited signs of respiratory distress
- Murmur (in some) (see **Cardiac murmurs** guideline)
- Hepatomegaly or other signs of cardiac failure

Investigations

- Chest X-ray
  - oligaemia/plethora/congenital anomaly
  - 'classic' appearance (e.g. 'boot-shaped' heart) is unusual
- Blood gas including lactate
- Echocardiogram if available
- Blood pressure in right upper limb and a lower limb (>20 mmHg difference between upper and lower limb is abnormal)
- Preductal (right upper limb) and postductal (lower limb) saturations (SpO_2 <95% in both limbs or >2% difference is significant) (see **Pulse-oximetry screening** guideline)
- Modified hyperoxia test (carries risk of duct closure: discuss with consultant first) to differentiate between respiratory (parenchymal) and cardiac cause of cyanosis including baseline saturation (and blood gas if arterial line *in situ*)
  - place baby in 100% ambient oxygen for 10 min
  - if there is respiratory pathology, SpO_2 usually rises to ≥95%

IMMEDIATE MANAGEMENT

A suspected cardiac baby presenting collapsed, shocked and/or cyanosed is a challenging neonatal emergency, discuss commencement of prostaglandin infusion urgently with consultant. Discuss urgently with cardiac centre and KIDS NTS (see* Transport and retrieval *guideline)

Immediate post-delivery and resuscitation

- If antenatally diagnosed duct-dependent lesion, tier 2 neonatal staff to be present at delivery
- Do not delay resuscitation of baby if required (see **Resuscitation** guideline)
- Check SpO_2 using pulse oximetry
- Once stable, transfer baby to NNU immediately in transport incubator (if on saturation monitor, SpO_2 75–85% should be acceptable for babies with antenatal diagnosis of duct-dependent cyanotic heart lesion)
  - if cyanotic heart lesions suspected but not confirmed postnatally, manage initially by trying to achieve maximum SpO_2 possible

Stable babies with normal breathing and SpO_2 ≥75% may not require intubation

Management in NNU

- Aim to maintain patency of (or open a closed) ductus arteriosus, and optimise systemic perfusion
- Commence prostaglandin infusion (as per antenatal plan if known) through peripheral IV line, or long line (see **Prostaglandin infusion** guideline)
  - two venous access lines recommended to ensure reliable infusion
- Unless access difficult, avoid umbilical venous line [cardiac centre may need umbilical venous catheterisation (UVC) for septostomy]; if multiple infusions (e.g. inotropes) required, discuss UVC with on-call consultant/cardiac team
- Use **dinoprostone** (prostaglandin E2, prostin E2) (see **Prostaglandin infusion** guideline)

CONGENITAL HEART DISEASE: DUCT-DEPENDENT LESIONS [Including hypoplastic left heart syndrome (HLHS) and left-sided outflow tract obstructions] ● 3/4

- start IV infusion at 5–15 nanogram/kg/min as indicated; dose may be increased up to 50 nanogram/kg/min if no response within 1 hr
- oral dinoprostone used temporarily on very rare occasions when IV access is extremely difficult (see **Neonatal Formulary**)
- if dinoprostone not available, use prostaglandin E1 (alprostadil) (see **Neonatal Formulary** for dose)
- make fresh solution every 24 hr
- **Be vigilant**: if apnoea occurs secondary to a prostaglandin infusion, intubate baby but do not reduce infusion dose (see **Intubation** guideline)
- Discuss management with cardiac team at regional paediatric cardiac centre
- Echocardiogram if available
- If any evidence of hypoperfusion (e.g. base deficit >5, lactate >3, hypotension, cool peripheries), give sodium chloride 0.9% 10 mL/kg IV fluid bolus

Monitor
- SpO_2
- Heart rate and ECG
- Blood gases (including lactate) and avoid acidosis
- Blood pressure (preferably using a peripheral arterial cannula – avoid umbilical lines – if UAC required, discuss with on-call consultant)
- Avoid hypothermia

Ventilation (see also **Ventilation** guidelines)
Indications
- If intubation not needed as emergency, discuss with KIDS NTS/cardiac centre (see **Transport and retrieval** guideline)
- Severe hypoxaemia, acidosis and cardiorespiratory failure
- Apnoea after starting prostaglandin infusion
- dose >20 nanogram/kg/min (review need for such a high dosage in stable baby)
- Features of high pulmonary flow in case of HLHS
- Elective ventilation, if preferred by paediatric cardiologist or retrieval team lead

Technique
- Use sedation/muscle relaxants as needed
- Avoid hyperventilation – can increase pulmonary blood flow
- Use supplemental oxygen judiciously if SpO_2 <75%
- Initial settings: PEEP 4–5 cm H_2O, low mean airway pressure, tidal volume 4–6 mL/kg and FiO_2 0.21, adjusted accordingly
- Aim for:
- $PaCO_2$ 5–7 kPa
- PaO_2 4–6 kPa
- pH 7.30–7.40
- SpO_2 75–85% (although many will run higher in room air)

Inotropes
- If signs of peripheral under-perfusion, discuss using fluid boluses and inotropes (e.g. dobutamine, milrinone etc.) with cardiac centre
- Arrange local echocardiography (if available) to assess contractility

Restrictive atrial septum
- Signs:
- severe cyanosis
- cool peripheries
- pallor
- respiratory distress
- X-ray signs of pulmonary oedema with relatively normal heart size. In contrast, if atrial septum is non-restrictive, pulmonary congestion with cardiomegaly and prominent right heart border is likely
- May require balloon atrial septostomy as an urgent procedure at cardiac centre. If too unstable for transfer or no beds at cardiac centre, discuss with KIDS NTS and cardiac team about the possibility of

this emergency septostomy procedure being done by transferring directly to theatres at cardiac centre (see **Transport and retrieval** guideline)
- due to change in septostomy equipment, outreach septostomy not possible in a neonatal unit

High pulmonary blood flow (especially in left-sided lesions such as HLHS)
Presentation
- If there is too much pulmonary blood flow due to pulmonary 'steal' phenomenon, baby may have:
- high or near normal saturations
- metabolic acidosis with a rising lactate
- low blood pressure (especially low diastolic)
- cool peripheries
- tachycardia

Management
- Aim is to improve perfusion and acidosis by balancing systemic versus pulmonary circulation
- Discuss urgently with cardiac centre
- Intubate and ventilate (technique as above)
- Fluid boluses and inotropes as needed

PARENT COMMUNICATION
- It is important that parents are kept informed and updated regularly during management
- Parent leaflets for specific heart conditions are available from British Heart Foundation website www.bhf.org.uk/

DIABETES AND FASTING FOR SURGERY ● 1/5

INTRODUCTION
Children with diabetes mellitus undergoing surgery are at risk of hypoglycaemia and hyperglycaemia

DEFINITIONS
Peri-operative management
- Dependent upon insulin regimen

Minor surgery
- Short procedures (<30 min)
- With/without sedation or anaesthesia
- Rapid recovery anticipated
- Expected to be able to eat by next meal
- Examples include:
- endoscopic biopsies
- myringotomy
- incision and drainage

Major surgery
- General anaesthesia >30 min or procedure likely to cause:
- post-operative nausea
- vomiting
- inability to feed adequately
- If unsure of length of anaesthetic or risk of slow post-operative recovery from anaesthesia, discuss with anaesthetist

ELECTIVE SURGERY
Glycaemic targets
- If glycaemic control:
- very poor [HbA_{1c} >75 mmol/mol (9.0%)]: postpone elective surgery
- poor: consider admission to hospital before surgery for assessment and stabilisation
  - if control remains problematic, cancel surgery and reschedule

Pre-operative assessment
- Surgeon to inform hospital, paediatric diabetes team and anaesthetist of:
- date and time of planned procedure (if possible first on morning list)
- type of procedure (major/minor)
- Before surgery paediatric diabetes team to:
- optimise glycaemic control
- ensure parents have clear written instructions regarding diabetes management (including medication adjustments)
- if surgery taking place in another hospital, local diabetes team must inform other hospital diabetes team

Pre-operative fasting
- Before surgery
- children: solid food >6 hr
- infants:
  - breast milk: >4 hr
  - other milks: >6 hr
- Encourage to drink clear fluids (including water, low-sugar squash) >2 hr before elective surgery
- if not possible, give IV fluid

Peri-operative blood glucose targets
- 5–11.1 mmol/L
- Check at least hourly before, during and after surgery

INSULIN TREATED
Minor elective morning surgery
Day before surgery
- Normal insulin and diet

Morning of procedure
- Admit
- If possible first on list
- Insert IV cannula
- Measure and record capillary blood glucose:
- hourly pre-operatively
- half-hourly during operation

Basal bolus regime using multiple daily injection (MDI) regimens with stable blood glucose (5–11.1 mmol/L)
- Omit rapid-acting insulin [e.g. insulin aspart (NovoRapid®), insulin lispro (Humalog®), insulin glulisine (Apidra®)] in the morning until after procedure, give with late breakfast
- If basal insulin analogue [insulin glargine (Lantus®) or insulin detemir (Levemir®)] usually given in the morning, continue

Insulin pump
- Before surgery:
- run pump at usual basal rate
- check blood glucose hourly; ask parents to adjust basal rates to maintain blood glucose 5–11.1 mmol/L
- During surgery
- run pump on normal basal setting for duration of procedure
- once nil-by-mouth check blood glucose hourly, and half-hourly during operation
- basal rate can be suspended for 30 min to correct any episodes of mild hypoglycaemia
- if pump stopped for 30–60 min, start IV insulin and IV fluid (see **Maintenance fluid guide** and **Insulin infusion guide**)

Biphasic regimen (premixed insulin in the morning)
- Delay morning dose until after procedure, then give with late breakfast

All insulin regimens (peri-/post-operative)
- Blood glucose <5 mmol/L
- glucose 10% 2 mL/kg IV bolus; recheck blood glucose 15 min later
- Blood glucose >12 mmol/L
- start IV insulin infusion and IV fluids as per sliding scale (see **Maintenance fluid guide** and **Insulin infusion guide**)
- If procedure delayed for further 2 hr, or child has had repeated low blood glucose, start IV maintenance fluids (see **Maintenance fluid guide**)

Minor elective afternoon surgery
Day before surgery
- Advise usual doses of insulin before procedure

Morning of procedure
- Normal breakfast no later than 0730 hr
- breakfast insulin dose dependent on regimen

- **MDI regimen**
- FULL usual dose rapid-acting insulin according to carbohydrate content of breakfast; as well as usual correction dose, depending on pre-meal blood glucose level
- if insulin glargine (Lantus®) or insulin detemir (Levemir®) given in the morning: give dose in FULL
- **Twice daily insulin regimen**
- give half rapid-acting component of morning dose as rapid-acting insulin
  Example: if usual morning dose 10 units of NovoMix® 30 or Humulin M3®, then the usual fast-acting component is:
  3/10 x 10 = 3 units of rapid-acting insulin [e.g. insulin aspart (NovoRapid®), lispro (Humalog®), glulisine (Apidra®)] give half of this i.e. 1.5 units
- **Insulin pump**
- run pump on normal basal setting
- check blood glucose at least hourly
- child/carer to alter infusion rate accordingly

Peri-operatively
- Measure and record capillary blood glucose on arrival
- Insert IV cannula
- First on list
- Once nil-by-mouth measure and record capillary blood glucose hourly, and half-hourly during operation
- Blood glucose <5 mmol/L:
- give glucose 10% 2 mL/kg IV bolus
- recheck blood glucose after 15 min
- if procedure delayed for further 2 hr, or child is continuing to have low blood glucose, start IV maintenance fluids (see **Maintenance fluid guide**)
- Blood glucose ≥12 mmol/L:
- start IV insulin infusion and IV fluids as per sliding scale (see **Maintenance fluid guide** and **Insulin infusion guide**)
- Insulin pump: continue provided blood glucose remains 5–11.1 mmol/L
- blood glucose to be checked hourly pre-operatively, and half-hourly during surgery
- if blood glucose <5 mmol/L, suspend pump for 30 min and give glucose bolus (see above)
- if pump stopped for >1 hr start IV insulin and IV fluid (see **Maintenance fluid guide** and **Insulin infusion guide**)

After procedure
- Once eating, give usual dose rapid-acting insulin generally taken with that meal
- If IV fluids and insulin infusion required, see **How to restart SC insulin after being on IV insulin**
- Insulin pump regimen:
- allow parents to re-start pump at usual basal rate once child recovered
- discharge when eating and drinking, regardless of blood glucose level (in consultation with diabetes team), parent will control this better at home

Major elective morning surgery
Day before surgery
- Admit
- Measure and record: weight, U&E, FBC, true blood glucose, urine or blood for ketones, pre-meal and bedtime capillary blood glucose
- Give usual insulin evening and night before surgery
- if using insulin pump, continue as usual with parental management until surgery

Morning of surgery
- First on list
- Nil-by-mouth <6 hr before operation
- morning list patients to commence nil-by-mouth 0300 hr (can drink clear fluids >2 hr before operation)
- Omit morning dose of rapid-acting insulin
- If insulin glargine (Lantus®) or insulin detemir (Levemir®) given in the morning, give usual FULL dose
- At 0630 hr start:
- IV maintenance fluids at maintenance rate
- IV insulin according to sliding scale
- Maintain blood glucose 5–11.1 mmol/L (see **Maintenance fluid guide** and **Insulin infusion guide**)
- Measure and record capillary blood glucose pre-operatively, and half-hourly during surgery
- Insulin pump: continue pump as usual with parental management until operation, then stop pump and commence IV infusion

After surgery
- Measure and record capillary blood glucose and ketones hourly
- Continue IV fluids and IV insulin infusion until ready to start eating
- Give basal insulin analogue at usual time (including if still on IV fluids and sliding scale of insulin)
- See **How to restart SC insulin after being on IV insulin**

Major elective afternoon surgery
Day before surgery
- Admit
- Measure and record: weight, U&E, FBC, true blood glucose, urine or blood for ketones, pre-meal and bedtime capillary blood glucose

- Give usual insulin evening and night before surgery
- Insulin pump: continue pump as usual with parental management until operation

Morning of surgery

- Light breakfast at 0700 hr on morning of procedure, then nil-by-mouth (check with anaesthetist for exact timing)
- MDI: rapid-acting insulin – FULL usual dose according to carbohydrate content, as well as usual correction dose, depending on pre-meal blood glucose level
- if basal insulin analogue given in the morning, give FULL dose
- Biphasic insulin regimen: give half usual morning insulin dose
- IV fluid infusions from 1200 hr and IV insulin infusion (see **Maintenance fluid guide** and **Insulin infusion guide**)
- Measure capillary blood glucose pre-operatively and half-hourly during operation
- Insulin pump: continue pump as usual with parental management until time of operation

After surgery

- Measure and record capillary blood glucose and ketones hourly including theatre
- Continue IV fluids and IV insulin infusion until ready to start eating
- See **How to restart SC insulin after being on IV insulin**

Emergency surgery

Before surgery

- Measure and record weight, capillary and plasma blood glucose, venous blood gases, blood ketones, electrolyte, urea and creatinine
- Inform diabetes team of admission
- If ketoacidotic:
- see **Diabetic ketoacidosis** guideline
- operate when rehydrated, blood pressure stable, blood glucose normal, and sodium and potassium in normal range
  - blood glucose levels to be stable; ideally 5–11.1 mmol/L (may not be possible for some life-saving operations)
- If not ketoacidotic:
- see **Major elective surgery**
- start fluid maintenance and IV insulin (see **Maintenance fluid guide** and **Insulin infusion guide**)
- if on insulin pump: stop pump once IV infusion commenced
- always give basal insulin analogue at usual time (including if still on IV fluids and sliding scale of insulin)

After surgery

- Measure capillary blood glucose hourly and check for blood ketones on every sample (including while in theatre)
- Continue IV fluids and insulin infusion until ready to eat
- See **How to restart SC insulin after being on IV insulin**

MAINTENANCE FLUID GUIDE

- Fluid of choice – sodium chloride 0.9% with glucose 5%

Glucose

- Use glucose 5%
- if concern about hypoglycaemia, use 10%
- If blood glucose >12 mmol/L, increase insulin supply (see **Insulin infusion guide**)

Potassium

- Monitor electrolytes
- IV fluid to include potassium chloride 20 mmol/L

Maintenance fluid calculation

- Use the following table <45 kg
- ≥45 kg cap at:
- female: 2 L/day (83 mL/hr)
- male: 2.5 L/day (104 mL/hr)

	Body weight (kg)	Fluid requirement in 24 hr
For each kg between	3–<10	100 mL/kg
For each kg between	10–20	Add additional 50 mL/kg
For each kg over	>20	Add additional 20 mL/kg

INSULIN INFUSION GUIDE

- Dilute 50 units soluble insulin (Actrapid®) in sodium chloride 0.9% 50 mL to make 1 unit per mL

Start infusion rate

Blood glucose (mmol)	Rate (mL/kg/hr)	Dose (unit/kg/hr)
5–≤7.9	0.025	0.025
8–11.9	0.05	0.05
12–15	0.075	0.075
>15	0.1	0.1

- Monitor blood glucose hourly before surgery, half-hourly during operation, and until child recovers from anaesthesia. Adjust IV insulin accordingly
- If blood glucose <5 mmol/L:
- stop IV insulin infusion for 10–15 min
- give glucose 10% 2 mL/kg IV bolus
- recheck blood glucose after 15 min

HOW TO RESTART SC INSULIN AFTER BEING ON IV INSULIN

If ready to eat at lunch give following insulin:

- Biphasic injection regimen, NOT using long-acting basal insulin analogue, allow to eat but continue IV insulin sliding scale until evening meal
- If using long-acting basal insulin analogues give rapid-acting insulin with lunch
- Check long-acting insulin has been carried on throughout stay
- if missed dose, delay restarting SC insulin until had long-acting insulin
- If on insulin pump:
- parents to restart insulin pump at usual basal rate once child feeling better and blood glucose levels stable with no ketones
- allow parents to manage according to their usual practice

If ready to eat by evening meal give the following insulin:

- Biphasic injection regimen NOT using long-acting basal insulin analogue: give usual dose of insulin with evening meal
- MDI regimen with long-acting basal insulin analogue: give rapid-acting insulin with evening meal and long-acting insulin analogue at usual time
- Always give dose of long-acting basal insulin analogue at usual time, even if still on IV fluids and IV insulin overnight, to prevent rebound hyperglycaemia
- If child given premixed insulin or long-acting basal insulin analogue dose, stop IV insulin 60 min after SC insulin commenced
- If given a rapid-acting insulin dose, stop IV insulin 10 min after SC insulin has commenced
- Insulin pump: parents to restart pump at usual basal rate once child feeling better and capillary blood glucose levels stable with no ketones. Stop IV insulin and fluids 10 min after insulin pump has been started
- allow parents to manage according to their usual practice

ORAL MEDICATIONS

Metformin

- Discontinue ≥24 hr before procedure for elective surgery
- in emergency surgery and when stopped <24 hr, ensure optimal hydration to prevent risk of lactic acidosis
- may be restarted no earlier than 48 hr following surgery/resumption of oral nutrition and provided that renal function has been re-evaluated and found to be stable

Other oral medications e.g. sulphonylureas/thiazolidinediones

- Stop on day of surgery

DIABETES NEW (NON-KETOTIC) ● 1/2

Any child or young person presenting to GP or A&E with symptoms suggestive of diabetes should be referred (by phone) immediately to paediatric diabetes team/paediatric assessment unit

RECOGNITION AND ASSESSMENT

Definition

Elevated blood glucose with no ketonuria/blood ketones

- Random plasma glucose ≥11 mmol/L or
- Symptoms + fasting plasma glucose ≥7 mmol/L

Symptoms and signs

- Change in school performance
- Thirst
- Weight loss
- Thrush
- Polyuria
- Nocturia
- Tiredness
- If obese, no ketonuria or evidence of insulin resistance (e.g. acanthosis nigricans), consider type 2 diabetes

Investigations

- Height and weight
- Blood:
- glucose
- electrolytes
- pH
- ketones
- HbA_{1c}
- FBC
- cholesterol and triglycerides
- TSH and FT4
- immunoglobulin A
- autoantibody screen for thyroid, coeliac, GAD, ZNT8 and IA2A

Do not arrange a fasting blood glucose or glucose tolerance test

IMMEDIATE TREATMENT

- Admit under admitting consultant of day/week
- Inform diabetes team, consultant or diabetes nurse specialist
- Start on multiple daily dose injection (basal bolus regimen)
- Add correction doses

Basal bolus regimen

- Basal dose is fixed and given once daily usually before bed
- Mealtime insulin dose based on carbohydrate counting and correction factor with 3 main meals

DIABETES NEW (NON-KETOTIC) ● 2/2

Weight of child (kg)	Dose of basal insulin (insulin degludec /Tresiba®) (units)	Meal insulin (insulin aspart/ NovoRapid®) based on insulin to carbohydrate ratios (units:g of CHO)	Correction dose insulin Units of insulin aspart/NovoRapid to be added to meal insulin as PRN doses if blood sugar high		
	Without DKA (unit)		Dose: Threshold blood sugar		
10–14	2	1 unit:40 g	0.5 unit >15 mmol	1 unit >20 mmol	
15–19	3	1 unit:30 g	0.5 unit >14 mmol	1 unit >19 mmol	
20–24	4	1 unit:25 g	0.5 unit >13 mmol	1 unit >18 mmol	
25–34	5	1 unit:20 g	0.5 unit >12 mmol	1 unit >17 mmol	1.5 unit >22 mmol
35–39	7	1 unit:15 g	0.5 unit >11 mmol	1 unit >15 mmol	1.5 unit >19 mmol
>40	10	1 unit:10 g	0.5 unit >10 mmol	1 unit >13 mmol	1.5 unit >16 mmol

SUBSEQUENT MANAGEMENT

- If tolerating food, allow patient to eat according to appetite for first 24–48 hr
- Adjust insulin according to eating habits
- Refer to dietitians

MONITORING TREATMENT

- Glucose stick monitoring pre-meals and bedtime (minimum 5)

DISCHARGE AND FOLLOW-UP

Prescribe following as TTO for all new patients

Insulin aspart 100 units/mL (NovoRapid® penfill 3 mL cartridges)	5 cartridges
Insulin degludec 100 units/mL (Tresiba® penfill 3 mL cartridges)	5 cartridges
GlucoRx HCT glucose test strips	50 strips
GlucoRx HCT ketone test strips	10 strips
GlucoRx lancets 0.31 mm/30 G Freestyle	200 pcs (lancing device included)
BD Microfine™ 4 mm needles	1 OP
Glucose 40% oral gel (Glucogel)	1 OP
Glucose tablets	1 OP
Sharps bin	

- Organise outpatient follow-up in 2 weeks

DIABETES KETOACIDOSIS (DKA) ● 1/9

RECOGNITION AND ASSESSMENT

Symptoms and signs

- Thirst
- Weight loss
- Polyuria
- Abdominal pain/vomiting
- Tachypnoea
- Sighing respiration (Kussmaul breathing)
- Odour of ketones
- Dehydration
- Drowsiness
- Coma
- Biochemical signs:
- ketones in urine or blood
- elevated blood glucose (>11 mmol/L)
- acidaemia (pH <7.3)

Assessment

- Airway, breathing, circulation
- record respiratory rate, heart rate, BP, peripheral pulse volume
- Conscious level: look for signs of cerebral oedema (see **Glasgow coma score** guideline)
- Headache, confusion, irritability, abnormal movements, slow pulse, high BP, papilloedema, small and irregular pupils
- Infection
- Height, weight
- Estimate dehydration based on pH value and replace over 48 hr

Assume 5% fluid deficit in children and young people in mild to moderate DKA (blood pH 7.1–7.29)
Assume 10% fluid deficit in children and young people in severe DKA (blood pH <7.1)

Investigations

- Insert 2 IV cannulas (as large as appropriate for child)

All cases

- Capillary blood glucose
- FBC
- Blood glucose
- Blood gas
- HbA_{1c}
- Blood osmolality, sodium, potassium, urea, bicarbonate, creatinine, pH
- Blood ketones
- Infection screen: blood and urine culture
- if meningism consider lumbar puncture
- Liver function tests and amylase

Severe cases

- Group and save

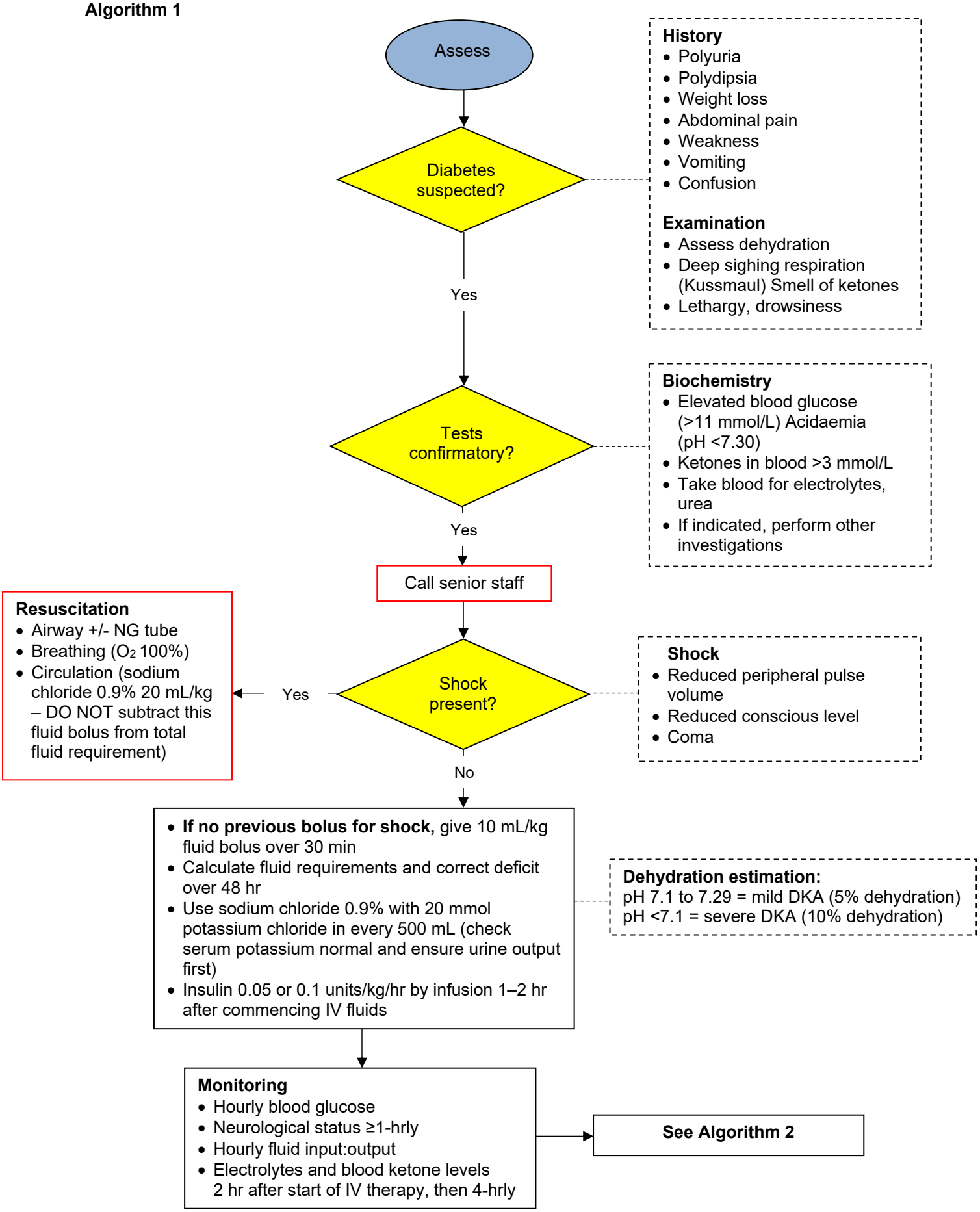
Newly diagnosed case

- Thyroid and coeliac disease antibody screen
- ZNT8 and IA2A
- GAD antibodies
- Thyroid function tests, TSH, T4
- Immunoglobulin A

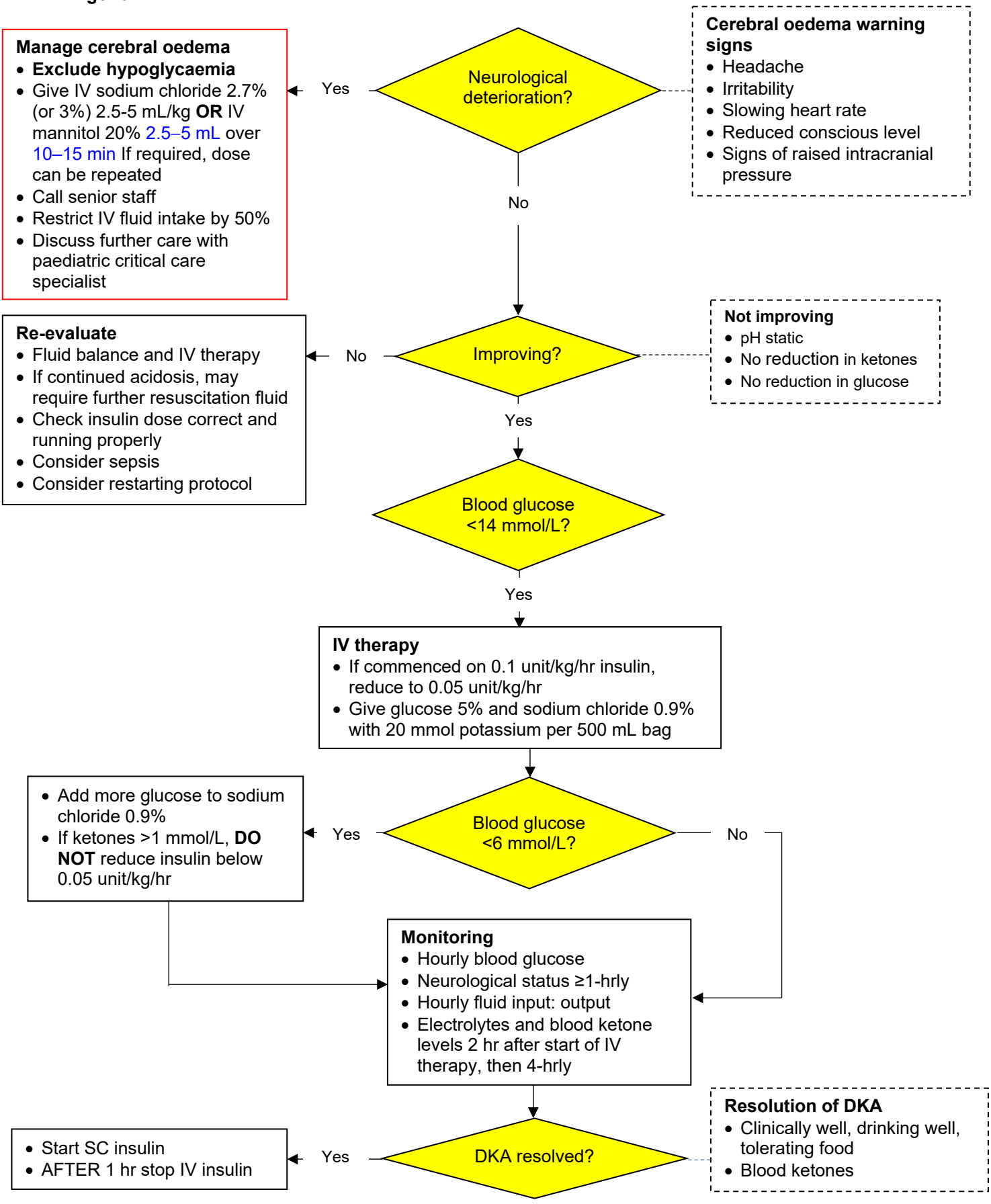
ALGORITHM (cross-referenced to text)

Management of diabetic ketoacidosis

Algorithm 1



Algorithm 2


Manage cerebral oedema
• Exclude hypoglycaemia
• Give IV sodium chloride 2.7% (or 3%) 2.5-5 mL/kg OR IV mannitol 20% 2.5–5 mL over 10–15 min If required, dose can be repeated
• Call senior staff
• Restrict IV fluid intake by 50%
• Discuss further care with paediatric critical care specialist
Yes
Neurological deterioration?
Cerebral oedema warning signs
• Headache
• Irritability
• Slowing heart rate
• Reduced conscious level
• Signs of raised intracranial pressure
No
Re-evaluate
• Fluid balance and IV therapy
• If continued acidosis, may require further resuscitation fluid
• Check insulin dose correct and running properly
• Consider sepsis
• Consider restarting protocol
No
Improving?
Not improving
• pH static
• No reduction in ketones
• No reduction in glucose
Yes
Blood glucose <14 mmol/L?
Yes
IV therapy
• If commenced on 0.1 unit/kg/hr insulin, reduce to 0.05 unit/kg/hr
• Give glucose 5% and sodium chloride 0.9% with 20 mmol potassium per 500 mL bag
• Add more glucose to sodium chloride 0.9%
• If ketones >1 mmol/L, DO NOT reduce insulin below 0.05 unit/kg/hr
Yes
Blood glucose <6 mmol/L?
No
Monitoring
• Hourly blood glucose
• Neurological status ≥1-hrly
• Hourly fluid input: output
• Electrolytes and blood ketone levels 2 hr after start of IV therapy, then 4-hrly
• Start SC insulin
• AFTER 1 hr stop IV insulin
Yes
DKA resolved?
Resolution of DKA
• Clinically well, drinking well, tolerating food
• Blood ketones

IMMEDIATE TREATMENT

Inform senior staff

Admission
- If alert and not shocked, admit to ward/HDU
- If shock or GCS <8, admit to PICU
- Discuss with PICU if:
- pH <7.1 and marked hyperventilation
- aged <2 yr

General
- Nil-by-mouth for first 8–12 hr
- if vomiting, abdominal pain, no bowel sounds or decreased GCS, insert NG tube
- Place on weigh-bed (if available)
- Strict fluid balance, consider catheterisation of children requiring HDU or PICU
- Start flow-sheet to record biochemistry and blood gases
- Monitor ECG for T wave changes
- Initiate IV fluids and insulin (see below)

Shock and resuscitation
- All children and young people with mild, moderate or severe DKA who are not shocked and require IV fluids – give sodium chloride 0.9% 10 mL/kg bolus over 30 min
- Shock is rare in children and young people with DKA
- Moderate to severe DKA: prolonged capillary refill, tachycardia and tachypnoea common – does not mean the child or young person is in shock (these are signs of vasoconstriction caused by metabolic acidosis and hypocapnia)

If shocked
- Children and young people with signs of shock, i.e. weak, thready (low-volume) pulse and hypotension, give sodium chloride 0.9% 20 mL/kg bolus as soon as possible
- Consider inotropes
- Require high dependency care
- Discuss with most senior paediatrician or intensivist available at earliest opportunity
- Avoid excessive fluid (risk of cerebral oedema) but give fluid to ensure adequate circulation
- Cerebral perfusion dependant on perfusion and intracranial pressure
- hypotension will exacerbate risk of brain injury
- When no longer shocked and circulated blood volume has been restored, calculate volume of fluid required (see below)

INTRAVENOUS FLUIDS

Volume of fluid
- Total fluid requirement is the addition of 4 categories:
- fluid to re-expand circulating volume if shocked
- maintenance fluids
- deficit
- continuing losses, do not include continuing urinary losses at this stage

Maintenance fluids
- Child will be nil-by-mouth and will need normal fluid requirement IV
- Calculate maintenance fluid using Holliday-Segar formula:
- 100 mL/kg/day for first 10 kg of body weight
- 50 mL/kg/day for next 10–20 kg body weight
- 20 mL/kg/day for each additional body weight >20 kg
- use maximum weight of 75 kg in calculation [i.e. cap at 75 kg = 2600 mL (2.6 L) per day or 108 mL/hr]

Fluid deficit
- Assume 5% fluid deficit in mild DKA (blood pH of 7.1 to 7.29)
- Assume 10% fluid deficit in severe DKA (blood pH <7.1)

- Deficit in mL = % dehydration × body weight (kg) × 10 (e.g. for a 10 kg child with 5% dehydration, the deficit is 5 × 10 × 10 = 500 mL)

Total fluid requirement = deficit + maintenance

- Hourly rate of fluid replacement = 48 hr maintenance requirements + deficit (see **Examples** below)
- Weight should rise gradually with rehydration
- If available use weigh-bed to record weight hourly to obtain accurate assessment
- **Resuscitation fluid**: volume of any fluid boluses given for resuscitation in children **in shock SHOULD NOT** be subtracted from total calculated fluid deficit
- Initial 10 mL/kg bolus given to all **non-shocked** patients requiring IV fluid **SHOULD BE SUBTRACTED** from total calculated fluid deficit

Example (1):

A 60 kg girl aged 15 yr with a pH of 6.9, who was shocked at presentation given sodium chloride 0.9% 20 mL/kg for resuscitation. Ongoing fluids will comprise:

Deficit 10%:	10 × 60 × 10 mL =	6000 mL to be replaced over 48 hr
	6000 mL/48hr =	125 mL/hr
Maintenance fluid	10 × 100 = 1000 mL/day for 1st 10 kg	
	10 × 50 = 500 mL/day for next 10 kg (10–20 kg)	
	40 × 20 = 800 mL/day for next 40 kg	2300 mL/day total (over 24 hr)
	2300 mL/24 hr =	96 mL/hr
Total Fluid	**Deficit of 10% over 48 hr = 125 mL/hr** **+**	
	Maintenance fluids = 96 mL/hr	**221 mL/hr**

Example (2):

A 20 kg boy aged 6 yr with pH 7.15 (moderate DKA = 5% dehydrated) will receive 10 mL/kg bolus (200 mL fluid) over 30 min as part of his initial management. Ongoing fluids will comprise:

Deficit 5%:	5 × 20 × 10 mL =	1000 mL
Subtract initial bolus	1000 - 200 =	800 to be replaced over 48 hr
	800/48 hr =	17 mL/hr
Maintenance fluid	10 × 100 = 1000 mL/day for 1st 10 kg	
	10 × 50 = 500 mL/day for next 10 kg (10–20 kg)	1500 mL/day total (over 24 hr)
	1500 mL/24 hr =	62 mL/hr
Total fluid	**Deficit of 5% - bolus over 48 hr = 17 mL/hr** **+**	
	Maintenance fluids = 62 mL/hr	**79 mL/hr**

Type of fluid

- Initially use sodium chloride 0.9% with potassium chloride dependent on serum potassium – see **Table 1**. Use **commercially premixed bag**
- Maximum rate of infusion of potassium chloride on ward 0.2 mmol/kg/hr (maximum 20 mmol/hr)
- If femoral line used prescribe dalteparin 100 units/kg/day (maximum 5000 units) SC

Table 1

Potassium <3.5 mmol/L	Potassium 3.5–5.5 mmol/L	Potassium >5.5 mmol/L
500 mL sodium chloride 0.9% with potassium chloride (40 mmol/500 mL) **via central line** and seek senior advice	Sodium chloride 0.9% with potassium chloride 0.3% (i.e. 20 mmol/500 mL or 40 mmol per litre) and can be given peripherally	Sodium chloride 0.9% **and seek senior advice**

If serum potassium <2.5 mmol/L, transfer to PICU. Discuss with consultant whether to give potassium chloride 0.2 mmol/kg in sodium chloride 0.9% by separate infusion over 1 hr. Before infusing bag containing potassium, connect patient to cardiac monitor.
If possible, use commercially premixed bag. Only in exceptional circumstances (with consultant agreement and 2 doctors checking procedure) should potassium chloride be added on the ward to a bag of sodium chloride 0.9% (MIX WELL)

- Further fluid and potassium as dictated by the child's condition and serum potassium (**Table 1**), repeated until glucose falls to 14 mmol/L, then move to **Subsequent management**

Fluid losses
- If a massive diuresis continues for several hours fluid input may need to be increased
- If large volumes of gastric aspirate continue, replace with sodium chloride 0.45% with potassium chloride

Oral fluids
- If receiving IV fluids for DKA **do not** give oral fluids until ketosis is resolving and no nausea/vomiting
- In the case of gastric paresis NG tube may be necessary
- If oral fluids given before 48 hr rehydration period completed, reduce IV infusion to take account of oral intake

Do not give IV sodium bicarbonate to children and young people with DKA

Insulin infusion
- **Start 1–2 hr after IV fluids**
- Soluble insulin (e.g. Actrapid®) infusion 1 unit/mL in sodium chloride 0.9% (i.e. 50 units in 50 mL) via IV syringe pump at 0.05 units/kg/hr
- If no fall in glucose after 2 hr (very unusual, check pump and patency of IV cannula), increase by 20%. If no fall after 4 hrs, increase to 0.1 unit/kg/hr and re-evaluate (e.g. sepsis, insulin errors)
- If blood glucose falls exceed 5 mmol/L/hr, reduce insulin infusion rate and adjust as necessary
- Do **not** stop insulin infusion. Check capillary glucose in 1 hr
- If IV fluids and insulin given through same cannula use anti-reflux valve

Do not give insulin bolus. Do not add insulin directly to fluid bags

Other insulin management
Continuous subcutaneous insulin infusion (CSII) pump therapy
- Stop pump when commencing insulin IV

Long-acting insulin [glargine (Lantus®)/detemir (Levemir®)]/degludec (Tresiba®)
- Initiate/continue usual dose/time throughout DKA treatment in addition to IV insulin infusion, in order to shorten length of stay after recovery from DKA
- D**O NOT** give long-acting insulin in patients on an insulin pump

MONITORING TREATMENT
- Hourly capillary blood gas and glucose after starting treatment, then 4-hrly blood ketones, capillary gas/U&E and laboratory glucose
- Neurological status, heart rate and blood pressure hourly (half-hourly if aged <2 yr)
- Complete DKA summary sheets
- If complaining of headache, for medical review
- Daily weight check

Medical reviews

- Doctor to carry out face-to-face review at start of treatment, and then 4-hrly, and more frequently if:
  - aged <2 yr
  - severe DKA (blood pH <7.1)
  - any other reasons for special concern
- At each face-to-face review assess following:
  - clinical status (including vital signs and neurological status)
  - blood investigation results
  - ECG trace
  - cumulative fluid balance record

SUBSEQUENT MANAGEMENT

When blood glucose falls <14 mmol/L use a glucose containing fluid

- Maintenance fluid dependent on, glucose and potassium

Table 2: Glucose

Blood glucose mmol/L	**Fluid:** sodium chloride 0.9% with potassium chloride 20 mmol per 500 mL (see **Table 1**) **and the following glucose concentration**
0–6.0	Glucose 10%
6.1–14.0	Glucose 5%
>14	No glucose

- If pH >7.3 reduce insulin infusion rate to 0.05 units/kg/hr (if on 0.1 unit/kg/hr)
- Blood glucose may rise as a result, **but do not revert to sodium chloride 0.9% unless plasma pH falls**
  - if pH falls, reassess fluid deficit and regimen
- If glucose falls <4 mmol/L, give glucose 10% 2 mL/kg IV. Reduce insulin infusion rate by 20%. Check capillary glucose in 1 hr
- To make glucose 10% (approx.) with sodium chloride 0.9% (with/without potassium): remove 50 mL from 500 mL bag of glucose 5%, sodium chloride 0.9% (with/without potassium) and add 50 mL of glucose 50%
- Continue with IV fluids and insulin infusion until blood ketones <0.5 and child tolerating oral fluids and food
- Start SC insulin ≥60 min before stopping IV insulin
- If using insulin pump therapy:
  - restart pump ≥60 min before stopping IV insulin
  - change insulin cartridge and infusions set
  - insert cannula into new SC site

If acidosis not improving, consider:

- Insufficient insulin to switch off ketones
- Inadequate resuscitation
- Sepsis
- Hyperchloraemic acidosis
- Salicylate or other prescription or recreational drugs

Hyperchloraemic metabolic acidosis

- May occur following administration of large amounts of chloride containing fluids given during DKA management
- Preferential renal excretion of ketones instead of chloride can result in hyperchloraemia
- If base deficit alone is used to monitor progress acidifying effect of chloride can mask the resolution of ketoacidosis – may appear to be continuing base deficit with continued low bicarbonate due to chloride component
- Carry out direct monitoring of ketones and calculation of component of base deficit due to chloride, to differentiate whether persisting acidosis due to ongoing ketosis that may need additional treatment (adjustment to insulin infusion or fluids) or hyperchloraemia
  - acidosis due to hyperchloraemia:
    - will correct spontaneously − does not require specific treatment

- need not delay transition to oral fluids and SC insulin
- requires differentiating from ongoing ketosis

Base excess due to chloride = (sodium - chloride) - 32 (ISPAD formula)

Example:
If following IV fluids patient remains acidotic with sodium = 142 and chloride = 126 then component of apparent base excess attributable to chloride calculated as:

Base excess due to chloride = (sodium - chloride) - 32

= (142 - 126) - 32
= (16) - 32
= - 16

Cerebral oedema
- Observe for headache, any change in symptoms, pH <7.2, or persistently low serum sodium as glucose corrects
- Exclude hypoglycaemia
- If cerebral oedema suspected, inform consultant immediately
- Give sodium chloride 2.7% (or 3%) 2.5–5 mL/kg of over 10–15 min
- if not available give mannitol 20% 2.5–5 mL/kg over 10–15 min, repeat mannitol after 2 hr if required
- restrict IV fluid intake to half maintenance and replace deficit over 72 hr
- if patient unconscious, insert urethral catheter
- admit to PICU
- consider CT scan/MR scan

OTHER COMPLICATIONS

Hypoglycaemia and hypokalaemia
- Avoid by careful monitoring and adjustment of infusion rates
- If BG falling quickly consider adding more glucose – even if still above 4 mmol/L

Systemic infections
- Do not give antibiotics as routine unless severe bacterial infection suspected
- Indicators of possible concomitant infection:
- fever
- raised lactate
- raised inflammatory markers

Aspiration pneumonia
- Avoid by nasogastric tube in vomiting child with impaired consciousness

Other associations with DKA require specific management
- Continuing abdominal pain is common − may be due to:
- liver swelling
- gastritis
- bladder retention
- ileus
- beware of appendicitis
  - request surgical opinion once DKA stable
- Raised amylase common in DKA

Converting to SC insulin
- Stop IV fluids when oral fluids tolerated
- When ketones <1, change to SC insulin
- Start on multiple daily dose injection (basal bolus regime) 60 min before stopping IV insulin
- Add correction doses
- Inform diabetes team (consultant, diabetes nurse and dietician)
- If patient on insulin pump, restart insulin pump 1 hr before stopping IV insulin
- change insulin cartridge and infusions set
- insert cannula into new SC site

Basal bolus regimen

- Basal dose is fixed and given once daily usually before bed
- Mealtime insulin dose based on carbohydrate counting and correction factor with 3 main meals

Weight of child (kg)	Dose of basal insulin (Insulin Degludec /Tresiba®) (units)		Meal insulin (insulin Aspart/NovoRapid) based on insulin to carbohydrate ratios (units:g of CHO)	Correction dose insulin Units of insulin Aspart/NovoRapid to be added to meal insulin as PRN doses if blood sugar high Dose: Threshold blood sugar		
	With DKA (unit)	Without DKA (unit)				
10–14	3	2	1:40	0.5 >15 mmol	1 >20 mmol	
15–19	4	3	1:30	0.5 >14 mmol	1 >19 mmol	
20–24	5	4	1:25	0.5 >13 mmol	1 >18 mmol	
25–34	6	5	1:20	0.5 >12 mmol	1 >17 mmol	1.5 >22 mmol
35–39	8	7	1:15	0.5 >11 mmol	1 >15 mmol	1.5 >19 mmol
≥40	12	10	1:10	0.5 >10 mmol	1 >13 mmol	1.5 >16 mmol

DISCHARGE AND FOLLOW-UP

Prescribe following as TTO for all new patients

Insulin aspart 100 units/mL (NovoRapid® penfill 3 mL cartridges	5 cartridges
Insulin degludec 100 units/mL (Tresiba® penfill 3 mL cartridges)	5 cartridges
GlucoRx HCT glucose test strips	50 strips
GlucoRx HCT ketone test strips	10 strips
GlucoRx lancets 0.31 mm/30 G Freestyle	200 pcs (lancing device included)
BD Microfine™ 4 mm needles	1 OP
Glucose 40% oral gel (Glucogel)	1 OP
Glucose tablets	1 OP
Sharps bin	

- Organise outpatient follow-up in 2 weeks

RECOGNITION AND ASSESSMENT

Definition of diarrhoea

- Passage of loose watery stools ≥3 times in 24 hr
- Most common cause is acute infective gastroenteritis

Diarrhoea and vomiting in infants may be a sign of sepsis
Treat sepsis using sepsis guidance including IV antibiotics

Symptoms and signs

- Sudden onset of diarrhoea (D) or vomiting (V), or both (D&V)
- Fever, malaise, lethargy
- Abdominal cramps
- Loss of appetite

Patient history

- Ask about:
- duration of illness
- frequency of stools and vomiting (>6 stools and/or 2 vomits in 24 hr means children are more likely to become dehydrated)
- colour of vomit (if green bilious vomit, consider obstruction)
- nature of stools, including presence of blood in stool
- feeds (fluid and food intake)
- urine output (number of wet nappies)
- contacts/exposure to infection
- recent travel abroad
- drug history: recent antibiotic use, immunosuppressants
- symptoms of other causes of D&V (e.g. high pyrexia, shortness of breath, severe/localised abdominal pain or tenderness, symptoms of meningitis/septicaemia)
- weight loss
- underlying problems e.g. low birth weight, malnutrition, immunodeficiency, neurodisability

Inform Public Health if outbreak of gastroenteritis suspected or reportable pathogen

Assessment

Assessment should be repeated regularly

- Weight, including any previous recent weight
- Temperature, pulse, respiratory rate
- Degree of dehydration (see **Table 1**) and/or calculate from weight deficit
- Complete systemic examination to rule out other causes of D&V
- Children aged <1 yr are at increased risk of dehydration

Calculating fluid deficit over 24 hr

- Aged <4 yr:
- 10% dehydrated: 100 mL/kg
- 5% dehydrated: 50 mL/kg
- Older children: deficit in mL = % dehydration x weight (kg) x 10
- e.g. for a 10 kg child with 5% dehydration deficit is 5 x 10 x 10 = 500 mL

Calculating maintenance fluids

Weight (kg)	Fluid volume
<10	100 mL/kg/day
10–20	1000 mL + 50 mL/kg/day for each kg >10 kg
>20	1500 mL + 20 mL/kg/day for each kg >20 kg

Table 1: Symptoms of dehydration (remote and face-to-face assessment)

Symptom	No clinically detectable dehydration (<5%)	Clinical dehydration 5–10% dehydrated	Clinical shock >10% dehydration
Appearance	Well	Unwell or deteriorating	–
Responsiveness	Alert and responsive	Altered (e.g. irritable, lethargic)	Decreased level of consciousness
Urine output	Normal	Decreased	–
Skin colour	Unchanged	Unchanged	Pale/mottled
Extremities	Warm	Warm	Cold

Table 2: Signs of dehydration (face-to-face assessment)

Sign	No clinically detectable dehydration (<5%)	Clinical dehydration 5–10% dehydrated	Clinical shock >10% dehydration
Responsiveness	Alert and responsive	Altered (e.g. irritable, lethargic)	Decreased level of consciousness
Skin colour	Unchanged	Unchanged	Pale/mottled
Extremities	Warm	Warm	Cold
Eyes	Not sunken	Sunken	–
Mucous membranes	Moist (except for 'mouth breather')	Dry (except after a drink)	–
Heart rate	Normal	Tachycardia	Tachycardia
Breathing	Normal pattern	Tachypnoea	Tachypnoea
Peripheral pulses	Normal	Normal	Weak
Capillary refill time	Normal	Normal	Prolonged
Skin turgor	Normal	Reduced	–
Blood pressure	Normal	Normal	Hypotension (decompensated shock)

Investigations

- If vomiting is a major feature or vomiting alone, or if baby aged <3 months: urine for dipstick and MC&S
- If septicaemia suspected, child immunocompromised, or if stools bloody, mucus present, diarrhoea not improving after 7 days send stools for MC&S, ova cysts and parasites, and virology
- If recent antibiotics and aged >2 yr consider *Clostridium difficile* if risk factors e.g. multiple courses of antibiotics with PPI
- If severe dehydration, possible hypernatraemic dehydration (see **Hypernatraemic dehydration** below) or diagnosis in doubt:
- FBC, U&E, chloride, glucose, blood and urine cultures. Blood gas or venous bicarbonate
- if decreased level of consciousness, consider lumbar puncture, especially in babies

IMMEDIATE TREATMENT

See flowchart **– Management of acute gastroenteritis in young children (aged <4 yr)**

General advice to parents

- Adequate hydration important
- Encourage use of low osmolarity oral rehydration solution (ORS e.g. Dioralyte™)
- 'clear fluids' (water alone/homemade solutions of sugar and fruit) lack adequate sodium content and are inappropriate
- sugar, fruit juices and cola have a high osmolar load and little sodium, and can worsen diarrhoea
- Recommend early refeeding with resumption of normal diet (without restriction of lactose intake) after 4 hr rehydration
- Do not use opioid anti-diarrhoeal agents.
- Anti-emetics e.g. ondansetron can be given for vomiting, refer to **BNFc** for dose guidance

Continue breastfeeding throughout episode of illness, ORS can be given in addition

Treatment of dehydration

- Admit if:

- patient ≥10% dehydrated
- failure of treatment (e.g. worsening diarrhoea and/or dehydration)
- other concerns (e.g. diagnosis uncertain, child aged <3 months, irritable, drowsy, potential for surgical cause)

Mild dehydration (<5%)

- Can be managed at home
- Rehydrate orally using ORS (prescribe sachets and give clear instructions: if genuinely not tolerated, parents may substitute with diluted sugar containing juice)
- calculate fluid deficit and replace over 4 hr with frequent small volumes (e.g. 5 mL every 1–2 min)
- Do not withhold food unless vomiting

Moderate dehydration (6–10%)

- If improving after 4 hr observation, can be managed at home provided social circumstances are appropriate/parents are happy. Otherwise, admit
- Calculate deficit and aim to replace with ORS 50 mL/kg oral over 4 hr (aged <4 yr)
- Give small frequent volumes (e.g. 5 mL every 1–2 min)
- If not tolerating oral rehydration (refuses, vomits, takes insufficient volume), use NG tube (or try water, milk, dilute juice)
- Review after 4 hr
- if dehydration persists, continue same regimen but replace fluid deficit with ORS over the next 4 hr
- if this fails, e.g. vomiting NGT ORS, or if not possible then use IV rehydration (see below). If venous access not possible discuss with senior to decide if intraosseous or NG tube is most appropriate
- If improving move to **Step 1**

Severe dehydration (>10%)

See flowchart – **Management of severe dehydration**

Beware hypernatraemic dehydration. See* Hypernatraemic dehydration *section

- Obtain IV access
- Take blood for U&Es and blood gas
- If child in shock, first resuscitate with sodium chloride 0.9% (10 mL/kg, repeated if required) and reassess
- Calculate deficit using recent normal weight if available
- if not available calculate losses based 10% dehydration and reassess response frequently
- Give 10 mL/kg aliquots of isotonic crystalloid e.g. sodium chloride 0.9%, up to 4 times, reviewing after each one. If requiring >40 mL/kg discuss with intensive care colleagues
- If oral/NG rehydration not possible, replace deficit with isotonic fluid IV e.g. sodium chloride 0.9% or sodium chloride 0.9% with glucose 5%; add potassium when U&Es available, provided not hyperkalaemic (see **Intravenous fluid therapy** guideline)
- if hypoglycaemic or at risk of hypoglycaemia use sodium chloride 0.9% with glucose 5% and potassium chloride
- start normal diet as soon as tolerated
- continue to replace ongoing losses with ORS for each watery stool or vomit (5 mL/kg per watery stool)
- Reassess regularly, when improves move to **Moderate dehydration (6–10%)**

Hypernatraemic dehydration (Na >150 mmol/L)

- In hypernatraemic dehydration, there are fewer signs of dehydration
- skin feels warm and doughy, child lethargic and irritable/jittery with hypertonia and hyperreflexic. They may have seizures
- if in shock, resuscitate with sodium chloride 0.9% 10 mL/kg bolus
- if Na >170 mmol/L, contact PICU for advice
- if child has passed urine, give IV fluid bags containing potassium – initially at 10 mmol/500 mL, adjust according to blood results when available

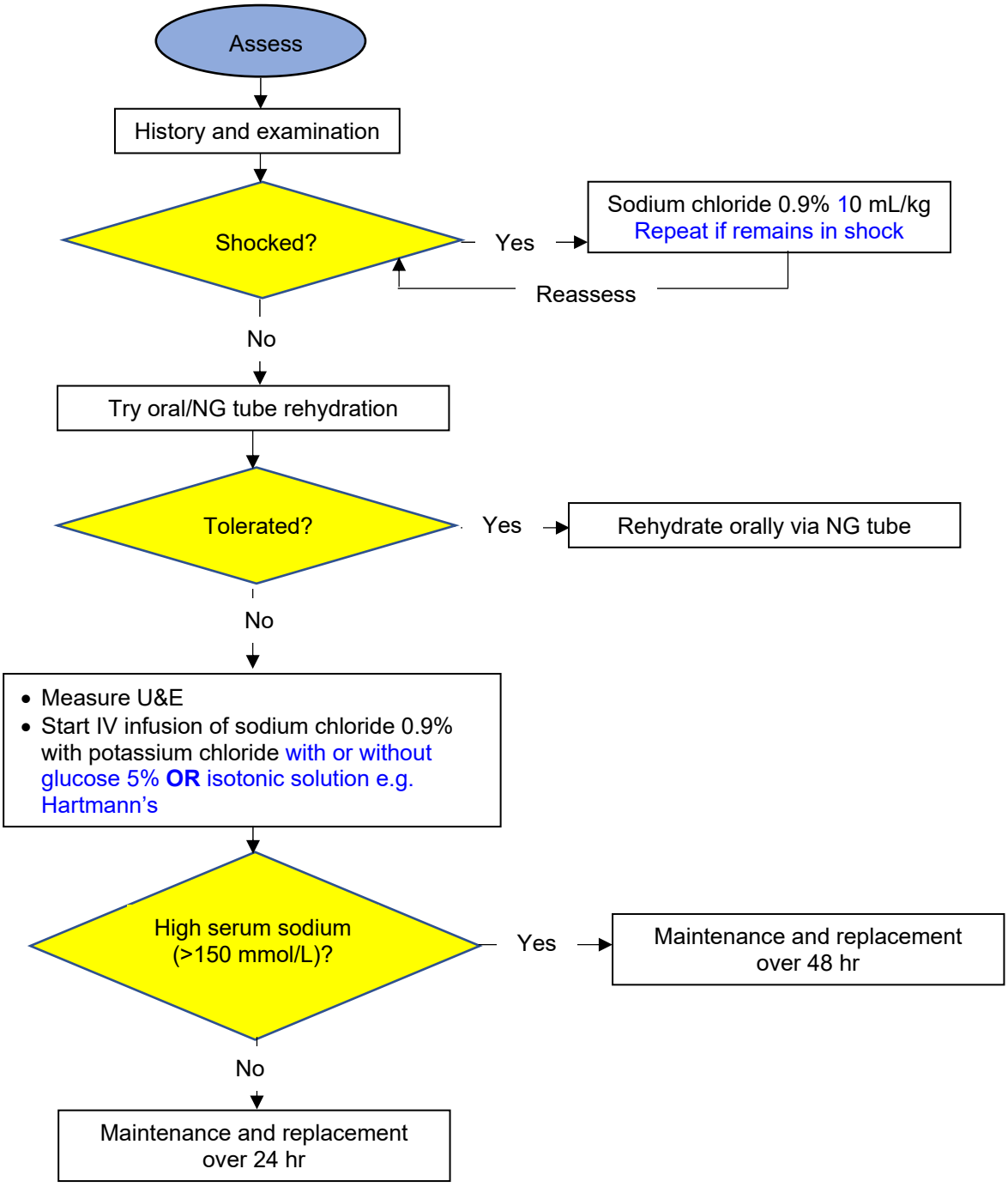
In hypernatraemic dehydration, aim to reduce sodium by no more than 10 mmol/L in 24 hr

- After initial resuscitation, give ORS: (maintenance) + replace deficit over 48 hr – via NG if necessary
- Check U&E after 4–6 hr
-

- If ORS not tolerated or sodium drops >0.5 mmol/L/hr, start IV rehydration with sodium chloride 0.9%, (maintenance) + replace deficit over 48 hr
- Recheck U&E after 4–6 hr (depending on rate of drop of serum sodium and starting value)
- If sodium dropping by >0.5 mmol/L/hr, reduce rate by 20%
- Once rehydrated, start normal diet including maintenance fluids orally

Hyponatraemia (see **Intravenous fluid therapy** guideline)

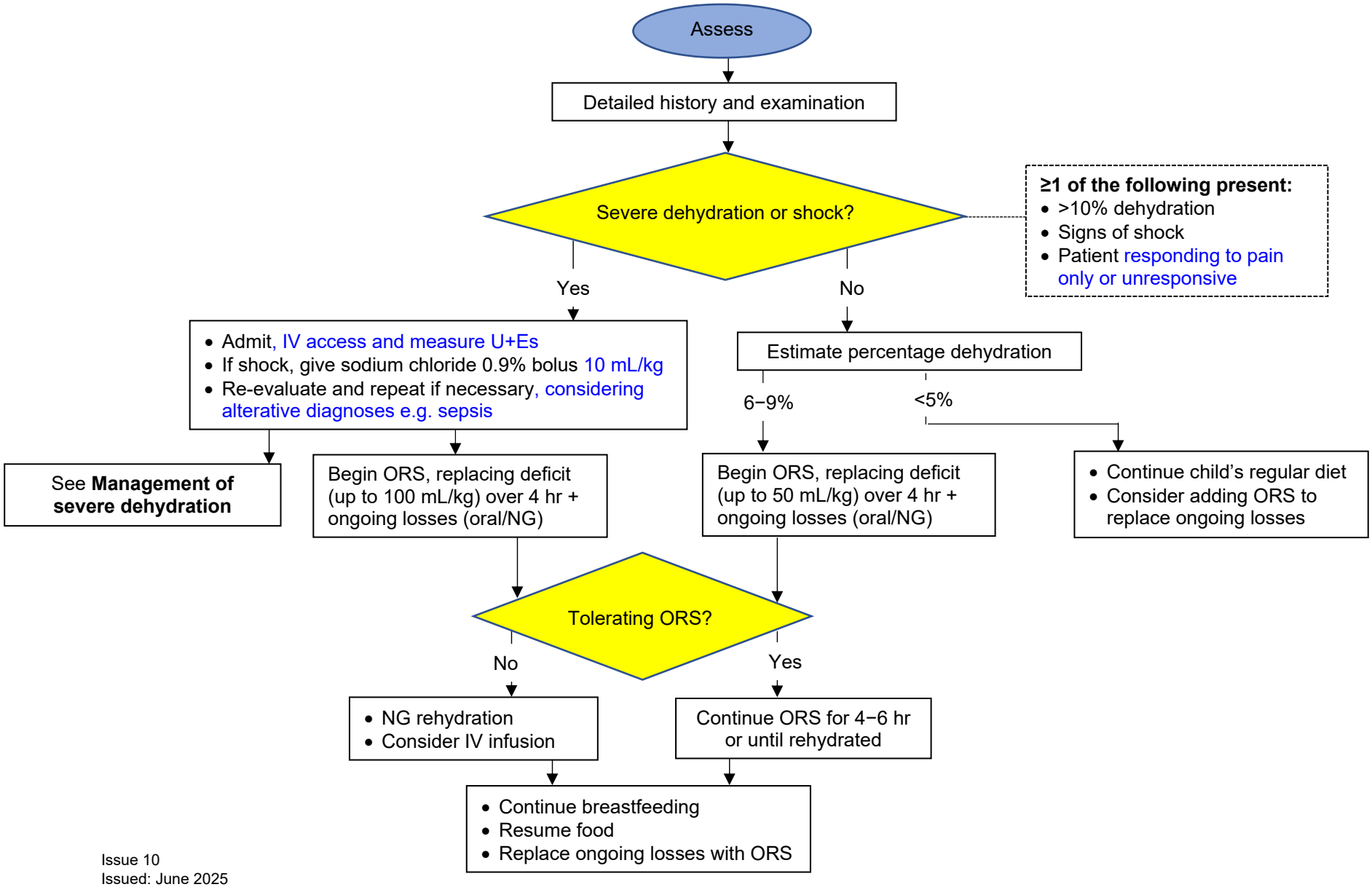
MANAGEMENT OF SEVERE DEHYDRATION



DISCHARGE AND FOLLOW-UP

- Fluid - ensure adequate oral intake prior to discharge
- Check child has passed urine
- Tell parents diagnosis and advise on management and diet
- Explain nature of illness, signs of dehydration, and how to assess and deal with continuing D&V (explain red flag symptoms in **Table 1**)
- Emphasise importance of adequate hydration. If dehydration recurs will need further rehydration
- If symptoms persisting, aged <1 yr or low birth weight, continue to supplement with ORS at 5 mL/kg per watery stool or vomit
- Do not withhold food (especially breast milk), full feeding appropriate for age if well tolerated after initial rehydration
- Advise parents how to prevent transmission to other family members and contacts
- patient should not share towels with others
- hand-washing with soap and warm water after using toilet or changing nappy. Dry hands properly
- Exclude from school/nursery until 48 hr from last episode of diarrhoea or vomiting
- Exclude from swimming for 2 weeks following last episode of diarrhoea
- Give open access if appropriate, ensure parents aware of how to seek help if needed
- If diarrhoea persists for >10 days, advise further medical reassessment

MANAGEMENT OF ACUTE GASTROENTERITIS IN YOUNG CHILDREN (AGED <4 YR)



RECOGNITION AND ASSESSMENT

Symptoms and signs

Anorexia nervosa (AN)

- Restriction of energy intake relative to requirements leading to low body weight (typically <85% median BMI for age and gender)
- Fear of gaining weight or persistent behaviour that prevents weight restoration
- Disturbance in perception of body weight or shape
- Self-evaluation unduly influenced by weight and body shape
- Ambivalence about very low weight

Bulimia nervosa (BN)

- Episodes of binge eating unusually large amount of food with sense of loss of control, occurring at least weekly with compensatory behaviour e.g. vomiting, laxative use, exercise and/or fasting
- Self-evaluation unduly influenced by weight and body shape
- May be underweight, normal range or overweight

Binge eating disorder (BED)

- Episodes of binge eating with no compensatory behaviour
- Associated with weight gain

Eating disorder not otherwise specified (EDNOS)/other specified feeding or eating disorder (OSFED)

- Resembles AN, BN, BED but does not meet diagnostic threshold
- atypical AN with weight in normal range
- atypical BN/BED as infrequent bingeing
- Purging disorder (vomiting/laxatives after food without bingeing)

Disordered Eating

- May fit above criteria for EDNOS
- Descriptive term rather than diagnosis characterised by similar risk and presentation but seen as form of self-harm, or maladaptive mechanism to manage emotional dysregulation
- May present with acute onset or total refusal of food and fluids

Avoidant/restrictive food intake disorder (ARFID)

- No body image disturbance
- Restricting food due to sensory issues relating to food e.g. intolerance of textures, smell etc or relating to environment e.g. eating in front of others
- leading to energy/nutritional deficit which can be normal, under or overweight
- May be related to fear of eating/psychological disturbance impairing nutrition (e.g. autistic spectrum disorder/attention deficit hyperactivity disorder, fear of choking, trauma)

Paediatric Feeding Disorder

- WHO definition – impaired oral intake not age appropriate and associated with medical, nutritional, feeding skill and possible psychosocial dysfunction e.g.
- due to reflux, constipation, cerebral palsy
- lack of sensory-oral skills e.g. sucking, chewing
- postural and fine motor skills
- associated with impaired growth but may be normal, under or overweight

Pica

- Persistent eating of non-nutritive substance

Rumination disorder

- Repeated regurgitation of food

DIFFERENTIAL DIAGNOSIS

- Consider physical causes of weight loss including:
- coeliac disease
- Addison's disease
- inflammatory bowel disease
- malignancy
- diabetes

- hyperthyroidism
- nutritional deficiencies (zinc, selenium, vitamin D)

BODY MASS INDEX (BMI)

- See **Table 1**
- BMI = weight (kg) ÷ height^2 (m^2)
- percentage median BMI (%mBMI) = 100 × BMI/mBMI for age/gender (see **Table 1**)
- calculation tool available at NHS BMI calculator https://www.nhs.uk/health-assessment-tools/calculate-your-body-mass-index/calculate-bmi-for-children-teenagers

Table 1: Approximate median BMI

Age (yrs)	Girls	Boys
9	16.1	16
9.5	16.4	16.2
10	16.6	16.5
10.5	16.9	16.7
11	17.2	17
11.5	17.6	17.2
12	18	17.5
12.5	18.4	17.9
13	18.8	18.1
13.5	19.1	18.3
14	19.5	18.8
14.5	19.7	19.2
15	20	19.5
15.5	20.25	19.7
16	20.5	20
16.5	20.7	20.3
17	20.9	20.6
17.5	21.1	21
18	21.2	21.1

REFEEDING

- A switch to carbohydrate metabolism after starvation can cause acute phosphate depletion, extracellular water retention, hypokalaemia, hypomagnesaemia or thiamine deficiency, with serious sequelae
- **After commencing feeding in high risk patients monitor following at least daily during risk period (typically 2–5 days):**
- U&E, phosphate, calcium, magnesium, glucose
  - if phosphate level falls, give 2–3 mmol/kg/day oral in 2–4 divided doses
- Monitor children in red or amber categories for refeeding syndrome (see **Table 2: Assessment of risk in feeding disorders**). See also **Nutritional first line advice** guideline
- Give Pabrinex® at appropriate dose for age or oral thiamine 100 mg 8-hrly, and vitamin B Co strong, 2 tablets twice daily aged >14 yr for ≥10 days (see **BNFc**)
- Avoid Hypostop® unless symptomatic non-ketotic hypoglycaemia
- Higher risk:
- BMI <70% median
- neutropenia
- minimal energy intake pre-admission
- previous history of refeeding syndrome
- If vomiting and/or laxative use have caused hypokalaemia, supplement with potassium 1–2 mmol/kg/day oral in divided doses [each tablet contains 12 mmol potassium (also available as a liquid formulation Kay-Cee-L®)]
- Repeat bloods at day 7–10 to assess for late refeeding

OTHER INVESTIGATIONS

- FBC, U&E, LFT, phosphate, magnesium, calcium, TFT, glucose
- If vomiting, amylase and bicarbonate may be raised
- B_{12}, folate, ferritin, coeliac screen, ESR, CRP, CPK
- Check zinc level, deficiency leads to altered appetite and may resemble AN
- Vitamin D:

- commonly deficient in eating disorders
- increases risk of osteoporosis

MANAGEMENT

- Be aware of refeeding syndrome
- Monitor for:
  - over activity
  - possible concealment of food
  - interfering with nasogastric feeds
  - vomiting and laxative use
  - manipulating weight (e.g. drinking water, heavy clothes, concealing weights)
- Discuss with local specialist CAMHS eating disorder team
  - aim to build a specialist medical emergencies in eating disorders (MEED) group; including psychiatrist, nurse, dietitian and paediatrician – see **RCPSYCH guidance**: https://www.rcpsych.ac.uk/improving-care/campaigning-for-better-mental-health-policy/college-reports/2022-college-reports/cr233
- Early recognition and treatment of AN improves outcomes

Table 2: Assessment of risk in feeding disorders

	Red (high risk)	Amber (alert to high concern)	Green (moderate risk)	Blue (low risk)
BMI and weight	• %mBMI <70% (approx. <0.4th BMI centile) • Recent loss ≥1 kg/week for 2 consecutive weeks	• %mBMI 70–80% (approx. 2nd–0.4th BMI centile) • Recent loss of weight of 500–999 g/week for 2 consecutive weeks	• %mBMI 80–85% (approx. 9th–2nd BMI centile) • Recent weight loss <500 g/week for 2 consecutive weeks	• %mBMI >85% (approx. >9th BMI centile) • No weight loss over past 2 weeks

Cardiovascular health	• Heart rate (awake) <40 bpm
	• History of recurrent syncope:
	  ◦ marked orthostatic changes (fall in systolic blood pressure of ≥20 mmHg) or
	  ◦ <0.4th–2nd centiles for age or
	  ◦ increase in heart rate of >30 bpm
	• Irregular heart rhythm (does not include sinus arrhythmia)
		• Heart rate (awake) 40–50 bpm
		• Sitting blood pressure (depending on age and gender)
		  ◦ systolic: <0.4th centile (84–98 mmHg)
		  ◦ diastolic: <0.4th centile (35–40 mmHg)
		• Occasional syncope; moderate orthostatic cardiovascular changes
		  ◦ systolic: fall ≥15 mmHg **or**
		  ◦ diastolic fall: ≥ 10 mmHg within 3 min standing **or**
		  ◦ increase in heart rate of up to 30 bpm
		• Cool peripheries; prolonged peripheral capillary refill time (normal central capillary refill time)
			• Heart rate (awake) 50–60 bpm
			• Sitting blood pressure (depending on age and gender):
			  ◦ systolic: <2nd centile (98– 105 mmHg)
			  ◦ diastolic: <2nd centile (40– 45 mmHg)
			• Pre-syncopal symptoms but normal orthostatic cardiovascular changes
				• Heart rate (awake) >60 bpm
				• Normal sitting blood pressure for age and gender with reference to centile charts
				• Normal orthostatic cardiovascular changes
				• Normal heart rhythm

ECG abnormalities	• QTc:
	  ◦ girls: >460 ms
	  ◦ boys: >400 ms
	  ◦ with evidence of bradyarrhythmia or tachyarrhythmia
		• QTc:
		  ◦ girls: >460 ms
		  ◦ boys: >400 ms
			• QTc:
			  ◦ girls: <460 ms
			  ◦ boys: <400 ms
			  ◦ taking medication known to prolong QTc interval
				• QTc
				  ◦ girls: <460 ms
				  ◦ boys: <400 ms

	(excludes sinus bradycardia and sinus arrhythmia); ECG evidence of biochemical abnormality		• family history of prolonged QTc or sensorineural deafness	
Hydration status	• Fluid refusal • Severe dehydration (10%): ◦ reduced urine output ◦ dry mouth ◦ decreased skin turgor ◦ sunken eye ◦ tachypnoea ◦ tachycardia	• Severe fluid restriction • Moderate dehydration (5–10%): ◦ reduced urine output ◦ dry mouth ◦ normal skin turgor ◦ some tachypnoea ◦ some tachycardia ◦ peripheral oedema	• Fluid restriction • Mild dehydration (<5%); may have dry mouth or not clinically dehydrated but with concerns about risk of dehydration with negative fluid balance	• Not clinically dehydrated
Temperature	• <35.5°C tympanic or 35°C axillary	• <36°C		
Biochemical abnormalities	• Hypophosphataemia • Hypokalaemia • Hypoalbuminaemia • Hypoglycaemia • Hyponatraemia • Hypocalcaemia	• Hypophosphataemia • Hypokalaemia • Hyponatraemia • Hypocalcaemia		
Disordered eating behaviours	• Acute food refusal or estimated calorie intake 400–600 kcal/day	• Severe restriction (<50% of required intake) • Vomiting • Purging with laxatives	• Moderate restriction • Bingeing	
Engagement with management plan	• Violent when parents try to limit behaviour or encourage food/fluid intake • Parental violence in relation to feeding (hitting, force feeding)	• Poor insight into eating problems • Lacks motivation to tackle eating problems • Resistance to changes required to gain weight • Parents unable to implement meal plan advice given by healthcare providers	• Some insight into eating problems • Some motivation to tackle eating problems • Ambivalent towards changes required to gain weight but not actively resisting	• Some insight into eating problems • Motivated to tackle eating problems • Ambivalence towards changes required to gain weight not apparent in behaviour
Activity and exercise	• High levels of uncontrolled exercise in the context of malnutrition (>2 hr/day)	• Moderate levels of uncontrolled exercise in the context of malnutrition (>1 hr/day)	• Mild levels of uncontrolled exercise in the context of malnutrition (<1 hr/day)	• No uncontrolled exercise
Self-harm and suicide	• Self-poisoning, suicidal ideas with moderate to high risk of completed suicide	• Cutting or similar behaviours • Suicidal ideas with low risk of completed suicide		
Other mental		• Other major psychiatric co-		

health diagnoses		diagnosis, e.g. OCD, psychosis, depression		
Sit Up Squat Stand (SUSS) Test	• Unable to sit up at all from lying flat (score 0)	• Unable to sit up without using upper limbs (score 1)	• Unable to sit up without noticeable difficulty (score 2)	• Sits up from lying flat without any difficulty (score 3)
Stand up from squat	• Unable to get up at all from squatting (score 0)	• Unable to get up without using upper limbs (score 1)	• Unable to get up without noticeable difficulty (score 2)	• Stands up from squat without any difficulty (score 3)
Other	• Confusion and delirium • Acute pancreatitis • Gastric/oesophageal rupture	• Mallory-Weiss tear • Gastro-oesophageal reflux or gastritis • Pressure sores	• Poor attention and concentration	

APPENDIX: EATING DISORDER CARE PLAN

Eating disorder care plan - *Guidance for paediatric ward staff*

Goal of this admission

- To monitor physical health and refeeding syndrome
- To stabilize physical health and completion of refeeding meal plan in line with medical emergencies in eating disorders (MEED) guidelines
- For CAMHS ED team to complete assessment of needs in preparation for discharge home to community treatment

Paediatric interventions

- Recommend overnight heart rate monitoring for patients with an awake heart rate of <50 bpm
- If clinically indicated paediatric early warning score (PEWS) every 4 hr or more frequently
- Prescribe following for all patients for 10 days:
  - Thiamine 100 mg BD
  - Multivitamin (Forceval®) x1 tablet once daily
- Paediatric team to monitor refeeding biochemistry (high risk patients need twice daily bloods) and provide additional mineral supplementation as needed – please see **MEED** guidelines for further advice and support to paediatric medical team
- All patients should be on bed rest and mobilise using a wheelchair
  - if patient requesting to go out of ward e.g. to shop or hospital grounds – this should be at discretion of consultant of the week who is able to make the decision based on physical health observations

Working together

- CAMHS ED team attending ward daily (Monday–Friday) to review patient and discuss with nursing team and concerns or observations they have made while patient has been on ward
- Day 4 of admission – multi-professional meeting
  - consultant of the week
  - community eating disorder service (CEDS) psychiatry
  - named nurse from CEDS or CEDS hospital liaison nurse

CAMHS ED team support to paediatric team

- Daily reviews (Monday–Friday) by nursing team on ward and provide meal support
- Dietetic review as required
- If patient requires a longer admission, attend day 4 or weekly planning meetings

Nursing considerations

Bed allocation

- If there are >1 eating disorder patients on ward if possible they should be in separate bays

Pressure area care

- Observe for signs of discoloration/evidence of skin breakdown daily

- If bed rest necessary or pressure sores detected, nurse on pressure mattress
- Skin may be dry, cracked, and broken areas slow to heal
- If pressure sores are apparent, referral to a tissue viability nurse is mandatory

Weighing and measuring patients

- Weigh patient ONLY TWICE A WEEK and weight chart kept away from patient e.g. in notes trolley or in nursing station as many patients will be distressed at finding out their weight and seeing potential weight gain
- Staff to be aware patients may try to add weight to their clothes/water load (by trying to consume excessive amounts of fluid before weighing) and are to be weighed in their underwear by a same sex member of staff
- No footwear to be worn. Explain procedure to young person on admission so they understand what will be expected
- Do not make comments about weight on scales. Stay neutral with your opinion
- General support and distraction are more useful as many patients with anorexia will be very anxious at this time
- Every patients' height to be recorded on admission; ensure they are standing straight and not slouched as this can affect body mass index (BMI)/expected body weight for age and height

1:1 supervision

- If patient at risk of self-harming, suicidal, exercising on ward or if parents/carers are not able to attend ward to monitor their child then registered mental health nurses (RMN's) or health care assistants (HCA's) can be helpful
- if no identified risks they are not always necessary for all patients, and their parents or carers are willing and able to support their child or young person on ward
- If 1:1 is needed, this needs to be reviewed every 24 hr
- ensure anyone doing 1:1 duty has access to, and has read care plan at start of their shift

Baths and showers

- Baths and showers present particular risk, as hot water hitting skin can cause 'vasodilation' –causes blood pressure to suddenly drop leading to fainting
- Strategies can help reduce risk of vasodilation
- patient should be seated where possible when bathing/showering
- support patient by staff member when he/she is getting up from seated position due to risk of blood pressure drop
- when patient bathing/showering, keep door unlocked and make staff aware of where they are. Allows quicker access should there be a problem
- temperature of water should be 'cool to warm' not hot – can trigger body to dilate veins close to skin, resulting in a sudden drop in blood pressure – can lead to fainting and injury

Use of toilet

- Use of toilet can present similar risks of blood pressure drops due to changes in body as it expels waste (actual volume etc.)
- Patient should make it known to ward staff that he/she intends to use toilet
- Keep toilet door unlocked to aid access should patient need assistance
- Accompany patient to toilet in case they need assistance
- patients should use wheelchair to mobilise to toilet

Keeping warm

- When body is in starvation, core body temperature can lower to conserve energy
- It's important to keep patient in warm room with warm clothes
- Avoid use of hot water bottles next to skin
- can cause vasodilation and move blood flow away from vital organs diverting it to skin surface and skin can be less sensitive to heat resulting in burns
- Body can also become less sensitive to cold, so if patient underdressed for temperature – encourage them to put on extra layers e.g. dressing gown/jumper

Meal support on ward

- All meals need to be observed by either dedicated health care professional, or parent/carer (as they will be caring for their young person at home), and each item eaten or drank documented on food record charts – aid dietetic assessment and medical management of refeeding syndrome

- Mealtimes are to be protected and neither external visitors nor doctors (doing ward rounds) should disturb patient
- Following principles are helpful for most young people and families:
  - consistent mealtimes on ward as 30 min for main meal and 15 min for snack
  - do not discuss calories, nutrition or healthy eating as this tends to increase distress
  - acknowledge mealtimes are difficult but ask what would be helpful – usually distraction techniques can be used before, during or after meal/snack
  - be supportive and directive
  - do not ask young person if they want it – tell them when it is ready
  - young person with anorexia nervosa will not relate to "wanting to eat"
  - be clear it is necessity and an expectation that they do
  - be clear with boundaries before meal commences i.e., food to be completed within 30 min and any food or fluid hidden/dropped will be replaced
  - ask young person what will help and what does not help in relation to coping with mealtimes – record as part of nursing care plan so staff can give consistent approach. It will help them to feel heard and to be able to feel involved in their care planning
  - may be helpful to have something planned to do once meal is completed, like manicure, game, reading or watching a film/television. This may help with difficult feelings after eating and be useful as a form of distraction
  - encouragement: be supportive and directive. Use phrases such as:
    - 'You need to make a start'
    - 'Keep going'
    - 'You need to complete this'
    - 'I can see how hard this is for you, but you need to keep going'
    - 'I will keep chatting, but you need to focus on eating'
    - Time reminders are useful i.e., 'you have x minutes left to finish this meal / snack'
  - meals need to be eaten within 30 min and snacks within 15 min
    - if meals are not eaten within time frame then offer equivalent number of calories as sip feed such as Ensure® Compact (2.4 kcal/ml) – patient will have 10 min to drink this
    - if they are unable to comply, call CEDS to discuss what additional support can be offered
  - if patient's life at risk secondary to their level of malnutrition, carefully consider NGT feeding under physical restraint (and mental health act) – jointly with consultant of the week and CEDS

Supporting confirmed or suspected neurodivergence

- Recommend following questions to help support creation of an ideal eating environment for young person and reduce anxiety:
  - do they prefer to eat in silence?
  - do they like you to talk to them? Encourage their eating?
  - do they prefer to watch their favourite TV show, use a tablet device, or listen to music?
  - does it help to wear noise cancelling headphones?
  - does it help to eat alongside reading, puzzles or other distractions such as tablets and radio?
  - does it help when person with them models eating (eats same food with them)? or do they prefer to be only one eating?
  - do they prefer it when someone sits next to them or in front of them?
  - does their chair have to face the door? Or specific direction?
  - can other people touch/prepare their food? e.g. others removing lids from food pots
- Consider options e.g. how food can be presented with routine appearance, how it can be made more acceptable (e.g. using specific branded products/kept separate on plate) and type of crockery and cutlery used
- Following checklist can be used to support refeeding meal plan. Complete with patient and their family and intended to support their experience and provide guidance to ward staff:
  - reasonable adjustment
    - I would like to bring in and use my own plate / bowl / cutlery/ straw from home

- I would like my milk served separately from my cereal portion
- I would like my beans served separately from my toast
- I would like my butter served separately from my bread/toast so I can add this myself
- I would like my sandwich filling to be served separately
- I would like my fruit cut-up rather than served whole
- I would like any 'hot food' to be served cold
- I would like drinks to be served cold from the fridge
- I would like my jacket potato and filling to be served separately
- I would like my baked beans to be a specific brand – please specify
- I would like my biscuits to be a specific brand – please specify
- I would like my cereal to be a specific brand – please specify
- I would like my bread to be a specific brand – please specify
- Where meal has 2 items, I would like these to be served separately rather than put in front of me at same time. This may mean I have lots of 'eating episodes' but this helps me to avoid feeling too full and reduces my anxiety
- Where possible, I would like my parent to oversee bringing me my specified meals and snacks so they can give me at more consistent/precise times each day
- Where possible, within health and safety restrictions, I would like to request my own preferred foods, are brought onto wards
- I would like to request that all my foods remain separate and don't touch one another
- I would like to request a milk alternative e.g. soya/almond/oat/rice/pea/coconut/other - please specify

Management of psychiatric risk

- Low level – verbal de-escalation
- Medium level – gentle hands-on redirection
- High level – security needed, recommend rapid tranquilisation (follow local policy)
- If endangering their life or safety of others, paediatric staff can act to protect a patient under common law

Discharge planning

- Patients will be safe to be discharged home to community team when following have been met:
- day 4 meeting has taken place
- resting heart rate >50 bpm overnight
- managing and completing day 6 of refeeding meal plan
- PEWS = 0 for past 24 hr
- follow-up is booked with CAMHS ED team for physical health monitoring and therapeutic interventions

ECG INTERPRETATION ● 1/6

PATIENT DETAILS

Understand the context

- Why is ECG requested
- Age
- Medical history
- Comorbidities
- Medications
- Known electrolyte disturbances

RECORDING TYPE

Paper speed and voltage

- Standard ECG speed: 25 mm/sec
- 1 small square = 0.04 sec
- Standard ECG voltage: 1 mV = 10 mm

ECG CHARACTERISTICS

Heart rate

- 1500/number of small squares between R-R interval

Heart rhythm

- Normal sinus rhythm defined as:
- P-wave preceding each QRS
- P-wave axis normal (0 to +90°): upright P-waves I and aVF

WAVE MORPHOLOGY

P-wave

- P-wave duration: increases slightly with age
- first year of life: ≤0.1 sec
- teenagers: ≤0.12 sec
- Wide P-wave suggests left atrial hypertrophy
- P-wave amplitude: no changes with age
- ≤2.5 mm in lead II
- tall P-wave suggests right atrial hypertrophy
- Variable P-wave morphology
- wandering atrial pacemaker

QRS axis

- Right axis deviation in neonates: +60° to +160° (mean +125°)
- By aged 3 yr, adult values reached: -10° to +110° (mean +50°)
- See **Example ECGs**: **Normal ECG in neonate, aged 5 yr, teenager**

Superior (left) axis deviation:

- AVSD
- Large VSD
- Tricuspid atresia
- Ventricular arrhythmias
- See **Example ECGs**: **Superior (left) axis deviation on ECG**

RS waves and progression

- Examine leads V1 and V6
- Neonates: dominant R-wave in V1, dominant S-wave in V6
- Aged >3 yr: dominant R-waves in V6, dominant S-wave in V1
- Aged 1 month–3 yr: variable picture, may have dominant R-waves in both V1 and V6

Table 1: R-wave and S-wave amplitude (98th centile) in leads V1 and V6

			Age								
			Months				Years				
			0–1	1–3	3–6	6–12	1–3	3–5	5–8	8–12	12–16
R-wave (mm): 98th centile	V1	Male	20.5	21	22	21.5	21	18	15	11	12
		Female	22	20	20	19	19	14	12	11	11
	V6	Male	18	22	27	28	29	31	30	32	30.5
		Female	16	27	28	27	26	29	32.5	30	25
S-wave (mm): 98th centile	V1	Male	14	16	20	19	23	21	23	25	24
		Female	15	16	16	19	22	21	25	26	20.5
	V6	Male	8	11	12.5	12	9	9	9	8	8.5
		Female	10	8	10	7	9	6	8	7.5	6

LEFT VENTRICULAR HYPERTROPHY (LVH)

- R-wave above 98th centile for age on V6 and S-wave above 98th centile for age on V1 (**Table 1**)
- Inverted T-waves in II, III, aVF, V4–6 imply strain pattern
- highly suggestive LVH (not always present)
- Additional markers (not always present)
- tall R-waves in aVF
- left axis deviation
- Q-waves in V4–6

RIGHT VENTRICULAR HYPERTROPHY (RVH)

Constellation of findings suggest RVH:

- R-wave above 98th centile for age on V1 (**Table 1**)
- S-wave above 98th centile for age on V6 (**Table 1**)
- R/S ratio above 98th centile on V1
- Upright T-waves in V1 (aged: 1 week–10 yr)
- Neonatal type R-wave progression in precordial leads in children/adolescents
- Right axis deviation (not to be used in isolation, especially in infants/young children)
- See **Example ECGs: RVH in ECG of child aged 2 yr**

Table 2: R/S ratio 2nd–98th centile in leads V1

			Age								
			Months				Years				
			0–1	1–3	3–6	6–12	1–3	3–5	5–8	8–12	12–16
R/S ratio: 2nd–98th centile	V1	Male	0.8–3.7	0.5–5.0	0.4–4.9	0.7–4.2	0.5–2.9	0.3–1.9	0.1–1.7	0.1–1.2	0.1–1.1
		Female	1.0–4.9	0.6–4.4	0.4–4.1	0.4–3.4	0.5–2.8	0.2–1.8	0.1–1.4	0.1–1.1	0.1–1.0

T-waves

- T-waves in lead V1 are upright at birth and become inverted by week 1 of life
- T-waves remain inverted in V1 aged ≤10 yr (exact age can vary)
- Upright T-waves between 1st week to aged 10 yr suggest RVH

Tall T-waves

(General rule – T wave should be no more than half the size of preceding QRS complex)

- Hyperkalaemia
- Ventricular hypertrophy
- Myocardial infarction
- Cerebrovascular episode

Flat T-waves

- Hypokalaemia
- Hypocalcaemia
- Hypothyroidism
- Myocarditis
- Digoxin effect
- Normal newborn

Q-waves

- Q-waves are seen normally in leads: II, III, aVF, V5, V6
- Pathological Q-waves:
- in lead aVL may signify anomalous left coronary artery from pulmonary artery (ALCAPA)

- in leads V1–3 may signify congenitally corrected transposition of great arteries (ccTGA)
- Q-wave amplitude >98th centile for age (**Table 3**) suggest myocardial infarction, ventricular hypertrophy, cardiomyopathy

Table 3: Q-wave amplitude (98th centile)

			Age								
			Months				Years				
			0–1	1–3	3–6	6–12	1–3	3–5	5–8	8–12	12–16
Q-wave (mm): 98th centile	II	Male	2.5	3.0	3.5	5.0	4.5	2.5	3.0	2.5	2.0
		Female	2.5	3.0	4.0	4.5	5.0	2.5	2.5	2.0	2.0
	III	Male	2.5	5.0	7.0	8.0	7.5	4.5	3.5	3.0	3.0
		Female	3.5	5.0	6.5	8.0	7.5	4.0	4.0	2.5	2.0
	aVF	Male	2.5	3.5	4.0	6.0	5.5	3.5	2.5	2.5	2.0
		Female	2.5	3.5	4.5	5.0	5.5	3.1	3.0	2.1	2.0
	V6	Male	2.0	3.0	3.5	6.0	5.5	4.0	4.0	4.0	4.5
		Female	1.5	3.5	4.0	4.0	5.0	4.0	4.1	3.5	2.5

PR interval

- Duration increases with age
- Ranges of normal (see **Table 4**)

Table 4: PR interval

		Age								
		Months				Years				
		0–1	1–3	3–6	6–12	1–3	3–5	5–8	8–12	12–16
PR interval (msec): median (2nd, 98th centile)	Male	99 (77,120)	98 (85,120)	106 (87,134)	114 (82,141)	118 (86,151)	121 (98,152)	129 (99,160)	134 (105,174)	139 (107,178)
	Female	101 (91,121)	99 (78,133)	106 (84,127)	109 (88,133)	113 (78,147)	123 (99,153)	124 (92,156)	129 (103,163)	135 (106,176)

Short PR interval:

- Wolff-Parkinson-White (WPW) syndrome
- Lown-Ganong-Levine syndrome
- Glycogen storage disease
- See **WPW syndrome on ECG**

Long PR interval:

- Normal variant
- 1st degree heart block
- Myocarditis, rheumatic fever
- Digitalis toxicity, hyperkalaemia

QRS duration

- Duration increases with age (see **Table 5**)
- up to 85 msec in first year of life
- up to 120 msec in adults

Wide QRS:

- Left or right bundle branch block (LBBB or RBBB)
- RBBB: common post cardiac surgery (especially VSD closure, Fallot's repair)
- incomplete RBBB (RSR in lead V1, normal duration QRS) may be benign but can be seen with ASD
- WPW syndrome
- Ventricular arrhythmias/ectopics
- Pacemaker

Table 5: QRS complex

		Age								
		Months				Years				
		0–1	1–3	3–6	6–12	1–3	3–5	5–8	8–12	12–16
QRS duration (msec):	Male	**67** (50,85)	**64** (52,77)	**66** (54,85)	**69** (52,86)	**71** (54,88)	**75** (58,92)	**80** (63,98)	**85** (67,103)	**91** (78,111)

median (2^{nd}, 98^{th} centile)	**Female**	**67** (54,79)	**63** (48,77)	**64** (50,78)	**64** (52,80)	**68** (54,85)	**71** (58,88)	**77** (59,95)	**82** (66,99)	**87** (72,106)

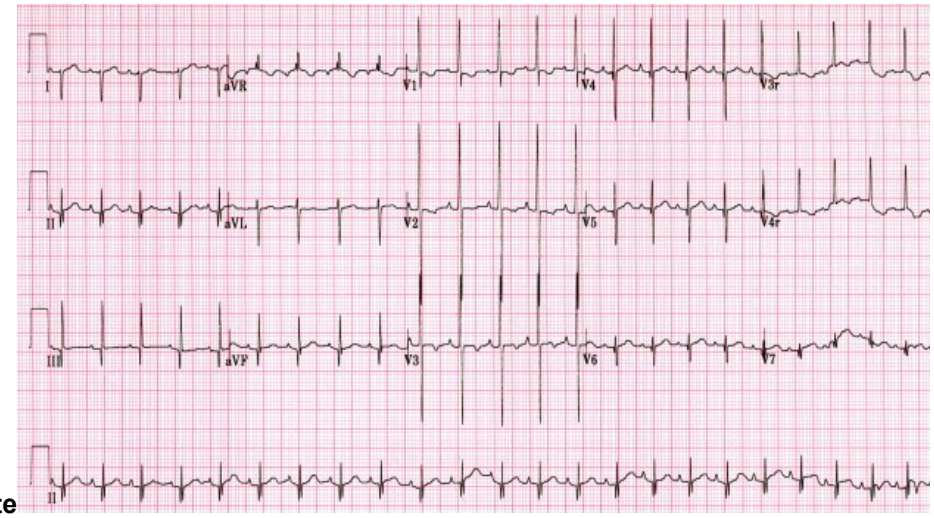
ST-segments
- ≤1 mm elevation/depression in limb leads: normal
- ≤2 mm elevation/depression in left precordial leads: normal
- Deviation from normal:
- ischaemia
- pericarditis
- myocarditis
- potassium abnormalities
- ventricular hypertrophy

QT-interval
- Corrected QT interval calculated using Bazett's formula: QTc=QT/$\sqrt{RR}$
- Normal range: ≤440 msec

Prolonged QT-interval:
- Long QT syndrome (risk for sudden death)
- Hypocalcaemia
- Myocarditis
- Drugs: list of drugs that prolong QT can be found at www.sads.org.uk/drugs-to-avoid

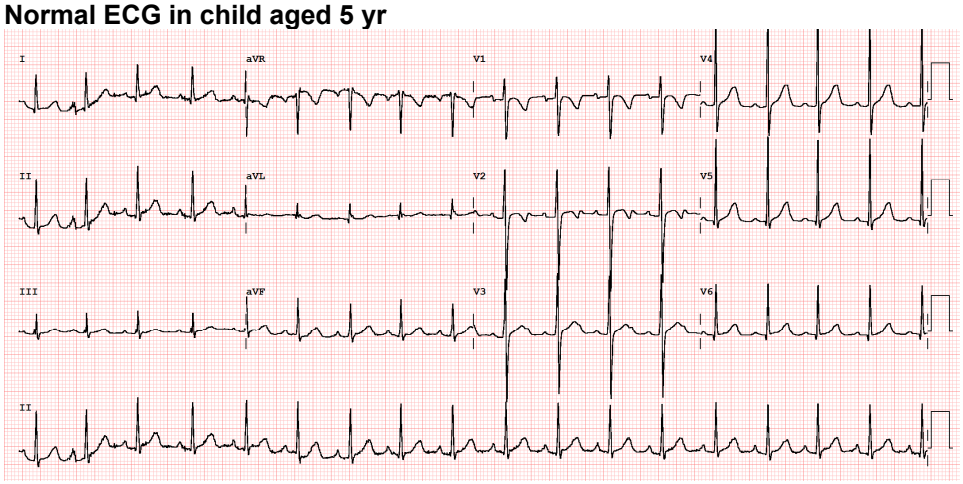
Short QT-interval (<350 msec):
- Short QT syndrome (new entity, associated with sudden death)
- Hypercalcaemia
- Hyperthermia
- Digoxin

EXAMPLE ECGS



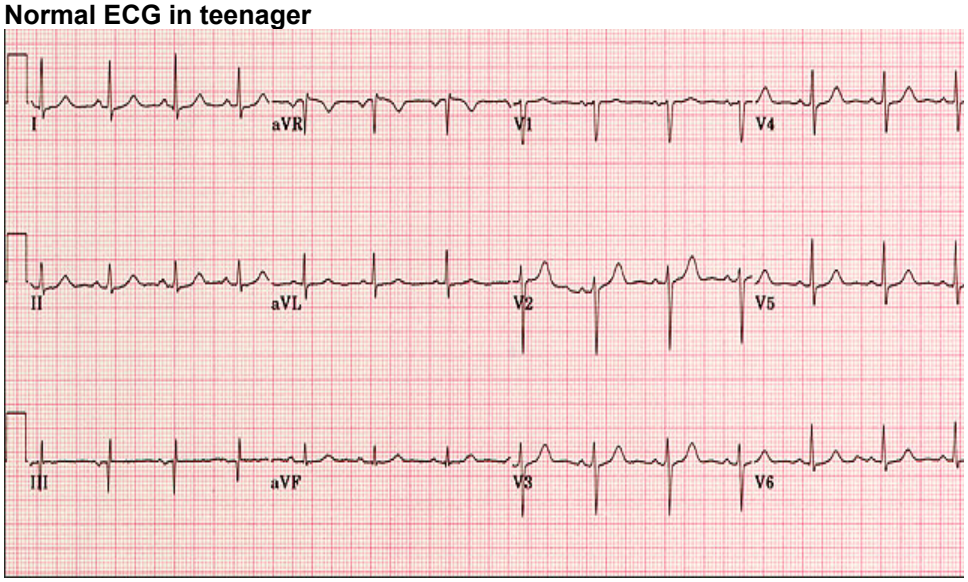
Normal ECG in neonate
Note QRS axis of approximately +120 of RV dominance

Normal ECG in child aged 5 yr



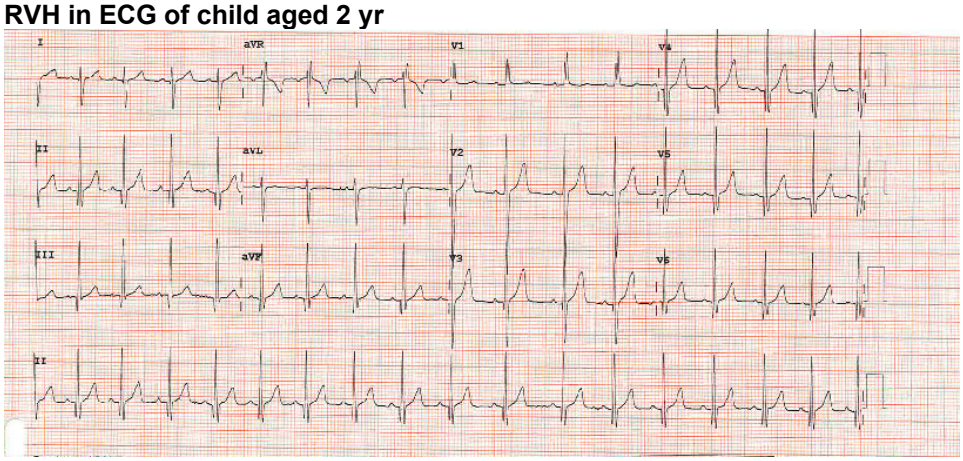
Note QRS axis of +45

Normal ECG in teenager



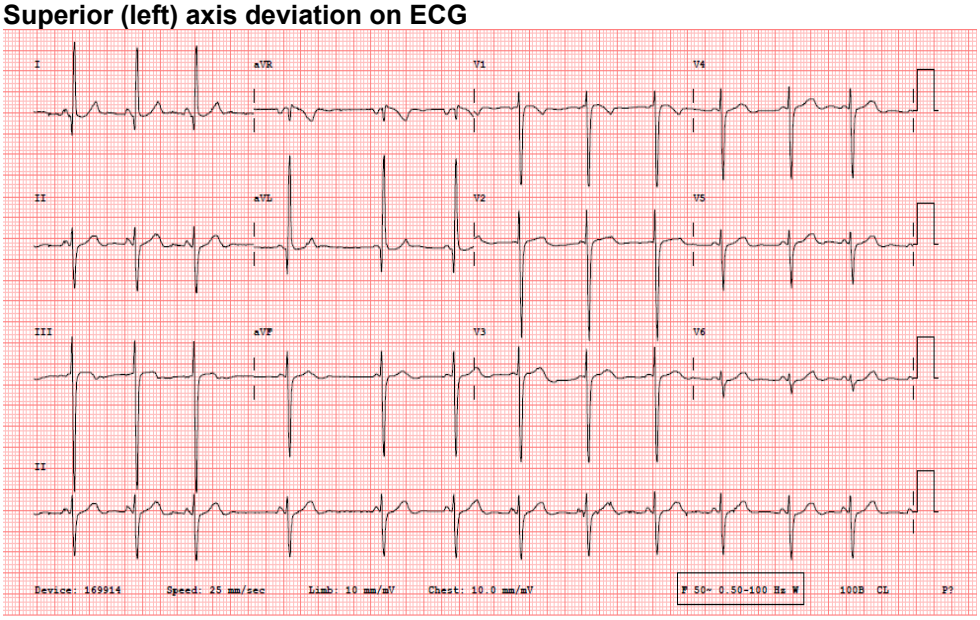
Note normal adult QRS axis of +15

RVH in ECG of child aged 2 yr



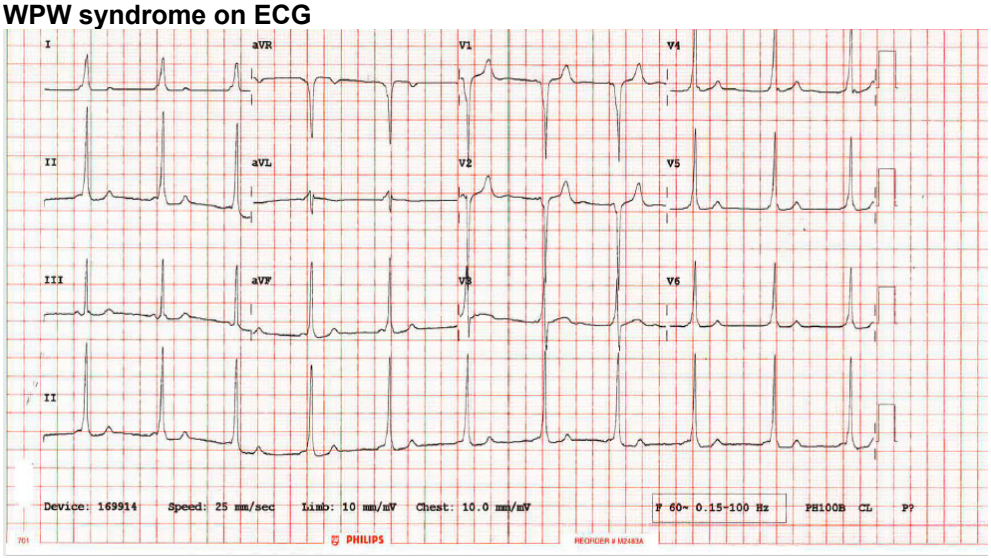
Note right axis deviation, and V1 showing upright T-waves and rSR pattern

Superior (left) axis deviation on ECG



Left axis deviation in tricuspid atresia (QRS axis approximately -45)

WPW syndrome on ECG



Note short PR interval with slurred upstroke to broad QRS, especially in lead II (Delta wave)

ECZEMA – INPATIENT TREATMENT ● 1/2

ADMISSION

- Possible reasons for admission
  - not improving despite adequate therapy at home
  - severe erythrodermic eczema
  - generalised weeping/haemorrhage exudate/crusts
  - all cases of eczema herpeticum
- Notify paediatric dermatology nurses of all admissions ≥24 hr
- Always grade eczema and document trigger factors

NURSING INTERVENTION AND MANAGEMENT

- If infected:
  - nurse inside room/cubicle
  - reserve bathroom for patient and place sign on door
  - obtain viral and bacterial swabs from affected areas and send for testing
  - monitor and document observations 4-hrly on paediatric early warning system (PEWS) chart
- Assist child and parent in ensuring prescribed creams applied every hour
- Ensure child bathes twice daily
- Always use spatula to remove creams/ointments from tubs (do not use hands)
- Observe skin for signs of improvement and deterioration
- Assess and monitor nutritional intake
- Inform doctor of any concerns/changes in condition
- Liaise with dermatology nurses and arrange follow-up appointment (always required)
- Encourage compliance at home and explain importance of this to parents and child
- Ensure good supply of prescribed ointments and creams readily available on ward. If not, order from pharmacy

EMOLLIENTS

Bath oil

- Bathe twice daily
- Use child's usual oil or Oilatum®
  - if infected use Dermol® 600

Soap substitute

- Use emulsifying ointment for baths in addition to bath oil and for washing hands
- If infected use Dermol® 500 lotion

Moisturiser

- If child has been seen in dermatology clinic apply usual emollient 2-hrly **OR** if not seen in clinic, Cetraben® cream 2-hrly
- Ointments e.g. emulsifying ointment, Hydromol®, Epaderm® and Zeroderm® useful for very dry skin
  - if infection present, do not use
- Leave ≥20 min between application of moisturiser and applying any topical steroids

TOPICAL STEROIDS

- Use if not responding to emollients
- Do not use in eczema herpeticum until no new lesions appearing (>48 hr)
- Apply twice daily to eczematous areas. Apply for 1000 hr and 1800 hr
- Use topical steroid ointments rather than creams
- Strength of topical steroid for face and body depends on age of child and severity of eczema. In general:
  - aged <2 yr: hydrocortisone 1% ointment
  - older children not responding to hydrocortisone 1%: clobetasone butyrate 0.05% (Eumovate®)
- Potent steroids e.g. betamethasone valerate 0.1% (Betnovate®) may be needed in older children with severe eczema

ANTIHISTAMINES

- Sedating antihistamine aged >1 yr: use appropriate dose for age and weight
  - use promethazine hydrochloride (see **BNFc** for doses)
  - alimemazine tartrate only to be prescribed in tablet form (syrup very expensive)

ECZEMA – INPATIENT TREATMENT ● 2/2

INFECTED ECZEMA

- Most children admitted will be infected
- All cases:
  - take ≥2 skin swabs for bacterial culture
  - take viral swab in viral transport medium for HSV infection
- Infection usually due to *Staphylococcus aureus* and/or beta haemolytic Streptococcus

Treatment

- Flucloxacillin oral for 10 days
- If penicillin allergy, use erythromycin
  - high incidence of staphylococcal resistance in atopic eczema
- Check skin swabs, especially to exclude MRSA
- If child vomiting and unable to tolerate oral use IV antibiotics

Steroid ointment

- If child has attended dermatology clinic use prescribed steroid creams/ointments

Eczema herpeticum

- Widespread herpes simplex virus infection of eczema
- Treat with aciclovir IV for 5 days
  - aged 3 months –11 yr: 1.5 g/m^2/day in 3 divided doses
  - aged ≥12 yr: 10 mg/kg 8-hrly
  - if skin healing well and no new lesions consider changing to aciclovir/valaclovir oral after 2–3 days
- Stop steroid creams/ointments until no new lesions and skin healing

SKIN CARE

- Nursing staff to teach parent(s) how to perform skin care
- Ensure parents are aware of fire hazard due to build up of emollient residue on clothing and bedding. Important not to smoke near child
- Notify health visitor and school nursing service regarding discharge
- Document in child's 'Red book'

DIET

- Continue normal diet
- If aged <1 yr and severe eczema consider casein hydrolysate milk substitute for 3 month trial
- If change of diet considered, always refer to paediatric dietician

FOLLOW-UP

- All children require ≥1 follow-up outpatient appointment with dermatology nurses 2–3 weeks following discharge
- Medical team to complete paperwork to action appointment

ECZEMA WET WRAP DRESSING ● 1/1

- Only to be prescribed after discussion with paediatric dermatology nurse
- Useful for severe erythrodermic eczema, widespread excoriations and eczema not responding to adequate therapy
- If eczema infected do not use
- Not usually used on face
- If concern regarding infection, treat with oral flucloxacillin
- Never cover wet wrap dressings with plastic, e.g. cling film

MANAGEMENT AND APPLICATION

- If child already has ready-made vest/leggings use these or,
- Prepare dressings from appropriate sized cotton tubular bandages (Tubifast®, Comfifast™ or Actifast®)
- 2 lengths required for
  - each arm and leg
  - body vests
- measure lengths required against an item of child's clothing
- if necessary add on enough to cover hands
- initially make up 3 suits (use 1 as template)
- Bathe child as prescribed
- Apply emollient (Cetraben® cream or child's usual emollient) to all affected areas on front and back of body
- areas where eczema under good control – treat with moisturiser alone
- apply topical steroid 20–30 min after emollient to affected areas
- Make 1 body vest length 'wet' using liberal emollient down inside and put on child
- Put dry vest length on top of wet creamy one
- Repeat 3–5 for arms and legs
- Ensure arm and leg lengths firmly secured to vest using small pieces of Tubifast®/Comfifast™/Actifast® as ties
- Change wet wrap dressings twice daily
- Ensure all clothing is cotton
- if ward is warm, pair of pants only are sufficient at night
- Use for 3–5 days depending on response
- longer periods can lead to pituitary-adrenal axis suppression

DISCHARGE AND FOLLOW-UP

- All children discharged from ward on wet wraps require 3 or 4 week follow-up appointments in nurse-led dermatology clinic
- Ensure request made to GP for vest and leggings (Clinifast®/Tubifast®)

- History of fever and any of:
- altered consciousness, personality or behaviour
- focal neurology
- focal seizures

Table 1: CSF interpretation

Investigation	Normal	Bacterial meningitis	Viral encephalitis	Tuberculous meningitis	Fungal
Opening pressure	10–20 cm	High	Normal/high	High	High/very high
Colour	Clear	Cloudy	Clear	Cloudy/yellow	Clear/cloudy
Cells-usually: Range:	<5	High/very high 100–50000	Slightly increased 5–1000	Slightly increased <500	Normal/high 0–1000
Differential	Lymphocytes	Neutrophils	Lymphocytes	Lymphocytes	Lymphocytes
CSF/plasma glucose	50–66%	<40%	Low	Low/very low <30%	Normal/low
Protein (g/L)	<0.45	High >1	Normal/high 0.5–1.0	High/very high 1.0–5.0	Normal/high 0.2–5.0

ADDITIONAL INVESTIGATIONS

Microbiology

- CSF (minimum 0.5 mL at least 15 drops) for PCR, including:
- meningococcal
- pneumococcal
- *Listeria monocytogenes*
- *E.coli* K1
- group B *Streptococcus*
- *Haemophilus influenzae*
- herpes simplex virus
- enterovirus
- VZV
- CMV
- human parechovirus
- human herpesvirus 6
- *Cryptococcus gatii/neoformans*
- measles

- Swab in viral transport medium
- throat and rectal swabs for enterovirus
- vesicle (if present) for VZV and HSV PCR
- Sputum (if symptoms) for respiratory virus PCR
- Parotid or buccal swabs for mumps PCR

- If history of recent travel consider:
- 3 x thick/thin malaria films
- rapid malaria antigen test
- CSF flavivirus IgM (Europe, Russia, eastern China)
- HIV antibody/antigen
- If psychiatric symptom presentation, anti-NMDA antibodies, syphilis serology, HIV, CMV, toxoplasma
- Whilst on aciclovir IV ensure adequate hydration and monitor fluid balance (risk of kidney injury)
- If LP not performed acutely, send CSF 10–14 days after illness onset for HSV specific IgG antibody
- If history suggestive, send acute and convalescent blood for EBV, arboviruses, Lyme disease, rickettsioses or ehrlichioses

EEG

- Indications
- if subtle motor status epilepticus suspected
- if unclear if psychiatric cause of encephalopathy

ENCEPHALITIS ● 2/3

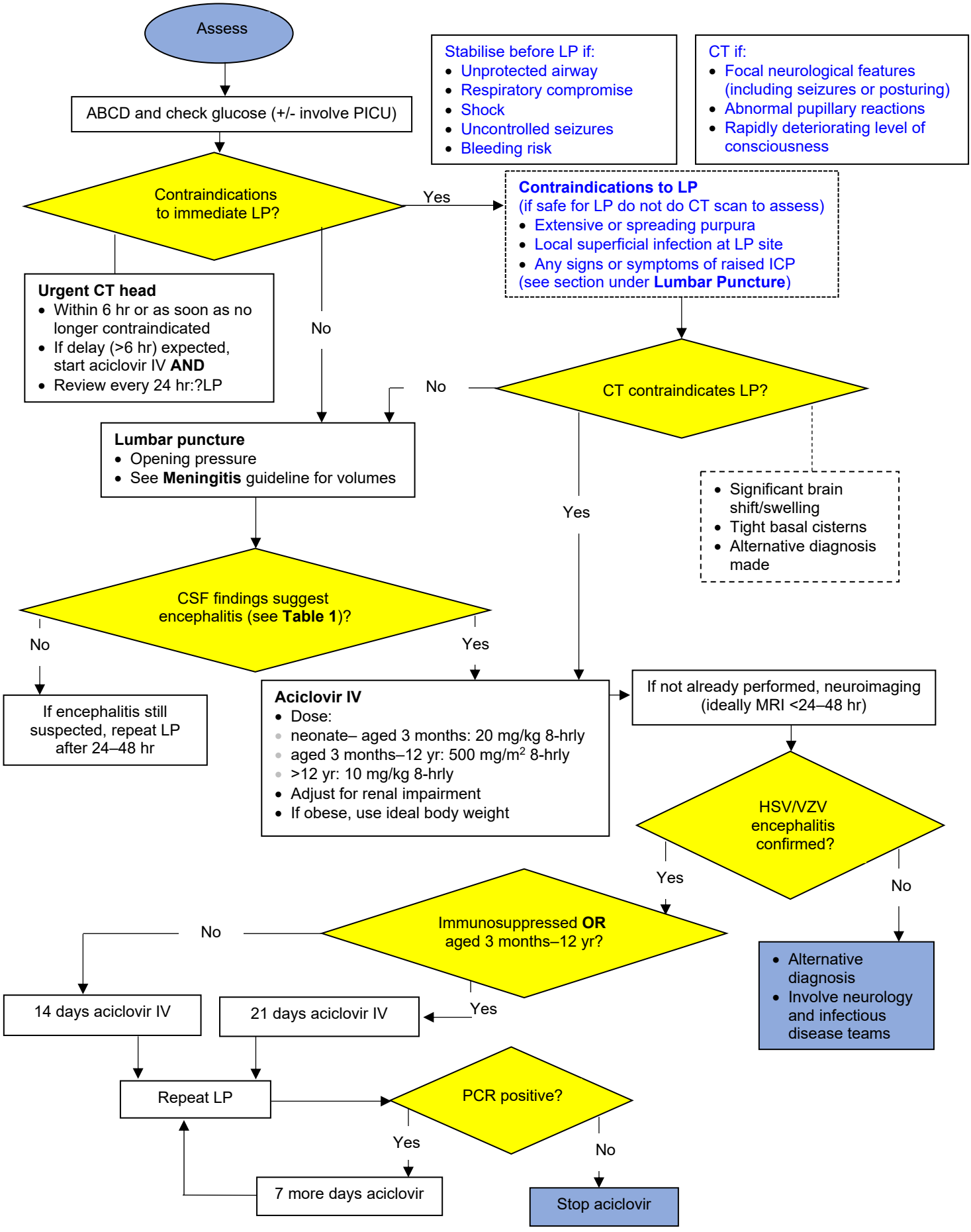
Involve

- Microbiology
- Infectious diseases
- Neurology

DISCHARGE

- If confirmed HSV disease aged <1 month: give suppressive therapy with aciclovir 300 mg/m^2 oral 8-hrly for 6 months (if immunocompromised, give 12 months)

Algorithm: Management of encephalitis



ENDOCARDITIS PROPHYLAXIS ● 1/1

BACKGROUND

- Vast majority of children with congenital or acquired heart diseases **do not** require antibiotic prophylaxis for infective endocarditis (IE) when undergoing:
- invasive dental procedures **or**
- non-dental procedures at the following sites:
  - upper and lower gastrointestinal tract
  - genitourinary tract; includes urological, gynaecological and obstetric procedures, and childbirth
  - upper and lower respiratory tract; includes ear, nose and throat procedures and bronchoscopy
- In all cases, a thorough discussion with the parents/patient covering the following topics to take place and document in notes before procedure:
- why antibiotic prophylaxis no longer routinely recommended (no proven effectiveness, antibiotic resistance and antibiotic adverse events)
- importance of maintaining good oral health
- symptoms that may indicate IE, and when to seek expert advice

WHEN TO CONSIDER ANTIBIOTIC PROPHYLAXIS

- Consider antibiotic prophylaxis for the following children (in consultation with local cardiologist):
- with any prosthetic valve, including a transcatheter valve, or those in whom any prosthetic material was used for cardiac valve repair
- with previous episode of IE
- with following congenital heart disease (CHD):
  - any type of cyanotic CHD
  - any type of CHD repaired with a prosthetic material, whether placed surgically or by percutaneous techniques up to 6 months after procedure, or lifelong if residual shunt or valvular regurgitation remains

If uncertain, seek advice from cardiology team at regional paediatric cardiac centre

EPILEPSY • 1/7

DEFINITIONS

- Epileptic seizure: abnormal electrical activity in the brain temporarily affecting consciousness, muscle control, sensation or behaviour
- Epilepsy is chronic brain disorder resulting in
  - ≥2 unprovoked (or reflex) seizures occurring >24 hr apart
  - 1 unprovoked (or reflex) seizure with probability a further seizure in ≥60%
  - based on specific clinical context and electroclinical diagnosis

RECOGNITION AND ASSESSMENT

- Detailed and accurate history from an eyewitness (beginning, middle and end of the episode)
- Smartphone video of suspected epileptic event is crucial for robust diagnosis of epilepsy
- Identify clear risk factors for epilepsy:
  - intellectual disability
  - known perinatal brain injury
  - known genetic conditions predisposing to epilepsy e.g. tuberous sclerosis Complex
- Screen for common co-morbidities:
  - development impairment
  - intellectual disability
  - autism
  - attention deficit hyperactivity disorder
- Family history is important – specifically ask about presence of neonatal/infantile seizures (in PRTT2 and SCN2A-related epilepsy) as well as febrile seizures (for SCN1A epilepsy) in parents/siblings
- Consider neurocutaneous syndromes when examining child to look for café-au-lait spots (for NF1) and use Wood's Light to look for hypopigmented macules/shagreen's patches (in tuberous sclerosis complex)
- Assess for any dysmorphic facial/body
- Perform detailed neurological and neurodevelopmental examination to confirm epilepsy. Ensure follow-up is in place with paediatrician with expertise in epilepsy and an epilepsy nurse specialist
- If diagnosis is uncertain of epilepsy, consider referral to paediatrician with expertise in epilepsy rather than empirical trials of treatment

Diagnosis of epilepsy is clinical

Seizure semiology based on 2021 ILAE classification

Generalised seizures

- Tonic-clonic/tonic
- Clonic
- Atonic
- Typical atypical absence
- Myoclonic absence
- Eyelid myoclonia with and without absences
- Myoclonic
- Myoclonic-atonic
- Epileptic Spasms
- Tonic
- Atonic

Focal seizures

May be with preserved or impaired awareness

- Characterised by ≥1 or more of the following features:
  - aura
  - motor manifestations
  - autonomic
- May evolve to bilateral tonic-clonic seizures

CHILDHOOD ONSET EPILEPSY ELECTROCLINICAL SYNDROMES

- Classify epilepsy into an electroclinical syndrome based on the following
  - age of onset of seizures
  - seizure semiology

- neurodevelopment and relevant investigations e.g. EEG, MRI and genetic/metabolic investigations

Focal epilepsy syndromes
- Self-limited neonatal epilepsy (SeLNE)
- Self-limited familial neonatal-infantile epilepsy (SeLFNIE)
- Self-limited infantile epilepsy (SeLIE)
- Self-limited epilepsy with centrotemporal spikes (SeLECTS)
- Self-limited epilepsy with epilepsy with autonomic seizures (SeLEAS)
- Childhood onset occipital epilepsy (COVE)
- Photosensitive occipital epilepsy (POLE)
- Sleep related hypermotor (hyperkinetic) epilepsy
- Familial focal epilepsy with variable foci
- Mesial temporal lobe epilepsy with hippocampal sclerosis
- Familial temporal lobe epilepsy
- Epilepsy with auditory features

Generalised epilepsy syndromes
- Genetic epilepsy with febrile seizures + (GEFS+)
- Myoclonic epilepsy in infancy (MEI)
- Childhood absence epilepsy (CAE)
- Juvenile absence epilepsy (JAE)
- Juvenile myoclonic epilepsy (JME)
- Epilepsy with eyelid myoclonia (E-EM)
- Epilepsy with myoclonic absences (E-MA)
- Epilepsy with myoclonic astatic seizures (EMAtS)
- Epilepsy with eyelid myoclonia
- Epilepsy with myoclonic absences

Developmental and epileptic encephalopathies
- Lennox-Gastaut syndrome (LGS)
- Developmental and/or epileptic encephalopathy with spike and wave activation in sleep (DEE-SWAS) or EE-SWAS
- Epilepsy in infancy with migrating focal seizures (EIMFS)
- Infantile epileptic spasms syndrome (IESS)
- Dravet syndrome
- Epilepsy with myoclonic atonic seizures (EtMATS)
- Rasmussen's syndrome
- Fever infection-related epilepsy syndrome (FIRES)

Common childhood/adolescent epilepsy syndromes

Childhood absence epilepsy (CAE)
- Usually presents aged 3–8 yr, 60–75% of cases in girls
- Many brief episodes of impaired awareness with abrupt onset/offset in a day sometimes with oral automastisms or clonic eyelid, head, eyebrow, chin or facial movements
- A typical EEG before treatment will capture epileptic absences with 3 Hz per sec spike and wave generalised discharges triggered by hyperventilation. Photosensitivity is typically not seen
- Ethosuxmide is first line drug of choice
- Most cases are self-limiting, and withdrawal of anti-epileptics should be considered after 2 yr of seizure freedom
- Minority of children may develop generalised tonic-clonic seizures in adolescence

Juvenile absence epilepsy (JAE)
- Usually presents between aged 9–13 yr
- Absence frequency is typically less than in childhood absence epilepsy
- *0% of children with JAE will develop generalised tonic-clonic seizures
- Awake interictal sleep EEG shows 3–5.5 Hz generalised spike and wave, fragments of generalised spike wave or polyspike wave. Photosensitivity may be seen
- First line treatment is either lamotrigine or levetiracetam
- Lifelong treatment with an anti-epileptic is indicated

Juvenile myoclonic epilepsy (JME)
- Typical age of onset is between aged 12–18 yr
- Myoclonic jerks are hallmark of this syndrome in addition to epileptic absences and generalised tonic-clonic seizures
- Myoclonic jerks typically occur after awakening and often go unrecognised initially
- 90% develop generalised tonic-clonic seizures at some stage
- First line treatment is levetiracetam, lamotrigine can also be considered but might make myoclonic seizures worse
- Lifelong treatment with an anti-epileptic is indicated

Self-limited epilepsy with centrotemporal spikes (SeLECTS) (previously known as Benign Rolandic Epilepsy)
- Usually nocturnal seizures
- Unilateral focal oro-motor seizures of face, palate and arm (e.g. gurgling, drooling, facial twitching)
- May become secondary generalised
- Sleep EEG shows high-amplitude spikes in centrotemporal region
- Children may only have 1–2 seizures and regular anti-epileptic treatment is not always necessary
- First line treatment is with levertiracetam or lamotrigine
- Low threshold to perform MRI brain imaging if EEG does not show entirely characteristic features of SeLECTS or no response to first-line anti-epileptic
- Withdrawal of treatment is indicated after 2 yr of seizure freedom

Self-limited epilepsy with epilepsy with autonomic seizures (SeLEAS) (previously known as Panayiotopoulos syndrome)
- Peak onset is aged 3–6 yr
- Characterised by focal seizures with retching, vomiting, malaise, pallor, flushing, pupil changes, abdominal pain, cardio-respiratory changes
- Usually nocturnal and happens in sleep
- Seizures can often be prolonged
- EEG shows high amplitude focal or multifocal epileptiform abnormalities which increase in drowsiness/sleep
- May only ever have 1 or 2 seizures so treatment with regular anti-epileptic may not be needed
- MRI brain is indicated to exclude a structural lesion
- First choice anti-epileptics could be levetiracetam or lamotrigine

Common focal epilepsies in children
Temporal lobe epilepsy (TLE)
- Focal seizures with either preserved or impaired awareness
- Seizure may be nocturnal or daytime
- Aura common before seizure, which could be sense of fear, abnormal abdominal sensation, déjà vu, behavioural arrest, orofacial automatisms
- Seizures might progress to generalised tonic-clonic seizures
- Children with history of prolonged febrile seizure in early years of life may have mesial temporal sclerosis as cause of their seizures
- Other known causes: cortical dysplasia, gliomas, dysembryonic neuroectodermal tumour
- Some patients can be a candidates for epilepsy surgery
- MRI brain imaging is always indicated

Frontal lobe epilepsy
- Semiology might involve hypermotor movements, clonic jerking, vocalizations and change in emotional state
- Repeated/multiple brief nocturnal seizures are a characteristic feature of frontal lobe epilepsy
- Interictal and sometimes even ictal EEG can be normal
- MRI brain is indicated
- First line treatment is with levetiracetam or lamotrigine

DEVELOPMENTAL AND EPILEPTIC ENCEPHALOPATHIES (DEEs)
- Group of rare and severe epilepsies characterized by seizures, which are often drug-resistant, and significant developmental impairment or regression

Infantile epileptic spasms syndrome (previously known as West syndrome)

Early diagnosis is important: suspect epileptic spasms in an infant presenting with clusters of unusual movements on waking up. Obtain sleep EEG within 24 hr of diagnosis being suspected

- Typically presents aged 3–8 months with:
  - spasms (flexor, extensor or mixed) occurring in clusters, usually on waking
  - sleep EEG is very abnormal (typically shows a hypsarrhythmia)
  - developmental regression and irritability might be present
- Look for features of tuberous sclerosis clinically
- Prognosis is improved by early identification and treatment
- Investigate all cases with MRI brain
- Seek tertiary neurology advice on treatment and investigations
- Usual treatment is with prednisolone and vigabatrin

Dravet syndrome

- Consider Dravet syndrome in all infants presenting with febrile status epilepticus (particularly hemiclonic status and recurrent status) aged <12 months
- If dravet syndrome is suspected and other common aetiologies excluded consider rapid whole genome sequencing
- Avoid treatment with sodium channel blockers which might worsen seizures e.g. lamotrigine, phenytoin and carbamazepine
- First line treatment is with sodium valproate
- Refer all cases urgently to tertiary centre

Lennox-Gastaut syndrome (LGS)

- Characterized by an epilepsy with multipe seizure types (tonic, atonic, generalised tonic-clonic, atypical absence, myoclonic, epileptic spasms, focal seizures), developmental impairment/intellectual disability and characteristic EEG features (slow-spike and wave, paroxysmal fast waves in sleep)
- Seizures are typically drug resistant
- First line treatment is with sodium valproate
- Refer all cases to a tertiary service

INVESTIGATIONS

Indications for EEG

- To characterise electroclinical syndrome after having made a clinical diagnosis of epilepsy based on history/observation of unprovoked seizures
- After an episode of unprovoked status epilepticus
- Suspicion of non-convulsive status in child with known diagnosis of epilepsy
- Acquired regression of speech or language function

EEG not indicated

- Non-epileptic episodes [e.g. syncope, reflex anoxic seizures, breath-holding episodes (ECG more appropriate)]
- Seizures in context of febrile infection
- First generalised tonic-clonic seizures
- To monitor progress in well-controlled epilepsy
- Before stopping treatment

Indications for MRI brain

- MRI brain (within 6 weeks of diagnosis) is indicated in all children unless they have an idiopathic generalised epilepsy or self-limited epilepsy with centrotemporal spikes with complete seizure control with first line medication
- Ensure that an epilepsy protocol scan is requested and paediatrician with expertise in paediatric radiology/neuroradiology can report scan. Consider use of anaesthesia and sedation for scan as required

Indications for genetic testing (through whole genome sequencing)

- Epilepsy with onset aged <2 yr of no cause identified on imaging
- Epilepsy in child with intellectual disability, autism, dysmorphic features, cognitive decline with no cause identified on imaging

- Clinical features of specific syndrome – for instance dravet syndrome
- Infants aged <12 month with epilepsy of known cause are eligible for rapid whole genome sequencing (R14)

When to consider metabolic investigations

- Early onset myoclonic seizures – consider white cell enzymes for Batten's disease, Buffy coat lymphocytes. oligosaccharides for sialidosis, mitochondrial genome sequencing
- Epilepsy with regression – MRI abnormalities might guide targeted metabolic testing
- Refractory neonatal seizures – investigation for vitamin responsive epilepsies. Consider sending urine for – alpha-aminoadipic semialdehyde (AASA), cerebrospinal fluid (CSF) for glycine and serine, very long chain fatty acids
- Epilepsy with refractory absences, myoclonic-atonic seizures – fasted lumbar puncture for paired CSF/serum glucose to exclude glut-1 deficiency
- Epilepsy with severe intellectual disability/autism – creatine synthesis disorders (send urine creatinine and guanidinoacetate ratio)

TREATMENT

General guidelines

- Discuss treatment with consultant before starting
- Preferably start treatment after initial EEG results obtained but do not delay treatment if there are frequent convulsive seizures
- Prescribe tablets if possible. Give liquids as sugar-free preparations
- Make sure you discuss potential adverse effects with parents and document these in notes
- If child develops adverse effects, discuss and reduce dose/switch medications
- Consider training for and prescribing of buccal midazolam for use in the community for children who have had a previous episode of prolonged (>5 min) or convulsive seizures

Discussion with child and parents

- Provide additional advice regarding safety (e.g. supervision when swimming, safe sleeping) and document discussion in notes
- Discuss and prescribe rescue treatment, with training for parents
- Provide written information, including information about national or local epilepsy associations and website for Epilepsy Action (www.epilepsy.org.uk)
- Explain how to gain access to an epilepsy specialist nurse
- Discuss sudden unexpected death in epilepsy patients (SUDEP) and need for nocturnal supervision particularly in children having nocturnal convulsive seizures

Valproate MHRA guidance

- Due to risk of teratogenicity do not use sodium valproate in women of childbearing age unless appropriate alternative anti-epileptic medications have been trialled
- Decision to start valproate must be agreed by two specialists with expertise in epilepsy and risks/benefits discussed with family and documented annually on risk acknowledgement form
- Due to emerging evidence on sodium valproate being associated with reversible reduction in fertility in males'
- not recommended as first line treatment in males aged <55 yr unless alternative medications have been trialled
- decision to start valproate must be agreed by two specialists with expertise in epilepsy and risks/benefits discussed with family and documented on risk acknowledgment form on starting the medication
- Valproate may be appropriate as first line medication in specific severe electroclinical syndromes e.g. LGS and dravet syndrome

Table: Drugs of first and adjunctive treatment of seizure types
(See https://www.nice.org.uk/guidance/cg137/chapter/appendix-e-pharmacological-treatment)

Seizure	First-line
Generalised tonic-clonic	Lamotrigine Levetiracetam
Tonic or atonic	Lamotrigine
Absence	Ethosuximide
Myoclonic	Levetiracetam
Focal	Lamotrigine Levetiracetam

Epilepsy in adolescence – additional factors to be considered
- Compliance
- Career choices
- Driving
- Contraception and pregnancy, including pre-pregnancy counselling
- Alcohol and drugs

SUBSEQUENT MANAGEMENT
- Increase dose of anti-epileptic gradually towards full dose or maximum tolerated dose until control good
- If control suboptimal with one drug or unacceptable side effects, start second line drug

OUTPATIENT MANAGEMENT
- Initial follow-up at 3 months
- Subsequent follow-up/structured review every 3–12 months based on clinical need

INDICATIONS FOR REFERRAL TO TERTIARY CENTRE
Urgent referral criteria for children with
- Epilepsy aged <3 yr
- Myoclonic seizures aged <4 yr
- Unilateral structural lesion
- Developmental regression

Other referral criteria
- Uncertain diagnosis after assessment by paediatrician with expertise in epilepsy
- Drug resistant epilepsy (ongoing seizures despite trial of two appropriate anti-epileptic medications) or likely to become drug resistant based on electroclinical syndrome
- Parental wish to participate in clinical trial
- Referral for epilepsy surgery assessment

Indications for epilepsy surgery assessment referral
- Children with:
- catastrophic early onset epilepsy with evidence of lateralisation to seizure onset
- aged <24 month with evidence of focality to seizure onset, with or without an MRI evident lesion
- any age with evident focal epilepsy, or lateralised seizures associated with congenital hemiplegia, resistant to two appropriate anti-epileptic drugs (AEDs)
- epilepsy associated with Sturge-Weber syndrome, benign tumours with developmental issues and/or ongoing seizures, or Rasmussen's syndrome
- any age with epilepsy associated with tuberous sclerosis resistant to two AEDs where seizures may arise from single focus (probably from single tuber)
- have 'drop attacks' as part of more complex epilepsy
- epilepsy associated with hypothalamic hamartoma

WITHDRAWAL OF ANTI-EPILEPTIC DRUGS
- Consider when child has been seizure free for 2 yr in epilepsy syndromes felt to be self-limiting e.g. CAE/ SeLECTS

- Do not withdraw anti-epileptics in syndromes where long term risk of seizure recurrence is very high e.g. JAE/JME
- Typically wean off anti-epileptics >12 weeks
- Some drugs (phenobarbital or benzodiazepines) need very slow withdrawal >4 months

EXTRAVASATION INJURIES ● 1/4

INFILTRATION AND EXTRAVASATION

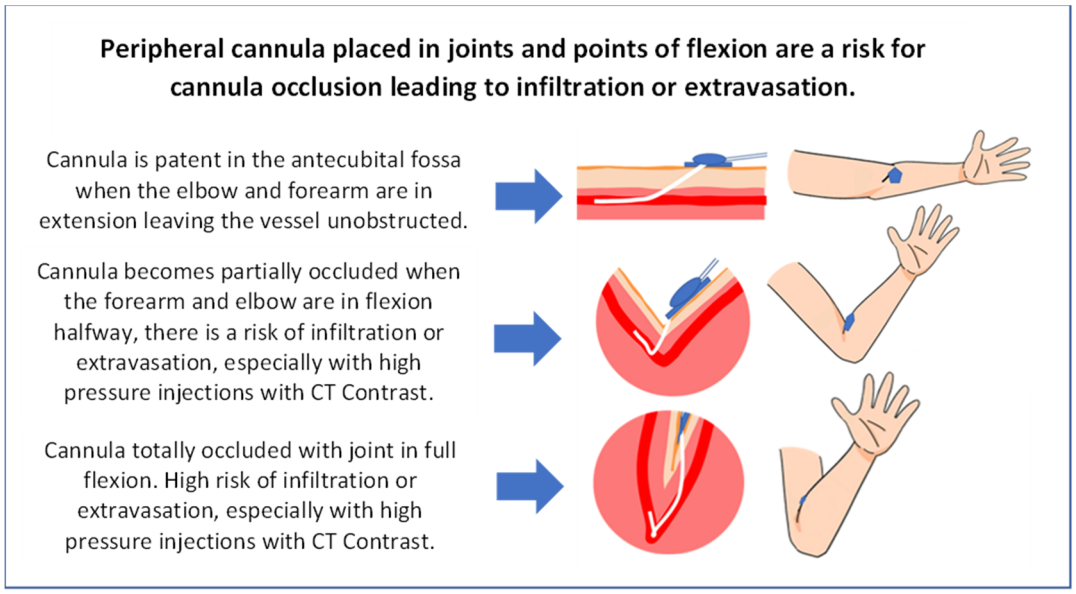
- Inadvertent leakage of IV fluid/medication into extravascular tissue from IV vascular access device, e.g. peripheral cannula/central venous catheter is likely result in minor injury
- if fluid/medication is vesicant, injury classed as extravasation – risk of tissue damage and serious injury is high

Vesicants

- Extravasation injury results from vesicant leaking into extravascular space, where medication/fluid itself causes damage to the tissues
- damage increases the longer the vesicant is within tissues
- Drugs or solutions (cytotoxic or non-cytotoxic) with potential to cause blistering and ulceration and, if left untreated, tissue necrosis e.g.
- chemotherapy: anthracyclines etc.
- non-physiological pH: high/low pH (outside of 5–9)
- vasopressors: noradrenaline etc.
- hyperosmolar solutions: osmolarity >600

RISK FACTORS

- Small/fragile veins
- Insertion sites across joints
- Sedated patients who cannot express pain
- Poorly secured vascular access devices (VAD)
- Devices placed in difficult IV access patients
- Bariatric/oedematous limbs



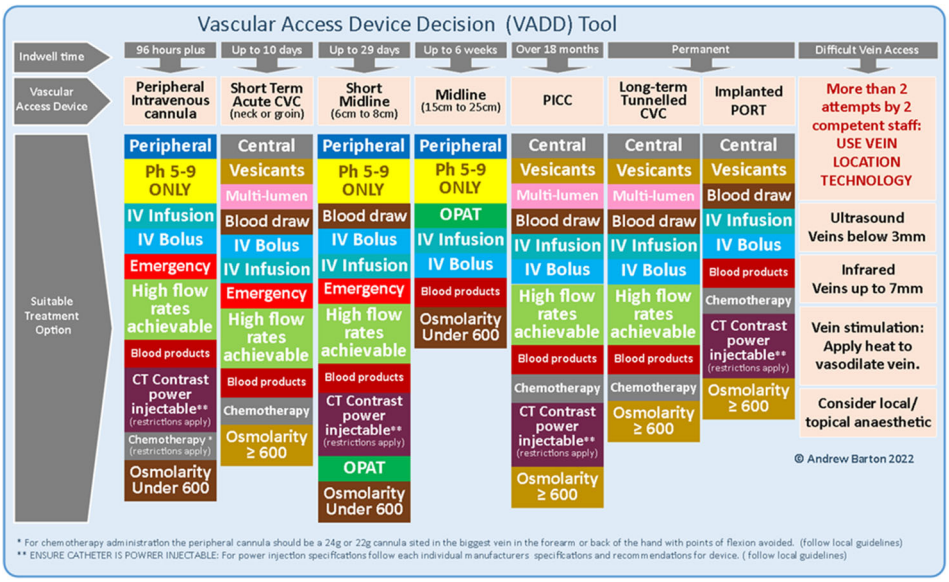
To reduce incidence and/or harm

- Prevention of extravasation imperative as treatment options are limited once injury has occurred
- Many extravasation injuries associated with human error and poor infusion practice. Following actions can help prevent leakage:
- extravasation prevention and recognition training for all clinical staff administering IV therapy (with regular ongoing updates)
- creation of a vascular access service team (VAST) to provide reliable and safe options for vascular access when peripheral cannula not viable
- adopt vessel health and preservation pathway
- advocate safest way to administer IV therapy, use:
  - NHS injectable medicines guide (MEDUSA)
  - medicine information leaflet
  - **BNFc**
  - agreed local guidelines
- ensure peripheral intravenous cannula (PIVC) is patent by flushing, before use with 10 mL sodium chloride 0.9% flush

- no resistance, pain/swelling during flushing or drug administration. Site around cannulation should not be red/painful
- use infusion site surveillance technology to reduce risk of extravasation

VASCULAR ACCESS DEVICE

- Choose correct IV device when administering vesicants (see below)



- If vesicants prescribed choose a central VAD
- Tip of central venous catheter must be in superior vena cava (SVC) below carina
- If central IV access not readily available, peripheral cannula is the only option; following clinical decisions can reduce risk of extravasation injures:
- place peripheral cannula away from joints, points of flexion and lower extremities
- avoid large bore cannula in antecubital fossa
  - 24 G or 22 G cannula is safer – allows turbulent blood flow around catheter
- choose most diluted option for IV therapy to reduce vesicant nature of drug
- use an infusion pump and check infusion site hourly ensuring pump pressure setting set to a low tolerance
  - if infusion <1 hr: check infusion site every 15 min
  - if infusion is ≥1 hr: check infusion site hourly
- for long courses of vesicant therapies e.g. antibiotics refer for peripherally inserted central catheter (PICC) as soon as possible
- educate patient, relative and staff about signs of extravasation and if those signs and symptoms present, stop infusion immediately and follow extravasation protocols
- consider implementation of difficult IV access pathway including access to ultrasound guided cannulation
- ensure there is an easy way (e.g. fluid balance chart) to track drugs/fluids administered (e.g. for patients with multiple IV lines). Important to know what drugs/fluids have been administered when an extravasation occurs – allows timely decision making should an intervention be required
- use coloured drug labels to indicate risk level of drug/fluid

IV SITE

- Flush cannulas as per Trust local policy to assist assessment of patency of IV access device (follow Trust local guidelines on training required)
- Infusion pump pressures <5 – refer to Trust policy on whether infusion pump pressures are monitored to detect problems with IV devices
- If alarm is used as prompt to check IV sites regularly – limiting IV pump cycle to 1 hr may minimise extent of tissue damage from extravasation

Suspected infiltration/extravasation

- Suspect if any of the following:
- pain
- swelling
- non-blanching skin

- dark necrotic skin
- blisters
- erythema
- Has vascular access device been in situ in affected limb in or around area of current concern, now or in past 2 weeks, used for IV therapy that would be classed as a vesicant?
- How does affected limb look?
- Is whole limb swollen and/or cold and dusky looking with reduced or absent capillary refill and poor or absent radial pulses?
- **Touch**
- feel for:
  - hardness
  - oedema
  - warmth/cold
  - pain
- **Look**
- ensure wide and clear visual inspection of entry site
- where tip of IV device ends, look for
  - swelling
  - redness/blanching
- **Compare**
- use other limb/side of chest etc. as benchmark to detect early signs of extravasation

THINK EXTRAVASATION OR COMPARTMENT SYNDROME
If there is NO: Exit site infection, Phlebitis, MARSI, Cellulitis, Oedema

ACTIONS – Reassure patient – Manage pain – call for help! (Plastics)

- Stop administration – leave vascular access device *in-situ* and attempt aspiration
- Identify vesicant involved and check for antidote in local guidelines or NIVAS toolkit
- if available ADMINISTER antidote (following guidelines) referral for washout treatment
  - if no antidote or washout – remove vascular access device
- Systemic anti-cancer therapy (SACT) chemotherapy extravasations – refer to SACT network guidance
- Mark outline of extravasation injury and document incident in patient record
- If appropriate, apply hot/cold compress
- Referral to plastics – take medical photograph (with patient consent) and upload to patient record
- Complete incident report on local system (RL), inform clinical team and arrange follow-up by specialist (local extravasation lead – could be consultant in plastic surgery or IV lead for the organisation)

ACUTE MANAGEMENT

- Stop administration – leave vascular access device *in-situ* and attempt aspiration
- Attempt to aspirate extravasated solution from VAD with 10 mL syringe
- Reassure patient
- Avoid applying pressure over site
- Call for help and advice – follow local guidelines
- **Chemotherapy extravasations – refer to network guidance**
- Mark outline of extravasation injury and document incident in patient record
- Medical photography (with patient consent – follow local process) to record injury
- Identify vesicant involved and check for antidote for specific drug
- Administer analgesia – apply hot/cold compress depending on the drug involved
- Contact plastics for urgent review
- Complete incident report and arrange follow-up

Grading extravasation injuries
Stage 1
- Capillary refill <2–3 secs
- Localised swelling <3 cm at site
- With or without pain

Stage 2
- Capillary refill >2–3 secs

- Oedema >3 cm –15 cm from site
- Erythema
- Skin hot to touch
- With or without pain
- Blistering

Stage 3
- Poor capillary refill
- Gross Oedema in limb
- Dark erythema
- Skin hot to touch
- Pain (moderate)
- Blistering
- Eschar forming
- Reduced limb function

Stage 4
- Absent capillary refill
- Gross Oedema in limb
- Dark erythema
- Skin hot to touch
- Pain (moderate)
- Blistering
- Eschar/Necrosis
- Limb tissue affected
- Reduced limb function

Extravasation injury timescale	
During administration	• Blood return unable to aspirate blood • Noticeable swelling at cannulation site due to infiltration • Burning and aching in cannulation/injection site
≤24 hr after extravasation	• Pain and burning sensation at injection site during or after infusion • Erythema at cannulation/injection site • Swelling localised around cannulation/injection site • Small fluid filled blister can develop
≤2 weeks after extravasation	• Non-blanching erythema extending around the cannulation/injection site • Affected area hot and painful to touch • Fluid filled blisters may have extended • Swelling in the distal part of the affected limb
>2–≤4 weeks after extravasation	• Non-blanching dark erythema with dusky margins at the cannulation/injection site • Affected area painful, hot and/or swollen • Fluid filled blisters may still be present • Areas of eschar developing with deeper areas of tissue necrosis • Wound evolving
>4 weeks after extravasation	• Non-blanching dark erythema with dusky margins around wound • Pain and swelling in affected limb. • Areas of eschar present with deeper areas of tissue necrosis. • Wound not improving without surgical intervention.

FOLLOW-UP AND MONITORING
- Review and redress injury daily for 3 days, then weekly
- Document progress with clinical photography
- Observe for signs of infection, non-blanching skin and skin necrosis
- If required to manage evolving wound, discuss with speciality and wound care team
- Ensure child/parent/carer has point of contact to telephone and is given information to access help

FURTHER INFORMATION
See: https://nivas.org.uk/contentimages/main/NIVAS-Infiltration-and-Extravasation-toolkit-version-1-Feb-2024.pdf

FACIAL PALSY • 1/1

RECOGNITION AND ASSESSMENT

Definition

- Bell's palsy: idiopathic lower motor neurone facial nerve palsy
- Exclude secondary causes of facial nerve palsy due to infection, inflammation, tumour, trauma, or vascular event, congenital and hereditary causes clinically and/or with appropriate investigations

Symptoms and signs

- Asymmetry of face or smile and loss of nasolabial fold on same side
- demonstrable weakness in lower motor neurone distribution (includes loss of wrinkles on forehead)
- Earache
- Increased or decreased lacrimation
- Hyperacusis
- Altered taste
- Facial pain
- Difficulty in closing eye
- Vesicles

History

- History of prior viral infection may be present
- Abrupt onset with no progression
- No history of preceding seizure or head injury
- No history of pallor, bleeding or bruising
- Any ear symptoms e.g. earache, pain around mastoid area, ear discharge

Examination

- Full neurological examination, including other cranial nerves, and fundoscopy
- Ears, nose and throat to exclude cholesteatoma, mastoiditis or herpes infection
- Blood pressure to exclude hypertension
- Check for lymphadenopathy, hepatosplenomegaly, pallor or bruising to exclude malignancy
- House-Brackmann grading may be used as an evaluation tool (https://facialparalysisinstitute.com/conditions/house-brackmann-grading-system/)

INVESTIGATIONS

- If all history/examination unremarkable and no other neurological signs/symptoms, no investigations needed
- If difficulty in closing eye, ophthalmology referral
- Bilateral facial palsy – consider Lyme disease, Guillain-Barré syndrome, brain stem pathology: discuss further investigations with consultant with special interest in neurology or tertiary paediatric neurologist
- Blood tests for systemic disease (leukaemia, HIV, mononucleosis, sarcoidosis)
- Recurrent facial palsy: discuss with senior
- Recurrent infections: first line immune deficiency investigations (including HIV)
- Severe pain associated with varicella zoster

IMMEDIATE TREATMENT

- If difficulty in closing eye, provide eye patch and carbomer ointment
- if eye closure is incomplete on maximal effort – ophthalmology opinion
- If vesicles suggest HSV, prescribe acyclovir oral
- Within 72 hr prednisolone 1 mg/kg/day (maximum 60 mg) for 5–7 days. Can be given as per adult practice (discuss with senior)
- If acute otitis media, acute mastoiditis, trauma suspected seek ENT opinion

DISCHARGE AND FOLLOW-UP

- 4 weekly GP follow-up until symptoms and signs resolved (95% by 1 yr)
- If facial palsy does not improve considerably within 4 weeks arrange cranial imaging – MRI brain with request to focus on brain stem
- If any other neurological signs/symptoms, consider early/immediate imaging

FALTERING GROWTH ● 1/3

Always follow your local safeguarding policies and procedures.
The safety of children is everyone's responsibility

RECOGNITION AND ASSESSMENT

- An infant or older child who fails to gain weight as expected without an apparent cause
- Growth below the 2nd percentile or a change in growth that has crossed downwards 2 major growth percentiles in a short time (approximately 4 months, or longer period in older child)
- Associated features include:
- developmental delay
- apathy
- misery

Symptoms and signs

- Gastrointestinal problems
- vomiting
- voracious appetite
- anorexia
- diarrhoea
- Full physical examination
- dysmorphic features
- heart murmurs
- abdominal distension
- wasting
- bruising
- examine mouth for cleft palate

Patient and family history

Child

- Take a full feeding history
- type of milk given
  - breast milk
  - formula milk
  - cow's milk
- volume given at each feed
- frequency of feeding
- method of making up feeds (correct strength)
- introduction of solids: age and type of solid
- any difficulty with feeding process (e.g. breathless, uncomfortable)
- Perform direct observation of child at mealtimes:
- oral
- motor
- co-ordination
- behaviour (e.g. crying, tantrums)
- appetite
- family interaction

Family

- Family history of siblings/children with unexplained growth faltering or early onset diarrhoea
- Ask about socio-emotional factors
- family composition (other children, age?)
- ask parental ages, health, educational status
  - was either parent in care during childhood?
  - do parents have a history of psychiatric illness or depression (including postnatal depression) or have a learning disability?
  - parents with inadequate social or problem solving skills?
- has the family any support network (e.g. grandparents)?
- social isolation?
- is there a lack of money in the home or unemployment?
- other sources of stress (e.g. divorce)?
- substance abuse?

- domestic violence?

Measurements

Measurements must be checked if there is doubt

- Record birth weight and gestation
- some 'light-for-dates' infants fail to catch up, and grow parallel but below the 2nd percentile
- Measure and plot
- weight (unclothed)
- head circumference
- length or height
- body mass index and plot on chart (useful if height or weight below 0.4th centile)
- Infant may be a small, normal child growing below but parallel to the 2nd percentile
- parents are often also small
- record height of parents and grandparents
- calculating midparental height, height velocity can be helpful – see **RCPCH: Growth Charts** available at: https://www.rcpch.ac.uk/resources/growth-charts
- review 'Red Book' growth charts for more information
- pubertal staging is helpful for teenagers

Single set of measurements of limited value and does not justify complex investigations
Serial measurements of more value and should be plotted on percentile charts

Investigations

First line tests

Perform as indicated where cause of poor growth is not obvious

- Blood gas
- Faeces: culture and sensitivity, microscopy for ova, cysts and parasites (if diarrhoea)
- Urinalysis for protein, nitrites and blood
- Hb, blood film (for signs of iron deficiency), WBC and ESR
- Biochemical profile including U&E, liver and bone profile, CRP, B_{12}, folate, ferritin, thyroid function, creatinine, bicarbonate, calcium and albumin
- Coeliac screen (anti-tTG and IgA) – only useful if having gluten in diet, i.e. after weaning commenced

Further tests

- If underlying pathology indicated by history, clinical examination or results of routine investigations, request further tests, e.g.:
- CXR
- bone age (X-ray of non-dominant hand and wrist)
- if head size is increasing, ultrasound of head before aged 6 months
- vitamin A, D, E, trace metals, faecal elastase
- sweat test/cystic fibrosis (CF) gene
- Further gastrointestinal investigation or management of malabsorption disorders should be undertaken by referral to specialist gastroenterology team as appropriate:
- endoscopy
- gastrointestinal imaging
- genetic testing appropriate to clinical features, e.g. DiGeorge and Turners syndromes

Differential diagnosis

- Low genetic growth potential:
- familial
- 'light-for-dates' baby
- genetic syndrome
- Social factors:
- maternal depression
- poor parenting skills
- abuse
- Malabsorption:
- pancreatic insufficiency: CF, Swachman-Diamond syndrome
- enteropathy: coeliac, cow's milk protein allergy
- inflammatory bowel disease (IBD)
- infective: Giardia, bacterial overgrowth

- others (rarer): abetalipoproteinaemia, lymphangiectasia
- Vomiting/severe regurgitation
- Any chronic underlying disorder:
- renal failure
- liver disease
- congenital heart disease
- severe asthma
- immunodeficiency
- other rare conditions e.g. endocrine, chromosomal or metabolic conditions if dysmorphic features present

MANAGEMENT

- Most patients can be managed as an outpatient
- record height and weight at each visit
- seek dietitian opinion
- if treatable cause identified, treat
- If social problems responsible, consider:
- admission to ward to demonstrate good weight gain out of home environment
- significant weight gain after admission (>180 g/week in infant) supports parenting issues as cause
- health visitor support
- social work support
- child psychology consultation, referral and/or intervention (evaluation of: child's cognitive development, food refusal etc.; parents' perception of the child; family/child disturbances of affect expression and family dynamics)
- day care and nursery provision
- case conference
- care proceedings

FEBRILE ILLNESS • 1/4

ASSESSMENT AND INITIAL MANAGEMENT

- Fever, in a child aged <5 yr, usually indicates underlying infection
- infants aged <3 months, low temperature could indicate infection
- consider vaccination induced fever in infants aged <3 months
- ask about recent travel abroad to tropical/subtropical areas, or areas with a high risk of endemic infectious disease
- consider current viral outbreak; ask about immunisation status

Parental perceptions of fever are usually accurate and must be taken seriously

IDENTIFYING RISK OF SERIOUS ILLNESS

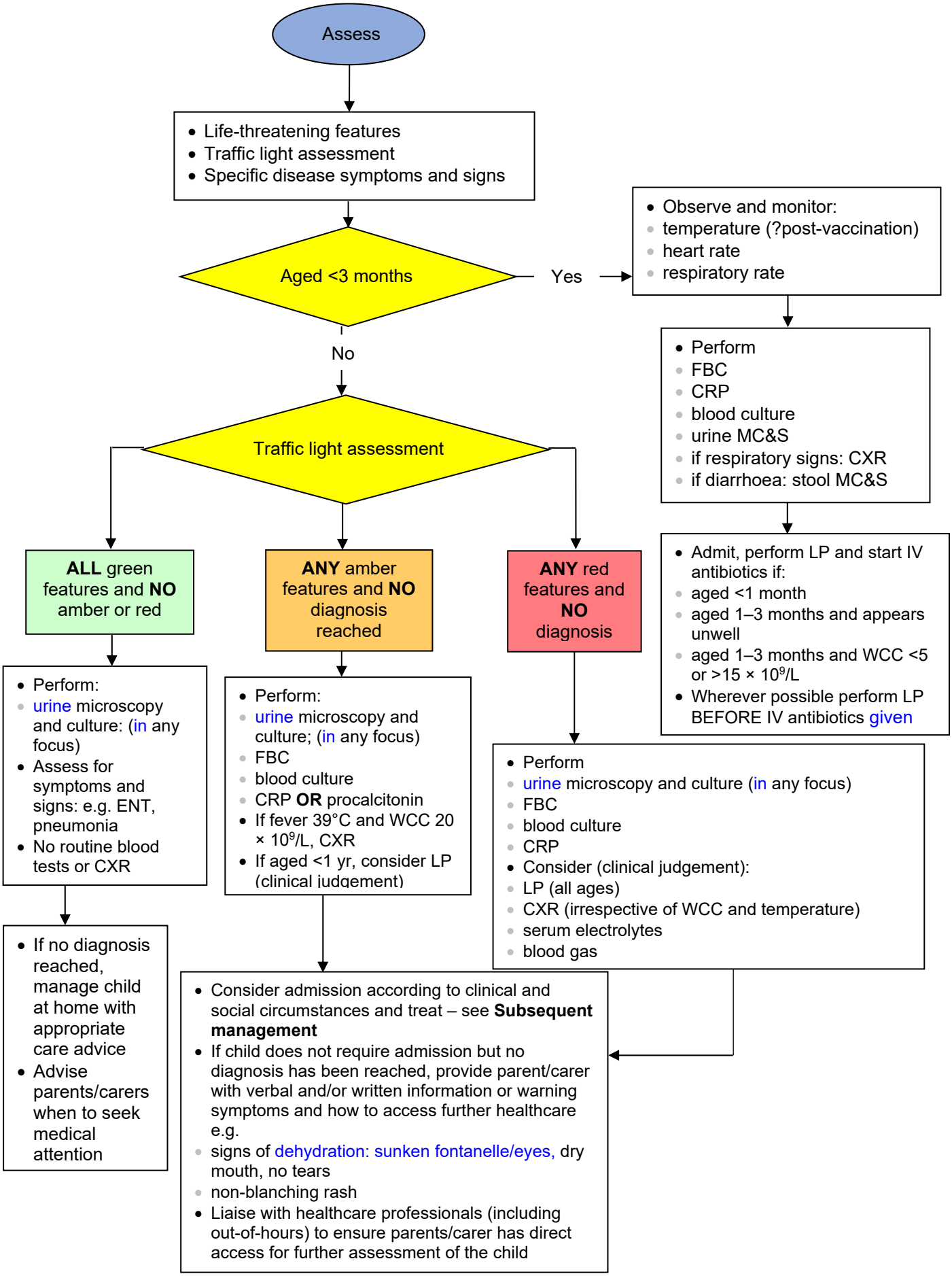
Three stages of clinical assessment

1. Identify life-threatening features [utilising Airway, Breathing, Circulation (hydration) and Disability assessment]
2. Assess risk of serious illness (see **Traffic light system for assessment**) – can be used with Paediatric Early Warning Score (PEWS)
3. Attempt to identify source of infection/features of specific serious conditions. If child has a learning disability, take this into account when interpreting the traffic light system – see **Symptoms and signs of specific diseases**

Traffic light system for assessment

<table>
<tr><th></th><th>Low risk</th><th>Intermediate risk</th><th>High risk</th></tr>
<tr><td>Colour</td><td>• Skin, lips and tongue normal</td><td>• Pallor reported by carer</td><td>• Pale, mottled, ashen or blue</td></tr>
<tr><td>Activity</td><td>• Responds to normal social cues
• Content/smiles
• Stays awake/wakes quickly
• Strong normal cry/settled/smiles</td><td>• Not responding normally to social cues
• Wakes only with prolonged stimulation
• Decreased activity
• No smile</td><td>• No response to social cues
• Looks ill
• Unrousable/does not stay awake after rousing
• Weak, high pitched or continuous cry</td></tr>
<tr><td>Breathing</td><td>• Normal</td><td>• Nasal flare
• Tachypnoea
◦ respiratory rate ≥50/min (aged <1 yr)
◦ respiratory rate ≥40/min (aged >1 yr)
• SpO_2 ≤95%
• Crackles on auscultation</td><td>• Grunting/nasal flare
• Tachypnoea
◦ respiratory rate >60/min (any age)
• Chest wall recession (moderate/severe)</td></tr>
<tr><td>Circulation and hydration</td><td>• Normal skin and eyes
• Moist mucous membranes</td><td>• Dry mucous membranes
• Poor feeding (infants)
<table><tr><th>Age</th><th>Heart rate (bpm)</th></tr><tr><td><1 yr</td><td>>160</td></tr><tr><td>1–2 yr</td><td>>150</td></tr><tr><td>2–5 yr</td><td>>140</td></tr></table>• CRT ≥3 sec
• Reduced urine output</td><td>• Reduced skin turgor</td></tr>
<tr><td>Other</td><td>• No amber/red features</td><td>• Temperature ≥39°C (aged 3–6 months)
• Rigors
• Fever ≥5 days
• New lump >2 cm diameter
• Swelling of joint/limb
• Not using a limb/weight bearing</td><td>• Temperature ≥38°C (aged <3 months)
• Non-blanching rash
• Bulging fontanelle
• Neck stiffness
• Status epilepticus
• Focal neurological signs
• Focal seizures
• Bilious vomiting</td></tr>
</table>

FEBRILE ILLNESS • 2/4



Observations

- Measure and record in **all** febrile children:
- temperature
  - aged <4 weeks: electronic thermometer in the axilla
  - aged >4 weeks: infrared tympanic or electronic thermometer in the axilla
- respiratory rate, heart rate, capillary refill time
- signs of dehydration: skin turgor, respiratory pattern, weak pulse, cool extremities
- travel history
- Re-assess all children with amber or red features within 1–2 hr

IMMEDIATE TREATMENT

Antipyretic treatment

- Tepid sponging not recommended
- Dress child normally
- If child appears distressed or unwell, give **either** paracetamol **or** ibuprofen
- do not routinely administer both drugs at same time with sole aim of reducing fever or preventing febrile seizures
- Alternate if distress persists or recurs before next dose due

Antibiotics

- Do not prescribe oral antibiotics to children with fever without apparent source
- if aged >3 months consider admission and observation with/without investigations

Signs of shock

- Increased respiratory and heart rate, cold peripheries, prolonged CRT, pallor/mottled, drowsy/agitated/confused
- Give immediate IV fluid bolus of sodium chloride 0.9% 10 mL/kg
- If signs of shock, SpO_2 <92% or clinically indicated, prescribe oxygen
- If ≥20 mL/kg of fluid bolus are needed, request urgent senior support and discuss with PICU See **Sepsis (including meningococcal)** guideline

SUBSEQUENT MANAGEMENT

- Serious bacterial infection suspected:
- shock
- unrousable
- meningococcal disease
- aged <1 month
- aged 1–3 months with a white blood cell count <5 or >15 × 10^9/L
- aged 1–3 months appearing unwell
- Cefotaxime 50 mg/kg (see **BNFc** for doses)
- When patient is stable change to once daily ceftriaxone:
- see dosage and contraindications (hyperbilirubinaemia etc.) in **BNFc**
- RSV/flu: assess for serious illness/UTI
- If rates of antibacterial resistance significant, refer to local policy
- See **Sepsis (including meningococcal)** and **Meningitis** guidelines

Symptoms and signs of specific diseases

Meningococcal disease

- Non-blanching rash with ≥1 of the following:
- ill-looking child
- lesions >2 mm in diameter (purpura)
- CRT ≥3 sec
- neck stiffness
- See **Sepsis (including meningogococcal)** guideline

Meningitis

- Neck stiffness
- Bulging fontanelle
- Decreased level of consciousness

- Convulsive status epilepticus
- See **Meningitis** guideline

Herpes simplex encephalitis
- Focal neurological signs
- Focal seizures
- Decreased level of consciousness
- See **Encephalitis** guideline

Pneumonia
- Tachypnoea, measured as:
- aged <1 yr: respiratory rate ≥50 breaths/min
- aged >1 yr: respiratory rate >40 breaths/min
- Crackles in the chest
- Nasal flaring
- Chest indrawing
- Cyanosis
- SpO_2 ≤95%
- See **Pneumonia** guideline

Urinary tract infection
- Vomiting (in children aged >3 months)
- Poor feeding
- Lethargy
- Irritability
- Abdominal pain or tenderness
- Urinary frequency or dysuria
- Offensive urine or haematuria
- See **Urinary tract infection** guideline

Septic arthritis/osteomyelitis
- Swelling of a limb or joint
- Not using an extremity
- Non weight bearing
- See **Osteomyelitis** guideline

Kawasaki disease
- Fever lasting >5 days and ≥4 of the following:
- bilateral conjunctival injection
- change in upper respiratory tract mucous membranes (e.g. injected pharynx, dry cracked lips or strawberry tongue)
- change in peripheral extremities (e.g. oedema, erythema or desquamation)
- polymorphous rash
- cervical lymphadenopathy
- See **Kawasaki disease** guideline

FEBRILE NEUTROPENIA ● 1/3

Frequent clinical re-assessment of patients is a vital part of effective management of febrile neutropenia in children

RECOGNITION AND ASSESSMENT

Definition

- Temperature ≥38°C at any time and
- Neutrophils ≤0.5 × 10^9/L

IMMEDIATE TREATMENT

See **Figure 1** (see **BNFc** for dose reduction in renal impairment)

ALL patients – with central venous access

- Culture both lumens/port-a-cath. Take FBC, group and save, U&E, lactate (blood gas), LFTs, CRP. If septic also do a coagulation screen (PT and fibrinogen)
- Urinalysis in all children aged <5 yr and if clinically indicated in older patients
- CXR only if respiratory signs i.e. increased respiratory rate, auscultatory signs
- Respiratory extended viral screen if coryzal and/or cough (nasal or throat)
- **Do not wait for results, administer antibiotics**
- 'Door to needle time' must be within 1 hr
- Follow individual trust antibiotic policy or individual patient plan if resistant organisms

No haemodynamic compromise and NOT on chemotherapy block containing IV methotrexate

- Start piperacillin with tazobactam (Tazocin®) 90 mg/kg 6-hrly (maximum single dose 4.5 g) administered over 30 min

No haemodynamic compromise and on chemotherapy block containing IV methotrexate or penicillin allergic or previous Tazocin® resistant gram negative infection

- Use meropenem 20 mg/kg 8-hrly over 5 min (maximum single dose 1 g)
- If previous documented MRSA infection, **add**
- **either** teicoplanin 10 mg/kg 12-hrly for 3 doses, then 10 mg/kg once daily
- **or** vancomycin 15 mg/kg 8-hrly given over at least 60 min as slow IV infusion, maximum 10 mg/min for doses above 600 mg (maximum initial single dose 1 g until levels available). Target trough level 10–15 mg/L
- Pre-dose vancomycin level before 3rd dose, and no post-dose sample required
- Adjust dose as follows dependent on pre-dose concentration (mg/L):
- <10: give 6-hrly and recheck level before dose 4 or 5
- 10–15: continue current dose and recheck level in 3–5 days
- 15–20: reduce dose by 10–20% and recheck level before dose 4 or 5 (unless higher levels advised by microbiology)
- >20 and <25: extend interval to 12-hrly. Recheck level at 12 hr and give dose without waiting for result
- >25: stop vancomycin and recheck level after 24 hr to see if therapy can be restarted and to determine interval

Haemodynamic compromise

- Check A, B, C and initiate appropriate resuscitation
- Give 10 mL/kg bolus of crystalloid (e.g. 0.9% sodium chloride/Hartman's/plasmacyte). Reassess and repeat if needed
- Start meropenem 20 mg/kg 8-hrly over 5 min
- Closely monitor urine output; may require HDU/PICU care

LOW RISK PATIENTS

- **No** central access **and**
- Neutrophils >0.5 × 10^9 cells/L **and**
- Clinically well
- discuss with oncology team/on-call consultant regarding discharge on oral antibiotics

SUBSEQUENT TREATMENT

- Reassess at 24 hr and chase blood cultures

FEBRILE NEUTROPENIA ● 2/3

Positive cultures

- Discuss with microbiologist or paediatric oncology team for advice on appropriate treatment.
- if blood cultures positive for yeast in presence of suspected line infection, remove lines promptly
- Give culture-positive patients at least 7 days treatment intravenously

Negative cultures

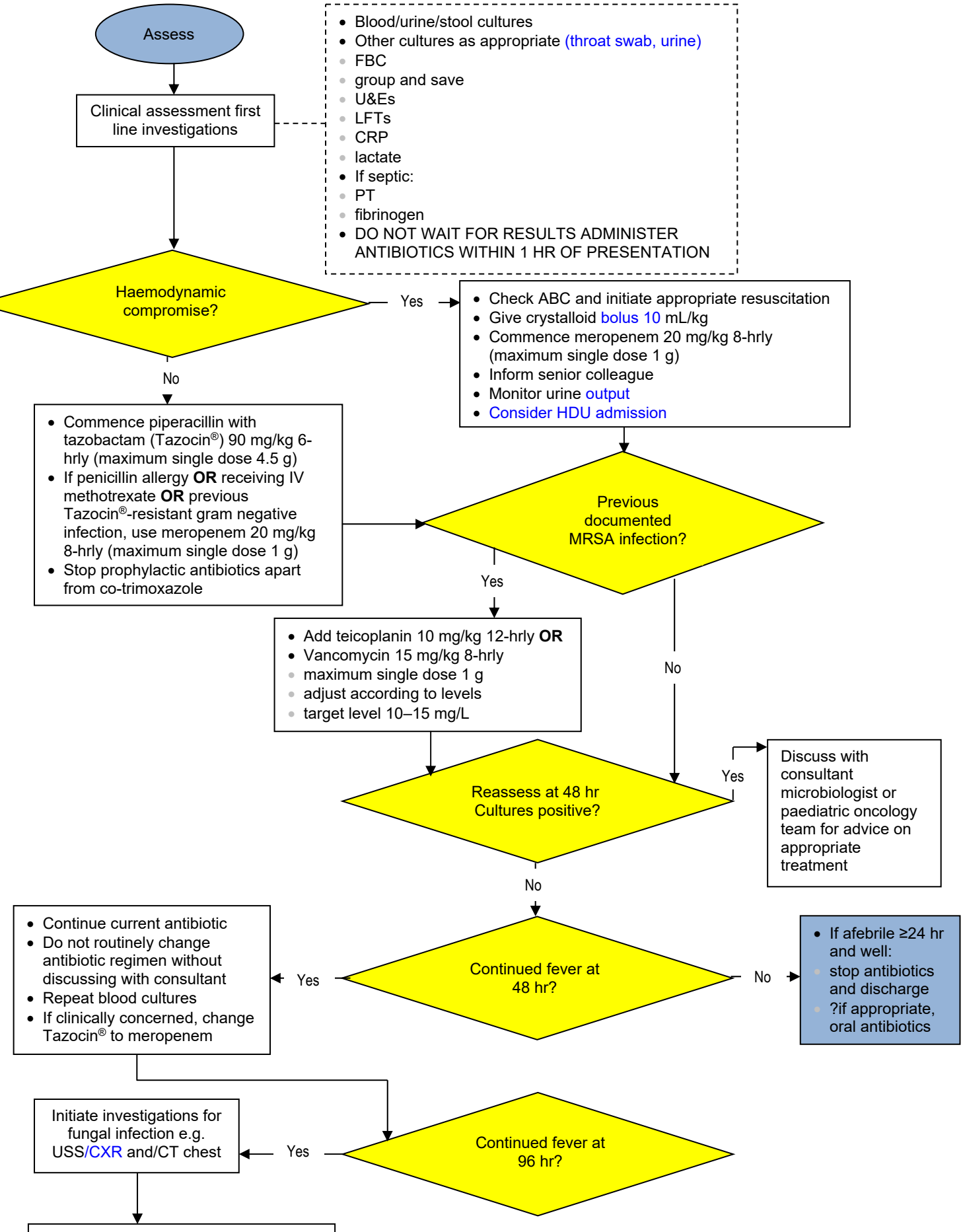
- Do not switch initial empiric antibiotics in patients with unresponsive fever unless there is clinical deterioration or a microbiological indication
- If febrile after 48 hr:
- repeat blood culture and discuss with on-call consultant/paediatric oncology team
- consider changing antibiotics from Tazocin® to meropenem, chase all cultures sent on admission to identify source of infection e.g.: bacterial/viral swabs, urine MC&S
- If febrile after 96 hr or clinically unstable between 48 and 96 hr:
- initiate investigations for fungal infection e.g. US abdo/CXR/CT chest
  - repeat blood cultures
  - add **liposomal amphotericin** (AmBisome®) **3 mg/kg/day** over 30–60 min, give test dose 100 microgram/kg (maximum 1 mg) over 10 min
  - if profoundly neutropenic and after discussion with oncology team consider G-CSF 5 microgram/kg SC once daily (non-leukemic patients only)

When to discharge

- If clinically well and afebrile for ≥24 hr, and no growth in blood cultures after 48 hr:
- stop antibiotics
- no need for routine inpatient observation after stopping antibiotics

FEBRILE NEUTROPENIA ● 3/3

Figure 1: Management of fever in neutropenic/immunocompromised child



FEVER OF UNKNOWN ORIGIN ● 1/3

RECOGNITION AND ASSESSMENT

Fever

- Type of thermometer used, site, user (?factitious)
- Duration, height
- Pattern:
- intermittent [pyogenic, TB, lymphoma, juvenile idiopathic arthritis (JIA)]
- baseline raised (viral, endocarditis, lymphoma)
- sustained (typhoid)
- days between (malaria, lymphoma)
- weeks between (metabolic, CNS, cyclic neutropenia, hyper-IgD)
- Circumstances when fever appears (e.g. exercise)
- Appearance
- when fever: well (factitious)
- between fever: ill (serious)
- Response to paracetamol and/or NSAID (no response: dysautonomia)

Symptoms

- Red eyes (Kawasaki)
- Nasal discharge (sinusitis)
- Recurrent pharyngitis with ulcers (periodic fever)
- GI: salmonella, intra-abdominal abscess, inflammatory bowel disease (IBD)
- Limb pain (leukaemia, osteomyelitis)

Contact

- Human illness (e.g. COVID)
- Animals

Travel

- Years ago (histoplasmosis)
- Part of country
- Prophylaxis and immunisations
- Contaminated water/food
- Bites (tick: arbovirus, malaria)
- Meat: undercooked (brucellosis, toxoplasmosis, hepatitis)
- Pica (visceral larva migrans, toxoplasmosis)

Medical history

- Operations

Drug history

- All, including any non-prescription

Ethnic group

- Sephardic Jew, Armenian, Turkish, Arab (Familial Mediterranean Fever)
- Ashkenazi Jew (familial dysautonomia)

Examination

- Sinuses
- Lymph nodes
- Chest: murmur, crackles
- Abdominal: hepato/splenomegaly (salmonellosis, cat scratch, endocarditis, malaria)
- Genito-urinary: girls – pelvic tenderness (child sex abuse – STI)

Skin

- Rash only during fever (JIA)
- No sweat (familial dysautonomia)
- Petechiae (endocarditis, rickettsia)
- Papules (cat scratch)
- Eschar (tularaemia)
- Erythema migrans (Lyme disease)
- Malar (SLE)

- Palpable purpura [polyarteritis nodosa (PAN)]
- Erythema nodosum (JIA, SLE, malignancy, IBD, TB)
- Seborrhoeic (histiocytosis)
- Sparse hair (ectodermal dysplasia)
- Scars (dysautonomia)

Eyes
- Conjunctivitis:
  - palpebral (infectious mononucleosis)
  - bulbar (Kawasaki)
  - phlyctenular (TB)
- Retinopathy (PAN, miliary TB, toxoplasmosis, vasculitis)
- Pupil dilatation (hypothalamic or autonomic dysfunction)
- Paediatric inflammatory multisystem syndrome (PIMS) post-COVID

Oropharynx
- Red, no exudates (EBV)
- Stomatitis, pharyngitis, adenitis (PFAPA)
- Dental abscess
- Conical teeth (ectodermal dysplasia)
- Smooth tongue (dysautonomia)
- Gum hypertrophy, tooth loss (leukaemia, histiocytosis)

Musculoskeletal
- Tender:
  - bone (osteomyelitis, malignancy)
  - muscle (trichinella, arbovirus, dermatomyositis, PAN)
- Trapezius (subdiaphragmatic abscess)
- Reflexes
  - brisk (hyperthyroid)
  - absent (dysautonomia)

Investigations

Initial
- FBC:
  - low Hb (malaria, endocarditis, IBD, SLE, TB)
  - high platelets (Kawasaki)
  - blasts (leukaemia)
  - eosinophils (fungal, parasites, neoplastic, allergic, immune deficiency)
- ESR/CRP: normal (factitious, dysautonomia, drug fever)
- LFTs: abnormal (EBV, CMV)
- Blood cultures: 3 sets from different sites at different times (endocarditis)
- Urine: pyuria (Kawasaki, intra-abdominal infection, GU, TB)
- Stool culture
- Throat swab
- Nose and throat swab for viruses (SARS CoV-2)
- CXR

Secondary
- IgG, IgA, IgM
- Serology: EBV, CMV, HIV, SARS CoV-2 antibody
- Anti-nuclear antibodies
- Sinus CT
- Abdominal ultrasound
- Whole body MRI

Selective
- Echocardiogram
- Bone marrow with culture (leukaemia, histiocytic haemophagocytosis, TB)
- Serology (syphilis, brucella, toxoplasma)

- Auto-antibodies (rheumatoid arthritis, SLE)
- IgE (allergy, eosinophilia)
- IgD (periodic fever)
- Gastric aspirate, (induced) sputum (TB)
- Ophthalmologist (uveitis, leukaemia)
- Biopsy (lymph node, liver)

Imaging (as indicated)

- CT/MR chest/abdo (IBD, abscess, lymphadenopathy)
- White cell scan (abscess)
- Bone scan (osteomyelitis)
- PET scan (abscess)

EMPIRICAL TREATMENT

- Critically ill: see **Sepsis (including meningococcal)** guideline
- TB treatment: discuss with regional paediatric infectious diseases consultant or local TB service
- Otherwise avoid antibiotics until organism isolated

REFERRAL

- Rheumatology (JIA, connective tissue disorder)
- Gastroenterology (IBD)
- Cardiology (endocarditis/Kawasaki/PIMS)

GLASGOW COMA SCORE ● 1/1

RESPONSE AGED ≥4 YR

Eye opening	Score
Spontaneously	4
To verbal stimuli	3
To pain	2
No response to pain	1

Best motor response	Score
Obeys verbal commands	6
Localises pain	5
Withdraws from pain	4
Abnormal flexion to pain (decorticate)	3
Abnormal extension to pain (decerebrate)	2
No response to pain	1

Best verbal response	Score
Orientated and converses	5
Disorientated and converses	4
Inappropriate words	3
Incomprehensible sounds	2
No response to pain	1

RESPONSE AGED <4 YR

Eye opening	Score
Spontaneously	4
To verbal stimuli	3
To pain	2
No response to pain	1

Best motor response	Score
Obeys commands or spontaneous	6
Localises pain or withdraws to touch	5
Withdraws from pain	4
Abnormal flexion to pain (decorticate)	3
Abnormal extension to pain (decerebrate)	2
No response to pain	1

Best verbal response	Score
Alert; babbles, coos, words to usual ability	5
Fewer than usual words, spontaneous irritable cry	4
Cries only to pain	3
Moans to pain	2
No response to pain	1

GLOMERULONEPHRITIS ● 1/2

RECOGNITION AND ASSESSMENT

Definition

- Acute inflammatory process affecting the glomeruli leading to haematuria and proteinuria; there may also be oedema, hypertension and renal insufficiency

Symptoms and signs

- Macroscopic haematuria, Coca-Cola® coloured urine
- History of sore throat in preceding 2–3 weeks
- Reduced urine output/oliguria (urine output: infant/child <1 mL/kg/hr)
- Hypertension +/- features of encephalopathy (headache, nausea, vomiting, visual disturbance, restlessness, confusion)
- Oedema variable, periorbital/pedal
- check weight – trend is useful
- check jugular venous pressure (JVP); if raised, indicates volume overload
- Headache/breathlessness, (could be indicative of pulmonary oedema)
- Signs of cardiac failure (tachypnoea, raised JVP, gallop rhythm, basal crackles, enlarged liver)

Investigations

Urine

- Urine dipstick (usually >1+ blood with proteinuria)
- early morning urine protein:creatinine ratio (UPCR)
- Urine microscopy (haematuria, red cell and granular casts)

Biochemistry

- U&E, calcium, phosphate, LFTs, blood gas
- low sodium is likely to be dilutional, albumin usually normal/low normal

Haematology

- FBC (low Hb usually dilutional)
- Blood film if haemolytic uraemic syndrome suspected
- Coagulation screen

Microbiology

- Antistreptolysin O titres (ASO) and Anti-DNase B
- Throat swab for Group A *streptococcus*

Immunology

- First line: C3, C4, anti-nuclear antibodies (ANA) and IgA
- Second line: dsDNA antibodies, ENA, ANCA, anti-GBM (discuss with nephrologist)

Imaging

- Renal ultrasound scan

Differential diagnosis

- Sequelae of other bacterial/viral infections
- Chronic renal failure with acute exacerbation
- IgA nephritis, Henoch-Schönlein purpura (HSP)
- IgA nephropathy
- Mesangiocapillary glomerulonephritis
- Alport hereditary nephritis
- ANCA-positive vasculitis
- Anti-GBM disease
- Systemic lupus erythematosus (SLE)

IMMEDIATE TREATMENT

- Admit (see **Acute kidney injury** guideline)
- Review current medication and reduce doses/stop all nephrotoxic medicines
- Strict fluid balance monitoring and management
- see **Acute kidney injury** guideline
- Treatment of volume overload/hypertension

- furosemide – Refer to **BNFc** for drug doses
- see **Hypertension** guideline
- severe cases of fluid overload will require dialysis
- Treatment of abnormal chemistry consequent to renal failure
- see **Acute kidney injury** guideline
- Oral antibiotics for post-streptococcal glomerulonephritis (Refer to **BNFc** for drug doses):
- phenoxymethylpenicillin suspension for 10 days
- if not tolerated or not able to take tablets, amoxicillin suspension for 10 days
- if penicillin allergy, azithromycin for 5 days
- Nutrition: encourage low salt, low potassium diet, high carbohydrate intake

DISCHARGE FROM HOSPITAL

- BP under control
- Passing urine normally on free fluids
- Renal function improving
- Normal serum potassium

SUBSEQUENT MANAGEMENT

Follow-up/progress for PSGN

- Gross haematuria, oliguria and abnormal chemistry usually resolves by 2–3 weeks
- BP usually normal by 3–4 weeks
- Serum C3 usually normal by 8–10 weeks
- Proteinuria usually resolves by 6 months
- Microscopic haematuria usually resolves by 12 months

Indications for tertiary referral

- Significant proteinuria (UPCR >200 mg/mmol)
- Family history of glomerular disease
- Microscopic haematuria >2 yr
- Macroscopic haematuria >2 weeks
- Persistent proteinuria (UPCR >50 mg/mmol) >6 weeks
- Oliguria/acute kidney injury (AKI)
- Hypertension
- Low C3 for >8 weeks
- Positive ANA, dsDNA, anti-GBM or ANCA
- Recurrent nephritis

Complement abnormalities at presentation in nephritis

Normal C3 and C4

- IgA nephropathy
- HSP
- ANCA-positive GN

Low C3, normal C4

- Acute post-streptococcal glomerulonephritis
- Mesangioproliferative glomerulonephritis

Low C3, low C4

- SLE
- Mesangioproliferative glomerulonephritis
- Shunt nephritis
- Infective endocarditis

DISCHARGE FROM FOLLOW-UP

- Normal BP (when not receiving antihypertensive treatment)
- Normal renal function
- Normal urinalysis

GASTRO-OESOPHAGEAL REFLUX ● 1/3

RECOGNITION AND ASSESSMENT

Definitions

- Gastro-oesophageal reflux (GOR)
  - passive physiological passage of gastric contents into oesophagus
- Gastro-oesophageal reflux disease (GORD): GOR causing symptoms needing treatment or leading to complications
- Vomiting/emesis: active retrograde passage of gastric contents associated with retching, pallor and sweating

It is very important to distinguish between vomiting and GOR

Key points in history

Infants

- Preterm/term
- Breast/bottle feeds
- Volume and number of feeds – overfeeding
- Vomiting
  - volume expelled
  - vomiting versus posseting
  - colour of posset/vomit
    - white
    - bile stained
    - blood
  - projectile/non-projectile
- Choking/gagging whilst feeding
- Excessive crying/unsettled during or after feeds
- Faltering growth
- Associated diarrhoea/constipation
- Blood in stools
- Family history of atopy
- Chronic cough/recurrent chest infections/pneumonia
- Sandifer's syndrome: episodic torticollis with neck extension and rotation
- Neurodisability

Older children

- Abdominal pain, heartburn, epigastric pain
- Halitosis
- Dental enamel problems
- Hoarseness
- School absenteeism

Examination

- Hydration
- Perfusion
- Abdomen – masses/tenderness
- Skin – eczema, perianal erythema
- Hernial sites
- Growth
- Document episode personally
- Parental mobile phone recording

Red flags

- Projectile vomiting: pyloric stenosis, raised intracranial pressure
- Bilious vomiting: intestinal obstruction
- Abdominal distension/tenderness/palpable mass: intestinal obstruction, constipation
- Haematemesis: gastritis, oesophagitis
- Intolerance of lumpy foods during weaning
- Dysphagia
- Late onset >6 months or persistent after aged 1 yr, consider UTI, raised intracranial pressure
- Blood in stools: infection, cow's milk protein allergy (CMPA), surgical cause

- Fever: UTI, meningitis, encephalitis, pneumonia
- Dysuria: UTI
- Bulging fontanelle: raised intracranial pressure
- Rapidly increasing head circumference: raised intracranial pressure
- Persistent/early morning headaches: intracranial pathology
- Altered sensorium/irritability: meningitis, encephalitis
- Family history of atopy: non-IgE-mediated food allergy

ADVICE TO PARENTS

- GOR is physiological and common (40%)
- Usually begins aged <8 weeks
- 90% of infants improve by aged 1 yr
- Majority need reassurance, no investigations and treatment
- Inform about red flags

HIGH RISK GROUP

- Preterm
- Neurodisability
- Family history
- Obesity
- Hiatus hernia
- Operated congenital diaphragmatic hernia
- Operated oesophageal atresia

REFER FOR SPECIALIST OPINION

- Red flags
- Unexplained feeding difficulties
- Unexplained distressed behavior (especially back arching, screaming on feeds)
- Persistent faltering growth
- Feeding aversion with regurgitation
- No improvement after aged 1 yr
- Chronic cough with overt regurgitation
- Second episode of pneumonia with overt regurgitation
- Sandifer's syndrome
- Recurrent otitis media
- Dental enamel defects in a child with neurodisability

NON-PHARMACOLOGICAL TREATMENT

- Review feeding history
- Reduce feed volume if excessive for current weight
- Small and frequent feeds
- Slightly propped position whilst feeding
  - do not use positional management to treat GOR in sleeping infants
  - Trial of thickened formula e.g. rice starch, corn starch
  - Thick & Easy™
  - Carobel
  - Nutilis®
- Family history of atopy, presence of eczema, pain on feeding
  - consider trial of extensively hydrolysed formula for 4 weeks
  - consider amino acid formula if partial response or relapse after response
  - if breastfed, trial of maternal cow's milk exclusion for 2 weeks minimum
- Obese patient
  - weight management
  - healthy lifestyle choices

PHARMACOLOGICAL TREATMENT

- Treat symptoms but does not reduce number of reflux episodes:
  - trial of alginate (Gaviscon®/Gaviscon® Infant) therapy for 2 weeks

- proton pump inhibitors (PPIs) for 4 weeks
  - omeprazole
  - lansoprazole
  - esomeprazole
- Refer if no response to treatment or recurrence on stopping treatment

Domperidone no longer recommended for children aged 12 yr https://www.gov.uk/drug-safety-update/domperidone-for-nausea-and-vomiting-lack-of-efficacy-in-children-reminder-of-contraindications-in-adults-and-adolescents

INVESTIGATIONS

- Requested by specialist
- 24 hr pH study – detects acid reflux episodes only
- 24 hr pH and impedance study – detects both acid and non-acid reflux episodes
- upper gastrointestinal contrast study or barium swallow – detects anatomical defects, hiatus hernia, malrotation and pre-surgery
- flexible upper gastrointestinal endoscopy and biopsies – inflammation, eosinophilic oesophagitis

SURGICAL TREATMENT

- Refractory patients
- fundoplication – laproscopic/Nissen
- surgical jejunostomy

HAEMOLYTIC URAEMIC SYNDROME ● 1/2

RECOGNITION AND ASSESSMENT

Definition

- Triad of features:
  - microangiopathic haemolytic anaemia
  - thrombocytopenia
  - acute kidney injury (AKI), usually with raised urea +/- creatinine

Symptoms and signs

- Diarrhoea with blood and mucus (rarely haemolytic uraemic syndrome can occur in absence of diarrhoea), rectal prolapse
  - dehydration if diarrhoea has been severe (see **Diarrhoea and vomiting** guideline)
  - check BP: hypotension
- Vomiting
- Abdominal pain
- Pallor, lethargy
- Reduced urine output/facial puffiness
- Tachycardia
- Reduced consciousness: consider cerebral oedema, intracranial thrombosis/haemorrhage
- Seizures: consider hyponatraemia, cerebral oedema, intracranial thrombosis/haemorrhage
- Paralysis: consider intracranial thrombosis/haemorrhage
- Over-hydration
  - oedema (periorbital/pedal) variable
  - weight gain, observe trend
  - raised jugular venous pressure (JVP) indicates volume overload
  - oliguria (urine output <1 mL/kg/hr)
  - tachypnoea
  - liver enlargement
  - low plasma sodium
- Non renal complications:
  - toxic megacolon
  - perforation
  - intussusception
  - rectal prolapse
  - cardiomyopathy
  - diabetes mellitus
  - intracranial thrombosis, haemorrhage, oedema

Investigations

- FBC and blood film (to look for fragmented red cells)
  - low Hb and platelets
- Clotting studies (typically with shortened INR and APTT – should not be DIC picture)
- U&E, creatinine, LDH (to confirm haemolysis)
- Bicarbonate
- Calcium, phosphate
- Glucose, amylase
- Liver function tests
- Serum *E. coli* O157 lipopolysaccharides (LPS) antibodies
- Urine stick test for significant blood and protein (indicating glomerular damage) and leucocytes
- Stool culture for *E. coli* (and typing for O157 strain

IMMEDIATE TREATMENT

- Admit, discuss with regional paediatric nephrology team in all cases
- Strict fluid balance, electrolyte monitoring and management, see **Acute kidney injury** guideline
- Dehydration
  - if signs of hypovolaemic shock give circulatory support (sodium chloride 0.9% 10 mL/kg IV immediately)
  - correct dehydration (see **Diarrhoea and vomiting** guideline)
- Over-hydration
  - if signs of overload/cardiac failure, furosemide – for drug doses, see **BNFc**
  - if furosemide ineffective, discuss dialysis with regional paediatric renal centre
- Hypertension (see **Hypertension** guideline)

HAEMOLYTIC URAEMIC SYNDROME ● 2/2

- Anaemia
- daily FBC: only transfuse after discussion with regional paediatric nephrology team as may require dialysis. If asymptomatic, Hb can be permitted to drop as low as 60 g/L
- Thrombocytopenia
- do not transfuse platelets unless there are life-threatening bleeds/surgical procedures are required
- **Avoid** antibiotics, anti-diarrhoeal treatment, NSAIDs, and other nephrotoxic medication
- Observe for non-renal complications e.g. encephalopathy and seizures, cardiomyopathy, diabetes mellitus (twice daily BM sticks for the first 48 hr)
- Protein and potassium restriction

Tertiary referral

- If significant renal impairment (oligo/anuria, rising creatinine, severe acidosis, hyperkalaemia or complications), (see **Acute kidney injury** guideline), refer to regional paediatric nephrology team
- Refer urgently if non-diarrhoeal haemolytic uraemic syndrome

DISCHARGE FROM HOSPITAL

- Patient may be discharged when all following criteria met:
- diarrhoea/abdominal pain resolved
- Hb stable (haemolysis ceased)
- drinking fluids freely and passing normal amounts of urine
- U&E improving with normal serum potassium
- Prescribe folic acid 2.5 or 5 mg daily until Hb normal

Follow-up

- Weekly until renal function normal
- if impaired renal function or proteinuria persists, arrange paediatric renal follow-up
- Once renal function normal, arrange GP or general paediatric follow-up every year to check BP and early morning urine (protein:creatinine ratio), with a detailed renal specialist review every 5 yr for formal GFR
- Advise that women with history of haemolytic uraemic syndrome require close monitoring during pregnancy
- Advise about avoiding smoking and obesity

DISCHARGE FROM FOLLOW-UP

- Renal function normal
- No proteinuria
- Renal growth and function satisfactory at 5 yearly review until aged 15 yr

BACKGROUND

- May occur as major or minor isolated injury or as part of multi-system trauma
- in minor injuries review airway, breathing and circulation and intervene as deemed necessary
- In all head injuries assess and record the following:
- Glasgow coma score (GCS)
- pupil reactions
- Take full history to ascertain whether
- any imaging is required
- any possibility of non-accidental injury (NAI) see **Child Protection** guideline
  - NAI in all subacute, delayed and repeated head injuries, especially in aged <2 yr
- Children who require admission, but no neurosurgical input are admitted under the care of paediatric team

TRIAGE: FACTORS INDICATING POTENTIALLY SERIOUS INJURY

History of substantial trauma – road traffic collision (RTC), fall from a height
History of loss of consciousness
Children who are not fully conscious or unresponsive
Obvious neurological signs/symptoms
headache
seizures/limb weakness

PRIMARY SURVEY AND RESUSCITATION

- All clothing must be removed

Airway

- Clear and maintain patent airway
- Control cervical spine until injury excluded

Breathing

- Oxygen 100% by mask
- Indications for immediate intubation and ventilation include:
- coma
  - not obeying commands
  - not speaking
  - not eye opening (GCS ≤8)
- cyanosis/oxygen saturation <90%
- PaO_2 <9 kPa on air **or** <13 kPa with oxygen
- $PaCO_2$ <3.5 kPa **or** >6 kPa
- loss of protective laryngeal reflexes
- respiratory irregularity
- deteriorating conscious level
- unstable facial fractures
- copious bleeding into mouth
- seizure

Circulation

- Commence IV infusion of sodium chloride 0.9% + glucose 5%
- Assess for shock and resuscitate as appropriate for age/weight
- Give minimum fluid to achieve adequate circulation (10 mL/kg aliquots)
- Prevent over-infusion and consequent worsening of cerebral oedema by careful titration of fluids and frequent reassessment
- Record pulse, blood pressure and respiratory rate initially every 15 min with serious injuries
- Control external haemorrhage by direct pressure and immobilise fractures
- Exclude occult haemorrhage (chest/abdomen/pelvis/lower limbs)

Disability

- Record pupillary size and reactivity
- Consciousness on GCS (see **Glasgow coma score** guideline) and limb motor responses
- Evidence of basal skull fracture (see below **When to suspect a basal skull fracture**)

- blood/cerebrospinal fluid (CSF) from nose/ear
- hemotympanum
- panda eyes/Battle's sign (bruising over mastoid process)

EXAMINATION

- FBC
- Clotting
- Glucose
- U&E
- Blood gas
- Blood for cross matching
- In all cases diagnosis and initial treatment of serious extracranial injuries takes priority over investigation and transfer to neurosurgery

SEIZURES

In association with head injury:

- Focal seizures are more significant
- Exclude hypoglycaemia
- Phenytoin 20 mg/kg IV **OR** levetiracetam 40 mg/kg IV max 3 g slowly over 20 mins with blood pressure and cardiac monitoring

FURTHER INVESTIGATION AND MANAGEMENT

- Current primary investigation of choice for detection of clinically important brain injuries is CT Imaging. See:
- **NICE** guideline on head Injury (updated January 2014) https://www.nice.org.uk/guidance/ng232/chapter/recommendations
- **NICE** guidelines for emergency CT scanning aged >16 yr https://www.nice.org.uk/guidance/ng232/resources/imaging-algorithm-pdf-13061125549

Indications for emergency head CT scan <1 hr since presenting to hospital

- These patients reviewed by emergency department registrar/consultant
- suspicion of non-accidental injury. See **Child Protection** guideline
- post-traumatic seizure but no history of epilepsy
- GCS <14 if aged <1 yr **or** <15 if aged >1 yr
- GCS <15 at 2 hr after injury
- suspected open/depressed skull fracture/tense fontanelle
- signs of basal skull fracture
- focal neurological deficit
- aged <1 yr: bruise, swelling/laceration >5 cm on head
- >1 following risk factors:
  - loss of consciousness (LOC) >5 min (witnessed)
  - abnormal drowsiness
  - >3 discrete episodes of vomiting
  - dangerous mechanism of injury (high-speed road traffic collision as vehicle occupant, pedestrian or cyclist; fall from >3 m; high-speed projectile injury) *
  - amnesia (antegrade/retrograde lasting >5 min)

* If high mechanism of injury that may warrant full examination for additional injuries +/- trauma team activation discuss with senior for review

Criteria for admission for observation

- If child has only one risk factor from above list for indication for emergency CT scan observe for minimum of 4 hr after injury
- if during observation any of following risk factors are observed perform CT head scan
  - GCS <15
  - further episode of abnormal drowsiness
  - further vomiting – child vomiting after head injury, consider whether or not there is additional cause for vomiting, (i.e. viral illness, gastroenteritis)

Isolated head injury

- If child has normal CT head scan and no evolving/continuing symptoms, then admission is not indicated

- If there is any deterioration, parent should receive written advice to return immediately (see **Head injury patient information leaflet**)
- Little or no role for skull X-ray, except as part of skeletal survey for suspected NAI

Criteria for admission to hospital

- Concerns about possible non-accidental injury
- Abnormal CT scan (excluding static pre-exiting abnormalities)
- GCS has not returned to 15, regardless of CT result
- Persisting focal neurological signs
- CSF leak
- Other medical conditions e.g. coagulation disorders, other injuries
- Difficulty in assessing patient e.g. suspected drugs/alcohol

INPATIENT MANAGEMENT

- Assess and maintain safe airway
- Perform neurological assessment
- if GCS <15 perform half-hourly observations until it is normalised
- includes
  - heart rate
  - respiration rate
  - blood pressure
  - oxygen saturations
  - GCS
  - pupil size
  - reactivity
  - limb movements
- Minimum frequencies of observations with GCS of 15 are:
- half-hourly for 2 hr, hourly for 4 hr then 2-hrly thereafter
- if child deteriorates and GCS drops <15 frequency of observations must return to half-hourly
- Observe for any swelling to head, face and body
- Observe for excessive vomiting
- If GCS or clinical condition deteriorates inform doctors immediately and move to high dependency unit (HDU)
- Monitor and record fluid input and output urinary catheterisation if needed. If continues to vomit commence IV fluids
- Assist with any investigations i.e. blood sampling, CT, MRI or X-ray
- If not in HDU closely monitor and observe close to nurses' station

Criteria for consultation with neurosurgical unit

- Intracranial injury on CT scan
- Persisting coma (GCS <8) after initial resuscitation
- Deterioration in GCS after admission (particularly motor response)
- Unexplained confusion lasting >4 hr
- Seizure without full recovery
- Focal neurological signs
- Definite/suspected penetrating injury – give antibiotics in penetrating injury
- Depressed fracture of skull vault
- Suspected fracture of skull base
- CSF leak

When to suspect a basal skull fracture

- Bleeding from nasopharynx or middle ear
- Postauricular ecchymoses (Battle's sign)
- Periorbital ecchymoses
- CSF otorrhoea (usually transient)
- CSF rhinorrhoea – high risk infection
- in CSF leak, no evidence for use of prophylactic antibiotics to prevent meningitis - if there is clinical deterioration, suspect meningitis

TRANSFER TO LOCAL PAEDIATRIC NEUROSURGICAL AND PICU TEAM

- Complete and record consultation process
- Consult with local intensive care unit/ retrieval service and decision support (KIDS https://kids.bwc.nhs.uk/ on about whether **time critical transfer** is indicated. This will be joint decision with critical care and emergency department teams
- Send with patient – photocopies of all clinical notes including paediatric early warning score (PEWS) and drug charts
- Send all radiological images via electronic transfer to PICU to which child is being transferred

HEADACHE ● 1/5

See also NICE Guideline: Headaches in over 12s: diagnosis and management updated 03 June 2025
https://www.nice.org.uk/guidance/cg150

INTRODUCTION

- Children presenting with headache require careful assessment for red flag features, in order to detect serious underlying secondary causes
- Most children presenting with headaches do not require investigations
- Supportive therapy with simple analgesia is mainstay of treatment for most cases of primary headache; opioids are not recommended
- Headaches can be classified as primary (intrinsic to nervous system) or secondary (due to another underlying condition/pathology)
- Most common primary headaches are migraines and tension-type headache
- Viral illnesses are most common cause of acute presentations with secondary headaches, while less common but serious causes include central nervous system infection (meningitis, encephalitis), raised intracranial pressure and haemorrhage
- Headaches may also be manifestation of underlying psychosocial issues

CAUSES

- Viral illness, ENT infections (sinusitis and throat infections), and minor head trauma
- Primary headache disorders – migraine, tension-type headache and other less common forms e.g. cluster headaches, trigeminal autonomic cephalgias
- **Neurological conditions presenting with headache needing urgent attention:**
- bacterial meningitis
- intracranial haemorrhage
- shunt related
- idiopathic intracranial hypertension (IIH)
- new hydrocephalus
- brain tumour
- brain abscess

ASSESSMENT

History

Headache (LIQDFOE)

- **L**ocation
- **I**ntensity
- **Q**uality
- **D**uration
- **F**requency
- **O**ther symptoms (nausea, vomiting, photophobia, dizziness)
- **E**ffect/degree of impairment due to headache

Associated symptoms

- Alteration in sensorium (drowsiness or low GCS − see **Glasgow coma scale** guideline)
- Seizure
- Persistent vomiting
- New visual symptoms: diplopia, abnormal eye movement, visual impairment
- Behaviour change
- Recent change in gait/balance/co-ordination
- Any other neurological symptoms
- Recent head trauma
- Recent history of illness
- Systemic symptoms
- Sleep quality: features of obstructive sleep apnoea

Trigger and pattern

Try to establish pattern of headache

- Acute recurrent
- migraine
- Chronic non-progressive

- tension-type headache
- anxiety, depression
- somatisation
- Chronic progressive
- tumour
- benign intracranial hypertension
- brain abscess
- hydrocephalus
- Acute on chronic non-progressive
- tension headache with co-existent migraine

Common migraine triggers include
- Illness
- Poor sleep
- Exercise
- Menstruation
- Stress
- Heat
- Sun glare
- Foods
- citrus
- monosodium glutamate (MSG)
- artificial sweeteners
- nuts
- onions
- salty foods
- caffeine
- chocolate
- skipped meals
- Missed medications/medication overuse

Red flags
- Headache that:
- wakes them at night
- present on awakening in morning
- progressively worsens
- triggered/aggravated by coughing, sneezing or bending down
- with fever and features of meningism
- associated with
  - vomiting
  - ataxia (disorders affect co-ordination, balance and speech)
  - change in conscious level/pervasive lethargy
  - squint or failure of upward gaze ('sunsetting')
- occurring <5 days of head injury
- Acute and severe headache
- Focal neurological symptoms
- Deterioration in school performance
- Increasing head circumference
- Abnormal head position
- Signs of raised intracranial pressure (papilloedema, altered mental state, ataxia)
- Headaches associated with abnormal growth/puberty
- Parental worry

Be cautious of first and worst headache, short history of progressively worse headache – see Imaging below

Examination
General physical examination
- Dysmorphic appearance
- Fever, skin rash

- Abnormal head position, torticollis
- Marker of neuro-cutaneous syndrome
- BP, pulse, oxygen saturation, temperature
- Weight, height, head circumference
- BMI
- Pubertal status
- Scalp, face, neck, oral cavity
- Full ENT examination

Neurological examination (especially look for)
- New onset of squint
- Cranial nerve palsy
- Any other focal neurological deficit
- Cerebellar signs, including nystagmus,
- Signs for meningism
- Increased tone, brisk reflexes, upgoing plantars

Fundus
- If uncertain/abnormal, discuss with ophthalmologist

IMAGING
- Investigations and management based on clinically suspected cause of headache
- Neuroimaging is not indicated in patients with clear history of uncomplicated migraine without red flag features for potential secondary headache and normal neurological examination
- MRI brain scan (if contraindication to MRI – CT brain)

Indications
- If any red flags present and headache difficult to classify into one of the primary headaches, e.g. migraine/tension-type headache
- First/worst headache
- Short history of progressively worse headaches
- Presence of new neurological symptoms/signs associated with headache
- persistent/recurrent vomiting
- balance/co-ordination problems
- abnormal eye movements/papilloedema or visual field defect
- behaviour change (particularly lethargy)
- seizures
- abnormal head position/head tilt
- focal neurological deficit

MANAGEMENT OF PRIMARY HEADACHES
- Headache diaries are helpful to identify triggers and establish patterns
- NICE: June 2025, recommends 8 weeks' worth of recording to document frequency, duration and severity of headaches, any associated symptoms, all prescribed and over the counter medications taken to relieve headaches, possible precipitants, relationship of headaches to menstruation

General advice:
- Ensure adequate hydration, encourage good sleep hygiene and healthy exercise pattern
- To prevent medication overuse headache, limit use of simple analgesics <15 days per month, and triptans <10 days per month
- Avoid triggers
- Address emotional stressors which may precipitating headache
- Simple analgesics
- paracetamol/ibruprofen at onset of migraine, rest in quiet dark room to relieve acute episodes
- if simple analgesics not effective triptans can be tried
- avoid opioids
- If nausea and vomiting are prominent features prescribe antiemetic in addition to analgesics: ondansetron/cyclizine/ prochlorperazine as tablets or melts
- If headache episodes are frequent affecting quality of life and school performance and attendance, discuss use of regular preventative medications for migraine

- pizotifen, propranolol, topiramate (to be used with caution in females of child-bearing age group in line with recent MHRA regulations) are usual first line choices

NICE: June 2025

- Recommends considering course of up to 10 sessions of acupuncture over 5–8 weeks for prophylactic treatment of chronic tension-type headache
- Suggests riboflavin (400 mg once a day) may be effective in reducing migraine frequency and intensity for some people

IDIOPATHIC INTRACRANIAL HYPERTENSION (IIH)

Diagnosis of IIH

Suspect IIH presenting with papilloedema, with/without

- 6th cranial nerve palsy causing diplopia
- Intact conscious level
- With any pattern of headache usually chronic daily headache

Features of raised intracranial pressure

- Nausea and vomiting
- Headache worse lying down/with coughing/bending/exercise

Additional features

- Child waking up in sleep with headache
- Pulsatile tinnitus
- Dizziness
- Ataxia
- Back/neck pain or stiffness

Common visual symptoms

- Transient visual loss/blurring of vision
- Request ophthalmologist to confirm papilloedema
- Obtain colour vision and visual field charting

Normal neurological examination

(except 6th nerve palsy and papilloedema)

Causes

- Obesity – usually association/risk factor
- Drugs (may be cause/contributory factor): steroid therapy or withdrawal, growth hormone, tetracycline, oral contraceptive pills
- Endocrine: hypo/hyperthyroidism, hypo/hyperparathyroidism, adrenal insufficiency, Cushing syndrome
- Haematological: iron deficiency anaemia, sickle cell anaemia
- Infections and systemic disorders: otitis media, Lyme disease, HIV, chronic renal failure, SLE
- Obstructive sleep apnoea
- Cerebral venous thrombosis

Investigations

- Initial: FBC, bone profile, TFT, U&E, parathyroid
- Other as clinically indicated

Imaging

- MRI brain modality of choice (CT brain only if contraindication to MRI/significant urgency for examination)
- If concerned about patency of cerebral venous drainage CT venogram is preferred investigative modality

Lumbar puncture

- Opening pressure of >28 cm H_2O, (legs straightened, neck not flexed when measuring pressure), normal cell count and biochemistry
- If cerebrospinal fluid (CSF) pressure raised drain CSF to bring closing pressure 12–15 cm of CSF
- CSF pressure can be falsely high/low
- Hyperventilation can reduce pressure
- Distress, anxiety, Valsalva can increase pressure
- Can be performed under analgesia, sedation or general anaesthetic; sedation can increase pressure

- End tidal CO_2 should be monitored and kept in normal range for LP under general anaesthetic

Treatment

- Discontinue suspected drugs
- If high BMI or recent rapid weight gain, reduce weight
- Treat underlying endocrinopathies
- Consider pharmacological management if:
- symptoms/signs recur following 1st lumbar puncture (LP)
- if presence of visual deficit on presentation with 1st LP
- First line of treatment: acetazolamide (47–67% effective when used alone). Strong carbonic anhydrase inhibitor
- dose: Start as per **BNFc** aiming for usually 50 mg/kg/day over 6 weeks to maximum of 100 mg/kg/day (maximum 2 g/day)
- titrate doses based on symptoms and tolerance. If significant side effects commonly dizziness, nausea/vomiting or numbness and tingling sensation, check blood gas and consider starting at a lower dose of 5 mg/kg once or twice a day and titrate up more slowly
- close ophthalmology follow-up 2–4 weekly initially to ensure resolution of papilloedema and improvement in vision
- in most children symptoms will resolve/improve at lower doses of acetazolamide
- if acetazolamide not tolerated or symptoms do not resolve/continue to worsen despite acetazolamide discuss urgently with tertiary care
- Rapid titration is associated with side effects of pins/needles, nausea
- If symptoms resolve, try weaning off after 4 months
- Monitor U&Es and bicarbonate levels after first 4 weeks, may need bicarbonate supplements
- If on acetazolamide for >6 months, do renal USS to check for nephrocalcinosis

Be careful about child with papilloedema suspected on routine eye check in an asymptomatic child. Seek advice before starting investigations to rule out other ophthalmological concerns like optic nerve drusen

Do not diagnose IIH on high CSF pressure alone in absence of typical clinical features

HEART FAILURE ● 1/2

COMMON CAUSES

In infancy

- Congenital heart defects
- Severe left sided obstructive lesions (e.g. co-arctation of aorta) present with heart failure in first 4 weeks of life, which may require prostaglandin therapy (see **Neonatal guidelines** for management for these conditions)
- Left-to-right shunts

Aged >1 yr

- Dilated cardiomyopathy
- Myocarditis
- Post-surgical cardiac patients (pericardial effusion, pump failure)

RECOGNITION AND ASSESSMENT

Symptoms and signs

- Dyspnoea on exertion (poor feeding in infants)
- Sweating
- Failure to thrive
- Tachypnoea
- Tachycardia
- Weak and thready pulses
- Gallop rhythm
- Murmur
- Cardiomegaly – very useful sign
- Hepatomegaly
- Basal crackles
- Cold and wet skin
- Some children present in extremis (cardiogenic shock)

- ***NOTE: Cardiogenic shock should be considered in any child with symptoms and sign of shock:***
- ***fails to improve after adequate fluid replacement (e.g. ≥40 mL/kg) or respiratory symptoms develop after fluid resuscitation***
- ***with known heart condition***
- ***in the presence of a large heart on CXR***
- ***with history of poisoning***
- ***when there a murmur, pulmonary oedema, or both***

INVESTIGATIONS

Chest X-ray

- Cardiomegaly
- Pulmonary oedema

Electrocardiogram

- Features of atrial or ventricular hypertrophy
- Rhythm abnormalities
- See **ECG interpretation** guideline

Echocardiogram

- Locally if available, or refer to regional paediatric cardiac centre

Bloods

- Capillary gas for lactate and pH
- FBC
- U&Es, including calcium levels
- LFTs and clotting

MONITORING

- Continuous cardiac monitoring – watch for arrhythmias
- Non-invasive BP

- Pulse oximetry
- Core-skin temperature difference
- Fluid balance
- daily weight
- urine output (≥1 mL/kg/hr)

TREATMENT

Any child presenting with heart failure to be discussed urgently with local paediatrician with expertise in cardiology (if available) or regional tertiary cardiology centre

In all children with heart failure

1. If breathless, elevate head and trunk
2. If infant not feeding well, give nasogastric feeds
3. In moderate-to-severe failure or if patient hypoxic or distressed, prescribe oxygen therapy via nasal cannulae (maximum 2 L/min) or face mask with reservoir bag (maximum 15 L/min) aiming for SpO_2 94–98%. In some complex cyanotic heart diseases, lower saturations are acceptable and may be desirable – seek advice from cardiologist
4. Diuretics: furosemide 1 mg/kg oral or by slow IV injection over 5–10 min and amiloride 100 microgram/kg oral (maximum single dose 10 mg) both 12-hrly
5. If on IV furosemide check potassium 12-hrly; repeat 4–6 hrly if outside normal range
6. If serum potassium <4 mmol/L, give enteral potassium chloride 0.5–1 mmol/kg (usual single dose maximum 25 mmol) 12-hrly (usual daily maximum 50 mmol). **Note:** potassium chloride should always be given enterally and not IV unless approved by a consultant. Kay-Cee-L® (1 mmol/mL potassium) oral liquid contains sorbitol and Sando-K® effervescent tablet (12 mmol potassium per tablet) contains sucrose
7. Correct acidosis, hypoglycaemia and electrolyte imbalance

If cardiogenic shock present

1. Urgent specialist input from PICU and cardiology
2. If pulmonary oedema present – mechanical ventilation with PEEP
3. Consider early IV inotropes (dobutamine, adrenaline) and vasodilators (milrinone)
4. Invasive monitoring
5. May require transfer to specialised centre with ability to provide mechanical support, including ECMO

HEART MURMUR ● 1/1

- Murmurs are relatively common in infants and children
- Likely to be innocent in older child (aged >1 yr), who are otherwise healthy and asymptomatic
- innocent murmur gets louder when child becomes unwell with fever and infection
- Could be first sign of underlying heart disease
- delay in diagnosis could lead to serious complications

CLUES TO PATHOLOGICAL MURMUR

History

Infants

- More likely to be pathological
- Feeding difficulties
- Failure to thrive or poor growth
- Sweating during feeds
- Recurrent respiratory infections

Older children

- Chest pain or dyspnoea on exertion
- Recurrent chest infection
- Syncope
- Palpitations
- Past history of:
- rheumatic fever
- Kawasaki disease

EXAMINATION

- Weak femoral pulses
- Oxygen saturations <94% (in neonates, check pre and post ductal saturations – refer to neonatal guidelines for interpretation)
- Right arm BP >20 mmHg than lower limb BP can occur in coarctation of aorta
- Tachypnoea
- Loud murmur, thrill
- Diastolic murmur
- Hepatomegaly

INVESTIGATIONS

(Not necessary unless high index of suspicion for pathological murmur)

- CXR: look specifically for cardiomegaly and pulmonary plethora
- ECG: look specifically for atrial and/or ventricular hypertrophy (see **ECG interpretation** guideline)

MANAGEMENT

If clinical diagnosis is innocent murmur

- Discharge
- Advise GP to listen when child otherwise well
- infants in 2–3 weeks
- older child in 6–8 weeks
- if murmur persists advise to refer to paediatrician with expertise in cardiology (PEC)

If clinical diagnosis is pathological murmur

Asymptomatic

- Refer to PEC clinic

Symptomatic

- Admit and discuss with consultant

HENOCH-SCHONLEIN PURPURA (HSP) ● 1/2

DEFINITION

- Vasculitic condition of unknown aetiology
- Typical age group aged 2–8 yr

Symptoms and signs

Rash

- Purpuric, raised on extensor surfaces of legs, buttocks and arms, with surrounding erythema

Gastrointestinal tract

- Abdominal pain mostly non-specific, typically resolves in 72 hr
- if severe or persistent, exclude intussusception, testicular torsion or pancreatitis (rare)
- Nausea and vomiting
- Intestinal haemorrhage: haematemesis, melaena, bloody stools (rare)

Joints

- Arthralgia and swelling of large joints, especially ankles and knees. Pain typically resolves in 24–48 hr

Renal

- Microscopic haematuria (common)
- Proteinuria can present 4–6 weeks after initial presentation
- Hypertension
- Nephritic syndrome: haematuria with ≥1 of following:
- raised urea and creatinine
- hypertension
- oliguria
- Nephrotic syndrome: proteinuria +/- oedema and hypoalbuminaemia
- Oedema of hands, feet, sacrum and scrotum

Neurological

- Headache (common)
- Seizures, paresis, coma (rare)

Differential diagnosis

- Purpuric rash:
- meningococcaemia – clinical diagnosis
- thrombocytopenia – FBC (rash looks different, ITP not vasculitic)
- rarer vasculitides – more difficult to exclude; differentiation requires review over a period of time
- Pancreatitis – suspect in abdominal pain

Investigations

All patients

- BP
- Urine dipstick
- if proteinuria, send urine for early morning protein:creatinine ratio
- if haematuria, send urine for microscopy

Additional investigations

Blood tests if urinalysis abnormal or diagnosis uncertain

- FBC + film
- U&E
- Albumin
- If fever, blood culture and ASO titre
- Coagulation
- Throat swab

IMMEDIATE TREATMENT/SUBSEQUENT MANAGEMENT

Indications for admission

- Orchitis
- Moderate or severe abdominal pain
- Arthritis involving >2 joints
- Proteinuria

- Clear evidence of gastrointestinal bleeding

- Inability to ambulate

Joint pain
- NSAIDs (ibuprofen 1st line. Use with caution if renal involvement or patient asthmatic)

Abdominal pain
- Give prednisolone 1 mg/kg/day (maximum 60 mg/day) for 2 weeks
- Renal involvement not a contraindication
- If severe and persists, exclude pancreatitis, intussusception or spontaneous bowel perforation

MONITORING

Uncomplicated HSP (e.g. urine analysis ≤1+ blood and protein, and normal BP)
- No hospital follow-up required but GP follow-up in 1–2 weeks. Monthly BP for 6 months and weekly urine dipsticks at home until urine clear

HSP with haematuria or proteinuria >1+ and normal renal function
- As above + routine follow-up in children's outpatients

Refer to nephrologist if:
- Urinalysis blood or early morning protein >1+ after 6 months
- Macroscopic haematuria or heavy proteinuria at presentation
- Hypertension (see **Hypertension** guideline)
- Significant proteinuria (early morning urine protein:creatinine ratio >100 g/mmol or 3+ proteinuria for 3 days)
- Impaired renal function

Refer to rheumatologist if:
- Atypical or rapidly evolving rash

DISCHARGE AND FOLLOW-UP

- Inform parents condition may fluctuate for several months but recurrence rare once settled properly
- Very rare risk of renal failure, hence importance of monitoring urine
- Seek medical advice if child develops headache, PR bleeding or severe abdominal pain

Uncomplicated HSP
- GP follow-up as above
- Discharge from GP follow-up if urine analysis **and** BP normal 6 months after onset

HEPATITIS B AND C ● 1/2

Discuss all children with suspected hepatitis B or C with regional liver unit/infectious diseases team for counselling, information, consideration for antiviral therapy and need for referral

HEPATITIS B

(For neonates see **Neonatal** guidelines)

Who to screen

- Close contacts of people with confirmed acute and chronic hepatitis B infection
- Migrants from highly endemic areas
- Looked after children
- Infants born to hepatitis B positive women when completed vaccination course at aged 12 months
- Children with chronic liver disease
- Before commencing immune suppression treatment or chemotherapy
- Children with Hepatitis C and HIV infection
- ALT > 2 x upper limit of normal

Screening tests

- HBsAg main test
- HBcAb (IgM and IgG) and HBsAb

Action

- If HBsAg +ve (infected) then check below tests and refer to regional liver unit/infectious diseases team (notify local health protection team):
  - HBeAg, HBeAb, genotype and HBV DNA PCR viral load
  - anti–HDV
  - anti-HIV
  - anti-HCV
  - anti-HAV
  - liver function tests including ALT, AST, GGT, bilirubin and albumin, full blood count, total globulins and prothrombin time
  - liver ultrasound scan (USS) and alfa-fetoprotein (AFP)

Interpretation

Interpretation	HBsAg	HBsAb	HBeAg	HBeAb	HBcAb IgM	HBcAb IgG
Not immune, not protected	-	-	-	-	-	-
Immune, recovered past infection	-	+	-	+	-	+
Immune, vaccinated	-	+	-	-	-	-
Acute Infection	+	-	+	-	+	-
Chronic Infection (active)	+	-	+	-	-	+
Chronic infection (inactive)	+	-	-	+	-	+

- What serological markers indicate:
  - HBsAg: infected
  - HBsAb: immune
  - HBcAb-IgM: acute infection
  - HBcAb-IgG: past infection (>6 months)
  - HBeAg: high risk viral replication
  - HBeAb: low replicative chronic HBV infection
  - HBV DNA quantitation: level of virus
  - HBV genotype: distribution based on geographical location (subtypes A–G)
    - may be responsible for variations in clinical outcomes and response to antiviral treatment, but not used to determine initial treatment of HBV
- If HBeAg +ve, indicates acute/active infection: urgent referral
- If HBeAb +ve, indicates chronic infection: routine referral

Advice to patients whilst awaiting liver review

- Take universal precautions to prevent passing on infection, e.g. not sharing tooth brushes, teenagers must practice protected sex etc.
- Vaccinate household

Antiviral agents and other agents

- Initiated by regional liver centre. Available for certain children, dependant on ALT level, HbeAg positivity and HBV PCR level, among other things, but cure rate is very low

HEPATITIS C

(For neonates see **Neonatal** guidelines)

Who to screen

- Children of women found to be infected with hepatitis C
- Close contacts of people diagnosed with hepatitis C
- Migrants from highly endemic areas
- Looked after children
- Recipients of multiple transfusions, pooled blood products or organ transplants from abroad

Diagnostic tests

- Hepatitis C Virus (HCV) antibody aged >18 months
- HCV PCR if HCV antibody +ve

Action

- If HCV Ab -ve, not infected. Discharge
- If HCV Ab +ve and HCV PCR negative in 2 samples taken 6 months apart, not infected (resolved infection or maternal antibody if aged <18 months). Discharge
- If HCV PCR +ve, check genotype, refer to regional liver unit/infectious diseases team for treatment

Antiviral agents

- Effective treatment available for all children aged >3 yr with chronic hepatitis C, regardless of stage of disease
- Cure rate of 95–100%
- Vital to screen and pick up cases

HIV AND HEPATITIS B POST-EXPOSURE PROPHYLAXIS (PEP) ● 1/4

RISK ASSESSMENT

No risk

- Intact skin contaminated with blood or body fluids
- Kissing
- Unprotected sex with an individual living with HIV on suppressive antiretroviral therapy (ART)

Low risk

- Mucous membrane or conjunctival contact with blood or body fluids
- Community acquired needle/sharp object injury
- Human bite
- Sexual contact with individual of unknown HIV status

High risk

- Significant exposure to blood or body fluids (including breastfeeding) from source known to be HIV, hepatitis B (HBV) or C (HCV) infected

MANAGEMENT

No risk

- Reassure
- Adolescent consensual sex: consider emergency contraception, STIs
- Discharge

Low risk

- HBV immunisation accelerated 0, 1, 2, 12 months (or booster if already immunised)
- PEP not recommended (except consider in sexual assault)

High risk

- HBV immunisation accelerated 0, 1, 2, 12 months (or booster if already immunised)
- HBV immunoglobulin if source known infected with HBV with high viral load
- HIV PEP

PEP not indicated

- Low risk
- Sex with HIV positive person confirmed viral load <200 copies/mL for >6 months
- Human bite
- Needlestick from a discarded needle in the community

PEP indicated

Risk	Exposure	Source
Blood	• Subcutaneous (SC) or intramuscular (IM) penetration with IV or IM needle, or intravascular device	• HIV positive or recent serostatus unknown, but presence of HIV risk factors
	• Percutaneous injury with sharp instrument (lancet), IM or SC needle, suture needle • Contact >15 min of mucous membrane or non-intact skin	• HIV positive
Genital secretions	• Vaginal sex and not on pre-exposure prophylaxis (PrEP) or low PrEP adherence	• Viraemic HIV positive ◦ if source person on ART, start PEP ◦ repeat HIV viral load, and, if undetectable, stop PEP
	• Anal sex and not on PrEP or low PrEP adherence	• Viraemic HIV positive or serostatus unknown but presence of HIV risk factors ◦ if source person on ART, start PEP ◦ repeat HIV viral load, and, if undetectable, stop PEP

Suggested PEP regimens:

ART regimens:

- Prescribe 3 drug PEP regimen: combination of 2 drug nucleoside backbone (NRTIs) with an anchor drug

HIV AND HEPATITIS B POST-EXPOSURE PROPHYLAXIS (PEP) ● 2/4

- PEP regimens for UK adults recommend integrase inhibitor (INSTI) raltegravir (RAL) with fixed dose NRTIs tablet of tenofovir and emtricitabine
- Raltegravir continues to be recommended as preferred PEP INSTI in adults
- For pragmatic reasons, preferred regimens for those ≥40 kg **and** aged ≥12 yr [i.e. once daily raltegravir (RAL) and tenofovir DF (TDF)/emtricitabine (FDC)] reflect adult PEP packs

Always check for possible drug interactions and dose adjustments that may be required
Discuss with pharmacist and/or utilise the Liverpool HIV drug interactions checker to identify risks (https://www.hiv-druginteractions.org/) and BNFc (online or app)

Weight/age	PEP recommendation	PEP alternative
≥40 kg **and** ≥12 yr	Raltegravir 1200 mg (2 x 600 mg tab) once daily with emtricitabine 200 mg/ tenofovir disoproxil 245 mg (1 tab)	Biktarvy (1 tab) once daily
≥25–<40 kg **and** ≥6 yr	Dolutegravir (DTG) + lamivudine + zidovudine	
>25 kg **and** <6 yr	Dolutegravir (DTG) + lamivudine + zidovudine	3rd agent: raltegravir **OR** Kaletra® (lopinavir/ritonavir) with lamivudine and zidovudine
<3 kg **or** <4 weeks	Seek expert advice from local paediatric infectious diseases specialist	

PEP alternative: only when recommended medicines are not immediately available

Raltegravir (specify formulation when prescribing):
- Aged ≥4 week
- Depending on weight and ability to swallow:
- **EITHER** oral suspension, chewable tablet
- **OR** film coated tablet
- Different formulations are **NOT** bioequivalent. Must specify formulation when prescribing; use chewable tablets for children ≥11 kg who cannot swallow tablets

Option 1: Raltegravir 100 mg granules for oral suspension (10 mg/mL):

Weight (kg)	Dose (mg) 12-hrly
3–<4	25
4–5	30
6–7	40
8–10	60
11–13	80
14–19	100

Option 2: Raltegravir chewable tablet (25 mg or 100 mg):

Weight (kg)	Dose (mg) 12-hrly
11–13	75 mg (3 x 25 mg)
14–19	100 mg
20–27	150 mg (1½ of 100 mg)
28–39	200 mg (2 x 100 mg)
≥40	300 mg (3 x 100 mg)

Option 3: Raltegravir film coated tablet:
≥40 kg: 1200 mg once daily (2 x 600 mg) or 00 mg 12-hrly

Dolutegravir (DTG)
Specify formulation when prescribing as film-coated tablispersible tablets are **NOT** bioequivalent

Dolutegravir (DTG) film coated tablet (50 mg): >20 kg 1 tablet once per day

Dolutegravir (DTG) 5 mg dispersible tablet (aged ≥4 weeks):

Age and weight (kg)	Dose (mg) once daily
3–5	5
6–9	10
10–13	20
14–19	25
≥20	30

- Check for drug interactions – if also taking medicines that can cause induction of UGT1A1 and CYP3A enzymes give standard dose twice/day
- Take with/without food
- Complex binding to polyvalent ions: calcium supplements, iron supplements, multi-vitamins or magnesium/aluminium-containing antacids; to be taken well separated in time from administration of dolutegravir (DTG) (minimum 2 hr after dolutegravir (DTG) or 6 hr before)
- To reduce risk of choking, not to swallow ≥1 tablet at a time
- weight 14–<20 kg dispersible tablet formulation (where possible)
- Common side effects: nausea, rash and sleep disturbance

Truvada [tenofovir disoproxil fumarate (TDF) emtricitabine (FTC)]

- Truvada® 1 tablet daily with raltegravir.
- If known renal impairment, Descovy® [tenofovir alafenamide (TAF) + FTC] 200 mg/25 mg 1 tablet with raltegravir
- **OR** if known renal impairment and raltegravir not available Descovy® 200 mg/10 mg 1 tablet with lopinavir/ritonavir (Kaletra®)

Lamivudine (3TC)

- Liquid
- ≥3 months: 5 mg/kg 12-hrly **or** 10 mg/kg once daily (maximum dose 300 mg/day)
- Well tolerated round up doses
- 150 mg tablet:
- 14–19 kg: 75 mg (½ 150 mg tablet) 12-hrly **OR** 150 mg tablet once daily
- >20–24 kg: 75 mg (½ 150 mg tablet) a.m. + 150 mg tablet p.m. **OR** 225 mg (1½ 150 mg tablets once daily
- ≥25 kg: 300 mg once daily

Zidovudine (AZT)

- Liquid:
- [3]28 days old and 4–8 kg: 12 mg/kg 12-hrly
- [3]28 days old and 9–30 kg: 9 mg/kg 12-hrly
- maximum dose 300 mg 12-hrly (600 mg/day)
- 100 mg capsule:
- ≥28 kg 250 mg 12-hrly

Points to consider:

- If paediatric formulations of above agents unavailable, do not delay commencing PEP if alternative is available
- If source has drug-resistant virus, seek expert help
- If patient known to have HIV do not give PEP
- Start as soon as possible (ideally within 24 hr)
- Do not start >72 hr after exposure
- Give starter pack for 5 days treatment until seen by specialist in infectious diseases
- Total treatment course will be 28 days

INVESTIGATIONS

Table 3: Recommended monitoring during PEP course and follow-up

Test	Baseline	14 days	4–6 weeks post-completion
HIV	✓	-	✓
HBsAg (if no history of vaccination)	✓	-	Only if not immune
Syphilis, Hep C, HBsAb/cAb	✓	-	✓
STI	✓	✓	If further unprotected sexual intercourse has taken place
Creatinine	✓	Only if abnormalities at baseline	-
ALT	✓	Only if abnormalities at baseline, Hep B/C co-infected or on Kaletra®	-
Urinalysis or uPCR	✓	Only if abnormalities at baseline	If abnormalities at baseline or 2 weeks
Pregnancy test	✓	If appropriate	If appropriate
Creatine kinase	-	Only if symptomatic of myositis	-

- After sexual exposure:
- screen for other sexually transmitted infections with urine for chlamydia and gonorrhoea and syphilis serology
- offer girls emergency contraception
- if non-consensual sexual activity refer to child protection co-ordinator
- Check need for tetanus immunisation

FOLLOW-UP

- Before discharge, provide families embarking on HIV PEP with:
- appointment to see a paediatrician with experience in antiretroviral drugs (ARTs)or member of ID/GUM team the same day or next working day
- for local paediatric HIV team see https://www.chiva.org.uk/professionals/clinic-networks/
- for national specialist advice ask for on-call paediatric infectious disease team at St Mary's London (020 3312 6666)
- contact telephone number in case of concerns about any aspect of HIV PEP
- enough antiretroviral medication to last until clinic appointment
- letter for GP
- If PEP given, review at 2 and 4 weeks
- at 2 weeks repeat STI screen following sexual exposure
- at 4–6 weeks repeat HIV, hepatitis and syphilis testing
- If source is HCV RNA PCR positive, arrange the following enhanced HCV follow-up:
- at 6 weeks: EDTA blood for HCV PCR
- at 12 weeks: EDTA blood for HCV PCR and clotted blood for anti-HCV antibodies
- at 24 weeks: clotted blood for anti-HCV antibodies
- If moderate risk: 12 weeks post exposure test for HIV antibody/antigen; HBsAg; hepatitis C antibody (if sexual exposure, add treponemal serology)

HIV TESTING ● 1/2

INTRODUCTION

- HIV is a treatable medical condition
- The majority of those living with the virus are well
- Many are unaware of their HIV infection
- Late diagnosis is life-threatening
- Vertical infection may not cause symptoms until adulthood

HOW

Who can test?

- Anyone – HIV testing can be done in any medical setting; health professionals can obtain informed consent for an HIV test in the same way as for any other medical investigation
- Do not delay testing, but discuss result with paediatric HIV specialist **before** discussing with patient/carer if any doubt over interpreting result

Who should be offered a test?

- First-line investigation for suspected immune deficiency: unusual type, severity or frequency of infection. See **Table 1**
- Sexually active young people: take a sexual history in post-pubertal children
- Children of HIV positive parents who have not previously been tested
- Looked after children only if specific individual risk factors

Source patient in a needlestick injury or other HIV risk exposure

- Consent must be obtained from source patient or parent/guardian before testing
- Person obtaining consent must be a healthcare worker, other than the person who sustained the injury

Pre-test discussion with parents and children able to give consent

- Purpose of pre-test discussion is to establish informed consent:
  - patient/parent must be aware of testing for HIV
  - how result will be disclosed
- Lengthy pre-test HIV counselling is not a requirement
- Document patient's consent to testing
- If patient refuses test, explore why and ensure decision has not resulted from incorrect beliefs about the virus or consequences of testing
  - advise that, if negative, testing will not affect patient's insurance
- Some patients, (e.g. those whose first language is not English) may need additional help to reach a decision
- Test as soon as possible
  - if aged <1 yr and mother known to be positive send RNA PCR (viral load) urgently
  - if maternal status not known, send HIV antibody
  - if negative excludes perinatal infection
  - if 'reactive' result may reflect maternal antibody aged <18 months: phone infectious diseases
- If testing delayed >6 months discuss with child protection team
- Document offer of HIV test in medical notes, together with any relevant discussion and reasons for refusal
- Written consent not necessary but record on laboratory request form that consent has been obtained
- Arrange appointment for result to be disclosed personally by testing clinician

POST-TEST

HIV negative result: post-test discussion

- If still within window period after a specific exposure, discuss need to repeat test
  - for definitive exclusion of HIV infection, a further test after 3 months is recommended
- If reported as reactive or equivocal, refer to infectious diseases (may be seroconversion)

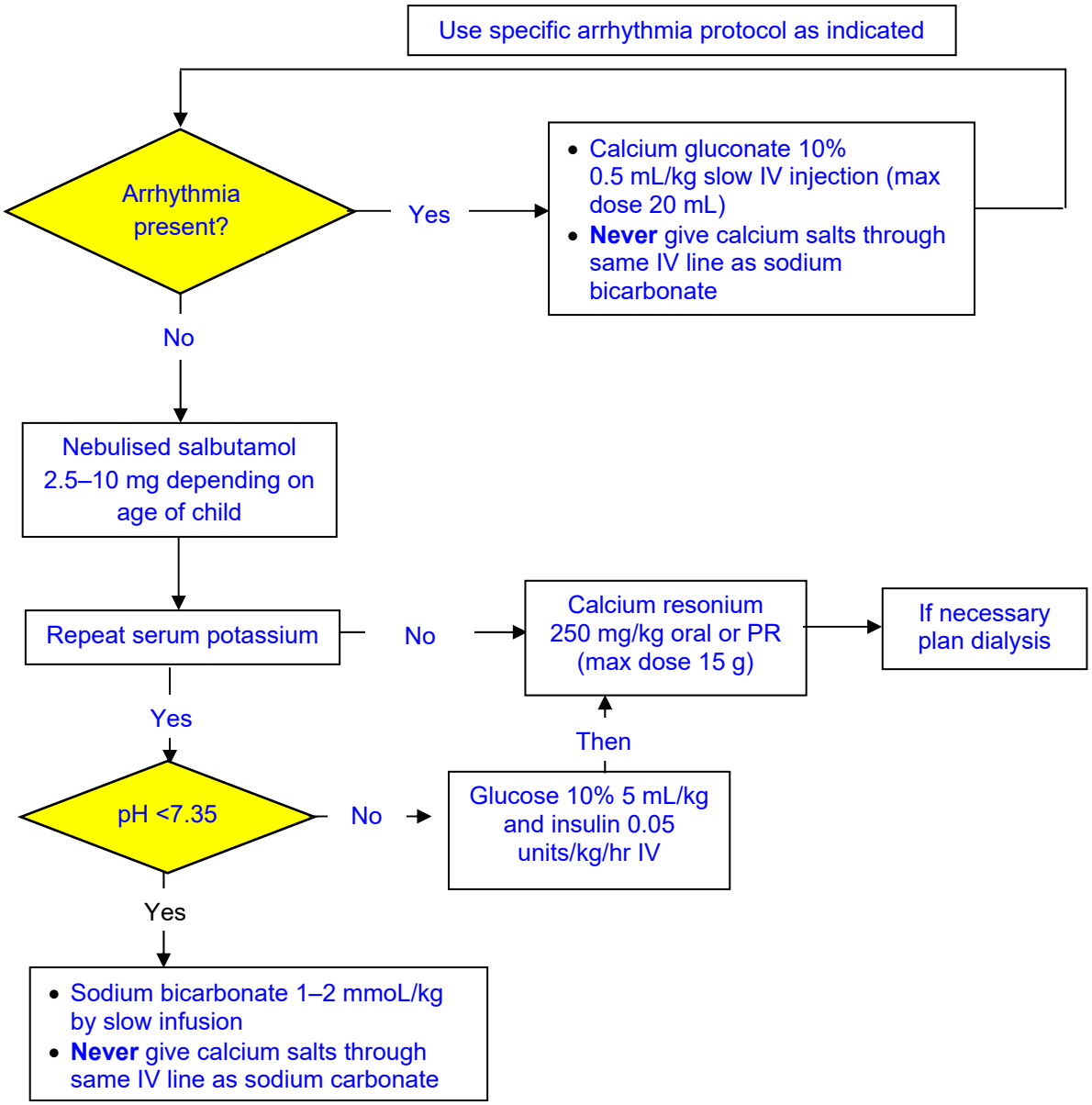
HIV positive result: post-test discussion

- For all new HIV reactive results, inform paediatric HIV team by phone (before informing patient of positive result)
  - confirmatory tests on a second sample will be required
  - result must be given personally to patient in a confidential environment and in a clear and direct manner
  - arrange urgent follow-up appointment with paediatric infectious diseases

Table 1: Clinical indicator diseases for HIV infection

System	AIDS-defining conditions	Other conditions where HIV testing should be considered
ENT		• Chronic parotitis • Recurrent and/or troublesome ear infections
Oral		• Recurrent oral candidiasis • Poor dental hygiene
Respiratory	• Pneumocystis • CMV pneumonitis • Tuberculosis	• Recurrent bacterial pneumonia • Lymphoid interstitial pneumonitis • Bronchiectasis
Neurology	• HIV encephalopathy meningitis/encephalitis	• Developmental delay • Childhood stroke
Dermatology	• Kaposi's sarcoma	• Severe/recalcitrant dermatitis • Multidermatomal or recurrent herpes zoster • Recurrent fungal infections • Extensive warts or molluscum contagiosum
Gastroenterology	• Wasting syndrome • Persistent cryptosporidiosis	• Unexplained persistent hepatosplenomegaly • Hepatitis B infection • Hepatitis C infection
Oncology	• Lymphoma • Kaposi's sarcoma	
Haematology		• Any unexplained blood dyscrasia including: • thrombocytopenia • neutropenia • lymphopenia
Ophthalmology	• Cytomegalovirus retinitis	• Any unexplained retinopathy
Other		• Recurrent bacterial infections (e.g. meningitis, sepsis, osteomyelitis, pneumonia etc.) • Pyrexia of unknown origin

Flowchart: Management of severe hyperkalaemia with ECG changes



Never give calcium salts through same IV line as sodium bicarbonate

INTRODUCTION

- Normal serum potassium (K^+) level is 3.5–5.5 mmol/L
- Neonates tolerate higher potassium levels quite well
- if serum K^+ high, ascertain not due to haemolysed sample; if unsure repeat sample
- if potassium <7.5 mmol/L: arrhythmia unusual

Serum K^+ 5.5–6.5 mmol/L

- Monitor strict fluid balance including urine output
- Check serum U&Es
- Remove extraneous sources of K^+ in feeds and/or fluids

Serum K^+ 6.5–7.5 mmol/L

- As above; perform ECG (electrocardiogram) looking for T-wave changes (tall, peaked T-waves and ST segment depression)
- Discuss further management with consultant
- Seek senior advice regarding treatment with calcium resonium 250 mg/kg/dose (maximum 15 g) given via NG/PR 6-hrly until serum K^+ <6.5 mmol/L

HYPERKALAEMIA ● 2/2

Serum K^+ >7.5 mmol/L: see flowchart and text below

- Urgent continuous ECG monitoring. Look for changes above as well as:
- prolonged PR
- diminished P waves
- widening of QRS complexes
- sine waves
- ventricular tachycardia
- ventricular fibrillation/asystole may ensue unless treated

TREATMENT

- If ECG changes and hyperkalaemia
- administer calcium gluconate 10% 0.5 mL/kg (0.11 mmol/kg) (maximum 20 mL = 4.5 mmol) over 5 min to stabilise myocardium
- give undiluted
- effect occurs within minutes and duration of action is around 1 hr
- repeat within 5–10 min as necessary

OTHER EMERGENCY MEASURES

Nebulised salbutamol

- 2.5–10 mg depending on age of child

Calcium resonium

- 250 mg/kg/dose (maximum 15 g) given via NG/PR
- if expelled from rectum within 30 min repeat
- unpalatable by mouth
- aims to remove potassium from body
- takes 4 hr for full effect
- always repeat potassium after initial therapy and if falling continue calcium resonium 6-hrly,
  - if not plan dialysis
- total daily dose of calcium resonium 1 g/kg; maximum dose 60 g/day by mouth **OR** 30 g/day PR
- continue until K^+ <5.5 mmol/L

Never give calcium salts through same line as sodium bicarbonate

Sodium bicarbonate

- If pH <7.35 give sodium bicarbonate 1–2 mmol/kg (1 mmol = 1 mL of 8.4% solution, dilute 1:5 in glucose 5%) as slow infusion over 30 min
- works best in acidotic patients
- if sepsis/renal failure check serum calcium – hyperkalaemia can be accompanied by hypocalcaemia
- if bicarbonate used then ionised calcium fraction is lowered rapidly and may lead to
  - tetany
  - convulsions
  - hypotension
  - arrhythmias
- monitor calcium regularly

Glucose insulin infusion

- commence if pH >7.35
- If peripheral access: glucose 10% 5–10 mL/kg/hr;
- central access: glucose 20% 2.5–5 mL/kg/hr
- Maintain blood glucose 10–15 mmol/L
- Physiological homeostasis increases endogenous insulin production
- If blood sugar >15 mmol/L, add insulin after 1 hr

- Novorapid® (soluble insulin) 50 units in 50 mL of sodium chloride 0.9% (1 unit/mL) and commence infusion at 0.05 mL/kg/hr
- maintain blood glucose 10–15 mmol/L by adjusting infusion rate in 0.05 mL/kg/hr steps
- can cause hypoglycaemia – measure blood sugar 15 min after start and then every 30 min until stable

HYPERNATREMIA ● 1/5

BACKGROUND

- Defined as serum sodium level >145 mmol/L
- Normal serum sodium level is 135–145 mmol/L
- Classified as:
  - mild (146–149 mmol/L)
  - moderate (150–169 mmol/L)
  - severe (≥170 mmol/L)
- Moderate to severe hypernatremia can lead to
  - acute brain shrinkage with vascular rupture
  - haemorrhage
  - demyelination
  - permanent neurological injury
- Chronic hypernatremia (>48 hr) is often well tolerated and asymptomatic due to cerebral compensation
- Infants and small children are more vulnerable to hypernatremia due to greater insensible losses and inability to communicate their need for fluids or access fluids independently

CAUSES OF HYPERNATREMIA

Water deficit

Common

- Gastrointestinal loss e.g. diarrhoea, stomal losses
- Skin loss (excess sweating/burns)
- Renal losses e.g. osmotic diuretics, diabetes mellitus, polyuria of acute tubular necrosis
- Inability to obtain water, including breastfed babies due to inadequate milk supply

Less common

- Diabetes insipidus (central, nephrogenic, systemic disease, drugs)
- Increased insensible losses
- Impaired thirst mechanism secondary to underlying neurological abnormalities or hypothalamic dysfunction

Sodium excess

- Ingestion of high sodium (inappropriate formula concentration, high osmolality rehydration solutions, salt poisoning)
- Latrogenic (hypertonic saline, sodium bicarbonate)
- Hyperaldosteronism
  - primary (Conn's syndrome)
  - secondary (congestive cardiac failure (CCF), nephrotic syndrome, steroids)

SYMPTOMS AND SIGNS

Red flag signs

- Irritability
- High pitched cry
- Altered mental status
- Lethargy
- Seizures
- Hyperreflexia
- Coma

History

- Fluid intake: detailed breast/formula/PEG feeding history – check feed concentration
- Fluid losses: GI, renal (polyuria), skin
- History of a midline brain defect and renal disease
- Medications (e.g on diuretics, desmopressin, hypertonic fluids)

Examination

- Assess hydration status
- Weigh bare child and compare with recent (<2 weeks) weight recording (if available)
  - serial weight measurements during treatment (up to every 6 hr depending on severity) are most helpful

- Clinical assessment of hydration status may be unreliable in chronic or severe hypernatremia where clinical signs may underestimate degree of hypovolaemia
- Non-specific initial signs:
- irritability
- restlessness
- weakness
- Followed by:
- vomiting
- muscular twitching
- fever
- doughy skin
- high pitched crying and tachypnoea in infants
- appearance of red flag signs with hypernatremia progressing to moderate or severe

INVESTIGATIONS

Initial tests

- U&E
- Serum calcium
- Magnesium
- Phosphate
- Albumin
- Plasma glucose
- Paired serum and urine osmolality
- Sodium
- Creatinine
- Urine dipstick (for quick check of osmolality when laboratory results delayed)
- Blood gas
- ionised sodium level is preferred over laboratory value in presence of hypoalbuminemia

Other tests

- Discuss with senior paediatrician
- cortisol
- aldosterone
- anti-diuretic hormone
- adrenocorticotropic Hormone
- consider brain imaging (CT/MRI) in severe hypernatremia, to rule out hypothalamic lesion affecting thirst centre

Table 1: Evaluation of hypernatremia using paired serum and urine osmolality

Urine osmolality < serum osmolality	Urine osmolality > serum osmolality
• Indicates defect in mechanism of concentrating urine	• Indicates intact urinary concentration
Causes • Central diabetes insipidus • Nephrogenic diabetes insipidus • Renal disease • Osmotic diuresis	Causes • Gastrointestinal losses • Increased insensible losses e.g. burns, excess sodium intake

MANAGEMENT

Urgent steps

- Recognise shock and treat as per APLS protocol
- Once circulating volume is restored, start maintenance IV fluid infusion with sodium chloride 0.9% + glucose 5%
- Rate of correction of hypernatremia should not exceed 0.5 mmol/L/hr, i.e., 10–12 mmol/L per day, to avoid cerebral oedema, seizures and permanent neurological injury

Any child with severe hypernatremia (≥170 mmol/L) is medical emergency – contact PICU team urgently

Mild hypernatremia (146–149 mmol/L)
- Manage underlying cause and repeat U&E in 4–6 hr

Moderate hypernatremia (150–169 mmol/L)
General principles
Treatment dependent on underlying causes *(see* **Treatment of moderate hypernatremia due to water deficit** and **Treatment of moderate hypernatremia due to sodium excess)**
- Strict intake – output monitoring is key
- Restrict and record oral fluid intake (thirst can be excessive)
- Cease any feed fortifications e.g. extra scoops of formula/polyjoule
- Monitor fluid status with urine output and repeated weights (weigh at least daily, and up to 6-hrly)
- If sodium level is decreasing at an appropriate rate repeat U&E 1–2 hr after initial management then 4–6 hrly
- If decrease in sodium is too rapid (>0.5 mmol/L/hr), cease/reduce rate of fluids and seek expert advice early
- If hypernatremia worsens/is unchanged, seek expert advice about hypotonic solutions
- Monitor neurological status closely

A. Treatment of moderate hypernatremia due to water deficit
- Total fluid requirement = maintenance + replacement of deficit + replacement of ongoing losses
- Maintenance fluid (to be replaced over 24 hr) =
- use Holiday Segar formula for calculating fluid rate in infant and children
  - newborn babies aged <28 days: if still in NICU calculate maintenance fluid as per NICU protocol
  - aged <28 days old babies presenting to paediatric ED/ward, calculate as per NICE guideline of intravenous fluid therapy in children and young people in hospital

Holliday-Segar formula
Formula for maintenance fluids

Weight (kg)	Water (mL/day)	Water (mL/kg)	Electrolytes (mmol/L H_2O)
0–10	100/kg	4/kg	Sodium 30, Potassium 20
11–20	1000 + 50/kg for each kg >10	40 + 2/kg for each kg >10	Sodium 30, Potassium 20
>20	1500 + 20/kg for each kg >20	60 + 1/kg for each kg >20	Sodium 30, Potassium 20

Example
23 kg child requires:
- 100 mL/kg for first 10 kg = 1000 mL/day
- +50 mL/kg for second 10 kg = 500 mL/day
- +20 mL/kg for remaining 3 kg = 60 mL/day
- Total daily requirement = 1560/day = 65 mL/hr

Holliday-Segar Maintenance Fluid Calculator: https://medicalculators.com/maintenance-fluid-calculations

Deficit calculation (to be replaced over 48 hr) = body weight x % of dehydration x 10

Percentage dehydration = $\frac{\text{well weight (kg)} - \text{current weight (kg)}}{\text{well weight}} \times 100$

Replacement of ongoing losses = replace mL by mL with sodium chloride 0.9%
- Choice of IV fluid: sodium chloride 0.9% and glucose 5%
- Once urine output established, add potassium to IV fluid prescription
- If sodium level increasing/unchanged in 1–2 hr, contact PICU for further advice
- If diabetes insipidus suspected, involve tertiary endocrine team

- If seizures occur
- suspect venous sinus thrombosis/cerebral infarction
- imaging with contrast CT scan required
- contact ICU – may need hypertonic saline to slow rapid decrease in sodium level

B. Treatment of moderate hypernatremia due to sodium excess

- Identify source and reduce excess sodium intake
- Get expert advice, regarding need for any hypotonic fluid (e.g., sodium chloride 0.45%), or dialysis if overloaded

Severe hypernatremia

- Assess airway, breathing, circulation and manage accordingly
- Seek urgent advice from PICU team

Indications for transfer to PICU

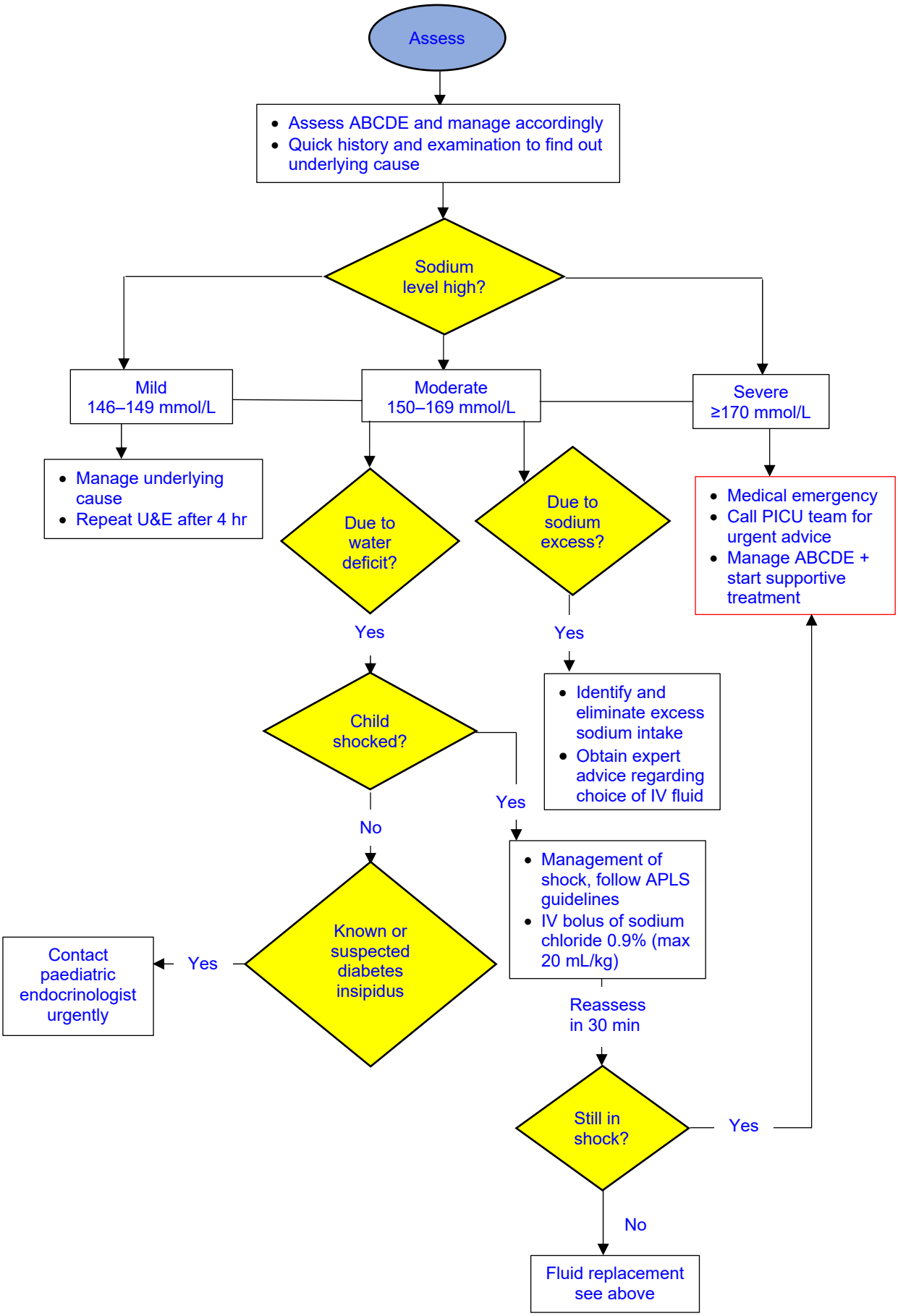
- Hypernatremia where cause is unclear
- Hypernatremia ≥170 mmol/L
- Displaying neurological symptoms
- Not responding to treatment as expected
- Requiring care beyond comfort level of hospital

Discharge criterion

- Cause for hypernatremia identified and treated adequately

FLOWCHART

See also Intravenous fluid therapy guideline



RECOGNITION AND ASSESSMENT

Diagnosis

Diagnosis is difficult because symptoms can be minimal and often go unrecognised

Definition

- Depends on age, sex and height of child
- Measure on ≥3 separate occasions with auscultatory method (if possible)
- Normal: systolic and diastolic BP <90th centile for age, sex and height
- High normal: systolic and diastolic BP between 90th and 95th centile for age, sex and height (>120/80 mmHg even if below 90th centile in adolescents)
- Hypertension: > 95th centile for age, height and sex
- Stage 1 hypertension: 95th–99th centile **plus** 5 mmHg
- Stage 2 hypertension: >99th centile **plus** 5 mmHg **and** symptoms

Symptoms and signs

Hypertension

- Most cases are asymptomatic and picked up incidentally
- Severe hypertension can cause:
- loss of consciousness
- seizure
- hemiplegia
- facial palsy
- Listed in order of frequency with common presenting features first:
- infants
  - congestive cardiac failure
  - respiratory distress
  - failure to thrive, vomiting
  - irritability
  - seizures
- older children
  - headaches
  - nausea, vomiting
  - hypertensive encephalopathy (see below)
  - polydipsia, polyuria
  - visual problems
  - tiredness, irritability
  - cardiac failure
  - facial palsy
  - hemiplegia
  - epistaxis
  - poor growth, weight loss
  - cardiac murmur
  - abdominal pain

Hypertensive encephalopathy (accelerated hypertension)

- Any neurological sign associated with grossly elevated blood pressure, most commonly:
- severe generalised headache
- visual disturbance (+/- retinal changes)/blindness
- seizure
- posterior reversible encephalopathy syndrome (PRES)

Do not delay initiation of treatment pending investigations once diagnosis has been made

History

- Family history of hypertension, cardiovascular and cerebrovascular disease, hereditary renal and endocrine disease
- Past history of renal, cardiac, endocrine or neurological problems

- Presenting complaints as listed above
- Drug intake such as corticosteroids, ciclosporin, tacrolimus, methylphenidate, antidepressants

Examination

- Staging of BP level and clinical review of child helps clinician to decide speed at which evaluation, treatment and referral is needed
- Detailed clinical examination of all systems
- **Do not** forget fundoscopy
- Height and weight
- Skin for neurocutaneous stigmata
- Check for cardiovascular causes
- femoral pulses
- right arm and leg blood pressure
- Thyroid status
- Disorder of sexual differentiation
- Cushingoid
- Abdominal bruit

Investigations

- Aims of investigations to:
- define aetiology
- assess
  - presence and severity of target organ damage
  - comorbidities

Recommended in all cases

- Urine dipstick for any protein and blood
- Urine culture for infection
- Full blood count
- Serum urea, creatinine and electrolytes
- Thyroid stimulating hormone
- Abdominal, renal and urinary tract ultrasound
- Echocardiography

Assessing comorbidities

- Random urine microalbumin
- Uric acid
- Lipid profile
- Fasting glucose and HbA_{1c}
- Fundoscopy

Further investigations as indicated and based on specialist advice

- Glomerulonephritis screen e.g. C3, C4, ANA, ANCA
- 24 hr urine collection for sodium
- Peripheral plasma renin and plasma aldosterone
- Plasma cortisol
- DMSA scan
- Urine and plasma catecholamines or metanephrines
- Renal colour Doppler ultrasonography
- Urinary steroid profile
- Sleep study
- MR angiography of abdominal aorta
- CT angiography
- Metaiodobenzylguanidine scanning
- Digital subtraction angiography of abdominal aorta and renal vessels
- Selective renal vein renin measurement

- Genetic studies

Differential diagnosis

- Incorrectly sized (too small) or placed BP cuff
- Transient hypertension secondary to pain, anxiety, distress,
- White coat hypertension

IMMEDIATE TREATMENT

Management of hypertensive emergency

- Hypertension with features of target organ damage e.g. hypertensive encephalopathy, congestive heart failure, acute kidney injury, papilloedema and/or retinal haemorrhage

Urgent treatment necessary, but bring BP under control slowly

- Abrupt BP reduction can result in cerebral ischaemia with the risk of permanent neurological sequelae (especially blindness) owing to failure of cerebral auto-regulation after sustained elevation of BP
- Excess BP = actual BP – acceptable BP (**Table 1** and **2**)
- 'acceptable BP' given by the 90th percentile according to height
- Reduce BP gradually. Aim to reduce 'excess BP' by ⅓ in first 12 hr, another ⅓ in next 12 hr, and final ⅓ in next 24 hr
- Mark target BP ranges on chart so nurses know when to ask a doctor to review
- Monitor perfusion: may need volume expansion in first 12 hr if rapid BP drop
- Discuss choice of drug treatment with **consultant**
- Options comprise in following order: (**Table 3**)
- **labetalol** infusion
  - starting dose 0.5–1 mg/kg/hr
  - increase by 1 mg/kg/hr every 15–30 min until effective
  - maximum dose 3 mg/kg/hr (maximum 120 mg/hr)
  - stop infusion when effective
  - restart as BP starts to rise again
  - normally lasts 4–6 hr
- **sodium nitroprusside** infusion
  - give in high dependency or intensive care unit as close BP monitoring (intra-arterial) required
  - starting dose 500 nanogram/kg/min
  - increase in increments of 200 nanogram/kg/min
  - maximum 8 microgram/kg/min for first 24 hr, reducing to 4 microgram/kg/min thereafter
  - only effective whilst infused as short half-life
  - protect infusion from light
  - stop infusion slowly over 15–30 min to avoid any rebound effects
- **hydralazine** infusion (or bolus as alternative) **– please check BNFc for dose**
- **nifedipine** oral (not first line for encephalopathy)
  - 200–300 microgram/kg 8-hrly (maximum 3 mg/kg/day or 90 mg/day)
  - avoid quick acting, use modified release to prevent large drop in BP
  - can be crushed but may have more rapid onset
  - may be used to clip peaks of BP
  - dose varies with product; check with pharmacy

SUBSEQUENT MANAGEMENT

Essential hypertension

- High normal BP
- non pharmacological measures such as weight loss, dietary modification (low salt diet), exercise
- give medication (**Table 3**) only if compelling indications such as if symptomatic, diabetes mellitus, heart failure, left ventricular hypertrophy
- Stage 1 hypertension
- non pharmacological measures
- give medications (**Table 3**) if symptomatic, presence of end organ damage, diabetes, persistent hypertension despite non pharmacological measures

- Stage 2 hypertension
- non pharmacological measures
- start medications
  - options include ACE inhibitors, alpha-blockers, beta blockers, calcium channel blockers and thiazide diuretics (see **BNFc** and **Table 3**)
- add drug therapy only after discussion with a consultant

Renal hypertension

- In children with impaired renal function, keep BP within same target range as for children with normal renal function

- See **Table 1** and **2**

OUTPATIENT MANAGEMENT

Table 1: Blood pressure (BP) for boys by age and height percentiles

		Systolic (mmHg) percentile of height							Diastolic (mmHg) percentile of height						
Age (yr)	**BP percentile**	**5%**	**10%**	**25%**	**50%**	**75%**	**90%**	**95%**	**5%**	**10%**	**25%**	**50%**	**75%**	**90%**	**95%**
1	Height (in)	30.4	30.8	31.6	32.4	33.3	34.1	34.6	30.4	30.8	31.6	32.4	33.3	34.1	34.6
	Height (cm)	77.2	78.3	80.2	82.4	84.6	86.7	87.9	77.2	78.3	80.2	82.4	84.6	86.7	87.9
	50th	85	85	86	86	87	88	88	40	40	40	41	41	42	42
	90th	98	99	99	100	100	101	101	52	52	53	53	54	54	54
	95th	102	102	103	103	104	105	105	54	54	55	55	56	57	57
	95th+12 mmHg	114	114	115	115	116	117	117	66	66	67	67	68	69	69
2	Height (in)	33.9	34.4	35.3	36.3	37.3	38.2	38.8	33.9	34.4	35.3	36.3	37.3	38.2	38.8
	Height (cm)	86.1	87.4	89.6	92.1	94.7	97.1	98.5	86.1	87.4	89.6	92.1	94.7	97.1	98.5
	50th	87	87	88	89	89	90	91	43	43	44	44	45	46	46
	90th	100	100	101	102	103	103	104	55	55	56	56	57	58	58
	95th	104	105	105	106	107	107	108	57	58	58	59	60	61	61
	95th+12 mmHg	116	117	117	118	119	119	120	69	70	70	71	72	73	73
3	Height (in)	36.4	37	37.9	39	40.1	41.1	41.7	36.4	37	37.9	39	40.1	41.1	41.7
	Height (cm)	92.5	93.9	96.3	99	101.8	104.3	105.8	92.5	93.9	96.3	99	101.8	104.3	105.8
	50th	88	89	89	90	91	92	92	45	46	46	47	48	49	49
	90th	101	102	102	103	104	105	105	58	58	59	59	60	61	61
	95th	106	106	107	107	108	109	109	60	61	61	62	63	64	64
	95th+12 mmHg	118	118	119	119	120	121	121	72	73	73	74	75	76	76
4	Height (in)	38.8	39.4	40.5	41.7	42.9	43.9	44.5	38.8	39.4	40.5	41.7	42.9	43.9	44.5
	Height (cm)	98.5	100.2	102.9	105.9	108.9	111.5	113.2	98.5	100.2	102.9	105.9	108.9	111.5	113.2
	50th	90	90	91	92	93	94	94	48	49	49	50	51	52	52
	90th	102	103	104	105	105	106	107	60	61	62	62	63	64	64
	95th	107	107	108	108	109	110	110	63	64	65	66	67	67	68
	95th+12 mmHg	119	119	120	120	121	122	122	75	76	77	78	79	79	80
5	Height (in)	41.1	41.8	43	44.3	45.5	46.7	47.4	41.1	41.8	43	44.3	45.5	46.7	47.4
	Height (cm)	104.4	106.2	109.1	112.4	115.7	118.6	120.3	104.4	106.2	109.1	112.4	115.7	118.6	120.3
	50th	91	92	93	94	95	96	96	51	51	52	53	54	55	55
	90th	103	104	105	106	107	108	108	63	64	65	65	66	67	67
	95th	107	108	109	109	110	111	112	66	67	68	69	70	70	71
	95th+12 mmHg	119	120	121	121	122	123	124	78	79	80	81	82	82	83
6	Height (in)	43.4	44.2	45.4	46.8	48.2	49.4	50.2	43.4	44.2	45.4	46.8	48.2	49.4	50.2
	Height (cm)	110.3	112.2	115.3	118.9	122.4	125.6	127.5	110.3	112.2	115.3	118.9	122.4	125.6	127.5
	50th	93	93	94	95	96	97	98	54	54	55	56	57	57	58
	90th	105	105	106	107	109	110	110	66	66	67	68	68	69	69
	95th	108	109	110	111	112	113	114	69	70	70	71	72	72	73
	95th+12 mmHg	120	121	122	123	124	125	126	81	82	82	83	84	84	85
7	Height (in)	45.7	46.5	47.8	49.3	50.8	52.1	52.9	45.7	46.5	47.8	49.3	50.8	52.1	52.9
	Height (cm)	116.1	118	121.4	125.1	128.9	132.4	134.5	116.1	118	121.4	125.1	128.9	132.4	134.5
	50th	94	94	95	97	98	98	99	56	56	57	58	58	59	59
	90th	106	107	108	109	110	111	111	68	68	69	70	70	71	71
	95th	110	110	111	112	114	115	116	71	71	72	73	73	74	74
	95th+12 mmHg	122	122	123	124	126	127	128	83	83	84	85	85	86	86
8	Height (in)	47.8	48.6	50	51.6	53.2	54.6	55.5	47.8	48.6	50	51.6	53.2	54.6	55.5
	Height (cm)	121.4	123.5	127	131	135.1	138.8	141	121.4	123.5	127	131	135.1	138.8	141
	50th	95	96	97	98	99	99	100	57	57	58	59	59	60	60
	90th	107	108	109	110	111	112	112	69	70	70	71	72	72	73
	95th	111	112	112	114	115	116	117	72	73	73	74	75	75	75
	95th+12 mmHg	123	124	124	126	127	128	129	84	85	85	86	87	87	87
9	Height (in)	49.6	50.5	52	53.7	55.4	56.9	57.9	49.6	50.5	52	53.7	55.4	56.9	57.9
	Height (cm)	126	128.3	132.1	136.3	140.7	144.7	147.1	126	128.3	132.1	136.3	140.7	144.7	147.1
	50th	96	97	98	99	100	101	101	57	58	59	60	61	62	62
	90th	107	108	109	110	112	113	114	70	71	72	73	74	74	74
	95th	112	112	113	115	116	118	119	74	74	75	76	76	77	77
	95th+12 mmHg	124	124	125	127	128	130	131	86	86	87	88	88	89	89

		Systolic (mmHg) percentile of height							Diastolic (mmHg) percentile of height						
Age (yr)	**BP percentile**	**5%**	**10%**	**25%**	**50%**	**75%**	**90%**	**95%**	**5%**	**10%**	**25%**	**50%**	**75%**	**90%**	**95%**
10	Height (in)	51.3	52.2	53.8	55.6	57.4	59.1	60.1	51.3	52.2	53.8	55.6	57.4	59.1	60.1
	Height (cm)	130.2	132.7	136.7	141.3	145.9	150.1	152.7	130.2	132.7	136.7	141.3	145.9	150.1	152.7
	50th	97	98	99	100	101	102	103	59	60	61	62	63	63	64
	90th	108	109	111	112	113	115	116	72	73	74	74	75	75	76

	95th	112	113	114	116	118	120	121	76	76	77	77	78	78	78
	95th+12 mmHg	124	125	126	128	130	132	133	88	88	89	89	90	90	90
11	Height (in)	53	54	55.7	57.6	59.6	61.3	62.4	53	54	55.7	57.6	59.6	61.3	62.4
	Height (cm)	134.7	137.3	141.5	146.4	151.3	155.8	158.6	134.7	137.3	141.5	146.4	151.3	155.8	158.6
	50th	99	99	101	102	103	104	106	61	61	62	63	63	63	63
	90th	110	111	112	114	116	117	118	74	74	75	75	75	76	76
	95th	114	114	116	118	120	123	124	77	78	78	78	78	78	78
	95th+12 mmHg	126	126	128	130	132	135	136	89	90	90	90	90	90	90
12	Height (in)	55.2	56.3	58.1	60.1	62.2	64	65.2	55.2	56.3	58.1	60.1	62.2	64	65.2
	Height (cm)	140.3	143	147.5	152.7	157.9	162.6	165.5	140.3	143	147.5	152.7	157.9	162.6	165.5
	50th	101	101	102	104	106	108	109	61	62	62	62	62	63	63
	90th	113	114	115	117	119	121	122	75	75	75	75	75	76	76
	95th	116	117	118	121	124	126	128	78	78	78	78	78	79	79
	95th+12 mmHg	128	129	130	133	136	138	140	90	90	90	90	90	91	91
13	Height (in)	57.9	59.1	61	63.1	65.2	67.1	68.3	57.9	59.1	61	63.1	65.2	67.1	68.3
	Height (cm)	147	150	154.9	160.3	165.7	170.5	173.4	147	150	154.9	160.3	165.7	170.5	173.4
	50th	103	104	105	108	110	111	112	61	60	61	62	63	64	65
	90th	115	116	118	121	124	126	126	74	74	74	75	76	77	77
	95th	119	120	122	125	128	130	131	78	78	78	78	80	81	81
	95th+12 mmHg	131	132	134	137	140	142	143	90	90	90	90	92	93	93
14	Height (in)	60.6	61.8	63.8	65.9	68	69.8	70.9	60.6	61.8	63.8	65.9	68	69.8	70.9
	Height (cm)	153.8	156.9	162	167.5	172.7	177.4	180.1	153.8	156.9	162	167.5	172.7	177.4	180.1
	50th	105	106	109	111	112	113	113	60	60	62	64	65	66	67
	90th	119	120	123	126	127	128	129	74	74	75	77	78	79	80
	95th	123	125	127	130	132	133	134	77	78	79	81	82	83	84
	95th+12 mmHg	135	137	139	142	144	145	146	89	90	91	93	94	95	96
15	Height (in)	62.6	63.8	65.7	67.8	69.8	71.5	72.5	62.6	63.8	65.7	67.8	69.8	71.5	72.5
	Height (cm)	159	162	166.9	172.2	177.2	181.6	184.2	159	162	166.9	172.2	177.2	181.6	184.2
	50th	108	110	112	113	114	114	114	61	62	64	65	66	67	68
	90th	123	124	126	128	129	130	130	75	76	78	79	80	81	81
	95th	127	129	131	132	134	135	135	78	79	81	83	84	85	85
	95th+12 mmHg	139	141	143	144	146	147	147	90	91	93	95	96	97	97
16	Height (in)	63.8	64.9	66.8	68.8	70.7	72.4	73.4	63.8	64.9	66.8	68.8	70.7	72.4	73.4
	Height (cm)	162.1	165	169.6	174.6	179.5	183.8	186.4	162.1	165	169.6	174.6	179.5	183.8	186.4
	50th	111	112	114	115	115	116	116	63	64	66	67	68	69	69
	90th	126	127	128	129	131	131	132	77	78	79	80	81	82	82
	95th	130	131	133	134	135	136	137	80	81	83	84	85	86	86
	95th+12 mmHg	142	143	145	146	147	148	149	92	93	95	96	97	98	98
17	Height (in)	64.5	65.5	67.3	69.2	71.1	72.8	73.8	64.5	65.5	67.3	69.2	71.1	72.8	73.8
	Height (cm)	163.8	166.5	170.9	175.8	180.7	184.9	187.5	163.8	166.5	170.9	175.8	180.7	184.9	187.5
	50th	114	115	116	117	117	118	118	65	66	67	68	69	70	70
	90th	128	129	130	131	132	133	134	78	79	80	81	82	82	83
	95th	132	133	134	135	137	138	138	81	82	84	85	86	86	87
	95th+12 mmHg	144	145	146	147	149	150	150	93	94	96	97	98	98	99

Table 2: Blood pressure (BP) for girls by age and height percentiles

			Systolic (mmHg) percentile of height						Diastolic (mmHg) percentile of height						
Age (yr)	**BP percentile**	**5%**	**10%**	**25%**	**50%**	**75%**	**90%**	**95%**	**5%**	**10%**	**25%**	**50%**	**75%**	**90%**	**95%**
1	Height (in)	29.7	30.2	30.9	31.8	32.7	33.4	33.9	29.7	30.2	30.9	31.8	32.7	33.4	33.9
	Height (cm)	75.4	76.6	78.6	80.8	83	84.9	86.1	75.4	76.6	78.6	80.8	83	84.9	86.1
	50th	84	85	86	86	87	88	88	41	42	42	43	44	45	46
	90th	98	99	99	100	101	102	102	54	55	56	56	57	58	58
	95th	101	102	102	103	104	105	105	59	59	60	60	61	62	62
	95th+12 mmHg	113	114	114	115	116	117	117	71	71	72	72	73	74	74
2	Height (in)	33.4	34	34.9	35.9	36.9	37.8	38.4	33.4	34	34.9	35.9	36.9	37.8	38.4
	Height (cm)	84.9	86.3	88.6	91.1	93.7	96	97.4	84.9	86.3	88.6	91.1	93.7	96	97.4
	50th	87	87	88	89	90	91	91	45	46	47	48	49	50	51
	90th	101	101	102	103	104	105	106	58	58	59	60	61	62	62
	95th	104	105	106	106	107	108	109	62	63	63	64	65	66	66
	95th+12 mmHg	116	117	118	118	119	120	121	74	75	75	76	77	78	78
3	Height (in)	35.8	36.4	37.3	38.4	39.6	40.6	41.2	35.8	36.4	37.3	38.4	39	40.6	41.2
	Height (cm)	91	92.4	94.9	97.6	100.5	103.1	104.6	91	92.4	94.9	97.6	100.5	103.1	104.6
	50th	88	89	89	90	91	92	93	48	48	49	50	51	53	53
	90th	102	103	104	104	105	106	107	60	61	61	62	63	64	65
	95th	106	106	107	108	109	110	110	64	65	65	66	67	68	69
	95th+12 mmHg	118	118	119	120	121	122	122	76	77	77	78	79	80	81
4	Height (in)	38.3	38.9	39.9	41.1	42.4	43.5	44.2	38.3	38.9	39.9	41.1	42.4	43.5	44.2
	Height (cm)	97.2	98.8	101.4	104.5	107.6	110.5	112.2	97.2	98.8	101.4	104.5	107.6	110.5	112.2
	50th	89	90	91	92	93	94	94	50	51	51	53	54	55	55
	90th	103	104	105	106	107	108	108	62	63	64	65	66	67	67
	95th	107	108	109	109	110	111	112	66	67	68	69	70	70	71
	95th+12 mmHg	119	120	121	121	122	123	124	78	79	80	81	82	82	83
5	Height (in)	40.8	41.5	42.6	43.9	45.2	46.5	47.3	40.8	41.5	42.6	43.9	45.2	46.5	47.3
	Height (cm)	103.6	105.3	108.2	111.5	114.9	118.1	120	103.6	105.3	108.2	111.5	114.9	118.1	120
	50th	90	91	92	93	94	95	96	52	52	53	55	56	57	57
	90th	104	105	106	107	108	109	110	64	65	66	67	68	69	70
	95th	108	109	109	110	111	112	113	68	69	70	71	72	73	73
	95th+12 mmHg	120	121	121	122	123	124	125	80	81	82	83	84	85	85
6	Height (in)	43.3	44	45.2	46.6	48.1	49.4	50.3	43.3	44	45.2	46.6	48.1	49.4	50.3
	Height (cm)	110	111.8	114.9	118.4	122.1	125.6	127.7	110	111.8	114.9	118.4	122.1	125.6	127.7
	50th	92	92	93	94	96	97	97	54	54	55	56	57	58	59
	90th	105	106	107	108	109	110	111	67	67	68	69	70	71	71
	95th	109	109	110	111	112	113	114	70	71	72	72	73	74	74
	95th+12 mmHg	121	121	122	123	124	125	126	82	83	84	84	85	86	86
7	Height (in)	45.6	46.4	47.7	49.2	50.7	52.1	53	45.6	46.4	47.7	49.2	50.7	52.1	53
	Height (cm)	115.9	117.8	121.1	124.9	128.8	132.5	134.7	115.9	117.8	121.1	124.9	128.8	132.5	134.7
	50th	92	93	94	95	97	98	99	55	55	56	57	58	59	60
	90th	106	106	107	109	110	111	112	68	68	69	70	71	72	72
	95th	109	110	111	112	113	114	115	72	72	73	73	74	74	75
	95th+12 mmHg	121	122	123	124	125	126	127	84	84	85	85	86	86	87
8	Height (in)	47.6	48.4	49.8	51.4	53	54.5	55.5	47.6	48.4	49.8	51.4	53	54.5	55.5
	Height (cm)	121	123	126.5	130.6	134.7	138.5	140.9	121	123	126.5	130.6	134.7	138.5	140.9
	50th	93	94	95	97	98	99	100	56	56	57	59	60	61	61
	90th	107	107	108	110	111	112	113	69	70	71	72	72	73	73
	95th	110	111	112	113	115	116	117	72	73	74	74	75	75	75
	95th+12 mmHg	122	123	124	125	127	128	129	84	85	86	86	87	87	87
9	Height (in)	49.3	50.2	51.7	53.4	55.1	56.7	57.7	49.3	50.2	51.7	53.4	55.1	56.7	57.7
	Height (cm)	125.3	127.6	131.3	135.6	140.1	144.1	146.6	125.3	127.6	131.3	135.6	140.1	144.1	146.6
	50th	95	95	97	98	99	100	101	57	58	59	60	60	61	61
	90th	108	108	109	111	112	113	114	71	71	72	73	73	73	73
	95th	112	112	113	114	116	117	118	74	74	75	75	75	75	75
	95th+12 mmHg	124	124	125	126	128	129	130	86	86	87	87	87	87	87

			Systolic (mmHg) percentile of height						Diastolic (mmHg) percentile of height						
Age (yr)	**BP percentile**	**5%**	**10%**	**25%**	**50%**	**75%**	**90%**	**95%**	**5%**	**10%**	**25%**	**50%**	**75%**	**90%**	**95%**
10	Height (in)	51.1	52	53.7	55.5	57.4	59.1	60.2	51.1	52	53.7	55.5	57.4	59.1	60.2
	Height (cm)	129.7	132.2	136.3	141	145.8	150.2	152.8	129.7	132.2	136.3	141	145.8	150.2	152.8
	50th	96	97	98	99	101	102	103	58	59	59	60	61	61	62
	90th	109	110	111	112	113	115	116	72	73	73	73	73	73	73
	95th	113	114	114	116	117	119	120	75	75	76	76	76	76	76
	95th+12 mmHg	125	126	126	128	129	131	132	87	87	88	88	88	88	88
11	Height (in)	53.4	54.5	56.2	58.2	60.2	61.9	63	53.4	54.5	56.2	58.2	60.2	61.9	63
	Height (cm)	135.6	138.3	142.8	147.8	152.8	157.3	160	135.6	138.3	142.8	147.8	152.8	157.3	160
	50th	98	99	101	102	104	105	106	60	60	60	61	62	63	64
	90th	111	112	113	114	116	118	120	74	74	74	74	74	75	75
	95th	115	116	117	118	120	123	124	76	77	77	77	77	77	77
	95th+12 mmHg	127	128	129	130	132	135	136	88	89	89	89	89	89	89
12	Height (in)	56.2	57.3	59	60.9	62.8	64.5	65.5	56.2	57.3	59	60.9	62.8	64.5	65.5
	Height (cm)	142.8	145.5	149.9	154.8	159.6	163.8	166.4	142.8	145.5	149.9	154.8	159.6	163.8	166.4
	50th	102	102	104	105	107	108	108	61	61	61	62	64	65	65
	90th	114	115	116	118	120	122	122	75	75	75	75	76	76	76
	95th	118	119	120	122	124	125	126	78	78	78	78	79	79	79
	95th+12 mmHg	130	131	132	134	136	137	138	90	90	90	90	91	91	91
13	Height (in)	58.3	59.3	60.9	62.7	64.5	66.1	67	58.3	59.3	60.9	62.7	64.5	66.1	67
	Height (cm)	148.1	150.6	154.7	159.2	163.7	167.8	170.2	148.1	150.6	154.7	159.2	163.7	167.8	170.2
	50th	104	105	106	107	108	108	109	62	62	63	64	65	65	66
	90th	116	117	119	121	122	123	123	75	75	75	76	76	76	76
	95th	121	122	123	124	126	126	127	79	79	79	79	80	80	81
	95th+12 mmHg	133	134	135	136	138	138	139	91	91	91	91	92	92	93
14	Height (in)	59.3	60.2	61.8	63.5	65.2	66.8	67.7	59.3	60.2	61.8	63.5	65.2	66.8	67.7
	Height (cm)	150.6	153	156.9	161.3	165.7	169.7	172.1	150.6	153	156.9	161.3	165.7	169.7	172.1
	50th	105	106	107	108	109	109	109	63	63	64	65	66	66	66
	90th	118	118	120	122	123	123	123	76	76	76	76	77	77	77
	95th	123	123	124	125	126	127	127	80	80	80	80	81	81	82
	95th+12 mmHg	135	135	136	137	138	139	139	92	92	92	92	93	93	94
15	Height (in)	59.7	60.6	62.2	63.9	65.6	67.2	68.1	59.7	60.6	62.2	63.9	65.6	67.2	68.1
	Height (cm)	151.7	154	157.9	162.3	166.7	170.6	173	151.7	154	157.9	162.3	166.7	170.6	173
	50th	105	106	107	108	109	109	109	64	64	64	65	66	67	67
	90th	118	119	121	122	123	123	124	76	76	76	77	77	78	78
	95th	124	124	125	126	127	127	128	80	80	80	81	82	82	82
	95th+12 mmHg	136	136	137	138	139	139	140	92	92	92	93	94	94	94
16	Height (in)	59.9	60.8	62.4	64.1	65.8	67.3	68.3	59.9	60.8	62.4	64.1	65.8	67.3	68.3
	Height (cm)	152.1	154.5	158.4	162.8	167.1	171.1	173.4	152.1	154.5	158.4	162.8	167.1	171.1	173.4
	50th	106	107	108	109	109	110	110	64	64	65	66	66	67	67
	90th	119	120	122	123	124	124	124	76	76	76	77	78	78	78
	95th	124	125	125	127	127	128	128	80	80	80	81	82	82	82
	95th+12 mmHg	136	137	137	139	139	140	140	92	92	92	93	94	94	94
17	Height (in)	60	60.9	62.5	64.2	65.9	67.4	68.4	60	60.9	62.5	64.2	65.9	67.4	68.4
	Height (cm)	152.4	154.7	158.7	163	167.4	171.3	173.7	152.4	154.7	158.7	163	167.4	171.3	173.7
	50th	107	108	109	110	110	110	111	64	64	65	66	66	66	67
	90th	120	121	123	124	124	125	125	76	76	77	77	78	78	78
	95th	125	125	126	127	128	128	128	80	80	80	81	82	82	82
	95th+12 mmHg	137	137	138	139	140	140	140	92	92	92	93	94	94	94

Table 3: Drugs commonly used for management of hypertension in children

Drug	Mechanism of action	Advice
Atenolol	Beta-adrenoceptor blocker	• Reduces heart contractility – contraindicated in early stages of hypertensive heart failure • Avoid in confirmed asthmatics
Labetalol	Non-cardioselective beta-blocker with additional alpha-blocking properties	• Combining alpha- and beta-blockade reduces tachycardia that can be a problem without beta-blockade • Contraindicated in asthmatics and in heart failure • Injection can be given orally
Nifedipine	Calcium channel blocker	• Can be used in heart failure as any negative inotropic effect offset by a reduction in left ventricular work • Side effects vasodilatation: flushing and headache, ankle swelling
Amlodipine	Calcium channel blocker	• Does not reduce myocardial contractility or produce clinical deterioration in heart failure • Side effects vasodilatation: flushing and headache, ankle swelling • Tablets disperse in water
Enalapril **or** Captopril solution for younger children	Angiotensin-converting enzyme (ACE) inhibitor	• Recommended in children with renal hypertension. Give small test dose for captopril whilst patient is supine. First dose should be given at night to prevent transient hypotension • In children with impaired renal function, check serum creatinine and potassium 2–3 days after starting treatment and consider withdrawal if they have risen • Contraindicated in renal artery stenosis • Tablets can be crushed and dispersed in water
Losartan	Angiotensin II receptor blocker	• In children with impaired renal function, check serum creatinine and potassium 2–3 days after starting treatment and consider withdrawal if they have risen • Contraindicated in renal artery stenosis
Sodium nitroprusside	Vasodilator	• Use for hypertensive emergencies • Avoid in hepatic or renal impairment • Monitor blood cyanide if used >3 days • Symptoms of cyanide poisoning (sweating, tachycardia, hyperventilation) see Toxbase

HYPOGLYCAEMIA ● 1/7

Management of unexplained and prolonged hypoglycaemia

RECOGNITION AND ASSESSMENT

Definition

- For purpose of guideline hypoglycaemia is defined as blood glucose <3 mmol/L in aged >1 month, **except for children with diabetes blood glucose <4 mmol/L** (see separate guideline for management of hypoglycaemia in children with diabetes if available locally)

Symptoms and signs

- Lethargy
- Jitteriness
- Loss of consciousness
- Seizure
- sweating
- shaking
- tachycardia
- anxiety
- hunger

Previous history

- Ask about:
- antenatal history e.g. small-for-dates, gestational diabetes
- prematurity
- history of neonatal hypoglycaemia
- early or prolonged jaundice
- family history of sudden infant death
- development, especially developmental regression
- medication (steroids)
- access to glycopaenic agents (e.g. insulin)
- onset and frequency of hypoglycaemia
- history of infection/food intake

Investigations

Certain pointers to cause of unexplained hypoglycaemia are detectable only during episode. Take blood samples BEFORE correcting blood glucose

Immediate samples

- Before treating, take blood samples (see **Table 1**)
- Bloods must arrive in laboratory within 30 min
- Write clear clinical details on request form
- If sample volume is limited prioritise glucose, insulin, C-peptide and cortisol
- Request urgent analysis for insulin and C-peptide (discuss with duty biochemist)
- Check blood ketones with ketone stick
- Once samples obtained, correct hypoglycaemia. See **Algorithm 3: Hypoglycaemia immediate treatment**
- Collect first urine voided after correction. Check for ketones using urine dipstick, send remaining urine for organic/amino acid metabolites and reducing substances

Table 1: Total blood requirement (5 mL minimum)

Bottle	Volume	Request for analysis
Fluoride (grey top)	1.3 mL (1 bottle)	Glucose, lactate, beta-hydroxybutyrate, free fatty acids
Lithium heparin (green top)	2.6 mL (2 bottles – 1 bottle on ice)	U&Es, LFTs, blood amino acids, acylcarnitines, ammonia
Clotted (red top)	2.6 mL (2 bottles)	Insulin, C-peptide, growth hormone, cortisol

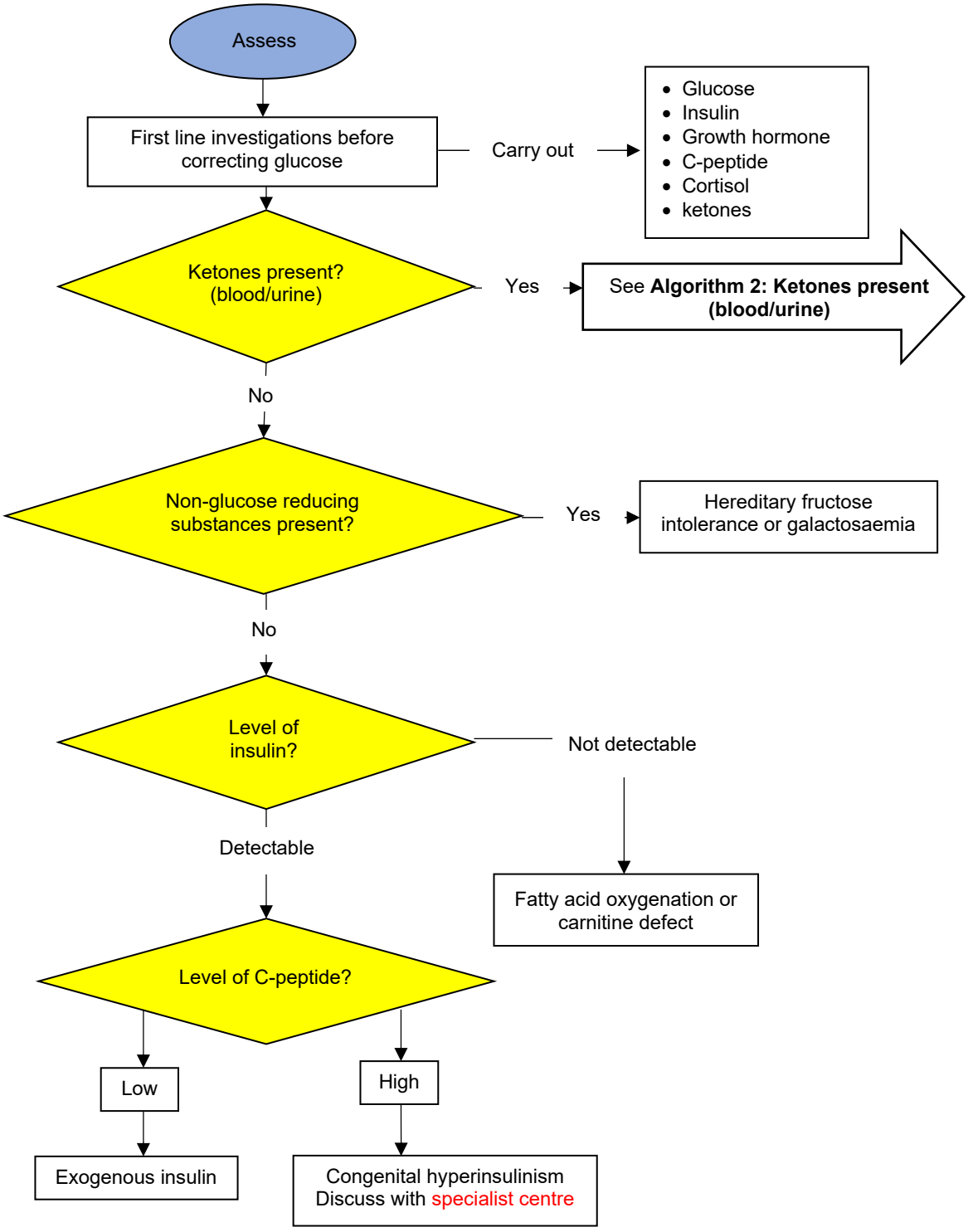
- In all prolonged/recurrent unexplained hypoglycaemia:
- glucose – point of care

- ketones. Urine dipstick or blood ketones stick
- capillary blood gases
- laboratory glucose to confirm hypoglycaemia
- insulin
- C-peptide
- U&E
- growth hormone
- cortisol
- if hyponatraemia present 17-hydroxyprogesterone in infant
  - **if urgent analysis required contact duty biochemist**
- Further investigations may be required, depending on results from above:
- IGF-1
- beta-hydroxybutyrate
- free fatty acids
- carnitines
- urine reducing substances
- urine organic acids
- urine and plasma amino acids

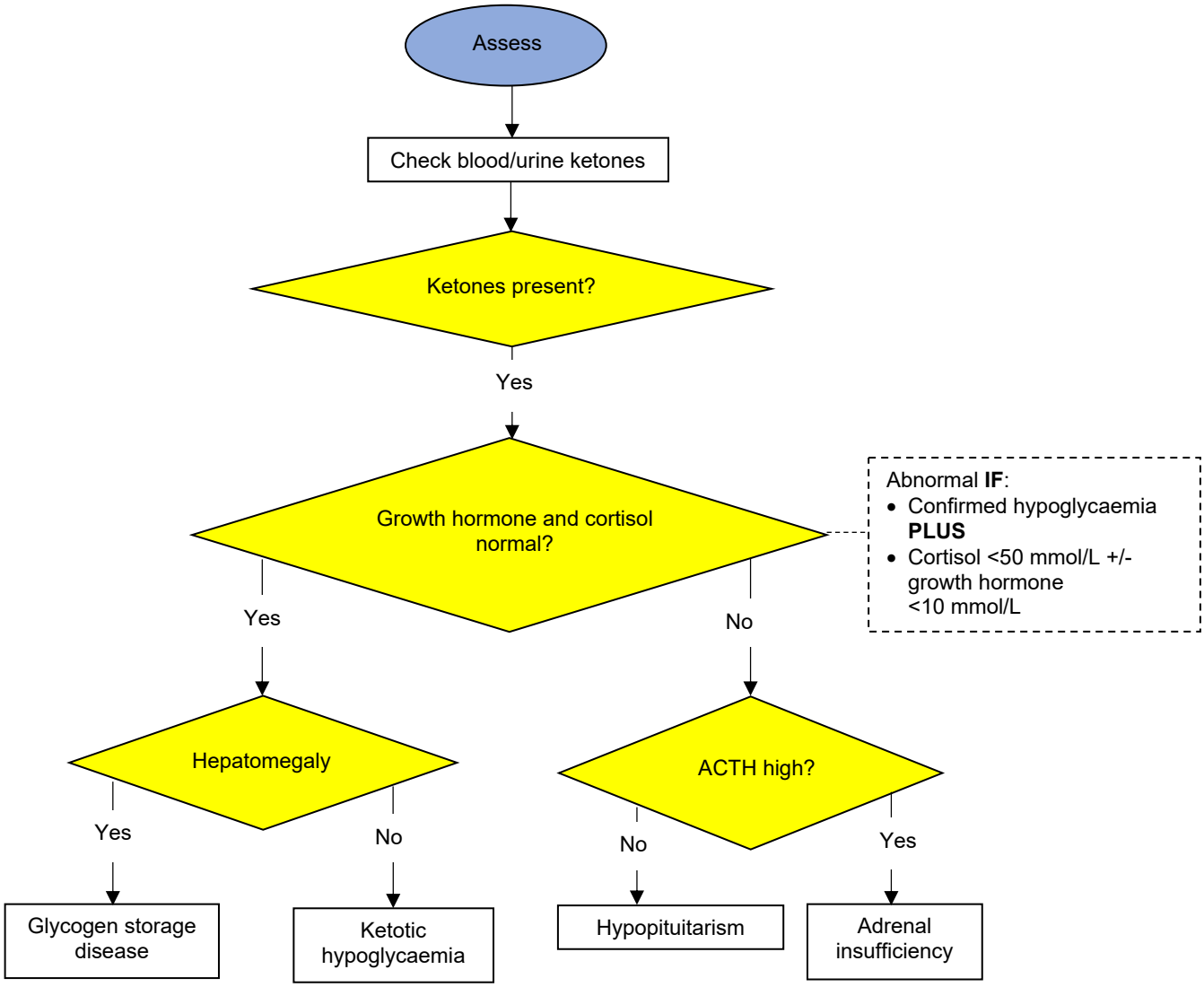
Physical examination

- Height and weight
- Midline defects, micropenis, optic nerve hypoplasia (pituitary disorder)
- Dysmorphic features: macroglossia, macrosomia, ear lobe crease (Beckwith-Wiedemann)
- Skin hyperpigmentation (adrenal insufficiency)
- Hepatomegaly (glycogen storage disorder)

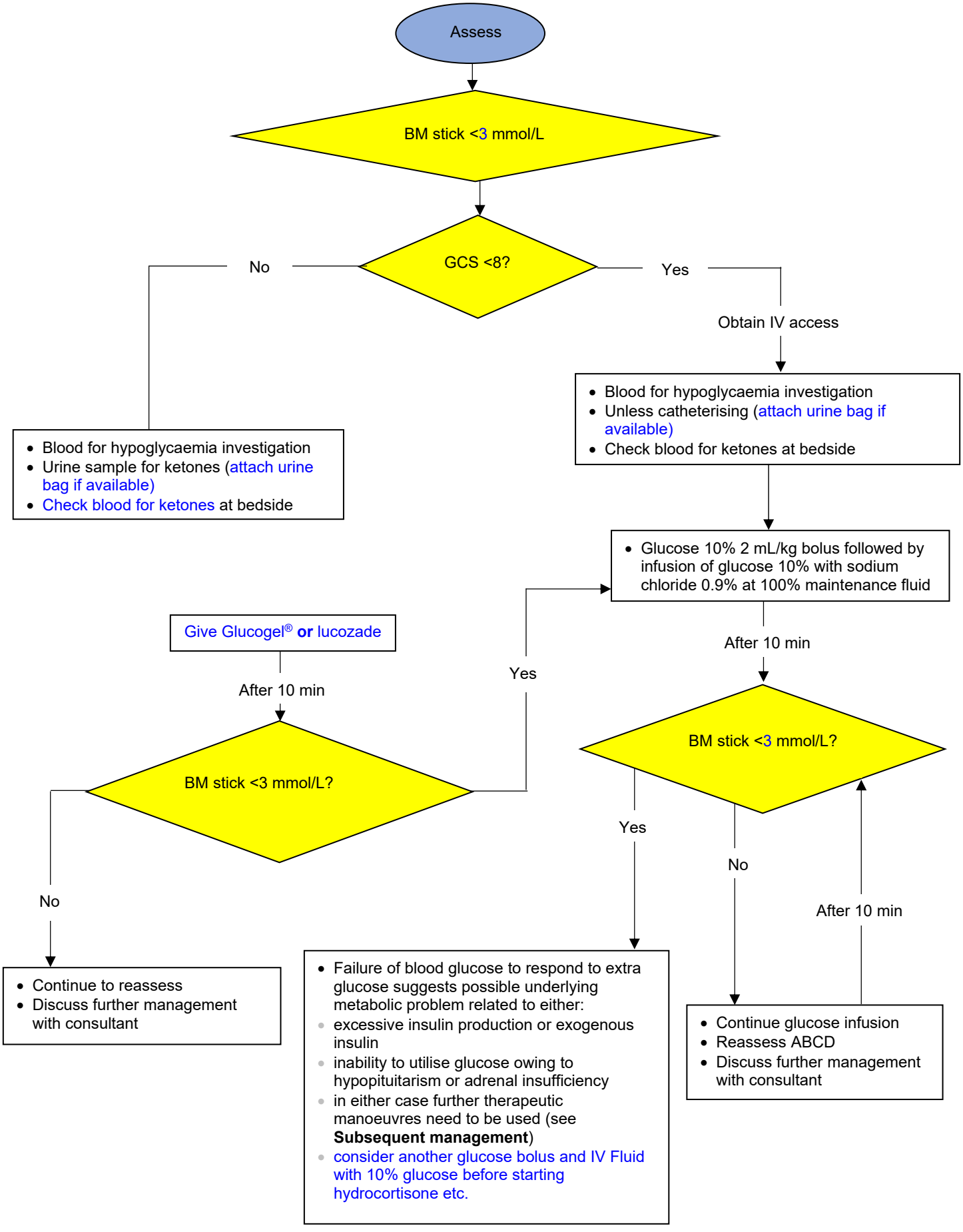
Algorithm 1: Differential diagnosis



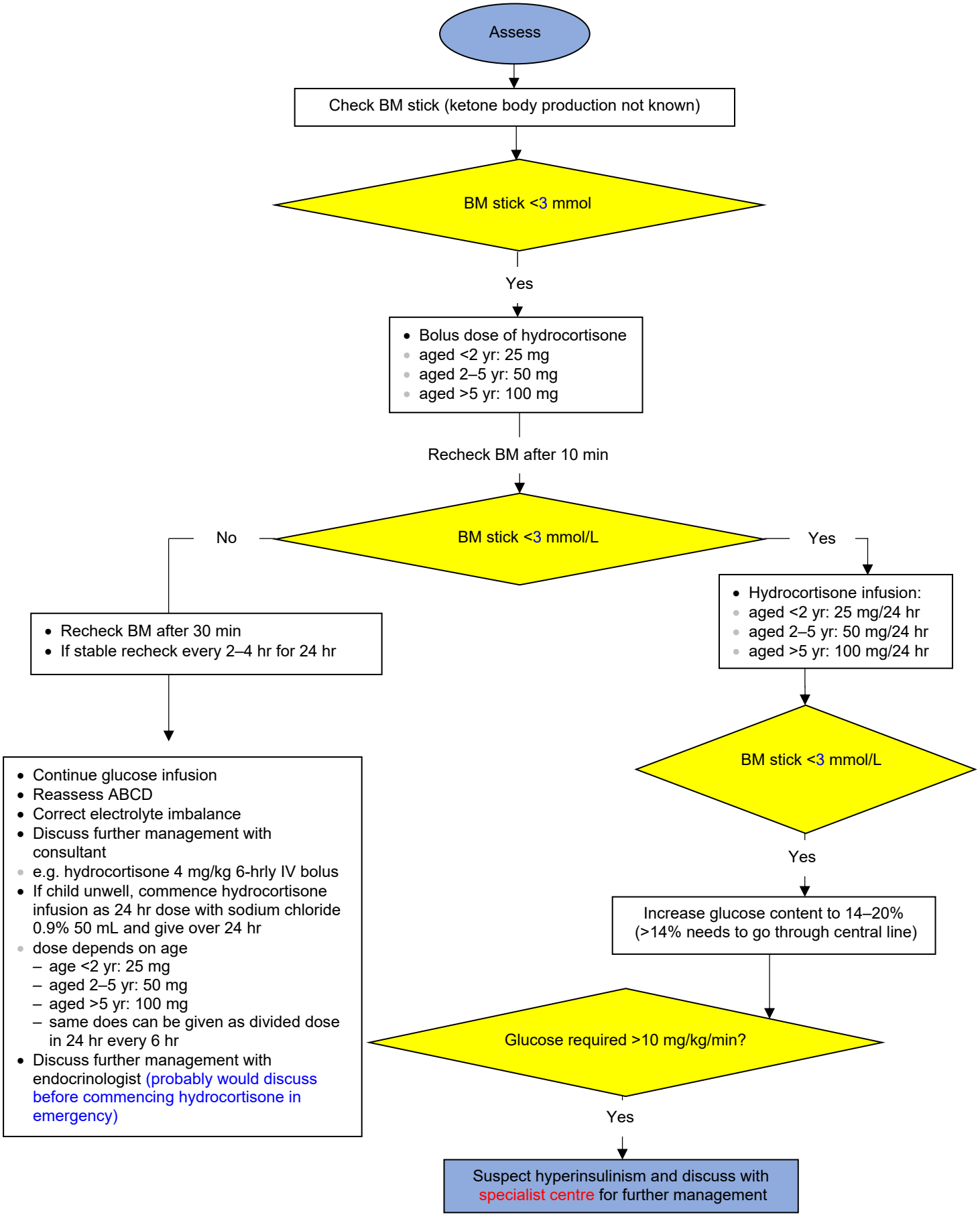
Algorithm 2: Ketones present (blood/urine)



Algorithm 3: Hypoglycaemia immediate treatment



Algorithm 4: Subsequent management



$$\textbf{Glucose requirement in mg/kg/min} = \frac{\textbf{\% glucose} \times \textbf{10} \times \textbf{mL/hr}}{\textbf{60} \times \textbf{wt (kg)}}$$

e.g. 5 kg child requiring 30 mL/hr of glucose 15% = (15 × 10 × 30) / (60 × 5) = 15 mg/kg/min

- Glucose infusion rate calculator https://www.pediatriconcall.com/calculators/glucose-infusion-rate-gir-calculator

CONGENTIAL HYPOTHYROIDISM ● 1/2

RECOGNITION AND ASSESSMENT

- Incidence 1 in 2000 newborns
- Most children with congenital hypothyroidism (CHT) are not symptomatic at birth
- Screening relies on elevated TSH of blood spot (Guthrie card)

SCREENING

- Normal TSH: <8.0 mU/L
- If TSH from newborn blood screen or venous blood (after day 4 of life) >20 mU/L, suspect CHT
- If TSH 8–20 mU/L (CHT borderline) repeat sample 7–10 days after initial test
- Babies born <32 weeks' gestation require repeat testing at 28 days postnatal age or discharge home, whichever is sooner
- If baby moved to another hospital, responsibility for taking CHT preterm repeat sample is transferred to receiving hospital

SYMPTOMS AND SIGNS

- Asymptomatic
- Sleepiness
- Poor feeding
- Cold extremities
- Neonatal jaundice
- Tongue protrusion
- Hypotonia
- Umbilical hernia
- Dry skin
- Constipation

IMMEDIATE MANAGEMENT

- Clinical nurse specialist from screening laboratory or hospital to inform parents and request mother and child to attend paediatric clinic/admission unit that day (or next day at the latest)
- Book urgent thyroid ultrasound scan

ASSESSMENT

- Take detailed history including:
- family history
  - maternal thyroid status (previous history of thyroid dysfunction, maternal antithyroid medication)
  - maternal diet (e.g. vegan or other low iodine diet)
- Examine for signs of CHT
  - look for associated anomalies e.g. congenital heart disease
- Obtain results of newborn hearing screen
- Take bloods
  - from baby for TSH, FT4 and (desirable) thyroglobulin
  - from mother for TSH, FT4 and (if history of autoimmune thyroid disease or thyroidectomy) thyroid receptor antibodies (TRAB)
- Provide CHT information leaflet to parents (see http://www.btf-thyroid.org/congenital-hypothyroidism-overview)
- Arrange repeat blood test in 2 weeks with endocrine specialist nurse and endocrinology clinic follow-up appointment in 4 weeks

TREATMENT

- Neonates: Levothyroxine 10–15 microgram/kg (maximum 50 micrograms) daily (normally in the morning). Adjusted in steps of 5 micrograms/kg as required
  - levothyroxine to be taken at same time each day, preferably 30–60 min before meals, or other medicines; this could be before breakfast or another more convenient time
  - tablets available in 25 microgram and 50 microgram sizes; tablet can be crushed and mixed with water or milk (round up/down to nearest half tablet)
  - licensed liquid formulation available but tablet is ideal (and first line in most formularies nationally)
- In suspected severe CHT aim for higher dose [i.e. absent gland on scan or highly elevated TSH (>40 mU/L) on venous sample]

CONGENTIAL HYPOTHYROIDISM ● 2/2

- Provide prescription. Give first dose same day and subsequent doses every morning
- Explain administration of the tablet
  - do not add to bottle of formula milk
  - suspensions not advised due to variable bioavailability
  - if baby vomits or regurgitates immediately after administration, repeat dose of thyroxine
- If diagnosed in first sample, treatment to be started within 14 days and within 21 days in those confirmed in second sample
- TSH must be normalised within 1 month of treatment
- Send completed CHT proforma to newborn screening laboratory

SUBSEQUENT MANAGEMENT

- Monitoring to be based on clinical assessment and biochemical testing (venous sample for TSH and T4) and repeat thyroid function test at 2, 4 and 8 weeks post commencement of treatment
- Check administration of tablet at each visit – can affect blood level
- Recommended serum levels:
  - TSH: within age-specific reference range (avoid undetectable TSH levels)
  - T4: in upper half of age-specific reference range
- Follow-up with clinical and biochemical evaluation:
  - 2 weeks after initiation of treatment then at aged 2, 4, 6, 9 and 12 months in infancy, and follow-up recommended every 4 months after infancy
- If dose adjustment of levothyroxine made, biochemical thyroid function tests to be performed 4–6 weeks later
- Physical and developmental checks should be performed at each clinic visit and adjust the dose of levothyroxine if required depending on the result

AFTERCARE

- Reassure parents that baby will grow into healthy adult with normal intelligence and stress the importance of regular treatment
- Objective of treatment is to normalise TSH within first month
  - if TSH suppressed or if baby showing signs of overtreatment dose of levothyroxine may need to be reduced
- Monitor TSH and thyroid hormone concentration closely so that levels are maintained within accepted ranges to enable normal growth and intellectual function
- Regular follow-up in paediatric endocrinology clinic
- In cases where cause or persistence/permanence of hypothyroidism has not been confirmed, confirmatory testing will be undertaken by stopping treatment at aged 2–3 yr with subsequent monitoring of thyroid function without treatment

USEFUL LINKS

- www.newbornbloodspot.screening.nhs.uk/cht-supportingdocs
- British Thyroid Foundation (BTF) website http://www.btf-thyroid.org
- British Society for Paediatric Endocrinology and Diabetes (BSPED) website www.bsped.org.uk/

IMMUNE THROMBOCYTOPENIC PURPURA (ITP) ● 1/2

DEFINITION

- Platelets <100 × 10^9/L, usually <20 × 10^9/L
- Self-limiting disease with shortened platelet survival and increased megakaryocytes
- Good prognosis
- Acute 0–3 months
- Persistent 3–12 months
- Chronic >12 months

SYMPTOMS AND SIGNS

- Acute onset bruising, purpura and petechiae
- serious mucosal bleeding unusual, look for other causes
- Preceding infection
- Absence of:
- hepatosplenomegaly
- lymphadenopathy
- evidence of serious cause/chronic underlying illness

INVESTIGATIONS

- FBC, blood film and clotting
- Blood group
- If headache and/or neurological signs, urgent CT scan of head
- Bone marrow aspiration unnecessary unless:
- neutropenia or severe anaemia
- hepatosplenomegaly
- lymphadenopathy
- pallor and lassitude
- pain limb/abdomen/back
- limp
- CMV and EBV IgM – as second line investigations or chronic ITP
- If risk factors: HIV, hepatitis B and C – as second line investigations or chronic ITP

IMMEDIATE TREATMENT

- None regardless of platelet count, unless life-threatening owing to significant bleeding
- If **significant bleeding** (e.g. uncontrollable epistaxis, GI haemorrhage, intracranial bleed), give:
- platelets (see **Blood and platelet transfusions** guideline) along with:
  - IV methylprednisolone 30 mg/kg/day by IV infusion (maximum 1 g per dose) for 3 days **or**
  - IV immunoglobulin (IVIG) 0.8–1 g/kg (see local policy) can be repeated once within 24–48 hr after initial dose if required – red indication in **demand management programme for IV immunoglobulin (IVIG)**
- If **moderate bleeding** e.g. prolonged mucosal bleeds, give:
- oral prednisolone (with antacid i.e. a PPI e.g. omeprazole for GI protection during steroid course) 2 mg/kg/day (use ideal body weight if obese) for 14 days then taper over 21 days **or**
- prednisolone 4 mg/kg/day maximum 200 mg/day (ideal body weight if weight is above 98th centile) for 4 days (no taper) **or**
- IVIG 0.8 g/kg (use ideal body weight if obese) IV single dose
- Consider tranexamic acid for small bleeds
- Avoid NSAIDs e.g. ibuprofen
- Reassure parents
- Discuss newly diagnosed ITP with paediatric haematologist/paediatric consultant with a haematology interest
- Discuss treatment with platelets with paediatric haematologist in event of:
- essential operations
- emergency dental extractions

SUBSEQUENT MANAGEMENT

- 75–80% resolve in 6 months
- favourable outcome irrespective of treatment

- Avoid contact sports
  - impossible to prevent fighting/rigorous knockabout games at home
- Parents can find additional information from ITP support association: www.itpsupport.org.uk

MONITORING TREATMENT

- FBC and film 2 weekly until diagnosis clear or recovery
- Repeat sooner if bleeding or increased bruising

DISCHARGE AND FOLLOW-UP

- Discharge from long-term follow-up when platelets >100 $\times$ 10^9/L and asymptomatic
- Advise of risk of relapse (20%)
- Note that mothers with history of ITP (even if they have normal platelet counts) can give birth to thrombocytopenic babies

CHRONIC IMMUNE THROMBOCYTOPENIC PURPURA

- Avoid NSAIDs
- Avoid contact sports
- Investigate for autoimmune disease (ANA antinuclear antibody; APLA antiphospholipid antibodies; ACA, anticardiolipin antibody; and LAC, lupus anticoagulant) and immune deficiency (HIV, IgG, IgA, IgM)
- Treat only:
  - profound thrombocytopenia (<10 $\times$ 10^9/L) with repeated mucosal bleeding
  - older girls with menorrhagia
  - trauma
  - acute neurological signs
- If treatment indicated, give:
  - oral prednisolone 2 mg/kg/day (use ideal body weight if obese) 14 days, then taper over 21 days **or**
  - oral dexamethasone 0.6 mg/kg/day (maximum 40 mg – ideal body weight if above 98th centile) for 4 days
  - if ongoing bleeding (GI protection during course with a PPI e.g. omeprazole)
  - consider tranexamic acid dose as per **BNFc**
  - must have bone marrow aspirate before treatment
- If unresponsive, discuss with paediatric haematologist about treatment with rituximab or thrombopoietin receptor agonists
- Splenectomy reserved for those with persistent/significant bleeding non-responsive or intolerant of other therapies

IMMUNODEFICIENCY ● 1/2

RECOGNITION AND ASSESSMENT

- SPUR to recognition: **S**erious, **P**ersistent, **U**nusual, or **R**ecurrent infections
- The younger the onset, the more life-threatening the immune defect likely to be
  - bacterial infection; early presentation: antibody defect
  - viral/fungal infection; later presentation: cellular defect
- Family history of primary immunodeficiency (PID): focused investigations and refer

Warning signs of PID:

- ≥4 new bacterial ear infections within 1 yr
- ≥2 serious sinus infections within 1 yr
- ≥2 months on antibiotics without resolution of symptoms
- ≥2 episodes of pneumonia within 1 yr
- Failure to thrive with prolonged or recurrent diarrhoea
- Recurrent, deep skin or organ abscess
- Persistent *Candida* in mouth or napkin area
- Need for IV antibiotics to clear infections
- ≥2 severe infections (e.g. meningitis, osteomyelitis, cellulitis or sepsis)
- Family history of PID

Symptoms of immune deficiency

- Delayed umbilical cord separation of ≥3 weeks, omphalitis
- Delayed shedding of primary teeth
- Severe adverse reaction to immunisation e.g. BCGitis
- Unusually severe course of measles or chickenpox
- Family history of any syndrome associated with immunodeficiency, (e.g. DiGeorge anomaly or Wiskott-Aldrich syndrome); or of death during early childhood
- High risk group for HIV and no antenatal HIV test (a negative antenatal HIV test does not exclude HIV in the child)
- Autoimmune liver disease, diabetes, vasculitis, ITP
- Poor wound healing
- Unexplained bronchiectasis or pneumatoceles
- >1 unexpected fracture

Signs of immune deficiency

- Congenital abnormalities: dysmorphic features, congenital heart disease, situs inversus, white forelock, albinism, microcephaly
- Children who appear chronically ill
- Scarring or perforation of tympanic membranes from frequent infection
- Periodontitis
- Enlargement of liver and spleen
- Hypoplastic tonsils and small lymph nodes
- Lymphadenopathy
- Skin: telangiectasia, severe eczema, erythroderma, granuloma, acneiform rash, molluscum, zoster
- Ataxia

Other investigations suggestive of immune deficiency

- Haemolytic anaemia
- Neutropenia
- Eosinophilia
- Hypocalcaemia

Unusual organisms or unusual diseases with common organisms

- Viruses: CMV, EBV, VZV, warts
- Fungi: *Candida, Aspergillus, Cryptococcus, Pneumocystis, Nocardia*
- Protozoa: *Cryptosporidium*, *Toxoplasma*, *Giardia*
- Bacteria: Salmonella, *Mycobacterium* (including BCG), *Serratia*
- Recurrent infection with common organisms: *H. influenzae, S. pneumoniae, N. meningitidis, S. aureus*

IMMUNODEFICIENCY ● 2/2

Investigations

- If severe combined immunodeficiency disease possible urgent initial tests below
- failure to thrive, diarrhoea, severe/disseminated infections, opportunistic infections, rash

Table 1: Initial tests (complete all tests for any suspected immune deficiency)

Investigations	Sample	Volume	
		Minimum	Ideal
Initial tests (complete all tests for any suspected immune deficiency)			
FBC and differential white cell count	EDTA	1.3 mL	4 mL
Immunoglobulins (G, A, M, E)	Clotted	0.5 mL	4 mL
Complement	Clotted	1 mL to reach lab within 2 hr	4 mL to reach lab within 2 hr or separate and freeze immediately
HIV antibody	Clotted	0.5 mL	4 mL
Lymphocyte subsets	EDTA	1 mL	4 mL

Table 2: Second-line tests (with immunology advice)

Investigations	Indication	Sample	Volume	
			Minimum	Ideal
Lymphocyte proliferation		Lithium heparin	Discuss with local immunology centre	Discuss with local immunology centre
Neutrophil function test for CGD	Normal neutrophil count	EDTA or lithium heparin	0.25 mL Discuss with local immunology centre	4 mL Discuss with local immunology centre
IgG function (antibody response to tetanus, Hib) Retest 4 weeks after vaccination	Recurrent or with family history of meningococcal disease	Clotted	0.5 mL	4 mL

RESULTS

- Isolated neutropenia or lymphopenia: if concerns possible immune deficiency, recheck 1–2 weeks. If persistent:
- auto-antibodies (ANA), allo-antibodies, Coombs test (neonates), C3, C4, rheumatoid factor, urine/saliva CMV
- pancytopenia: discuss with haematology
- hypogammaglobulinaemia: discuss with local immunology centre

SUBSEQUENT MANAGEMENT

- Avoid live vaccines (e.g. BCG, MMR and varicella)
- Ensure that any blood products given to patients with suspected or proven T-cell immunodeficiency are irradiated and CMV negative
- For specific infections, use same antibiotics as in immunocompetent patients, at higher recommended dosage
- Obtain throat, blood and other culture specimens before starting treatment
- Treat infectious episodes for longer than usually recommended (approximately double)
- In patients with B-cell, T-cell or phagocytic defects, request regular pulmonary function tests and home treatment plan of physiotherapy and inhalation therapy similar to that used in cystic fibrosis
- In children with significant primary or secondary cellular (T-cell) immunodeficiency (e.g. aged <1 yr CD4 <25%, aged 1–5 yr CD4 <15% or aged >5 yr <200 CD4 cells/mm^3), give *Pneumocystis jiroveci* (PCP) prophylaxis with co-trimoxazole

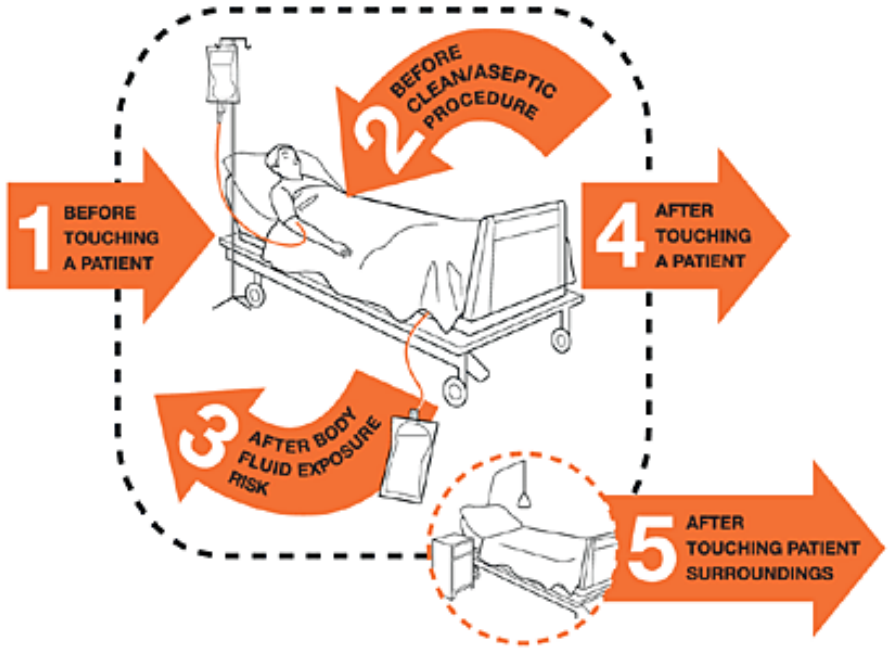
HAND HYGIENE

- Describes decontamination of hands using soap and water, antiseptic wash or alcohol hand rub solution
- Good hand hygiene is the most effective way to prevent spread of infection
- Use this safe method of working at all times to protect staff, patients and others from infection
- All practitioners are personally accountable for their hand hygiene practices

ASSESSMENT OF NEED TO DECONTAMINATE HANDS

- Hands must be decontaminated at critical points before, during and after patient care to prevent cross-infection of micro-organisms – see **Figure 1**
- Hand decontamination must be carried out at the following 5 moments of care regardless of whether or not gloves have been worn
  - before touching a patient
  - before and after aseptic non-touch technique (ANTT)/aseptic procedure
  - after body fluid exposure
  - after touching a patient
  - after touching patient surroundings

Figure 1: Five moments for hand hygiene



- Hands must also be decontaminated
  - on arrival at and before leaving ward/department
  - after visiting the toilet
  - before serving/preparing food or drinks
  - after any activity or contact that potentially results in hands becoming contaminated
  - on entering and leaving an isolation cubicle
  - after removing personal protective equipment

CHOICE OF HAND HYGIENE PREPARATIONS

- Alcohol hand rub is an effective method of hand decontamination on visibly clean hands but is not recommended when hands are visibly dirty

Alcohol hand rub alone must not be used after caring for patients (or their equipment/environment) with suspected or known infectious diarrhoea e.g.* C. difficile *or Norovirus, regardless of whether gloves are worn

- Hand washing with liquid soap and water removes dirt, organic matter and transient flora by mechanical action, and is to be used:
  - when hands are visibly dirty/visibly soiled with body fluids or other organic matter

- when caring for patients with:
  - suspected or confirmed diarrhoea and/or vomiting
  - *C. difficile*/Norovirus and during outbreaks of these organisms on wards/in bays
- after several consecutive applications of alcohol hand rub
- after visiting the toilet
- Liquid soap alone does not provide sufficient hand disinfection before invasive procedures and surgery

DRESS CODE

- Bare below elbow for all staff working within clinical areas (e.g. no sleeves below elbow, no wrist watches, wrist jewellery or plaster casts/wrist splints)
- Do not wear false nails, nail extensions, gel nails or nail varnish
- Keep nails short and clean
- No stoned rings (acceptable to wear a plain wedding band)
- Long hair tied back or up

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Aprons

- <2 metres of child with respiratory tract infection
- Contact with infectious materials or equipment anticipated
- Using hazardous chemicals
- ANTT – see below

Gloves (non-sterile)

- Contact with respiratory secretions or other infectious material or contaminated surfaces
- ANTT – see below
- Single patient use; new gloves and apron for every procedure
- Take gloves and apron off at point of use and clean hands
- Do not carry gloves in your pocket
- Do not use alcohol hand rub on gloves

Remove gloves and aprons as soon as clinical activity completed before touching pens, notes, phone, computer etc.

Sterile gloves and gown

- For central venous line (CVL) including peripheral long line (PICC)
- Sterile gloves for ANTT if touching key parts/key sites

Masks

- Surgical face mask
- <2 metres of child with respiratory tract infection
- FFP3 mask (fit-tested) for aerosol generating procedure (e.g. intubation, CPAP) with respiratory tract infection and when advised by infection prevention team

Eye protection

- <2 metres of child with persistent coughing or sneezing
- When increased risk of splashing of body fluids into eyes
- If increased risk of organism transmitted through conjunctiva (e.g. SARS CoV-2)

ANTT

- See **local ANTT** guidelines

Definition

- Essential procedure aimed at protecting patients from infection during invasive procedures
- Achieved by minimising presence of pathogenic micro-organisms as much as is practically possible
- Specific type of aseptic technique with a unique theory and practice framework, providing core principles for safe aseptic technique and a standardised approach to assessing and applying safe aseptic technique to any invasive clinical procedure
- Protect and do not touch ‘key parts’ or ‘key sites’ e.g. use caps and covers for end of syringes/needles

Preparation phase
- Decontaminate hands
- Decontaminate tray or trolley using Trust approved disinfectant
- Clean hands
- PPE (as above)
- Prepare and assemble equipment using a non-touch technique protecting key parts at all times by not touching them
- Remove gloves and decontaminate hands

Patient phase
- Decontaminate hands at point of care
- Apply appropriate PPE non-sterile gloves not touching key parts (e.g. IV drug administration, venepuncture/cannulation) sterile gloves if touching key parts (e.g. urinary catheterisation, central line/PICC insertion)
- Prepare all equipment using a non-touch technique, protecting key parts at all times by not touching them
- Decontaminate key sites using single use chlorhexidine 2% in alcohol 70% (SEPP/FREPP or ChloraPrep® 3 mL) and allow drying for 30 sec
- Perform procedure, ensuring protection of key parts/sites at all times

Decontamination phase
- Dispose of sharps into sharps box immediately at point of use
- Remove PPE at patient's bedside
- Dispose of all equipment as clinical waste in nearest clinical waste bin, return equipment to clinical room ensuring it is cleaned with detergent wipes
- Decontaminate hands

ISOLATION

If unsure, discuss with infection prevention team

Indications for cubicle when available
- Infectious disease
  - airborne: always isolate
  - droplet: isolate or cohort
  - contact: isolate or cohort
  - enteric: isolate or cohort
- Immune deficiency
- Special risk of infection

Prioritisation of cubicles
- Move low risk to bay first
- Then intermediate risk
- Then high risk

Cohort several children with same illness
- Bronchiolitis cohort
- Diarrhoea or vomiting

Low risk
- Shingles (if rash on non-exposed part of body), impetigo, scabies, lice, herpes
- Non-pulmonary TB
- Respiratory viruses including COVID
- Transfer from another hospital pending screening results
- HIV CD4 >350 x 10^6/L or >25%

Intermediate risk
- Preterm infants aged <2 months
- Symptomatic congenital heart disease
- Chronic lung disease in oxygen
- MRSA colonised; no skin lesions
- ESBL, VRE or *C. difficile* with diarrhoea

- HIV CD4 200–350 x10^6/L or 15–25%

High risk
- Neutropenic (<0.5 x 10^9/L)
- Cystic fibrosis, burns
- PVL *S. aureus*
- MRSA with skin lesions or in sputum
- Carbapenemase colonised
- Gastroenteritis or *E. coli* O157
- Mumps, hepatitis A
- HIV CD4 <200 x 10^6/L or <15%

Always isolate or manage at home
- Measles
- Chickenpox
- Smear +ve TB and coughing <1 week into treatment
- Consult with infection prevention or infectious diseases team

Negative pressure with anteroom for donning and doffing (i.e. suspected high consequence infectious diseases):
- MDR TB
- Viral haemorrhagic fever (e.g. Ebola)
- SARS
- MERS
- Avian influenza (e.g. H5N1, H5N6, H7N7, H7N9)
- Mpox
- Hantavirus
- Pneumonic plague

First 24 hr treatment, then can move to multi-occupancy bay if responding and apyrexial
- Meningitis (no rash) intermediate risk
- Meningococcal disease (purpuric rash) high risk
- Group A strep (e.g. scarlet fever) high risk

Above lists are not exhaustive. Consult with infection prevention or on-call microbiologist as required

INTRAOSSEOUS INFUSION ● 1/3

Do not carry out this procedure unsupervised unless you have been trained to do so and have demonstrated your competence under appropriate supervision

INDICATIONS

- Cardiac arrest and severely ill infants and children when immediate vascular access needed and peripheral access not possible (maximum 2 attempts)
- allows rapid expansion of circulating volume
- gives time to obtain IV access and helps by increasing venous filling

EQUIPMENT

- EZ-IO drill and needles (<40 kg: 15 mm pink; >40 kg: 25 mm blue) or intraosseous infusion needles for manual insertion on resuscitation trolley
- 5 mL syringe with extension and 3-way tap to aspirate and confirm correct position
- 10 mL sodium chloride 0.9% flush
- 20 or 50 mL syringe to administer fluid boluses
- Infusion fluid
- Lidocaine 1% (10 mg/mL) preservative-free

If patient responds to pain – for manual insertion, infiltrate skin with lidocaine 1% (10 mg/mL) 1–2 mL up to 3 mg/kg (0.3 mL/kg), maximum dose 200 mg
This is NOT for intraosseous administration

PROCEDURE (EZ-IO)

1. Locate landmarks
2. Aseptic non-touch technique: clean site
3. Choose appropriate size needle and attach to drill (held magnetically)
4. Hold drill and needle at 90° to skin surface and push through skin without drilling, until bone is felt
5. Activate drill continuously and exert pressure until there is loss of resistance – there is a palpable give as needle breaches the cortex
6. Remove drill and unscrew trocar
7. If possible, aspirate the marrow
8. Attach pre-prepared connection tube
9. Secure needle (with EZ-IO fixator)
10. If awake, give lidocaine 1% (preservative-free) 0.5 mg/kg (0.05 mL/kg, maximum dose 20 mg) over 2 min through IO, leave 1 min then flush with sodium chloride 0.9% 2 mL
11. Proceed with required therapy
12. If EZ-IO drill power fails, repeated clockwise-anticlockwise twisting with gentle pressure allows manual insertion

PREFERRED SITES

Avoid fractured bones and limbs with fractures proximal to possible sites

Proximal tibia

- Identify anteromedial surface of tibia 1–2 cm below tibial tuberosity
- Direct needle away from knee at approximately 90° to long axis of tibia

Figure 1: Access site on proximal tibia – lateral view

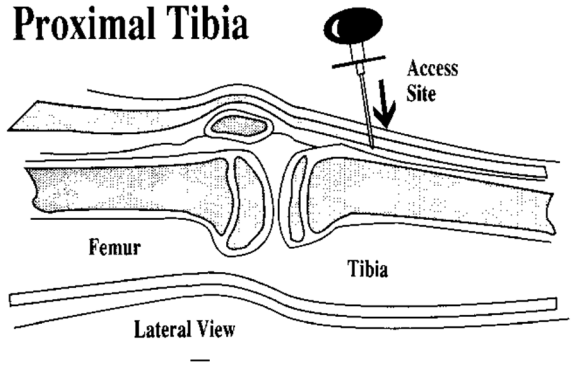
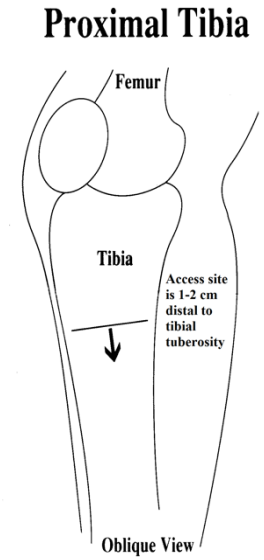


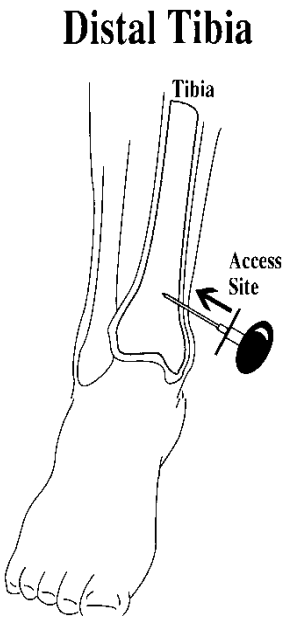
Figure 2: Access site on proximal tibia – oblique view



Distal tibia

- Access site on medial surface of tibia proximal to medial malleolus

Figure 3: Access site on distal tibia



Distal femur

- If tibia fractured, use lower end of femur on anterolateral surface, 3 cm above lateral condyle, directing needle away from epiphysis

INTRAOSSEOUS INFUSION ● 3/3

COMPLICATIONS

- Bleeding
- Infection
  - revert to central or peripheral venous access as soon as possible
- Compartment syndrome
  - observe and measure limb circumference regularly
  - palpate distal pulses and assess perfusion distal to IO access site
- Pain from rapid infusion: give lidocaine 1% 0.5 mg/kg (maximum dose 20 mg) over 5 min

INTRAVENOUS FLUID THERAPY ● 1/7

GUIDELINE COVERS PRINCIPLES FOR IV THERAPY THROUGH:

- Assessment and monitoring
- Fluid resuscitation
- Maintenance fluids
- Replacement and redistribution
- Managing hyponatremia and hypernatremia during IV fluid therapy

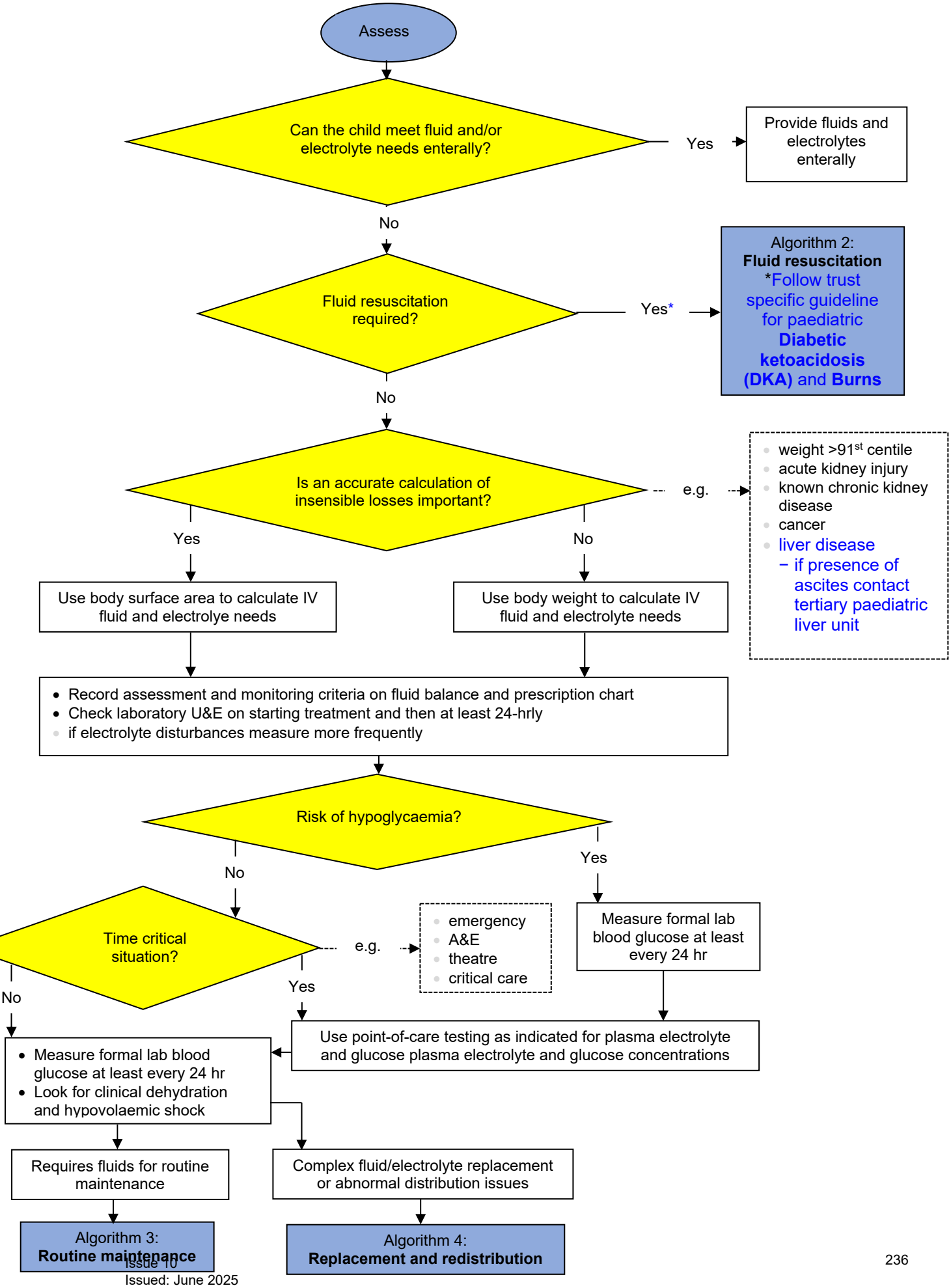
INTRODUCTION

- Applies to children aged 1 month–16 yr who cannot receive enteral fluids
- Use enteral route whenever possible
- NOT for use in children with renal, cardiac or endocrinological (including diabetic ketoacidosis) conditions or neonates
- infants and children with above conditions: discuss IV fluid management with consultant

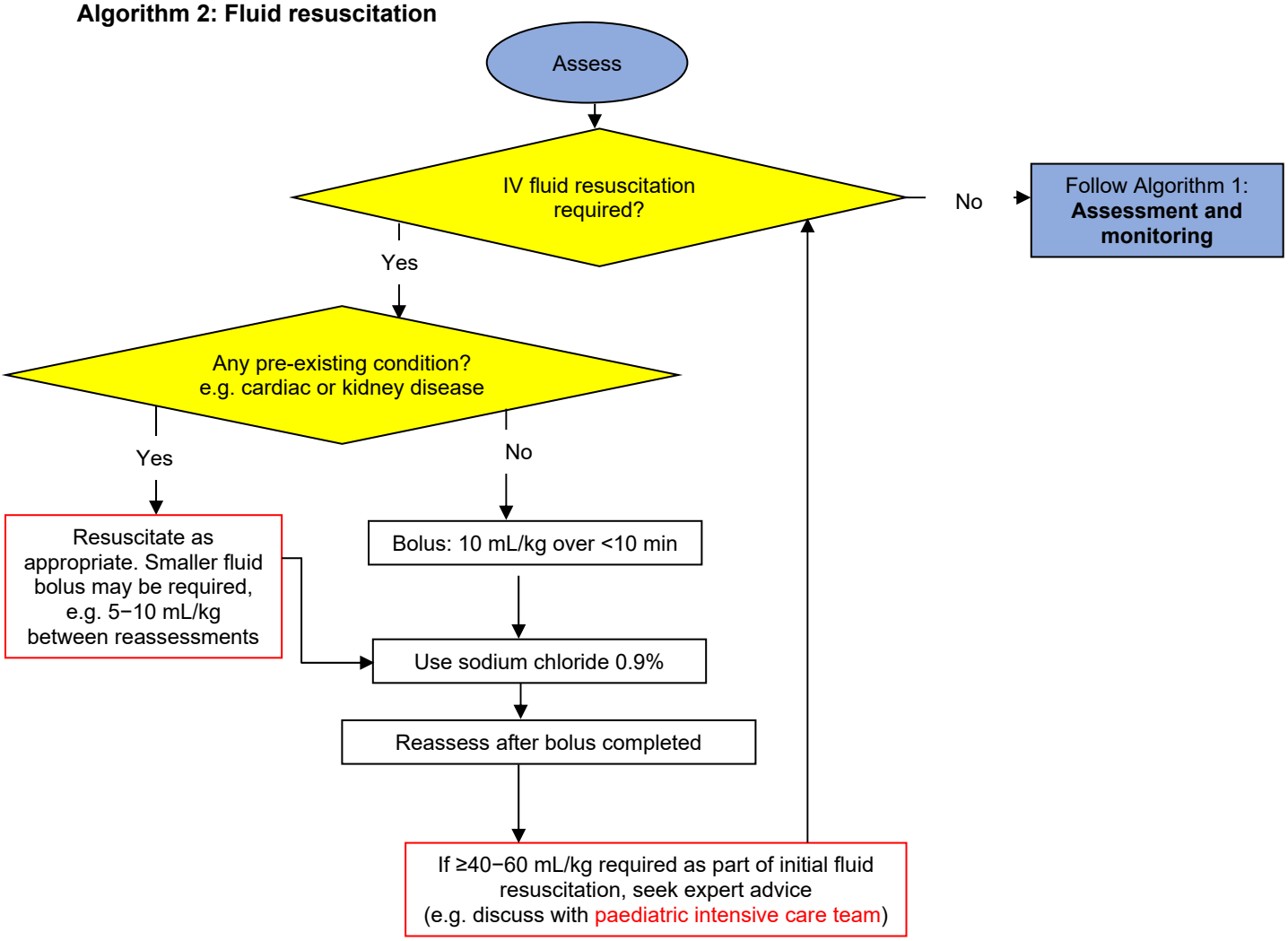
HIGHLIGHTS

- What fluids to prescribe for resuscitation
- What fluids to prescribe for maintenance
- usually sodium chloride 0.9% and glucose 5%
- add KCL depending on serum electrolyte
- How to prescribe IV maintenance fluids in children with Holliday-Segar formula
- What to consider when hyponatremia/hypernatremia develops during IV fluid therapy
- Fluid charts with input and output monitoring when on IV fluids
- Monitoring of blood sugar, serum electrolyte and clinical assessment of fluid status

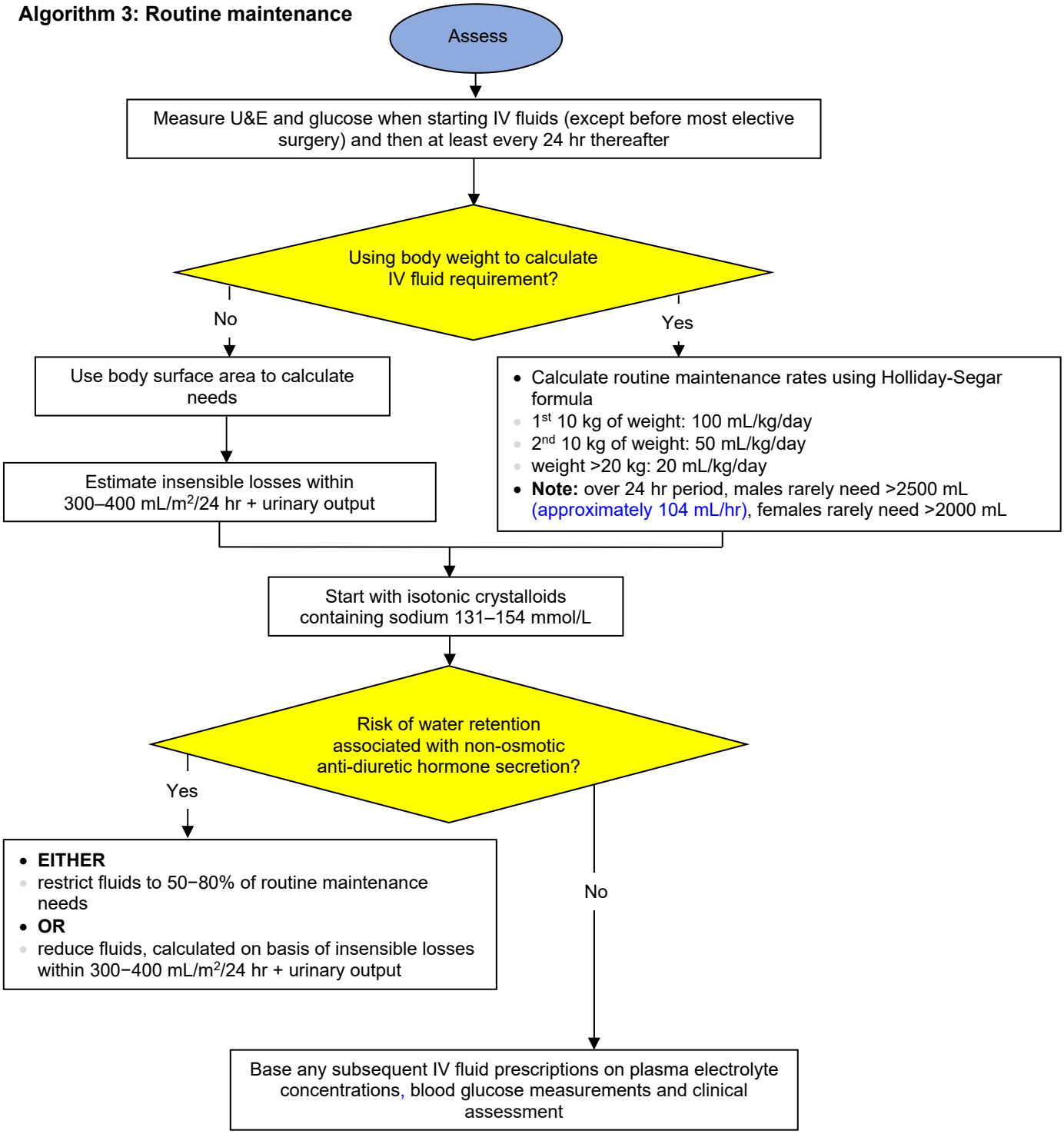
Algorithm 1: Assessment and monitoring



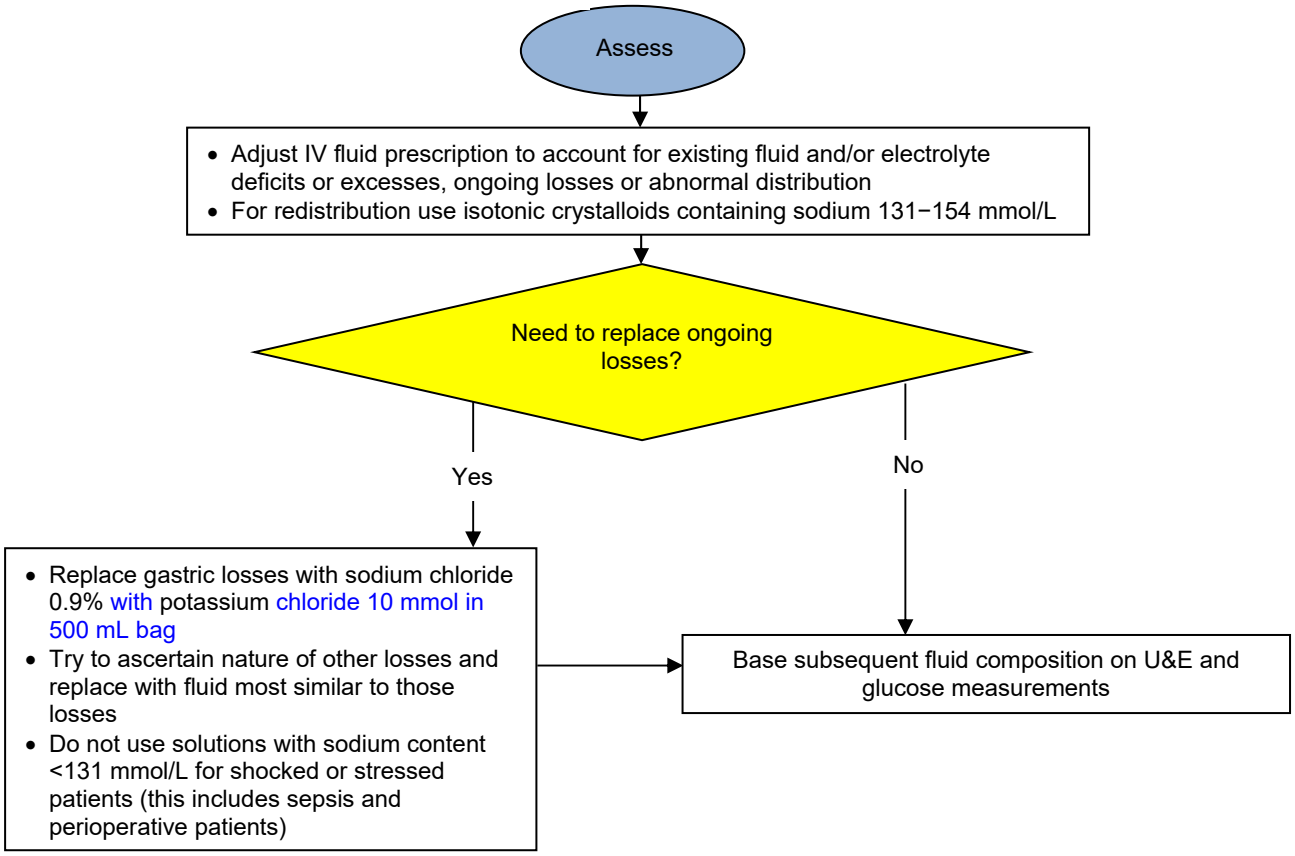
Algorithm 2: Fluid resuscitation



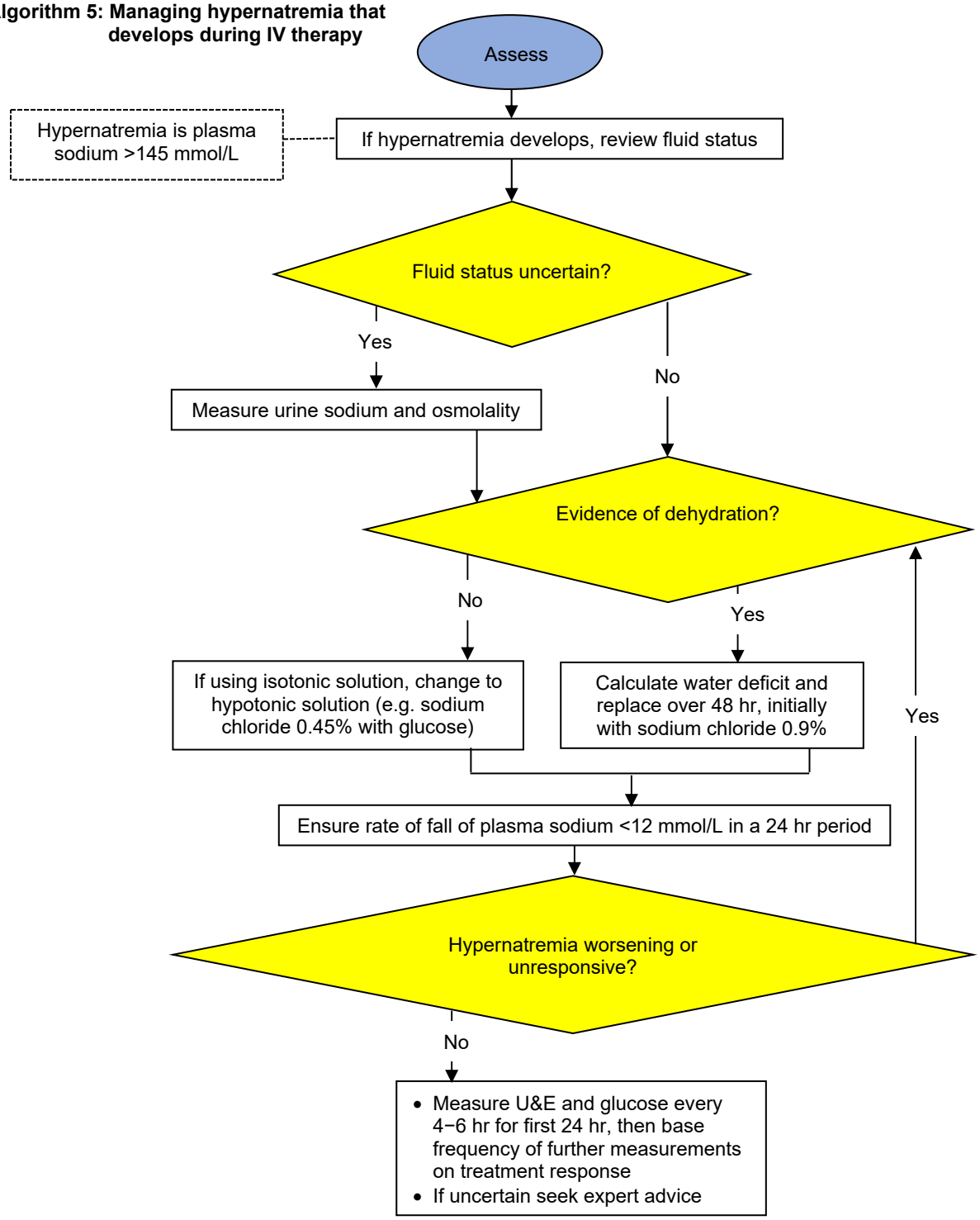
Algorithm 3: Routine maintenance



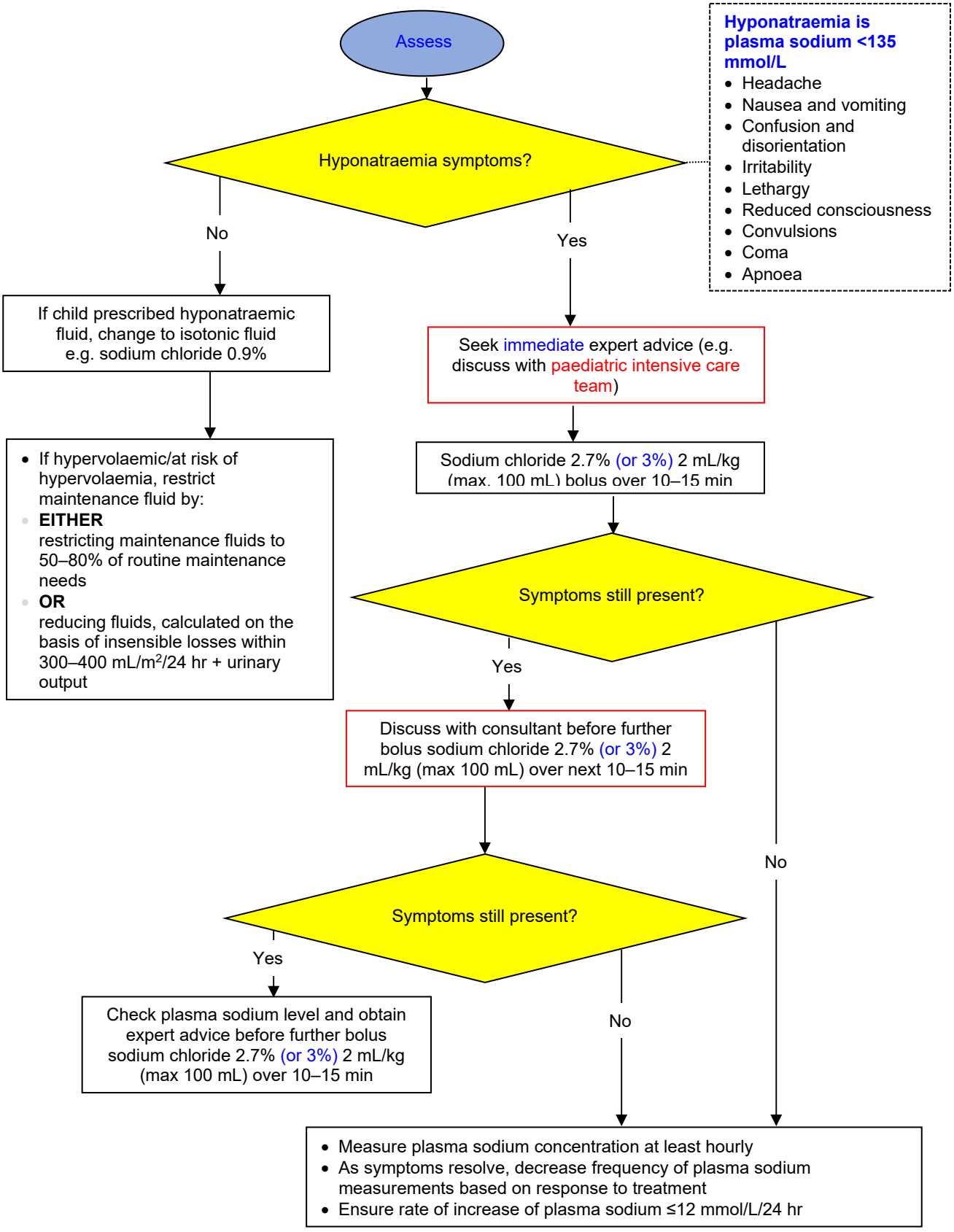
Algorithm 4: Replacement and redistribution



Algorithm 5: Managing hypernatremia that develops during IV therapy



Algorithm 6: Managing hyponatraemia that develops during IV therapy



JAUNDICE IN NEONATES ● 1/3

Jaundice in neonates aged >7 days (aged <7 days see **Neonatal** guidelines)

RECOGNITION AND ASSESSMENT

Symptoms and signs

- Any visible yellow colouration of skin in any infant
- Yellow conjunctivae in dark-skinned infants
- In an infant aged >14 days (or >21 days preterm infants <37/40)

Assess for red flags

- Stools (pale and/or chalky; refer to CLDF stool colour chart) and urine colour (yellow or orange is abnormal and suggests conjugated hyperbilirubinaemia. Most infants have colourless urine)
- Pallor (haemolysis)
- Poor feeding, drowsiness (neurotoxicity)
- Poor weight gain (plot on centile chart, is growth satisfactory and has infant regained birth weight?)
- Hepatosplenomegaly (blood-group incompatibility cytomegalovirus, or liver disease)
- Splenomegaly (e.g. haemolytic anaemia, spherocytosis)
- Dysmorphic features

Causes of persistent jaundice
(>14 days in term infants and >21 days in preterm)

- Physiological/breast milk jaundice
- Prematurity
- Increased bilirubin load (e.g. bruising, blood group incompatibility)
- G6PD deficiency and other red cell enzyme deficiencies
- congenital spherocytosis
- Cephalohaematoma
- Rarely infection (e.g. UTI, congenital infection)
- Metabolic disorder (e.g. galactosaemia, tyrosinaemia)
- Endocrine disorders (e.g. hypothyroidism, hypopituitarism)
- Biliary atresia
- Liver disease (e.g. neonatal hepatitis, alpha-1-antitrypsin deficiency)
- TPN-induced cholestasis

Investigations
All

- Total bilirubin
- Conjugated bilirubin on all babies aged >14 days (or >21 days in preterm infants <37/40) Can wait until next working day in the absence of red flags (as above)
- Visualise and document stool and urine colour
- Urine dipstick and send for MC&S
- Blood glucose if baby is unwell

Second-line investigations
(Indicated if ≥1 red flags present)

- If conjugated bilirubin >25% of total bilirubin, seek advice of specialist liver unit as infant may require further investigations such as:
- save stool sample for senior review
- U&E and bicarbonate
- LFTs (ALT/AST, alkaline phosphatase, gamma GT, albumin)
- pre-feed blood glucose, performed for at least first 24 hr of admission
- FBC, retics and blood film
- blood group and direct Coombs' test
- coagulation screen including PT and/or INR [give 300 microgram/kg [phytomenadione IV (vitamin K) if prolonged and repeat after 12 hr] (further doses as required depending on clinical picture and coagulation status)
- G6PD screen in African, Asian or Mediterranean patients
- thyroid function tests: ask for 'FT4 priority and then TSH'
- congenital infection screen:
  - CMV PCR: in urine first 2 weeks of life, later test newborn blood spot card
  - toxoplasma ISAGA-IgM and

  - HSV PCR
- metabolic investigations:
  - blood galactose-1-phosphate uridyltransferase
  - urine dipstick for protein
  - urine for reducing substances
  - urine for amino acids and organic acids
  - quantitative serum amino acids
  - alpha-1-antitrypsin level and phenotype
  - cortisol
  - cholesterol and triglycerides
  - immunoreactive trypsinogen (IRT)

Third-line investigations
(May be recommended by paediatric gastroenterologist or hepatologist)
- Liver and abdominal ultrasound
- DESIDA or HIDA radionucleotide scan
- Lactate, ammonia and pyruvate
- Very long chain fatty acids
- Urine and serum bile acids
- Acyl carnitine
- Isoelectric focussing of transferrin
- Ferritin and transferrin saturation
- Muscle biopsy
- Bone marrow for storage disorders
- Skin biopsy for fibroblast culture
- Liver biopsy
- If Alagille syndrome suspected: CXR to look for butterfly vertebrae
- Syphilis serology
- Ophthalmological examination (for Alagille syndrome, panhypopituitarism and TORCH infection)
- Echocardiography (Alagille syndrome)
- MRI brain+/- MR spectroscopy (mitochondrial cytopathy)
- MRI pancreas (gestational alloimmune disease - specific sequences to be done)

If conjugated bilirubin elevated at any age (>25% of total bilirubin), discuss with consultant urgently

TREATMENT OF UNCONJUGATED JAUNDICE

Limits (micromol/L) for phototherapy and exchange transfusion for infants ≥38 weeks' gestation − see http://www.nice.org.uk/guidance/CG98 under 'Tools and resources' then 'CG98 Neonatal Jaundice: treatment threshold graphs'
For other gestations see Neonatal guidelines

General
- Adequate fluid and energy intake
- Phototherapy

Phototherapy
- If bilirubin near exchange threshold or still rising:
- increase power number of lights
- increase area exposed (e.g. biliblanket and overhead)

Exchange transfusion
- See **Exchange transfusion** in **Neonatal** guidelines

IVIG
- For dose information see https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/216671/dh_131107.pdf
- Use as an adjunct to multiple phototherapy in rhesus disease when bilirubin continues to rise by >8.5 micromol/L/hr

JAUNDICE IN NEONATES ● 3/3

MONITORING TREATMENT

- If haemolysis present, check bilirubin 4–6 hrly until rate of rise flattens
- If bilirubin concentration approaching threshold for exchange transfusion, or rising rapidly (>10 micromol/hr), check 4-hrly

SUBSEQUENT MANAGEMENT

- When bilirubin concentration has fallen below threshold for phototherapy (see above), discontinue phototherapy
- Ensure rebound bilirubin after discontinuation of phototherapy does not again approach phototherapy/exchange transfusion level by monitoring bilirubin levels for 48−72 hr
- if phototherapy required consider rare causes, e.g. Criggler Najjar-Type 1
- If jaundice persists after aged 14 days, review and treat cause

TREATMENT OF CONJUGATED JAUNDICE

- Fat soluble vitamins (A,D,E and K)
- Ursodeoxycholic acid (after discussions with liver unit)

FOLLOW-UP

Conjugated jaundice

- Conjugated bilirubin <25% of total bilirubin in a well baby without red flags
- discharge to routine community care
- advise parents to look out for ‘worrying features’
- Conjugated fraction >25%
- discuss with consultant as this will depend on cause and severity of conjugated jaundice

Unconjugated jaundice

- GP follow-up with routine examination at 6–8 weeks
- If exchange transfusion necessary or considered, request development follow-up and hearing test
- In babies with positive Coombs’ test who require phototherapy, check Hb at aged 2 and 4 weeks because of risk of continuing haemolysis and give folic acid daily (2.5–5 mg)

KAWASAKI DISEASE ● 1/5

Early treatment reduces mortality from coronary artery aneurysms

RECOGNITION AND ASSESSMENT

Symptoms and signs

- Fever ≥5 days and 4 of the following:

Table 1

Feature	Details
Conjunctivitis	Bilateral, bulbar, non-exudative
Oral changes	Red lips/pharynx/tongue
Peripheral oedema	Erythema palms and soles, following by desquamation fingertips 10–15 days after onset of fever
Rash	Polymorphous (no vesicles or crusts)
Lymph nodes	Acutely enlarged cervical nodes >1.5 cm diameter

- Evidence of an infectious trigger does not exclude Kawasaki disease
- Presence of a coronary artery aneurysm with any 1 of the above features is diagnostic

Other features

- Most common in children aged <5 yr, peak 18–24 months
- Atypical cases may not fulfil all the above criteria
- if fever <5 days but 4 signs above
- persistent raised CRP and no other diagnosis and suspicion of Kawasaki disease
- fever usually precedes the other signs, unresponsive to antipyretics
- common features: irritability, erythema of BCG site
- other features include aseptic meningitis, uveitis, cough, vomiting, diarrhoea, abdominal pain, urethritis, arthralgia and arthritis
  - examine for aneurysms in other areas e.g. axillary

High risk features

- Already failed IVIG
- Aged <1 yr
- Severe inflammation (persistently raised CRP despite IVIG, liver dysfunction, hypoalbuminaemia, anaemia)
- Features of haemophagocytic lymphohistiocytosis (persistent fever, hepatosplenomegaly, cytopenia >2 cell lines, hypertriglyceridemia, hypofibrinogenaemia, increased D-dimers, hyperferritinaemia, falling ESR)
- Shock
- Evolving coronary or peripheral aneurysms
- Kobayashi risk score >5 (see **Table 2**)

Table 2: Kobayashi risk score

Parameter	Score
Na ≤133 mmol/L	2
≤4 days of illness	2
ALT ≥100 iu/L	1
Platelets ≤300 x 10^9/L	1
CRP ≥100 mg/L	1
Aged ≤1 yr	1
≥80% neutrophils	2

Investigations

None is diagnostic, but investigations are mainly to exclude other differentials

- FBC: neutrophilia and thrombocytopenia early
- ESR and CRP elevated
- LFTs: raised bilirubin, ALT, low albumin
- Urine: sterile pyuria (proteinuria is suggestive of an alternative diagnosis)
- CSF: lymphocytes

- ECG: ST depression, T wave inversion, heart block
- Echo: do not delay therapy before echocardiogram
- Throat swab for Group A Strep
- Anti-streptolysin O titre (ASOT) or anti-DNase B for evidence of streptococcal infection
- Blood culture
- Urinalysis, microscopy and culture
- If rash present, serology for enterovirus, parvovirus, EBV, CMV
- If features of measles, urine or throat swab in viral transport medium for PCR

Incomplete Kawasaki disease

- Children with fever ≥5 days and 2 or 3 compatible clinical criteria **or**
- Infants with fever ≥7 days with other explanation
- CRP <30 mg/L and ESR <40 mm/hr
- if fever persists, serial clinical and laboratory re-evaluation
- if typical peeling develops, echocardiogram
- CRP ≥30 mg/L and/or ESR ≥40 mm/hr treat if:
- anaemia for age
- platelets ≥450 x 10^9/L after 7^{th} day of fever
- albumin <30 g/L
- elevated ALT
- WBC >15 x 10^9/L
- urine ≥10 WBC/microlitre

When to ask advice from paediatric rheumatology

- Incomplete Kawasaki
- Features suggestive of an alternative rheumatological/inflammatory diagnosis
- Aged <1 yr
- Failed first dose of IVIG

IMMEDIATE TREATMENT

- Aspirin 7.5–12.5 mg/kg oral 6-hrly until afebrile or a minimum of 2 weeks (then see **Subsequent management** for aspirin dosing)
- Intravenous immunoglobulin (IVIG) 2 g/kg
- check concentration (g/mL) for preparation used in your Trust
- administer at gradually increasing rate or as per Medusa (https://www.rcpch.ac.uk/resources/medusa-injectable-medicines-guide) or summary of product characteristics (SPC), as below:

Table 3

Rate*	Duration
30 mg/kg/hr	30 min
60 mg/kg/hr	30 min
120 mg/kg/hr	30 min
240 mg/kg/hr*	30 min
360 mg/kg/hr*	30 min
480 mg/kg/hr*	To completion

*** Volume will depend on concentration used and maximum rate may be restricted by product literature** [refer to Medusa (https://www.rcpch.ac.uk/resources/medusa-injectable-medicines-guide) or summary of product characteristics (SPC)]

Start IVIG 2g/kg as soon as possible (delayed treatment increases risk of aneurysm)

Monitoring IVIG Infusion

- Monitor temperature, heart rate, BP and respiratory rate:
- every 5 min for first 15 min
- then every 15 min for first hour
- Anticipate anaphylaxis, flushing, fever, headache, shivering
- If tolerated, increase infusion rate to give total dose over remaining 10 hr and monitor hourly
- If mild reaction, stop infusion for 15 min then restart at slower rate

High risk features present

- Aspirin and IVIG as above
- Methylprednisolone 0.8 mg/kg IV 12-hrly for 5–7 days or until CRP normalises
- then prednisolone 2 mg/kg/day oral and wean over 2–3 weeks

SUBSEQUENT MANAGEMENT

- If fever persists 36 hr after completion of IVIG, consider a single repeat dose of IVIG (as above)
- If fever persists after second dose IVIG discuss with paediatric rheumatology and consider methylprednisolone IV as above if not already given
- Discuss with paediatric rheumatology about infliximab
- Fever settled for 48 hr, clinical improvement and falling CRP, reduce dose of aspirin to 2–5 mg/kg (maximum 75 mg) oral as single daily dose for minimum 6 weeks (until result of echocardiogram known)

DISCHARGE AND FOLLOW-UP

- Discharge when fever settles
- Echocardiogram at 10–14 days and 6 weeks from onset of signs and symptoms
- Outpatient appointment 1 week after each echocardiogram
- Advise to avoid excessive strenuous activity until outpatient appointment after echocardiogram
- Advise to avoid all live vaccines (e.g. MMR) for 3 months following IVIG therapy

OUTPATIENT MANAGEMENT

- No aneurysms at 6 weeks echocardiogram
- stop aspirin
- no restriction on activity
- follow-up at 12 months and discharge if well
- Single aneurysm <8 mm diameter
- aspirin 2–5 mg/kg (maximum 75 mg) once daily until aneurysm disappears
- cardiologist will advise on limitation of activity, exercise stress test, MR/CT angiogram
- 6 monthly ECG and echocardiogram
- lifelong follow-up and advice on reduction of cardiovascular risk factors
- Multiple or giant aneurysm or stenosis
- as for single aneurysm **and**
  - lifelong aspirin 2–5 mg/kg/day (maximum 75 mg once a day)
  - warfarin (after heparinisation)

PAEDIATRIC INFLAMMATORY MULTISYSTEM SYNDROME (PIMS or PIMS-TS)

- Discuss patients who are deteriorating or have haemodynamic compromise with local retrieval/PICU as per local pathways
- Discuss all patients with local PIMS-TS MDT (rheumatology, infectious diseases, cardiology, PICU) to confirm diagnosis and decide on treatment
- where available treatment should be on a recognised clinical trial e.g. RECOVERY

DIAGNOSIS

- See https://www.rcpch.ac.uk/resources/paediatric-multisystem-inflammatory-syndrome-temporally-associated-covid-19-pims-guidance
- Presenting with:
- persistent fever
- inflammation
  - neutrophilia
  - elevated CRP
  - lymphopaenia
- evidence of single or multi-organ dysfunction
  - shock
  - cardiac
  - respiratory
  - renal
  - gastrointestinal

  - neurological disorder
  - may include children fulfilling full/partial criteria for Kawasaki disease
- Exclusion of any other microbial cause, including:
- bacterial sepsis
- staphylococcal or streptococcal shock syndromes
- infections associated with myocarditis e.g. enterovirus
- waiting for results of these investigations should not delay seeking expert advice
- SARS-CoV-2 PCR testing may be positive or negative

CLINICAL FEATURES

All:
- Persistent fever >38.5°C

Most:
- Oxygen requirement
- Hypotension

Some
- GI
- abdominal pain
- diarrhoea
- vomiting
- Cardiovascular
- syncope
- Respiratory
- cough
- shortness of breath
- Mucosal/cutaneous/eyes

INVESTIGATIONS

Haematology
- FBC
- Clotting with fibrinogen
- D-dimer

Biochemistry
- U&E
- LFT
- Albumin
- LDH
- ASOT
- Triglycerides
- Ferritin
- Troponin
- Pro-BNP
- CK

Microbiology
- Covid PCR (and serology if PCR negative)
- EBV
- CMV
- Adenovirus
- Enterovirus on blood
- Urine dipstick
- Cultures:
- blood
- urine
- stool

Common blood abnormalities (none are diagnostic)

- Lymphopenia
- Neutrophilia
- elevated platelets
- Raised CRP
- Raised ESR
- Low albumin
- Raised ALT
- Raised D-dimer
- Elevated troponin
- Elevated Pro-BNP

Other investigations

- ECG (variable features including ischaemia) and echo (where available) normal, impaired function, coronary artery abnormalities
- If respiratory symptoms – CXR
- If abdominal pain/abnormalities on examination – abdominal ultrasound

MANAGEMENT

- Appropriate PPE
- Standard APLS resuscitation (see **APLS – Recognition and assessment of the sick child** guideline)
- Broad spectrum antibiotics (e.g. cefotaxime)
- add clindamycin if features of toxic shock [see **Sepsis (including meningococcal)** guideline]
- Call local retrieval team/PICU early
- patients can deteriorate quickly and require early initiation of inotropes guided by PICU
- Decision on further immunomodulatory treatment to be made by local PIMS MDT (rheumatology, infectious diseases, cardiology, PICU) ideally on a recognised clinical trial. See https://www.rcpch.ac.uk/resources/paediatric-multisystem-inflammatory-syndrome-temporally-associated-covid-19-pims-guidance
- Monitor for signs of clinical deterioration (cardiovascular, respiratory, CNS and abdominal) and signs of worsening inflammation including HLH

FOLLOW-UP

- Long-term outcomes are not fully known − follow-up in centre with expertise in managing patients with PIMS-TS
- outcomes for patients have been favourable to date

KETONE MONITORING ● 1/2

If clarification required, contact diabetes team

- Check blood ketone levels whenever child is ill, regardless of blood glucose level
- Never stop or omit long-acting insulin
  - doses may need to be reduced/increased, depending on blood glucose and ketone levels
- Check blood glucose more frequently e.g. every 2 hr, including through the night
  - will help distinguish between conditions associated with hyperglycaemia and hypoglycaemia

Rarely, ketone levels may be elevated even if blood glucose levels are normal, e.g. in gastroenteritis

- If blood glucose above target give additional fast-acting insulin every 2 hr (see **Table 1: Ketone monitoring**). Ketones are:
  - <0.6 mmol/L: give usual correction insulin dose
  - 0.6–1.5 mmol/L: prescribe 10% of total daily dose (TDD) of insulin, or 0.1 unit/kg body weight, as additional fast-acting insulin
  - >1.5 mmol/L: prescribe 20% of TDD, or 0.2 units/kg body weight as additional fast-acting insulin
- If ketones present when blood glucose low, ('starvation ketones') respond to drinking extra fluids containing sugar
  - monitor blood glucose very closely
  - extra insulin may be required when blood glucose starts rising
- Advice to keep well hydrated by drinking plenty of fluids
  - water/sugar-free fluids most appropriate in majority of cases where blood glucose levels are normal/high
  - if blood glucose levels low, drinks containing glucose required, or take carbohydrates (if possible)
  - avoid carbonated drinks (if possible)
- Inform diabetes team early to seek advice
- Treat underlying condition

Table 1: Ketone monitoring

Blood ketone monitoring for all SC insulin regimens and insulin pump therapy

Negative ketones <0.6 mmol/L	Low to moderate ketones 0.6–1.5 mmol/L	Moderate to high ketones >1.5 mmol/L
Give correction dose to correct high blood glucose in addition to normal bolus for carbohydrates eaten	Give: • 10% of total daily dose of insulin as additional fast acting insulin **or** • 0.1 unit/kg body weight as additional fast acting insulin	Give: • 20% of total daily dose of insulin as additional fast acting insulin **or** • 0.2 units/kg body weight as additional fast acting insulin
Then: • Re-check blood glucose and ketones in 2 hr	Then: • Monitor fluid intake and ensure remains well-hydrated • Re-check blood glucose and ketones in 2 hr (see below)	Then: • Monitor fluid intake and ensure remains well-hydrated • Re-check blood glucose and ketones in 2 hr (see below)
If blood glucose is going down that is a good sign, but monitor closely throughout the day **If blood glucose increasing but ketones <0.6 mmol/L:** • Give another correction dose using fast acting insulin If ketones 0.6–1.5 mmol/L, follow low/mod column advice	If ketone negative follow negative column advice **If blood glucose increasing but ketones remain 0.6–1.5 mmol/L:** • EITHER Continue to give 10% of total daily dose • OR 0.1 unit/kg as additional fast acting insulin every 2 hr using pen • Give usual boluses for food	If ketones negative follow negative column advice **If blood glucose increasing but ketones reduced to 0.6–1.5 mmol/L:** follow low/mod column advice If ketones still >1.5 mmol/L: • EITHER Give another 20% total daily dose • OR 0.2 units/kg as additional fast acting insulin every 2 hr using pen

If ketones >1.5 mmol/L, follow **mod/high** column advice	• Re-check blood glucose and ketones every 2 hr, including through night If ketones increase to >1.5 mmol/L follow **mod/high** column advice	• Give usual boluses for food • If vomiting with high ketones, have low threshold for admission to hospital

SICK DAY DOSES

Insulin pumps

- When unwell, if blood glucose levels are high carry out standard checks on pump for:
  - occlusions
  - disconnection
  - battery failures
- Blood ketone level:
  - ≤0.6 mmol/L: give correction dose through pump
  - >0.6 mmol/L: give additional fast acting insulin using pen
- If 1 correction dose via pump has no effect in 1 hr, repeat correction dose with insulin pen
- Monitor blood glucose regularly
- If blood glucose levels rising in unwell child needing frequent additional insulin doses, consider using higher temporary basal rates – up to 200% of normal basal rates may be needed in some patients

MANAGEMENT OF INFECTIONS USUALLY ASSOCIATED WITH HYPOGLYCAEMIA (E.G. GASTROENTERITIS)

- Encourage regular small sips of sugar-containing drinks (**not** diet drinks)
- Monitor blood glucose ≤2-hrly
- If oral intake reduced and blood glucose in normal/low range: decrease usual fast acting insulin while illness persists
- Blood glucose:
  - 10–14 mmol/L: give usual fast acting dose of insulin
  - >14 mmol/L: see above for extra insulin doses
- Once oral intake tolerated again, give normal dose of insulin
- If not tolerating anything orally and blood glucose <4 mmol/L advise attend hospital
- If drowsy or reduced conscious level advise give glucagon IM as follows and dial 999:
  - body weight <25 kg: 500 microgram glucagon IM
  - body weight ≥25 kg: 1 mg glucagon IM
  - if then able to tolerate oral intake and blood glucose ≥4 mmol/L can go home
- If not tolerating anything orally or blood glucose still <4 mmol/L, admit for observation and IV glucose if necessary (if nil-by-mouth, follow insulin sliding scale guidelines)
- If child has been vomiting and not eating they may have ketones with normal blood glucose (starvation ketones)
- Monitor blood glucose frequently and encourage fluids containing sugar
- If blood glucose >14 mmol/L with ketones and vomiting, this is DKA - see **Diabetic ketoacidosis** guideline for inpatients
  - if occurs out of hospital – advise attend hospital urgently

LIMPING CHILD ● 1/5

DEFINITION

- Abnormal gait usually caused by:
  - pain
  - weakness
  - deformity
- Usually characterised by shortened stance phase on the affected side
- Parents/carers may use the term 'limping' to describe any abnormality of gait

RECOGNITION AND ASSESSMENT

History

- Trauma
- Weight loss
- Tiredness
- Birth history including presentation at delivery and hip screening
- Development disorders, e.g. cerebral palsy
- Fever
- Recent viral infection
- Joint swelling
- Joint stiffness (particularly early morning if considering inflammatory causes)
- Sickle cell status
- Duration of symptoms
  - if delay in presentation consider non-accidental injury (see **Child protection** guideline)

Examination

- Observations including:
  - temperature
  - weight
- Look for:
  - rashes
  - pallor
  - lymphadenopathy
  - hepatosplenomegaly
- Torsion can present as limp – examine testes

Paediatric Gait, Arms, Legs and Spine (pGALS) screening

- Gait – is it antalgic/Trendelenberg?
- Tip-toe walking, then heel walking
- Arms
  - look for:
    - restricted range of motion
    - stiffness
    - swelling
    - erythema
- Legs
  - look for:
    - bruising
    - deformity
    - erythema
    - is the pelvis level and are leg lengths equal?
  - feel for:
    - knee effusion and warmth
    - passive and active knee flexion with internal and external rotation of hip – compare internal rotation of both hips; restricted internal rotation is a sensitive sign of hip pathology
- Spine
  - observe from side and behind
  - ask child to touch toes and observe curve
- If joint abnormality found on screening examination: more detailed **LOOK, FEEL, MOVE** approach may be needed
- Interaction between child and parents
  - in non-accidental injury mechanism may not fit injury found (see **Child protection** guideline)

- Hip pathology can lead to pain in knee and vice versa

DIFFERENTIAL DIAGNOSIS

Always consider septic arthritis, malignancy and non-accidental injury as possible causes of a limp in childhood

Primary differentials of atraumatic limp by age

0–3 yr	• Septic arthritis/osteomyelitis • Developmental hip dysplasia • Fracture/soft tissue injury (toddler's fractures/non-accidental injury)
3–10 yr	• Transient synovitis/irritable hip • Septic arthritis/osteomyelitis • Perthes' disease • Fracture/soft tissue injury (stress fracture)
10–15 yr	• Slipped upper femoral epiphysis (SUFE) • Septic arthritis/osteomyelitis • Perthes' disease • Fracture/soft tissue injury (stress fracture)
Other important differential diagnoses	• **In all age groups consider non-accidental injury** • Neoplastic disease, e.g. acute lymphoblastic leukaemia • Haematological disease, e.g. sickle cell anaemia • Infective disease, e.g. pyomyositis or discitis • Metabolic disease, e.g. rickets • Neuromuscular disease, e.g. cerebral palsy or muscular dystrophy • Primary anatomical abnormality, e.g. limb length inequality • Rheumatological disease, e.g. juvenile idiopathic arthritis (see **Arthritis** guideline)

Transient synovitis

- Commonest atraumatic cause of limp – usually occurring in children aged 3–8 yr
- Male predominance
- Diagnose with caution in aged <3 yr due to increased risk of non-accidental injury/septic arthritis
- Recent history of URTI (not always)
- Child able to walk but in pain
- Otherwise well – afebrile and with normal systemic examination
- Mild reduction of internal rotation of hip
- Diagnosis of exclusion – always consider septic arthritis
- Symptoms <48 hr and following brief period of observation child systemically well, afebrile and able to weight bear: no further investigations necessary
- Follow-up in 48 hr and investigate if symptoms persist
- Aged >8 yr and risk factors for SUFE: further investigations including AP and frog lateral X-rays of pelvis

Septic arthritis

- If not treated urgently joint destruction and growth arrest may occur
- Predominantly due to haematogenous spread
- blood cultures +ve in majority of cases
- Particularly prone joints:
- hip
- ankle
- shoulder
- elbow
- *Staph. aureus* most common cause (can be caused by Group B *streptococcus* in neonates)
- Aged <18 months more vulnerable as physis does not prevent blood entering epiphysis

Children aged <3 yr are vulnerable to septic arthritis and non-accidental injury, with transient synovitis being a rare diagnosis
Investigate all aged <3 yr

Perthes' disease
- Idiopathic avascular necrosis of capital femoral epiphysis
- More common in boys aged 4–8 yr
- Diagnosed on plain AP pelvis X-ray showing sclerosis, fragmentation and flattening of capital femoral epiphysis – may need bone scan/MRI
- Symptoms >2 weeks
- 20% bilateral

Slipped upper femoral epiphysis
- Typically affects children aged >10 yr
- Male predominance
- Often overweight
- Associated with hypothyroidism and growth hormone deficiency
- May present with knee pain
- Hip can appear shortened and externally rotated
- Plain AP films may be normal – lateral projection required if suspected
- Urgent fixation improves outcome
- Can be bilateral

RED FLAGS
- Child aged <3 yr
- Unable to weight bear
- Pseudoparesis
- Fever
- Systemically unwell
- Lymphadenopathy/hepatosplenomegaly
- Night pain/night sweats
- Multiple joints affected/symptoms lasting >6 weeks
- Child aged >9 yr with pain/restricted hip movement

INVESTIGATIONS
- FBC and blood film
- ESR
- CRP
- If febrile, blood cultures
- X-ray 2 views; site of pain and pelvis
- If SUFE suspected obtain AP and frog lateral views of pelvis
- If suspicion of transient synovitis or septic arthritis perform joint aspiration, microscopy and culture (these cannot usually be differentiated by ultrasound and require laboratory and clinical correlation)
- If osteomyelitis/other abnormality suspected, or no clear diagnosis with persisting symptoms, further investigations may be needed; may include:
  - MRI pelvis (with/without contrast) with paediatric radiologist
  - bone scan
  - CT (usually as addition to MRI or in unusual situations – discuss with paediatric radiologist)
- CK, sickle screen

SEPTIC ARTHRITIS
- Fever >38.5°C
- Unable to bear weight
- ESR >40 mm in first hour
- CRP >20 mg/L
- White cell count >12 x 10^9/L

Septic arthritis can still be present in the absence of these criteria

MANAGEMENT
- If any features consistent with septic arthritis:
  - severe pain
  - range of movement <75% normal

- fever >38.5°C
- unable to weight bear
- ESR >40 mm in first hour
- CRP >20 mg/L
- WBC >12 x 10^9/L

OR

- X-ray abnormal or suggests orthopaedic problem (e.g. Perthes' disease, SUFE)
- Refer to orthopaedics for diagnostic aspiration/washout **before** starting antibiotics (see **Osteomyelitis and septic arthritis** guideline)

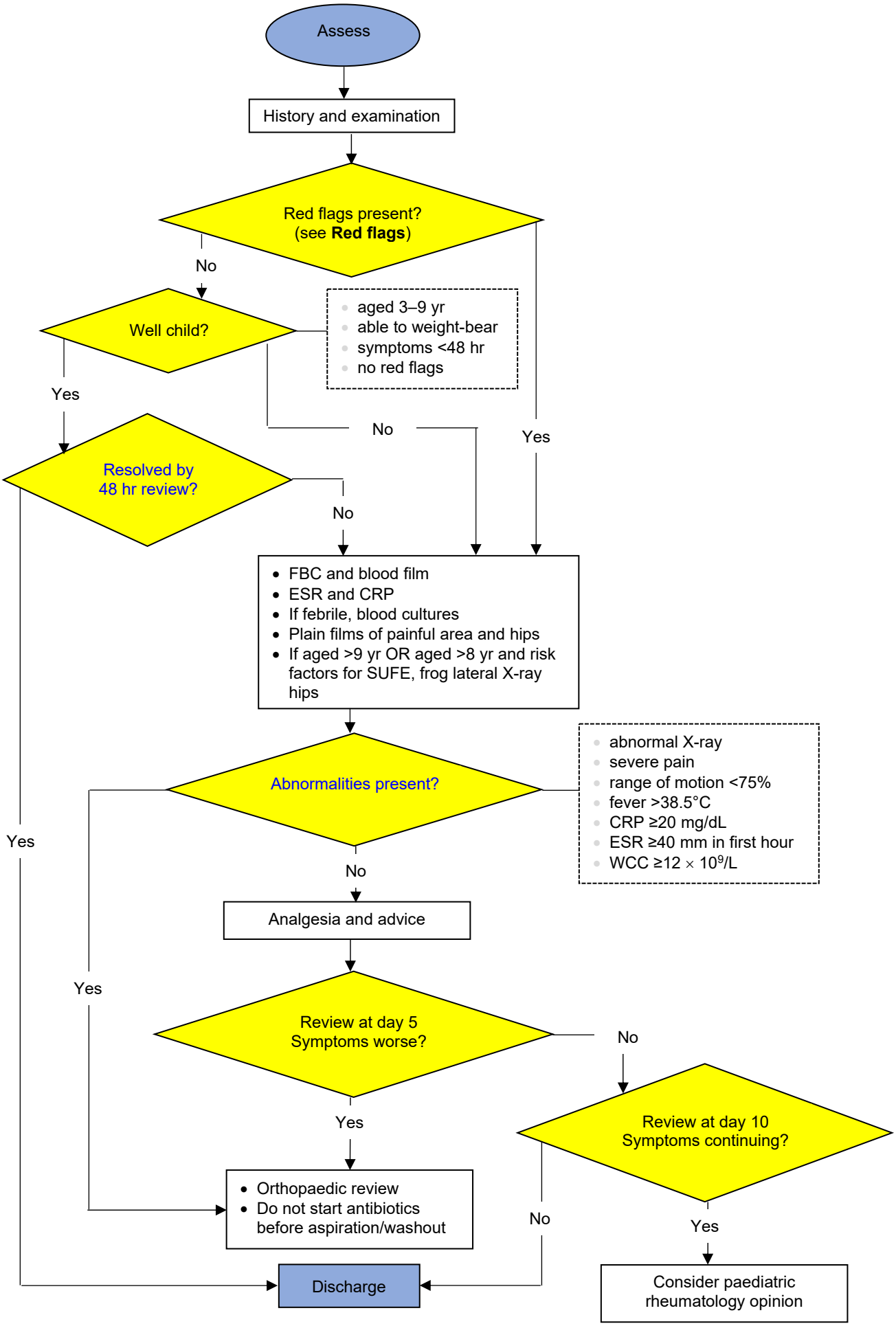
DISCHARGE AND FOLLOW-UP

- If blood tests and X-ray normal, irritable hip (reactive arthritis) likely
- discharge with analgesia, information leaflet and reassurance
- advise return if fever occurs or problem becomes worse

Review after 5 days

- If worse, refer for orthopaedic opinion
- If no worse, review after a further 5 days
- If still no better, arrange joint orthopaedic/paediatric review, and consider referral for paediatric rheumatology opinion
- If normal at 5 or 10 days, discharge

Algorithm: Management of limp in childhood



LONG LINE INSERTION ● 1/4

INDICATIONS

- Midlines for patients where proposed IV therapy is 5–14 days duration and not requiring central administration
- Peripherally inserted central catheter (PICC)
- for drugs that have to be given centrally (e.g. if they cause phlebitis)
- if risk of infection high (e.g. parenteral nutrition)
- for access >14 days

INSERTION SITES

- Commonly long saphenous at ankle or medial/lateral antecubital veins
- If access is difficult for midlines, other large peripheral vein or scalp vein can be used

EQUIPMENT

- Assistant
- Midline:
- Leaderflex 22 G (2.5 F) line 6, 8 or 20 cm
- PICC:
- Vygon PICC 3, 4 or 4.5 F 60 cm Lifecath
- Vygon Nutriline 2, 3 or 4 F 30 cm
- Vygon Neocath or Epicutaneo-Cava catheter 2 F (23 G) 15, 30 or 50 cm has different insertion technique, not recommended except neonates

DO NOT ATTEMPT INSERTION UNLESS YOU ARE FULLY TRAINED
Use whichever line you have been trained to use

- Flush solution: sodium chloride 0.9% 5 mL
- Single dressing pack
- Sterile gown and gloves; mask and hat for operator and assistant
- Sterile scissors
- 2 extra sterile towels
- 5 mL syringe/green needle
- Tape measure
- Sterile clear dressing (e.g. Opsite®/Tegaderm®)
- 2 extra packs gauze swabs
- Single-use application of chlorhexidine 2% in isopropyl alcohol 70%
- if sensitivity use povidone-iodine
- 3 wide Steri-strips™ (optional to secure line)
- Biopatch™
- Sterile non-toothed forceps
- Needle holder
- Sutures
- Instrument checklist

PROCEDURE

Measure insertion distance

- Upper limb: measure from insertion site to upper sternum – line tip to be within superior vena cava
- Lower limb: measure from insertion site to xiphisternum – line tip to be within inferior vena cava

PICC line preparation

- Check patient's notes for comments regarding previous line insertions. Some veins can be particularly difficult, and patient can often provide guidance
- Assess whether patient will need sedation. Rarely, children with needle phobia or difficult vascular access issues will need the line inserted under general anaesthetic. Arrange appropriate person to administer sedation
- If necessary, remove hair from insertion site using clippers (single use disposable razor can be used if clippers unavailable) to allow dressing to be applied post insertion and avoid hair plucking when dressing removed

- If using topical local anaesthetic cream, specify exactly where you would like this sited. Apply anaesthetic cream to chosen veins (3 sites) ≥1 hr before starting procedure (depending on manufacture's recommendation)
- if ventilated additional sedation, analgesia or muscle relaxant may be required
- Use single patient use tourniquet
- Check whether blood samples required
- Gather all necessary equipment including spare line (unopened)

Consent
- Explain procedure and reassure patient and parent/carer
- Obtain and record consent

Position of patient
- Position patient seated in chair or lying with his/her arm or leg out-stretched and supported by table or bed (on a utility drape)
- ensure patient in position and comfortable, and lighting optimal

Surgical aseptic non-touch technique (ANTT)
- Always use ANTT
- Put on surgical mask and hat
- Wash hands with chlorhexidine, povidine-iodine and put on apron/gown and sterile gloves
- Clean patient's skin thoroughly with single use application of chlorhexidine 2% in isopropyl alcohol 70% and allow to dry for ≥30 sec
- if patient has sensitivity use povidone-iodine (for neonate skin preparation see **Neonatal** guidelines)
- Drape sterile sheet to expose only chosen vein, and cover surrounding areas to provide working room and a flat surface on which to rest your line, forceps and flush
- if sterility compromised at any stage abandon procedure and restart with new equipment

Lifecath 3, 4 or 4.5 F
- Assemble line fully and flush with sodium chloride 0.9% 1 mL to ensure patency
- Insert using aseptic Seldinger technique [see **Surgical aseptic non-touch technique (ANTT)**]
- **Lifecath can be cut to desired length** – follow manufacturer's recommendations
- record length of line in notes to ensure it can be fully removed later
- ensure stiffening wire within the Lifecath is withdrawn beyond site to be cut, to ensure that wire is not damaged/weakened (may lead to wire snapping within the patient)
- Place everything you will need onto sterile sheet within reach
- Ask assistant to apply tourniquet, but remain ready to release
- Check patient is ready for you to start
- Clean insertion area [see **Surgical aseptic non-touch technique (ANTT)**]
- Access vein with introducer supplied with line or cannula

Be careful; introducer for PICC line is much stiffer than standard cannula and more likely to perforate entire vein

- Insert guidewire via cannula or introducer
- wire does not need to be fully inserted and may cause arrhythmias if inserted too far
- do not force the guidewire – this will damage the vessel and may weaken the wire causing it to bend or snap
- it is important that, at any time, operator is able to grasp directly either free end of wire or wire itself as it passes through skin, to ensure that it does not pass entirely into vein
- Remove cannula or introducer
- Insert dilator and peelable sheath over guidewire until blood flowing freely (in some patients this will come quite quickly so have catheter ready)
- Release/ask assistant to release tourniquet to reduce blood flow
- Remove dilator and guidewire then insert PICC line via sheaf. At approximately 6–7 cm you will reach the tip of the sheaf line. If line passes easily beyond 6 cm, you have probably succeeded. Resistance at any point usually indicates failure to thread vein or curling of line. Insert line to previously measured distance from site of insertion. Manipulation of the limb may be helpful if there is difficulty in advancing the line past a joint
- When tip of line judged to be in correct position, carefully withdraw sheath and remove from around line by pulling apart the 2 wings, then remove the stiffening wire from within the line

- Apply pressure on entry site (it may bleed for a few minutes). Aspirate then flush line with sodium chloride 0.9% 2 mL. Secure line with suture or Steri-strips™ (according to local policy). Once any bleeding has stopped, apply Biopatch™ over entry site
- Cover entry site, connections and any exposed line with clear dressing (e.g. Opsite®)
- X-ray line to check tip position if near heart or if no blood flushes back up line. Do not draw blood back up the line (this increases risk of line blockage). While waiting for X-ray confirmation of tip position infuse sodium chloride 0.9% 0.5–1 mL via each lumen of line to ensure continued line patency. Confirm removal of complete guide and stiffening wires with assistant
- Following confirmation of line position flush once more and line is then ready to use

Leaderflex lines

- Insert using surgical ANTT Seldinger technique [see **Surgical aseptic non-touch technique (ANTT)**]
- **DO NOT** cut lines
- Cannulate target vein with either needle provided or a 24 G Jelco® cannula or blue cannula (do **not** use Neoflan™)
- Feed guidewire into vein through cannula sheath and remove sheath leaving wire *in situ*
- Feed line over guidewire and into vein with a gentle twisting action. It is important that, at any time, operator is able to grasp directly either free end of wire or wire itself as it passes through skin, to ensure that it does not pass entirely into vein
- Remove guidewire and secure line in place
- Once any bleeding has stopped apply Biopatch™ over the entry site (if local policy)
- Cover entry site, connections and any exposed line with piece of clear dressing (e.g. Opsite®)
- It is not necessary to verify position of 6 or 8 cm lines radiologically unless inserted into axillary vein

Nutriline PICC line

- Insert using surgical ANTT [see **Surgical aseptic non-touch technique (ANTT)**]
- Assemble line fully and flush with sodium chloride 0.9% 1 mL to ensure patency
- Place everything you will need onto sterile sheet within reach
- Ask assistant to apply single patient use tourniquet but remain ready to release
- Clean insertion area
- Access vein with introducer supplied with line

Be careful; introducer for PICC line is much stiffer than standard cannula and more likely to perforate entire vein

- Remove needle leaving peelable sheaf *in situ* and insert line using forceps
- Release or ask assistant to release tourniquet to reduce blood flow
- At approximately 6 cm you will reach tip of sheaf. If line passes easily beyond 6 cm, you have probably succeeded. Resistance at any point usually indicates failure to thread vein or curling of line. Insert line to previously measured distance from site of insertion. Manipulation of the limb may be helpful if difficulty advancing line past a joint
- When tip of line judged to be in correct position, carefully withdraw sheath and remove from around line by pulling apart the 2 wings

- Without releasing pressure on entry site (it may bleed for a few minutes) flush with sodium chloride 0.9% 2 mL using a 10 mL syringe (smaller syringes cause greater pressure and may rupture the line)
- With sterile scissors, cut rectangle of gauze (1 × 2 cm) to prevent hub of line rubbing skin
- Check all connections are firmly tightened. Coil any unused line next to insertion site and secure with Steri-strips™
- Once any bleeding has stopped apply Biopatch™ over the entry site (if used locally)
- Cover entry site, connections and any exposed line with one piece of clear dressing (e.g. Opsite®)
- X-ray line [0.5 mL of contrast [e.g. Omnipaque (iohexol) 240 mg/mL] may be required to adequately see line tip position – use according to local guidelines] to check tip position if near heart or if no blood flushes back up line. Do not draw blood back up line (this increases risk of line blockage)

Use standard ANTT when accessing the system or for dressing changes.
***See* Surgical aseptic non-touch technique (ANTT)**

AFTERCARE

- Confirm removal of all guidewires with assistant and document using instrument checklist
- Document insertion and all interventions in patient notes

- Flush after each use with sodium chloride 0.9% 2 mL in 10 mL syringe (or bigger) using a pulsed, push-pause technique, and clamped whilst flushing to create positive pressure in the line
- Ensure each lumen has continuous infusion of 0.5–1 mL/hr of IV fluid to maintain patency or use heparin 100 units/mL to line lock (aspirate before use) if line accessed less than every 7 days
- Decontaminate access port using chlorhexidine 2% in isopropyl alcohol 70% and allow to dry
- require 1 min contact time to disinfect port
- if patient has sensitivity use povidone-iodine in alcohol 70%
- Curos caps are a needle free device for each port and alternative to wiping port
- if port not accessed must be changed every 7 days, single use curos caps to be placed on all ports
- Change dressings every 7 days (or sooner if visibly soiled or coming away)
- Cleaning of the access site should be carried out using single use chlorhexidine 2% in isopropyl alcohol 70%
- if patient has sensitivity use povidone-iodine in alcohol 70%
- Maintain standard ANTT for accessing system and dressing changes. Before accessing system, disinfect hub and ports with disinfectant compatible with catheter (e.g. alcohol or povidone-iodine)
- Prescribe skin decontamination wash e.g. Octenisan® to reduce risk of line infection
- Inspect site at least daily for any signs of infection and remove if signs of infection present
- Minimise number of times the long line is accessed
- Replace administration sets depending on what is being infused according to local policy. Routine catheter replacement is unnecessary

Assess need for device daily and remove as soon as possible

- When removed document date of removal and reason for removal in notes

.

COMPLICATIONS

- Clinical deterioration of a patient with a central venous catheter should raise the question of catheter related complication
- Commonest complication is sepsis
- Extravasation of fluids into pleural, pericardial and subcutaneous compartments – seek immediate senior advice and follow local extravasation guidelines
- Suspect pericardial tamponade if:
- acute or refractory hypotension
- acute respiratory deterioration
- arrhythmias
- tachycardia
- unexplained metabolic acidosis
- Check pericardial tamponade by X-ray or echocardiogram
- drain pericardial fluid to treat
- To reduce risk of damaged or snapped lines:
- avoid using small syringes <2 mL for bolus injections – generate high pressures
- avoid using acetone to clean around catheter – may weaken line
- do not exceed recommended pressure limits or flow rates (found on product packaging) for individual lines
- If forced on removal, lines can snap
- If retained line/line fragments suspected, inform consultant – may require surgical removal

REMOVAL

Indications

- Clinical use no longer justified
- Complication associated with indwelling line identified

Technique

- Use standard ANTT [see **Surgical aseptic non-touch technique (ANTT)**]
- Carefully remove dressing
- Pull line gently in direction of vein
- Ensure line has been removed intact
- If sepsis suspected, send line tip (length <4 cm; cut off with sterile scissors) for culture
- Apply pressure over line site to prevent bleeding
- Document removal in notes and record length to ensure removed in full

LYME DISEASE ● 1/3

RECOGNITION AND ASSESSMENT

History

- Ticks mainly found in grassy and wooded areas, including urban gardens and parks
- Bites may not always be noticed
- Particularly high-risk areas South of England and Scottish Highlands (but infection can occur in many areas)
- Lyme disease may be more prevalent in parts of central, eastern and northern Europe (including Scandinavia) and parts of Asia, United States and Canada
- Most tick bites do not transmit Lyme disease
- Prompt, correct removal of the tick reduces risk of transmission

Do not diagnose Lyme disease in individuals without symptoms, even if they have had a tick bite

SYMPTOMS AND SIGNS

Rash (two types)

- See **Figure 1: Images of rash**

Erythema migrans	Reaction to tick bite
• Erythematous • Increases in size and may have a central clearing • Not usually itchy, hot or painful • Usually becomes visible from 1–4 weeks (but can appear from 3 days–3 months) after a tick bite and lasts for several weeks • Usually at site of a tick bite	• Usually develops and recedes within 48 hr from time of tick bite • More likely than erythema migrans to be hot, itchy or painful • May be caused by inflammatory reaction or infection with a common skin pathogen

Organ systems

- Consider possibility of Lyme disease in children presenting with symptoms and signs relating ≥1 organ system
- Neurological symptoms
  - facial palsy or other unexplained cranial nerve palsies
  - meningitis
  - mononeuritis multiplex
  - encephalitis
  - neuropsychiatric presentations
- Inflammatory arthritis
  - affecting ≥1 joint – may be fluctuating and migratory
- Cardiac problems
  - heart block
  - pericarditis
- Eye symptoms
  - uveitis
  - keratitis
- Skin rashes
  - acrodermatitis chronica atrophicans
  - lymphocytoma

Other symptoms

- Fever and sweats
- Swollen glands
- Malaise
- Fatigue
- Migratory joint or muscle aches and pain
- Cognitive impairment, e.g. memory problems and difficulty concentrating (sometimes described as 'brain fog')
- Headache
- Paraesthesia
- Neck pain or stiffness

LYME DISEASE ● 2/3

INVESTIGATION

- If high clinical suspicion of Lyme disease and erythema migrans, diagnose and treat (no laboratory testing required)
- If erythema migrans not present
  - if <4 weeks from symptom onset and high clinical suspicion, start treatment
  - if ≥4 weeks from symptom onset offer enzyme-linked immunosorbent assay (ELISA) test – see NICE guidance https://www.nice.org.uk/guidance/ng95/chapter/recommendations#test-for-lyme-disease
    - if high clinical suspicion, negative result does not rule out Lyme disease
    - if negative >12 weeks from symptom onset, offer immunoblot test
- If ELISA positive, offer immunoblot test
- If immunoblot positive, offer antibiotics
- If immunoblot negative, consider alternative diagnosis or refer to paediatric infectious diseases specialist

MANAGEMENT

See also:

- NICE Lyme disease guidelines https://www.nice.org.uk/guidance/ng95/chapter/recommendations#management
- **BNFc**

Erythema migrans, non-focal symptoms affecting cranial nerves or peripheral nervous system

- Aged ≥9 yr: doxycycline 21 days
- Aged <9 yr: amoxicillin 21 days

Lyme disease affecting CNS

- Ceftriaxone
  - when symptoms resolve, if aged >9 yr, switch to doxycycline
- Total treatment 21 days

Lyme disease arthritis OR acrodermatitis chronica atrophicans

- Aged ≥9 yr: doxycycline 28 days
- Aged <9 yr: amoxicillin 28 days

Lyme carditis

- Haemodynamically stable aged ≥9 yr
  - doxycycline 21 days
- Haemodynamically unstable or aged <9 yr
  - ceftriaxone 21 days

Figure 1: Images of rash

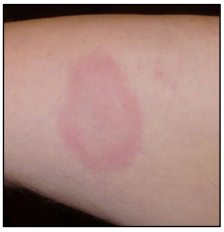


Image 1: Small erythema migrans lesion on arm with a central clearing and 'bull's eye'
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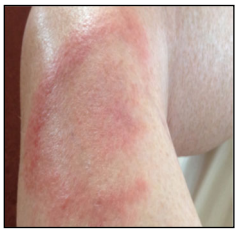

Image 2: Large erythema migrans lesions on leg with a central clearing and 'bull's eye'
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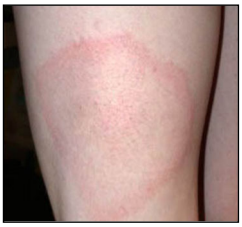

Image 3: Large erythema migrans lesion on leg with faint 'bull's eye'
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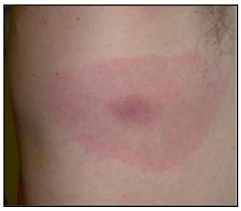

Image 4: Large erythema migrans lesion under the arm without a central clearing
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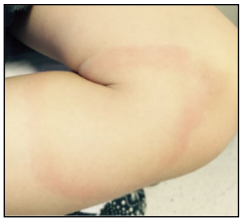

Image 5: Large erythema migrans lesion on child's leg without a 'bull's eye'
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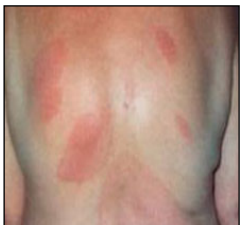

Image 6: Multiple erythema migrans lesions on back
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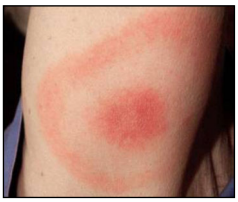

Image 7: Small erythema migrans lesion with a central clearing and 'bull's eye'
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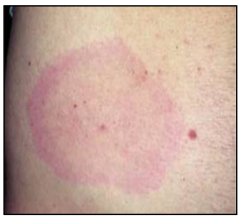

Image 8: Erythema migrans lesion without a 'bull's eye'
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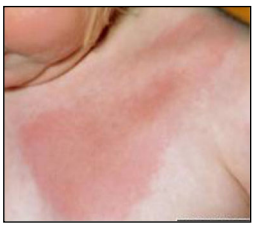

Image 9: Large erythema migrans lesion on child's shoulder and chest without central clearing or 'bull's eye'
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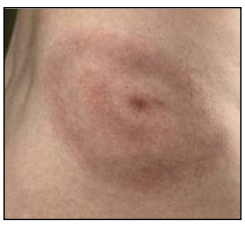

Image 10: Large erythema migrans lesion on back with central clearing and 'bull's eye'
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MALARIA • 1/3

Falciparum is a medical emergency; immediate treatment is essential

RECOGNITION AND ASSESSMENT

- Test for malaria anyone with fever and appropriate travel history
- to a malarial area within the last 12 months
- or febrile infant whose mother has travelled to a malarial area in pregnancy

Clinical features

Non-specific	Severe (complicated) malaria
• Fever • Malaise • Headache • Sweating • Diarrhoea • Vomiting • Abdominal pain • Splenomegaly • Anaemia • Thrombocytopenia • Jaundice	• Persistent vomiting, severe dehydration • Shock, renal failure (oliguria <0.5 mL/kg/hr) • Depressed conscious state, seizures • Tachypnoea or increased work of breathing • Hypoxia (SpO_2 <95%) • Metabolic acidosis (base deficit >8) • Severe hyperkalaemia (K^+ >5.5 mmol/L) • Hypoglycaemia (glucose <3 mmol/L) • Severe anaemia (Hb <80 g/L) • Unable to walk • Parasitaemia >2% or schizonts on film

Investigations

- EDTA blood sample sent to haematology for urgent blood film. If film not done locally, send for rapid diagnostic test (ICT)
- Negative malaria ICT does not exclude malaria
- Do not treat unless ICT or blood film positive
- If negative and clinical suspicion of malaria, send a repeat after 12–24 hr and third after further 24 hr
- Admit all patients with falciparum to a unit with experience in managing severe malaria (e.g. infectious disease unit)
- Opportunistic screen for other imported diseases; hepatitis B, HIV, blood culture

If malaria is diagnosed on blood film, but type unclear, treat as falciparum malaria

SEVERE (COMPLICATED) MALARIA

Anti-malaria treatment

- Artesunate IV (if BMI >91st centile use ideal body weight to calculate dose):
- <20 kg: 3 mg/kg IV
- ≥20 kg: 2.4 mg/kg IV
- see packet insert for reconstitution using buffer supplied
- e.g. add 1 mL sodium bicarbonate 5% (provided) to each 60 mg vial and dilute further in 5 mL sodium chloride 0.9% to make 10 mg/mL solution and inject dose slowly over 3–4 min
- give at 0, 12 and 24 hr and then once daily (i.e. every 24 hr). Maximum duration 7 days
- When parasitaemia resolving and patient improving, switch to oral agent:
- artemether with lumefantrine (Riamet®) 6 doses (at 0, 8, 24, 36, 48 and at 60 hr) – see **Treatment of uncomplicated falciparum malaria**
- if Riamet® unavailable give atovaquone-proguanil (Malarone®), or oral quinine (if neither other agent available)

If artesunate unavailable

- Quinine (of dihydrochloride) IV diluted to 2 mg/mL with sodium chloride 0.9% or glucose 5%
- loading dose: 20 mg/kg (maximum 1.4 g) as infusion over 4 hr (NEVER as IV bolus)
- omit loading dose if mefloquine or quinine or quinidine used in previous 24 hr
- BM sticks 2-hrly during IV quinine, cardiac monitor and daily ECG (check QTc);
- maintenance dose: 10 mg/kg (dihydrochloride) after 8–12 hr, followed by 10 mg/kg (dihydrochloride) every 8 hr, infused over 4 hr, for up to 48 hr. Maximum maintenance dose 700 mg
- When parasitaemia resolving and patient improving, switch to oral agent as above
- daily FBC, U&E and blood films as inpatient until asexual parasites undetectable

Complications

- Parasitaemia >10%: admit PICU
- Renal failure: discuss early filtration/dialysis with PICU

- Hypovolaemia: cautious rehydration (high risk pulmonary oedema)
- Shock: add ceftriaxone [see **Sepsis (including meningococcal)** guideline]
- Hypoglycaemia: common, give glucose 10% 2 mL/kg IV bolus then glucose 10% 5 mL/kg/hr with sodium chloride 0.9%:
  - remove 50 mL from 500 mL bag of glucose 5% with sodium chloride 0.9% and add 50 mL of glucose 50%
  - makes 500 mL of glucose 10% (approximately) and sodium chloride 0.9% (approximately)
- Anaemia: common, transfuse only if symptomatic severe anaemia
- Thrombocytopenia: expected, transfuse only if bleeding and platelets <20 × 10^9/L

CEREBRAL MALARIA

Impaired level of consciousness

- Correct hypoglycaemia
- Monitor GCS, reflexes, pupils
- Plan for intubation and transfer to PICU if:
  - signs of raised ICP
  - persisting shock after 40 mL/kg fluid or
  - pulmonary oedema

TREATMENT OF UNCOMPLICATED MALARIA (no clinical features of severe malaria)

- All species (falciparum, vivax, ovale, malariae)
- If child can tolerate oral intake: **Riamet®** 20 mg/120 mg tablets [artemether with lumefantrine (can be crushed and dispersed in water)
- Not if given treatment overseas for this episode already
- No second agent required

Weight (kg)	Dose (at 0, 8, 24, 36, 48 and 60 hr)	Total number of tablets over 60 hr
5–14	1	6
15–24	2	12
25–34	3	18
35+ (aged 12–18 yr)	4	24

OR

Malarone® (atovaquone with proguanil) once a day for 3 days (may be crushed and mixed with food)

- Not if on Malarone® prophylaxis
- Paediatric tablet contains proguanil 25 mg with atovaquone 62.5 mg
- Standard tablet contains proguanil 100 mg with atovaquone 250 mg
- No second agent required

Weight (kg)	5–8	9–10	11–20	21–30	31–40	>40
Dose	2 paed tablets	3 paed tablets	1 standard tablet	2 standard tablets	3 standard tablets	4 standard tablets

OR

Quinine sulphate

- 10 mg/kg (maximum 600 mg) oral 8-hrly
- Reduce to a 12-hrly regimen if severe cinchonism (severe tinnitus, deafness, unsteadiness)
- Mild tinnitus and feeling of 'blocked' ears are expected on quinine and resolve once therapy completed
- Continue until blood films negative or for a 7 day course (whichever is longer). A shorter course may be possible but only at infectious diseases consultant's discretion
- With quinine give second agent
  - aged <12 yr: clindamycin 7–13 mg/kg (maximum 450 mg) 8-hrly for 7 days
  - aged ≥12 yr: doxycycline 200 mg once daily for 7 days

Weight (kg)	Paediatric dosing of oral quinine sulphate
5–7	50 mg (¼ x 200 mg tablet)

8–12	100 mg (½ x 200 mg tablet)
13–17	150 mg (¾ x 200 mg tablet)
18–22	200 mg (1 x 200 mg tablet)
23–27	250 mg (½ x 300 mg + ½ x 200 mg tablet)
28–37	300 mg (1 x 300 mg tablet)
38–45	400 mg (2 x 200 mg tablet)
46–57	500 mg (1 x 200 mg tablet and 1 x 300 mg tablet)
>57	600 mg (2 x 300 mg tablet) = maximum dose

If in doubt treat as severe (complicated) malaria

NON-FALCIPARUM MALARIA

- Riamet® dosing as for uncomplicated falciparum
- Start primaquine after checking G6PD levels:
- normal G6PD range:
  - aged 0–9 months: 8.3–20.1 u/gHb
  - aged >9 months: 4.8–13.6 u/gHb
- do not delay chloroquine for G6PD levels

- Aged >6 months with normal G6PD levels:
- *P. ovale*: primaquine 250 microgram/kg oral (maximum 15 mg) daily for 14 days
- *P. vivax*: primaquine 500 microgram/kg (maximum 30 mg) daily for 14 days

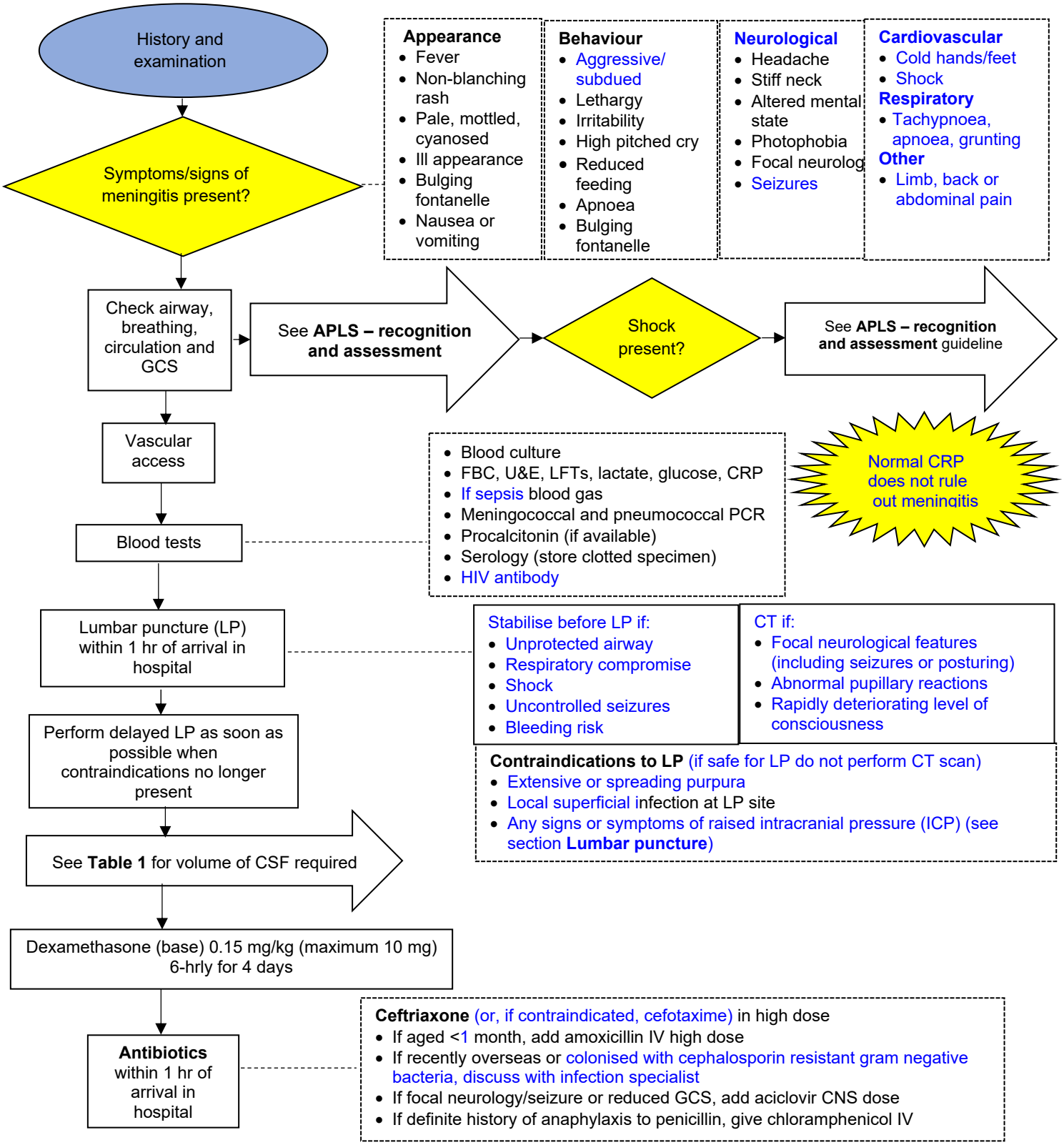
- Aged >6 months or mild–intermediate G6PD deficiency (3–6 u/gHb):
- primaquine 750 microgram/kg (maximum 45 mg) **once a week** for 8 weeks

- Aged <6 months and G6PD deficiency or severe deficiency (<3 u/gHb):
- contact ID specialist

ASSESSMENT

Red flag: Fever, headache, neck stiffness, and altered level of consciousness or cognition

- See https://bsac.org.uk/paediatricpathways/



LUMBAR PUNCTURE (LP)

- Perform LP before starting antibiotics, unless it is not safe to do so, or it will cause a clinically significant delay to starting antibiotics
- If started on antibiotics before having LP, perform LP as soon as possible (if it is safe to perform)
- Treat and stabilise any of the following before performing LP:
  - unprotected airway
  - respiratory compromise
  - shock
  - uncontrolled seizures
  - bleeding risk
- **DO NOT perform LP until the following factors resolved:**
  - extensive or rapidly spreading purpura
  - infection at LP site
  - if any of these symptoms or signs are present which might indicate raised ICP, e.g.:
    - new focal neurological features (including seizures or posturing)
    - abnormal pupillary reactions
    - Glasgow coma scale (GCS) score of <9, or a progressive and sustained or rapid fall in level of consciousness
  - if there is any previous history of headaches associated with vomiting, personality changes or unresponsive episodes, consider space occupying lesion
- Measure blood glucose immediately before LP, so that cerebrospinal fluid to blood glucose ratio can be calculated

Risk factors for meningitis

- Missed immunisations
- Hyposplenism or immune deficiency
- Family history or contact meningococcal disease
- CSF leak or cochlear implant

CSF specimens

- One fluoride tube (and 4 CSF bottles)
- If tap traumatic, may need more samples
- If insufficient CSF discuss priorities with microbiology

Table 1: Collection of specimens (stated volumes represent minimum required)

Department	Specimens required (6 drops = approx 0.2 mL)
Biochemistry	• 0.2 mL in CSF bottle for protein • 0.2 mL in fluoride tube for glucose (also send blood glucose) and for lactate if metabolic disorder suspected
Microbiology	• 0.2 mL in CSF bottle for MC&S • 1 mL (10 mL in older children) for AFB, TB culture and PCR if TB suspected
Virology	If possible viral meningitis or encephalitis: • 0.5 mL for HSV PCR
Cytology	• 0.2 mL if TB suspected
Save	• 0.5 mL in plain bottle for additional neurology tests (e.g. oligoclonal bands) depending on other results and progress

Other investigations

- If signs of meningococcal sepsis, throat swab for bacterial culture (label 'For meningococcal culture')
- If lymphocytes in CSF, stool for enterovirus PCR
- Negative meningococcal PCR does not rule out meningococcal disease
- If LP contraindicated, perform as soon as no longer contraindicated
- Repeat LP in neonates with:
  - persistent or re-emergent fever
  - deterioration in clinical condition
  - new clinical findings (especially neurological)
  - persistently abnormal inflammatory markers

MENINGITIS ● 3/3

RESULTS

- See **Encephalitis** guideline for interpretation of results
- If history of travel, low CSF: blood glucose ratio +/- raised protein, discuss with TB team urgently about starting TB treatment
- Manage as meningitis if:
  - aged <28 days: ≥20 white cells/μL
  - aged >28 days: >5 white cells/μL or >1 neutrophil/μL
  - lower cell count
  - no CSF available for examination
  - CSF findings uninterpretable
  - antibiotics given before LP and no growth on culture
  - other symptoms and signs suggest the diagnosis, especially in neonates

MONITORING TREATMENT

- In a semi-conscious patient, monitor hourly until improvement evident:
  - respiratory rate
  - pulse and BP
  - level of consciousness and pupils
  - in young infants, measure head circumference daily
- If persistent pyrexia and not improving look for other foci
  - repeat blood cultures and other investigations according to signs
  - CT scan at 10 days for microabscess or hypodensity
  - if CT normal, repeat LP
- Do not restrict fluids unless raised ICP or increased antidiuretic hormone secretion

SUBSEQUENT MANAGEMENT

Length of antibiotic course

- Meningococcus: 5 days (if not recovered at 5 days, 7 days)
- *Haemophilus influenzae:* 10 days
- Pneumococcus or Group B Streptococcus: 14 days
- Gram negatives: 21 days
- Listeria: 21 days (with gentamicin for first 7 days)
- No organism identified:
  - aged >3 months, 10 days
  - aged <3 months, 14 days
- Other, discuss with paediatric infectious diseases/microbiologist
- If causative organism not pneumococcal stop dexamethasone

Public health

- Inform Public Health consultant of a case of suspected meningitis (see **Notifiable infectious diseases and food poisoning** guideline)
  - Health protection team will arrange prophylaxis for close contacts
- Meningococcal meningitis
  - if ceftriaxone given as treatment, eradication treatment not required for patient
  - close contacts (all ages): ciprofloxacin single dose
- *Haemophilus influenzae*
  - close contact aged <10 yr, give rifampicin oral once daily for 4 days

DISCHARGE AND FOLLOW-UP

- Organise formal hearing test 6 weeks after discharge from hospital
- If severely ill during admission, discuss with consultant about follow-up to monitor developmental progress
- Refer to immunology or paediatric infectious disease specialist IF
  - pneumococcal
  - recurrent serious bacterial infections OR
  - family history of meningococcal disease or immune deficiency OR
  - >1 episode of meningococcal disease serogroup despite previous immunisation

MIGRANT CHILDREN HEALTH SCREENING ● 1/1

BACKGROUND

- If screening not previously done, screen opportunistically on presentation to secondary care
- If unsure, seek infectious diseases advice
- Take cultures **before** giving antibiotics and adjust treatment in line with sensitivity results

HISTORY

- In addition to usual medical history, specifically ask about:
- risk factors
  - geographical: country of origin, transit countries, refugee camps
  - blood-borne infection: overseas surgery, blood transfusion, tattoos, drug use
  - nutritional: diet, contamination risks
- Past medical history and before treatment: handheld documentation available
- Family history – HIV, hepatitis B or C, TB
- Immunisations
- Social history – legal guardian/family structure/unaccompanied minor
- Substance abuse – current/former
- Sexual history – consensual or non-consensual (high rates of abuse/exploitation for migrants)

INVESTIGATIONS

All children

- FBC, U&E, LFT, bone profile, vitamin D
- Growth: height and weight measurements. See growth chart

Consider

- Congenital infection screen: HIV antibody, HBsAg, hepatitis C antibody, syphilis serology
- Helminth screen:
- 3 x stool sample for ova, cysts and parasites **or** empiric mebendazole 100 mg twice/day 3 days
- if eosinophilia, IgG for strongyloides
- if from Africa, schistosomiasis serology
- Latent or symptomatic tuberculosis:
- screen all asymptomatic children from countries with TB incidence >150/100,000 (countries in https://www.gov.uk/government/publications/tuberculosis-tb-by-country-rates-per-100000-people)
- Mantoux test: see **Tuberculosis** guideline
- Malaria: see **Malaria** guideline
- all febrile children having visited country with endemic malaria in last 12 months
- infants born to mother with history of fever who visited malarial country in pregnancy
- perform 3 blood films 12 hr apart
- if febrile blood culture: Typhoid
- If sexually active: urine for chlamydia and gonorrhoea

Consider referrals to other services

- Optician
- Dentist
- Audiologist
- CAMHS e.g. concern post-traumatic stress disorder
- STD clinic
- Obstetrics

MANAGEMENT

Treat any conditions found on screening

Vaccinations

- Assume children are unvaccinated unless reliable evidence of immunisation provided
- if unvaccinated, organise full course of vaccinations
- if incomplete primary vaccinations, resume course (no need to repeat doses or restart course)
- organise catch up immunisations as quickly as possible to complete UK primary immunisations
- see vaccination of individuals with uncertain or incomplete immunisation status (https://www.gov.uk/government/publications/vaccination-of-individuals-with-uncertain-or-incomplete-immunisation-status)

MONITORING EX-PREM INFANTS AND NEONATES AGED <1 MONTH POST GENERAL ANAESTHETIC ● 1/1

- Risk of apnoea after general anaesthetic (GA) increased with:
- anaemia
- chronic lung disease who have required oxygen treatment within last 6 months

MANAGEMENT

Pre-operative

- Check Hb
- if Hb <90 g/L, arrange transfusion
- Arrange overnight stay for post-operative monitoring if:
- full term (≥37 weeks), and aged <1 month
- preterm (<37 weeks), and <60 weeks' post-conceptional age
- Overnight stay may also be at discretion of anaesthetist and surgeon

Immediate post-GA period

- Transfer patient with oxygen supply, continuous SpO_2 monitoring and full resuscitative equipment
- Admit patient to a designated HDU ward area

Subsequent post-GA management

- High dependency nursing care
- Monitoring to include:
- continuous pulse oximetry
- continuous ECG
- continuous respiratory rate
- transcutaneous CO_2
- If apnoea >15 sec:
- immediate respiratory support by nurse (airway manoeuvres, bag and mask ventilation)
- contact on-call paediatric middle grade, or resident anaesthetist in charge
- liaise with anaesthetist responsible for patient
- review period of HDU care

DISCHARGE AND FOLLOW-UP

- Discharge patient home same day or next day providing there have been no apnoeic episodes

NEEDLE STICK INJURIES IN CHILDREN OUT-OF-HOSPITAL ● 1/1

This guideline does not apply to children or staff who have needlestick injuries in hospital. Refer to local occupational health guidelines in this situation
See HIV testing, HIV and Hepatitis B and Post-Exposure Prophylaxis guideline
See Hepatitis B and C guideline

INTRODUCTION

- Children may find discarded needles in community and injure themselves
- can produce much anxiety in parents about blood-borne infections
- risks are extremely small, but offer children relevant protection and follow-up if they want to discuss this issue

TREATMENT

- If needle available, record type (blue, orange etc.) and whether it contains visible blood
- Dispose of needle in sharps bin
- Wound:
- wash thoroughly
- examine
- record site and depth
- Check child has received 3 doses of tetanus vaccine within past 10 yr
- if not, arrange appropriate immunisation
- Re-assure family that risks of blood-borne infections in this situation are low
- hepatitis B is most infectious (up to 60% from known high risk source), but protection will be arranged and risk of infection from discarded needle from an IV drug user of unknown hepatitis B status <1 in 100,000
- risk for hepatitis C is approximately 1:500
- risk for HIV is approximately <1 in 1:100,000
- if family still concerned, refer to paediatric infectious disease clinic
- Take blood for serology
- Request baseline hepatitis BsAg, hepatitis C IgG and HIV serology
- If child has been infected by needle inform family this sample cannot confirm
- if they require confirmation further blood test in 12 weeks is required

IMMUNISATIONS

- Children born after 1 August 2017 should have received 3 doses of hepatitis B vaccine as part of routine immunisation schedule and already have protection
- Check child's immunisation history
- Children born before August 2017, and children born after that who have not received 3 doses of hepatitis B vaccine to be offered first dose of vaccine (0.5 mL), preferably within 48 hr of injury
- even if child presents up to 1 week after injury vaccine can still be given
- Hepatitis immunoglobulin not necessary

FOLLOW-UP

- Arrange for GP to give up to 2 further doses of hepatitis B vaccine (in 1 and 2 months' time) to bring child's total number of doses up to 3
- Arrange repeat serology as above after 12 weeks
- If family cannot be reassured and want further advice, arrange for child to be seen in paediatric infectious diseases clinic
- Most people with diagnosed HIV infection in UK are on antiviral treatment and not infectious
- if known HIV infected source case has been on antiviral treatment for >6 months and known to have plasma HIV viral load <200 copies/m then post-exposure prophylaxis is not required
- if significant exposure to HIV infected blood or body fluids (i.e. needlestick with fresh blood from known HIV positive person who does not meet these criteria, then), consider post-exposure prophylaxis for HIV

FURTHER INFORMATION

- See **HIV testing, HIV and Hepatitis B and Post-exposure Prophylaxis (PEP)** guideline
- See **Hepatitis B and C** guideline
- Further details available at https://www.chiva.org.uk/guidelines/chiva-pep-2015/

RECOGNITION AND ASSESSMENT

Definition

- Oedema
- Hypoalbuminaemia: plasma albumin <25 g/L
- Heavy proteinuria, defined as:
- dipstick 3+ or more, or
- urinary protein >40 mg/m^2/hr, or
- early morning protein:creatinine ratio >200 mg/mmol
- Hypercholesterolaemia

Symptoms and signs

Oedema

- Peri-orbital, pedal, sacral, scrotal
- Also ascites or pleural effusion

Cardiovascular

Can be difficult to assess due to oedema, so assess carefully for hypovolaemia

- Child with diarrhoea and vomiting and looks unwell
- Abdominal pain: strongly suggestive
- Poor peripheral perfusion and capillary refill >2 sec
- Pulse character: thready, low volume, difficult to palpate
- Tachycardia or upward trend in pulse rate
- Hypertension may be an early sign, hypotension a late sign
- Jugular venous pressure (JVP) low

Muffled heart sounds suggest pericardial effusion (serious complication of nephrotic syndrome)

Respiratory

- Tachypnoea and recession: suggest pleural effusion

Abdomen

- Swelling and shifting dullness: suggest ascites
- Tenderness with fever, umbilical flare: suggest peritonitis (see **Complications**)
- Scrotal oedema: stretching can cause ulceration or infection

Investigations

Femoral blood sampling is contraindicated because of risk of thrombosis

Urine

- Urinalysis
- Early morning urine protein:creatinine ratio first morning after admission
- normal value <20 mg/mmol; nephrotic >200 mg/mmol, usually >600 mg/mmol
- low urine sodium (<10 mmol) suggests hypovolaemia

Baseline bloods

- U&E and creatinine
- Albumin
- FBC
- Immunoglobulins G, A and M
- Complement C3 and C4
- Zoster immune status: as a baseline
- Hepatitis B and C serology

Second-line tests

Request only if features suggestive of more aggressive nephritis (hypertension, macroscopic haematuria, high creatinine, no response to corticosteroids)

- Anti-streptolysin O titre and anti-DNase B
- Anti-nuclear antibodies
- Anti-dsDNA antibodies

Interpretation
- High haematocrit suggests hypovolaemia
- Raised creatinine or urea suggests hypovolaemia, tubular plugging or other nephritis
- Serum cholesterol and triglycerides: often elevated
- IgG usually low
- C3 normal

Differential diagnosis
- Minimal change disease (95%)
- Focal segmental glomerular sclerosis (FSGS)
- Multisystem disorders (e.g. HSP, SLE, diabetes mellitus)
- Congenital nephrotic syndrome very rare and seen in under 2s

IMMEDIATE TREATMENT

General
- Admit
- Strict fluid balance monitoring
- daily weight: **mandatory**
- Avoid added salt, but a low salt diet not indicated
- Manage hypovolaemia – see **Complications**
- seek **senior advice before volume resuscitation**, as risk of volume overload

Fluid restriction
- Restrict to insensible losses e.g. 300 mL/m^2 plus urine output
- If not tolerated, aim for:
- 600 mL/day in children aged <5 yr
- 800 mL/day in children aged 5–10 yr
- 1000 mL/day in children aged >10 yr

Medication
- Prednisolone 60 mg/m^2 oral once daily (maximum 80 mg per day), in the morning (see **BNFc** for surface area)
- Phenoxymethylpenicillin (penicillin V) for pneumococcal prophylaxis (**presentation only**) – see **Infection precautions**
- if liquid formulation required − amoxicillin
- If oedema upsetting to patient or causing discomfort, add furosemide 1–2 mg/kg oral **or** 1 mg/kg IV over 5−10 min (maximum 4 mg/min − lower rate may be required in renal impairment)
- treatment with furosemide may intensify hypovolaemia, in which case use albumin 20%: discuss with **consultant or specialist centre**
- If disease severe, especially with hypovolaemia, as judged by poor perfusion, high Hb, thrombophilia, or abdominal pain, treat with:
- dipyridamole to reduce risk of thrombotic complications. Discuss need for heparin/warfarin with paediatric nephrologist
- Give omeprazole for gastroprotection whilst on high dose oral steroids
- use esomeprazole granules or lansoprazole oro-dispersible for patients with enteral tubes

COMPLICATIONS

Hypovolaemia
- Abdominal pain, vomiting, looks unwell, tachycardia, poor perfusion, high Hb
- Seek **senior advice before volume resuscitation**, as risk of volume overload
- give sodium chloride 0.9% 10 mL/kg
- start dipyridamole

Do not confuse 4.5% albumin with 20% albumin, as the latter is hyperosmolar and can easily cause intravascular fluid overload

- Low JVP, rising urea and creatinine, and poor response to diuretics
- Treatment: check with consultant first
- salt-poor hyperosmolar albumin **20%** 0.5–1 g/kg (2.5–5 mL/kg) over 2–4 hr with furosemide 1 mg/kg IV midway through infusion over 10 min (maximum 4 mg/min)

- regular observations for signs of circulatory overload (e.g. raised JVP, tachycardia, gallop rhythm, breathlessness, low SpO_2)
- often required daily: liaise with specialist centre

Peritonitis
- Difficult to recognise
- steroids may mask signs, including fever, or cause leucocytosis
- Abdominal pain
- consider hypovolaemia and appendicitis: request early surgical opinion
- Obtain blood culture and peritoneal fluid (for Gram stain and culture) if possible, then start piperacillin with tazobactam (Tazocin®) IV pending culture results
- if penicillin allergic, discuss with microbiologist or consultant in infectious diseases

Cellulitis
- Commonly caused by haemolytic streptococci and pneumococci – treat promptly

Thrombosis
- Renal vein: an important differential in abdominal pain
- Cerebral vasculature
- Pulmonary vein
- Femoral vein: femoral blood sampling contraindicated
- A fall in platelets, rise in D-dimers and reduced PTT are suggestive
- USS with Doppler study to look at perfusion and to image renal vein and IVC can be helpful
- If in any doubt, seek advice from paediatric nephrologist regarding investigation/management

DISCHARGE POLICY AND SUBSEQUENT MANAGEMENT
- Discharge once in remission
- defined as trace/negative urine protein for 3 days
- patients with normal BP and stable weight who are well may be allowed home on ward leave with **consultant approval**. Normally twice weekly review will be required until in remission
- Arrange plan of care with patient and carers – see **below**
- Outpatient review in 4 weeks

New patients
- Prednisolone 60 mg/m^2 (maximum 80 mg) once daily for 4–6 weeks
- Then 40 mg/m^2 (maximum 40 mg) alternate days for 4–6 weeks
- gradually reduce dose aiming to stop after 3–4 weeks
- Response usually apparent in 7–10 days
- No response after 4 weeks daily steroid 60 mg/m^2 suggests corticosteroid resistance

Relapsing patients
- Three consecutive days of 3+ or more early morning proteinuria, having previously been in remission = relapse
- Start prednisolone 60 mg/m^2 (maximum 80 mg) once daily
- continue until nil or trace proteinuria for 3 days
- then 40 mg/m^2 (maximum 40 mg) alternate days for a further 4 weeks, gradually reduce dose aiming to stop after 3 weeks
- If relapses frequent despite alternate-day prednisolone, discuss with paediatric nephrologist

Oral prednisolone
- While on prednisolone 60 mg/m^2 once daily advise to:
- carry a corticosteroid card
- seek prompt medical attention for illness, especially zoster contacts (if not zoster immune)

Other management
- Urine testing
- teach technique and provide appropriate dipsticks
- test only first urine sample of the day
- keep a daily proteinuria diary and bring to **every** clinic attendance
- Corticosteroid diary with instructions regarding corticosteroid dosage

NEPHROTIC SYNDROME ● 4/4

Infection precautions

- Avoid live immunisations for 3 months after completion of treatment with high-dose corticosteroids
- Benefit of inactivated vaccines can be impaired by high-dose corticosteroids and so a similar delay advisable where possible
- where not possible because of frequent relapse, give INACTIVATED vaccines after a shorter delay and check for an antibody response
- Continue phenoxymethylpenicillin (penicillin V) (**presentation only**) prophylaxis until oedema has resolved (if penicillin allergic give azithromycin)
- if liquid formulation required − amoxicillin
- If exposure to chickenpox and zoster non-immune (VZV IgG negative) and on high-dose corticosteroids, give IM zoster immunoglobulin (obtain from local Public Health England laboratory)
- after definite zoster contact. A contact is infectious 2 days before onset of rash until all lesions crusted over
- can be given up to 10 days after exposure. Contact consultant microbiologist on duty (or local virology laboratory) for release of VZIG
- at first sign of illness give aciclovir IV
- varicella vaccine (live vaccine) available and should be given if a suitable opportunity arises between relapses
- Give pneumococcal vaccine if child has not received pneumococcal conjugate vaccine – see **BNFc** for schedule

Indications for referral to paediatric nephrologist

- Corticosteroid-resistant disease
- non-responsive after 4 weeks of daily prednisolone, but start discussions with specialist centre in third week, or if relapses frequently
- Corticosteroid-dependent disease
- two consecutive relapses during corticosteroid treatment or within 14 days of cessation
- Significant corticosteroid toxicity
- Aged <1 yr or >12 yr at first presentation
- Mixed nephritic/nephrotic picture: macroscopic (not microscopic) haematuria, renal insufficiency or hypertension
- Low complement C3/C4
- ANA +ve

NEUROMUSCULAR DISORDER ● 1/3

ON ADMISSION

- Children with neuromuscular disorders suffer associated specific medical problems, including:
  - respiratory illness
  - cardiac disease
  - feeding and gastro-intestinal problems
  - skeletal problems
  - malignant hyperthermia following anaesthesia (in certain conditions)
  - adrenal insufficiency (if on corticosteroids)
- Ask parents if they have copy of care plan
- Inform child's long-term consultant

RESPIRATORY ILLNESS

- Respiratory failure commonly occurs without signs of respiratory distress – susceptibility to respiratory failure due to:
  - muscle weakness
    - upper airway
    - intercostals
    - diaphragm
  - poor secretion clearance
  - chest infections
  - aspiration
  - scoliosis
  - sleep disordered breathing

Ask about

- Adequacy of cough and swallowing
- Previous sleep difficulties and wakefulness at night (nocturnal hypoventilation)
- Difficulty waking in morning
- Early morning headache (nocturnal hypoventilation)
- Poor appetite and weight loss (chronic respiratory failure)

Assess

- Adequacy of chest wall excursion and cough
- SpO_2 in air
- CO_2 by blood gas, transcutaneous CO_2 or end-tidal CO_2 (especially if needing oxygen)
- Spirometry – FVC most useful if previous readings available
- CXR – clinical signs can fail to detect collapse/consolidation/cardiomegaly

Management

- Oxygen to achieve SpO_2 between 94–98%, but monitor CO_2 and respiratory effort as risk of hypercapnia (despite normal oxygen saturations) if respiratory drive is overcome by oxygen therapy
- High-flow high-humidity air or oxygen (e.g. Optiflow™) – monitor CO_2
- Mask ventilation (bi-level positive airway pressure, BIPAP)
- Chest physiotherapy and postural drainage
- Use insufflator-exsufflator (e.g. Cough Assist) if patient has one
- Suction
  - if copious loose secretions:
    - **EITHER** use hyoscine hydrobromide soluble tablets 10 microgram/kg 6–8 hrly maximum per dose 300 microgram
    - **OR** glycopyrronium given as oral solution (Sialanar®)
    - **OR** glycopyrronium IV solution (200 microgram/mL) given orally, via PEG or IV
    - see **BNFc** for dosing
  - if thick tenacious secretions use nebulised sodium chloride 0.9%/sodium chloride 3%, or nebulised acetylcysteine
- Antibiotics
  - obtain cough swab or sputum MC&S, if possible, before starting
  - check previous culture results
  - use broad-spectrum cover
  - if bronchiectasis, use 14 days broad-spectrum antibiotics to include cover for gram negative organisms (discuss with senior)

- if not improving on first line antibiotics add macrolide for atypical pneumonia
- Consult senior to discuss need for ITU care, escalation of respiratory support

CARDIAC DISEASE

- Certain conditions, e.g. Duchenne muscular dystrophy, known to develop cardiomyopathy and cardiac decompensation

Ask about

- Palpitations
- Breathlessness
- Chest pain (cardiomyopathy)

Assess

- Pallor
- Tachycardia
- Signs of circulatory compromise
- ECG
- Blood gas
- CXR: clinical signs can fail to detect collapse/consolidation/cardiomegaly

Management

- Fluid restriction
- Diuretics
- Oxygen and respiratory support
- Cardiology consultation

FEEDING AND GASTRO-INTESTINAL PROBLEMS

- May be prone to:
- gastro-oesophageal reflux
- gastritis
- gastric ulceration (especially if on corticosteroids)

Ask about

- Abdominal pain
- Abdominal distension
- Melaena (GI perforation)

Assess

- Abdominal signs (GI bleed, perforation, gastritis)

Management

- Nil-by-mouth and IV fluids
- Omeprazole
- Senior advice

SKELETAL PROBLEMS

- Patients are prone to fractures, especially vertebral, if on long-term corticosteroids

Ask about

- Muscle cramps
- Skeletal pain
- Back pain (for fractures)

Assess for possible fractures

- Skeletal/spinal X-rays
- Check calcium and vitamin D

Management

- Analgesia
- Orthopaedic consultation
- Consult with metabolic bone expert about IV bisphosphonates for vertebral fractures

MALIGNANT HYPERTHERMIA

Malignant hyperthermia is a medical emergency

- Occurs following general anaesthesia and may be first presentation of a neuromuscular disorder
- Check creatine kinase, calcium, renal function, urine output and for myoglobinuria: dialysis may be needed
- In addition to temperature control and general life support measures, use IV dantrolene to control excessive muscle contraction
- Obtain senior anaesthetic advice and liaise with PICU

ADRENAL INSUFFICIENCY (IF ON CORTICOSTEROIDS)

- If unwell on **long-term corticosteroids**, double usual daily dose of steroids for 2–3 days. If unable to tolerate oral steroids, see **Steroid dependence** guideline

NOTIFIABLE INFECTIOUS DISEASES AND FOOD POISONING ● 1/2

URGENT NOTIFICATION

- Urgent out-of-hours notifications (to be followed by normal paper notification later)
- meningitis (suspected bacterial)
- meningococcal infection (clinical diagnosis)
- haemolytic uraemic disease (suspected)
- infectious bloody diarrhoea

NOTIFIABLE DISEASES

Admitting doctor required to notify **suspected** or confirmed cases of the following to Health Protection Unit:

- Cluster or outbreak suspected (≥2 cases epidemiologically linked in amber box below)
- Any other case where potential for transmission significant (e.g. highly infectious)
- Where contacts are particularly susceptible (e.g. healthcare worker, school)
- Where public health action is known to be effective (e.g. prophylaxis, immunisation)
- Other infections or contaminations (e.g. chemical) not listed below if potential risk of further harm
- Report other diseases that may present significant risk to human health under the category 'other significant disease'

ALL OTHER HAZARDS

Cases with potential public health implications to be notified as 'URGENT'. This list is not exhaustive. If in doubt telephone your local health protection team

- Chemical exposure e.g. carbon monoxide, lead, mercury
- Radiation exposure
- New and emerging infections (e.g. new strains of influenza)
- Cases that occur as part of an outbreak/cluster e.g. *Clostridioides difficile*, Norovirus)
- Other infections where vulnerable contacts are at risk: e.g. infection in a healthcare worker, varicella zoster exposure in pregnant or immunocompromised people
- See https://www.gov.uk/guidance/notifiable-diseases-and-causative-organisms-how-to-report UK Health Securtiy Agency (UKHSA) notifiable disease poster

Refer within 3 days	Routine: urgent if UK acquired or part of cluster	Urgent referral
COVID Encephalitis Leprosy Mumps Rubella* Scarlet fever* Typhus	Brucellosis Food poisoning* Malaria Tetanus Tuberculosis* Whooping cough* Yellow fever	Anthrax Botulism Cholera Diphtheria Dysentery Group A streptococcal invasive disease Haemolytic uraemic syndrome Hepatitis A/B/C Legionnaires' disease Measles* Meningitis Meningococcal septicaemia Mpox Poliomyelitis Plague Rabies SARS Smallpox Typhoid/paratyphoid Viral haemorrhagic fever

***Definitions**

- **Food poisoning or suspected food poisoning:** inform Public Health if acquired abroad or if patient or family member is a food handler or healthcare worker

NOTIFIABLE INFECTIOUS DISEASES AND FOOD POISONING ● 2/2

- **Measles:** fever, maculopapular rash for ≥3 days and ≥2 of following: Koplik's spots, coryza, conjunctivitis, raised measles IgM, measles encephalitis or pneumonitis. Inform Public Health of MMR or measles vaccination history. Do not bring children with suspected measles in primary care to hospital for diagnosis, only if hospital based treatment required or if immunocompromised: arrange for immediate isolation on arrival
- **Rubella:** rash and occipital lymphadenopathy or arthralgia (if not parvovirus), **or** congenital rubella or raised IgM to rubella. Inform Public Health England of MMR vaccine history
- **Scarlet fever:** tonsillitis, fever, rash with either culture of *Streptococcus pyogenes* from throat or raised ASO or anti-DNase B titre
- **Tuberculosis:** diagnosed clinically, not just microbiologically (atypical mycobacterial infection or patients given chemoprophylaxis but not thought to have TB are not notifiable)
- **Pertussis/whooping cough:** cough with a whoop, with history of contact with similar illness **or** positive pernasal swabs for *Bordetella pertussis* or raised IgM to *B. pertussis* in an adult or child. Inform Public Health England of pertussis immunisation history

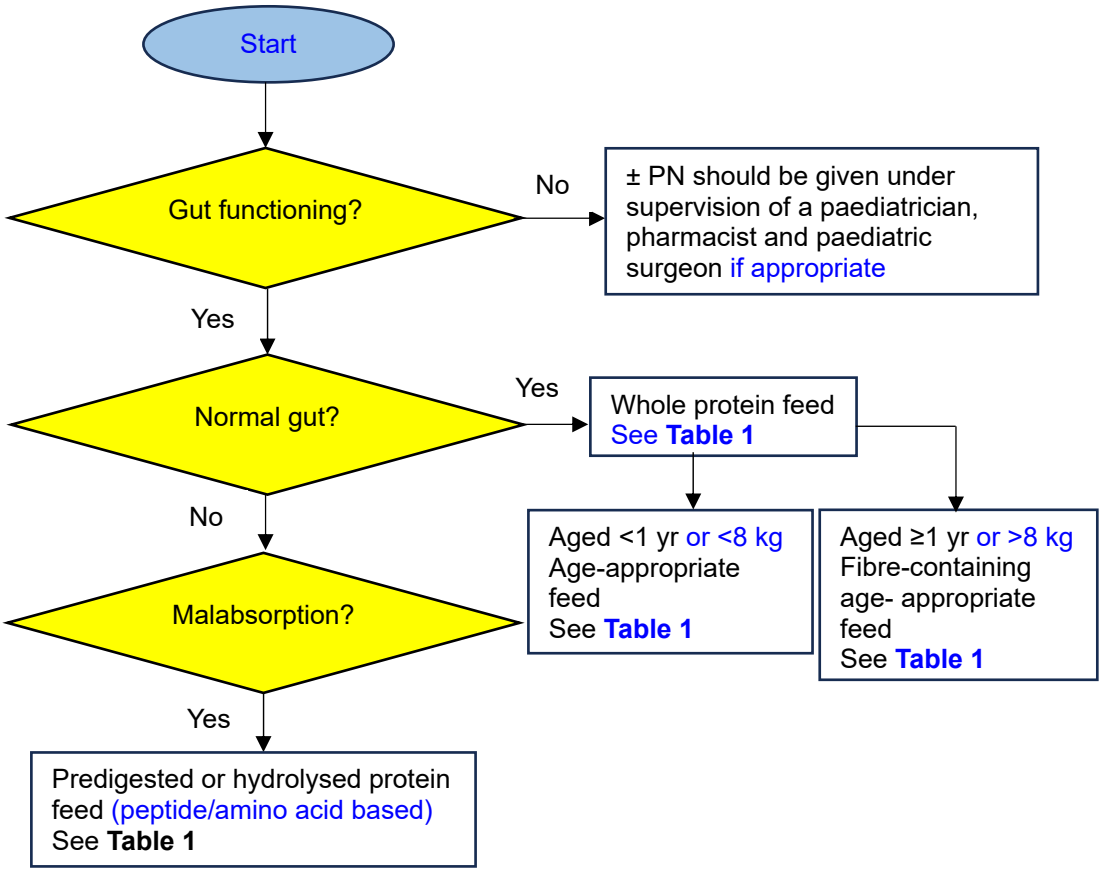
CONTACT DETAILS

- Complete a notification form immediately on diagnosis of a suspected notifiable disease. Notification form: https://www.gov.uk/government/publications/notifiable-diseases-form-for-registered-medical-practitioners
- Do not wait for laboratory confirmation of a suspected infection or contamination before notification. How to report: https://www.gov.uk/guidance/notifiable-diseases-and-causative-organisms-how-to-report

FEEDS

- Initial guide to feeding when child not able to eat normally and dietitian not available
- Choose appropriate feed for age
- if very underweight for age, use appropriate feed for actual body weight

If unable to feed enterally see IV fluid therapy guideline before starting parenteral nutrition (PN)



(*PN needing additions must be ordered by 10.30 a.m., or pharmacy hours for standard)

Table 1: Age-appropriate feeds

Weight	Standard fibre containing feed	Standard non-fibre containing feed	Peptide based feed	Amino acid feed
<8 kg (usually <1 yr)		• Breastmilk † • Standard infant formula	• Nutramigen® 1 LGG • Aptamil Pepti-Junior® [45% medium chain triglycerides (MCT)] • Aptamil Pepti® 1 • Althera®	• Alfamino® (24% MCT) (SMA) • Neocate LCP® • Neocate Syneo® (33% MCT) • Puramino (33% MCT)
<8 kg 1 kcal/mL (where faltering growth or fluid restriction is required)		• Similac High Energy® • Infatrini • (1 kcal/ml feeds)	• Infatrini Peptisorb (50% MCT)	
8–30 kg	• PaediaSure® Fibre • Nutrini Multi Fibre	• PaediaSure® • Nutrini	• PaediaSure® Peptide • Nutrini Peptisorb	• Neocate Junior® (suitable from aged 1–10 yr) (33% MCT) • Elemental 028 extra (35% MCT)

20–45 kg (usually >1 yr to puberty)	• Tentrini Multi Fibre if pre-existing feed only	• Tentrini if pre-existing feed only		
>30 kg (usually from start of puberty)	• Jevity® 1.1 kcal (17% MCT) • Nutrison Multi Fibre (15% MCT)	• Osmolite® (17% MCT) • Nutrison (15% MCT)	• Perative® (37% MCT) • Nutrison Peptisorb (47% MCT)	• Elemental 028 extra (35% MCT)

- Indications for (MCT): problems with digestion, absorption or transport of long chain fats e.g. cholestasis, short gut, pancreatic insufficiency – speak to a dietitian

† If failure to thrive or fluid restricted, fortify breast milk – refer to product information or seek dietetic advice

- ***Commence neonates < 34 weeks and <1.8 kg on Nutriprem 1 or SMA Gold Prem where there is insufficient maternal breast milk to meet requirements***
- ***Commence neonates born < 34 weeks and ≥1.8 kg on Nutriprem 2 or SMA Gold Prem 2 where there is insufficient maternal breast milk to meet requirements***

Table 2: Suspected cow's milk allergy (see https://gpifn.org.uk/imap/)

	Non IgE mediated reaction	IgE mediated reaction
Type of feed	Extensively hydrolysed formula or peptide based feed	Nutramigen 1 LGG®, Aptamil Pepti-Junior®, Aptamil Pepti 1, Althera®
	Amino acid formula or elemental feed	Alfamino®, Puramino®, Neocate® LCP, Neocate Junior and Elemental 028®

- Contact paediatric dietitian (refer patient) to assess individual requirements and appropriate feed at first available opportunity Monday-Friday. Check telephone or bleep number via hospital intranet or switchboard
- Prescribe all feeds
- Hospital pharmacy will advise which feed is used locally (all similar composition for ages but different manufactures)
- See **Table 3, 4, and 5** for daily fluid and nutritional requirements

FLUID AND ENERGY REQUIREMENTS

How to calculate energy requirements for tube feeds

- Choose appropriate feed for age
  - if very underweight for age, use appropriate feed for actual bodyweight (see **Initial guide to feeding when child not able to eat normally and dietitian not available (FEEDS heading above**)
- Calculate amount of feed to use in 24 hr based on kcal/kg
- Calculate fluid requirement
  - if restricted, continue to use feeds above until reviewed by dietitians
    - if extra fluid required, give water
  - feeding method depends on clinical condition

Table 3: Fluid requirements – for infants <10 kg (approximately aged 1 yr)*

Age	Approximate weight (kg)	Fluid (mL/kg)
Premature	1–2	150–200
0–6 months	3–8	150
7–12 months	6–10	120

Table 4: Fluid requirements for children >10 kg (Holliday-Segar formula)

Weight (kg)	Fluid (mL/kg)
11–20	• 100 mL/kg for first 10 kg • +50 mL for next 10 kg
>20	• 100 mL/kg for first 10 kg • +50 mL for next 20 kg • +20 mL for following kg • up to maximum of 2500 mL a day

Example:
Daily fluid requirement for 21 kg child:
- 10 x 100 = 1000 mL for first 10 kg
- 10 x 50 = 500 mL for next 10 kg
- 1 x 20 = 20 mL for remaining 1 kg
- Total = 1520 mL/day = 63 mL/hr

Calculation caveats
- Overweight child: requires less fluid than calculated volume/per kg (body weight is higher than normal)
- Underweight child: calculate fluid requirements for child's actual weight
- may require increased energy and protein for catch-up growth

Table 5: Estimated average energy requirements by age

Age	Energy (kcal/kg/day)* ¥
1–2 months	96–120
3–4 months	96
5–6 months	72–96
7–12 months	72
1 yr	80
2 yr	81.5
3 yr	80
4 yr	83
5 yr	77.5
6 yr	72
7 yr	69
8 yr	65
9 yr	61
10 yr	62.5
11 yr	59
12 yr	56
13 yr	52
14 yr	50
15 yr	48
16 yr	46.5
17 yr	45.5
18 yr	45.5

*Great Ormond Street Hospital (GOSH) for children's nutritional requirements
¥ Energy requirements using GOSH nutritional requirements taking an average between boys and girls requirements
NB: GOSH requirements based on Department of Health report No 41– Dietary Reference values 1991 and scientific Advisory Committee on Nutrition (SACN) 2011

REFEEDING

(adapted with permission from Leicester hospital guidelines)
- Refer all children at risk of refeeding to dietitian (see **Eating disorders at risk of refeeding**)

Children at risk of refeeding (≥1 of symptoms below)

- <50% of usual intake or no nutrition for ≥5 days (infants may be at risk of refeeding after less time of no oral intake)
- Acute weight loss: ≥15% in last 6 months
- Abnormal blood levels of potassium, magnesium, or phosphate before feeding
- Very low weight (especially weight for height/BMI <70–80%)
- Acute starvation with rapid weight loss before commencement of nutrition
- Prolonged IV therapy without glucose/fasting and nil-by-mouth

Children who are at risk of refeeding syndrome can be identified with two or more of the following symptoms below

- Experience acute weight loss of 5–10% in past 2 months
- Previous history of refeeding syndrome
- Severely underweight
- Identify by plotting on growth chart
  - current and historical weights
  - height/length/head circumference
  - body mass index (BMI)
    - if child's BMI <0.4th centile classed as severely underweight
- Experienced malabsorption, severe vomiting and/or diarrhoea for ≥5 days
- Medical comorbidities and/or complications may increase risk of refeeding e.g.
  - pneumonia
  - oncology CF
  - liver disease
- Electrolyte abnormalities before starting feeds
- Low white cell count

Commencing feed

- If dietitians are not available, i.e. out-of-hours start feeding using following tables

Table 6: Aged ≤12 months (always refer to dietitian – use following as guidance to commence feeds out-of-hours)

Age (months)	Expressed breast milk (mL/kg/day)	Breast milk substitute (standard infant formula) (mL/kg/day)	High calorie infant formula (mL/kg/day)	Mixed feeding– breast milk and standard infant formula (mL/kg/day)
0–2	72	90	60	90
3–4	72	72	48	72
5–6	54	72	48	54
7–12	54	54	36	54

- Discuss route/frequency of feeding and any additional fluid which may be required with lead consultant
- If bloods stable and corrected, increase by 20 mL/kg/day until requirement for age met
- If known allergy, use their alternative infant formula at a standard concentration (as per basic instructions found on the formula tin)

Table 7: Aged ≥1 yr (always refer to dietitian – use following as guidance to commence feeds out-of-hours)

Age (yr) Male/Female	(mL/kg/day)
1–5	40
6–10	33
11–14	28
15–18	24

- Use 1 kcal/mL as standard feed
- Discuss route (oral/NG/NJ/PEG/PEJ etc.), frequency of feeding and any additional fluid which may be required with lead consultant
- Known allergy: seek advice from lead consultant regarding alternative feed
- If already fed via enteral feeding tube, use their feeding plan, and commence feeds at 50% of usual feeding volume
- If bloods stable increase overall daily intake by 200 kcal/day up to estimated average requirement

Monitoring

- Check blood electrolytes every 12–24 hr initially, followed by daily until full energy requirements reached – further monitoring guided by lead consultant
  - sodium
  - potassium
  - magnesium
  - PO4
  - calcium
    - if electrolytes drop below normal range do not increase feeds until corrected (only increase feeds as per dietetic advice)
  - if no change in bloods continue to monitor once/day and increase feeds as per dietetic advice
  - if necessary, refer to specialist gastroenterology
  - may require monitoring up to 2 weeks
- Document in medical notes

Vitamins

- Medical team prescribe
  - thiamine
  - B-vitamins
- Currently no published data on use and dosing of vitamin supplementation for prevention of refeeding syndrome – contact paediatric pharmacist for advice

Eating disorders at risk of refeeding

- Alternatively, we can use medical emergencies in eating disorders (MEED) guidelines for patients with eating disorders. See **Eating Disorders** guideline
  - See MEED guidelines https://www.rcpsych.ac.uk/improving-care/campaigning-for-better-mental-health-policy/college-reports/2022-college-reports/cr233
- Base line refeeding bloods
  - creatinine
  - sodium
  - potassium phosphate
  - calcium
  - magnesium
  - continue to monitor for first 5 days then on day 10 and 14 (refeeding can occur up to 2 weeks)
- Start 30–40 kcal/kg/day (MEED guidelines day 1–1400 kcal (aged ≤18 yr or 10–20 kcal/kg/day generally)
- Each day increase by 200 kcal until requirements met
- Correct any deranged blood results before increasing kcal
- For vitamin and mineral supplementation refer to MEED guidelines or local trust guidelines
- Refer to dietitian

ORBITAL CELLULITIS AND SINUSITIS ● 1/3

RECOGNITION AND ASSESSMENT

Orbital cellulitis is an ophthalmic emergency that can cause sight threatening complications

- Unilateral eyelid oedema and erythema
- Unilateral eye pain or tenderness
- Consider differentials
- Check for red flags suggesting CNS complications

Red flags URGENT senior review if:

- Increasing drowsiness
- Meningism/irritability
- Severe headache persisting despite regular analgesia (ibuprofen and paracetamol) or worse on lying down or in morning
- Persistent vomiting
- Severe retroorbital pain
- New onset squint or diplopia – covering up one eye
- Deteriorating vision – complaining of blurred vision
- New limb weakness – may exhibit change of hand preference
- Unsteady gait or coordination issues

If signs of intracranial infection, consider urgent neuroimaging

Differentials

- Neonatal: consider gonorrhoea/chlamydial infections
- Bilateral findings and/or painless swelling; consider allergic reaction
- Hordeolum (stye)
- Acute blepharitis
- Conjunctivitis
- Angioneurotic oedema
- Insect bite
- Cavernous sinus thrombosis
- Leukaemia or late presentation of a rhabdomyosarcoma/retinoblastoma
- Non-accidental injury
- If swelling exclusively below eye consider facial cellulitis or dacrocystitis
- If swelling at cheek level – if decayed teeth (especially upper canine teeth) refer to dental/maxillofacial review and/or odontogram

Assessing severity

Clinical signs not all signs need to be present for a diagnosis of postseptal (orbital) cellulitis to be made	Postseptal (orbital)	Preseptal
Proptosis	Yes	No
Hypoglobus (downward displacement of eye)	Yes (if large collection)	No
Double vision (if both eyes open)	Yes	No
Eye movements	Painful and restricted	Normal
Vision (acuity, fields, colour)	Worse in severe	Normal
Relative afferent pupillary defect	Yes in severe	Absent i.e. normal
Severe or persistent headache	Yes in severe	No

Factors associated with increased disease severity

- Clinical suspicion of orbital cellulitis or unable to assess eye due to swelling
- Systemically unwell including fever and persisting tachycardia/tachypnoea
- Immunocompromised

- Worsening despite 36–48 hr of oral antibiotics
- If features of sepsis, for urgent senior input/paediatric input

Factors associated with milder disease severity
- Normal eye assessment
- History of insect bite or mild trauma

INVESTIGATIONS
- For mild or moderate preseptal cellulitis, no investigations required
- If increased disease severity
- perform FBC, CRP and blood culture
- If nasal endoscopy performed by ENT team
- collect sinus swab (endonasal swab)
- If clinical suggestion of postseptal (orbital) cellulitis
- perform FBC, CRP and blood culture, for senior review and neuroimaging

Indication for imaging (after starting empiric antibiotic therapy)
- Contrast enhanced CT orbit, sinuses and brain if:
- CNS involvement/focal neurology/meningism
- unable to examine eye/open eyelids
- clinical signs of postseptal (orbital) cellulitis
- clinical progression despite 24 hr treatment or no improvement after 48 hr
- continued pyrexia after 48 hr IV antibiotics

MANAGEMENT
Preseptal cellulitis

Mild
- Mild preseptal cellulitis can be managed with oral antibiotics +/- topical decongestant
- Optimise analgesia (paracetamol or ibuprofen)
- Choice of oral antibiotics as per local/national empirical antimicrobial guidelines
- Total duration of antibiotics 5 days
- Provide verbal and written safety netting information

Moderate
- If significant periorbital swelling or fever, or unable to tolerate/absorb oral antibiotics
- start IV antibiotics +/- topical decongestant (in children aged >6 yr as per local empirical antimicrobial guidelines)
- optimise analgesia (paracetamol or ibuprofen)

Severe
- If moderate/severe preseptal cellulitis – ENT and ophthalmology review
- Assess for early ambulation on IV antibiotics from ED or assessment unit (admission avoidance) unless:
- clinical risk factors:
  - haemodynamically unstable
  - acutely worsening eye signs
  - concerns about postseptal (orbital) cellulitis
- social/caregiver risk factors

Admission
- If admitted, should be under general paediatric or paediatric ENT team
- If no improvement after 48 hr assess severity as above for neuroimaging for sinus drainage – daily review whilst on IV antibiotics
- Ensure robust clinical governance systems and documentation in place for children being ambulated
- Provide verbal and written safety netting information and suggest daily photos taken by parents
- Switch from IV antibiotics to oral when clinically improving and apyrexial
- Choice of oral antibiotics as per local/national guidelines
- Total antibiotic course (IV+oral), 7 days

Postseptal (orbital) cellulitis
- If no orbital collection on neuroimaging – manage as preseptal cellulitis (see above)

ORBITAL CELLULITIS AND SINUSITIS ● 3/3

- Admit under general paediatric or paediatric ENT team. Involve ENT and ophthalmology +/- maxillofacial teams as per local pathways
- ENT team for consideration of surgical drainage
- ophthalmology for ongoing visual assessment
- Commence IV antibiotics and topical decongestants as per local/national empirical antimicrobial guidelines

If immunocompromised

- discuss with microbiology
- optimise analgesia (paracetamol or ibuprofen)

Drainage generally indicated for

- Larger, non-medial subperiosteal or orbital collections
- Significant proptosis
- Concerns about visual compromise
- Restricted eye movements

Small collections can be managed conservatively

- 4-hrly eye and neuro-observations with head of bed elevation
- daily ophthalmology review whilst on IV antibiotics and suggest daily photos taken by parents
- if no improvement after 48 hr, consider repeat neuroimaging

If clinically stable and no risk factors

- Consider ambulation on IV antibiotics
- Switch from IV antibiotics to oral when clinically improving and apyrexial
- Choice of oral antibiotics per local/national guidelines
- Total antibiotic course (IV+oral), 14 days
- If CNS complications prolonged IV antibiotics course will be required – discuss with paediatric ID/microbiology
- Provide verbal and written safety netting information

SINUSITIS

- URTI symptoms ≥10 days and ≥1 of:
- nasal congestion and discharge
- persistent cough (often nocturnal)
- If acute, treat with amoxicillin
- If no response after 48 hr (IV if severe), change to co-amoxiclav
- Total 7 days antibiotics
- Severe if falling GCS, temperature >39°C, purulent discharge
- ENT, neurosurgical review
- If complications are present:
- orbital – CT with contrast
- neurological – MRI with contrast
- Plain CT of sinuses for sinusitis
- if stable, can be done as outpatient

OSTEOMYELITIS AND SEPTIC ARTHRITIS ● 1/4

See also **Limping child** guideline

RECOGNITION AND ASSESSMENT

Symptoms and signs

- Fever or history of fever (not always at presentation)
- Loss of function e.g. limp
- Pain in bone/joint
  - localised (often ends of long bones)
  - constant
  - increasing
  - pain site often misleading – i.e. hip infection, more often than not presenting with knee pain
- Restricted range of movement
- Soft tissue swelling
- Point tenderness of bone
- Effusion
- Reluctance to sit or stand
- Impaired ability to bend due to pain

Above symptoms and signs are suggestive of osteomyelitis or septic arthritis (in absence of clear history of obvious trauma) irrespective of WBC, CRP, ESR and fever or radiological appearance; keep nil-by-mouth pending orthopaedic aspiration/surgery

Previous history

- Ask about:
  - duration of symptoms
  - injuries
  - fever
  - antibiotics
  - antipyretics/anti-inflammatories
  - haemoglobinopathies (e.g. thalassaemia, sickle cell disease)

Urgent investigations

- FBC
- ESR
- CRP
- Blood culture **before antibiotics** (minimum 4 mL older children, 2 mL neonates)
- If cause of fever uncertain, collect other specimens (e.g. urine) for culture before antibiotics
  - if immunocompromised, penetrating injury or failed primary treatment, also anaerobic and TB, fastidious organisms and fungal culture

Differential diagnosis

- Transient synovitis of hip
  - aged 4–10 yr
  - usually can weight bear
  - history of URTI last 2 weeks
  - non-toxic
  - temperature <38.5°C
  - CRP <20 mg/L
- Fracture or trauma
  - history of trauma
  - bruise
  - no fever
- Lyme arthritis
  - epidemiology
  - usually knee
  - no fever
- Baker's cyst
  - CRP <40 mg/L
- Cellulitis
  - erythema precedes pain

- skin tender and oedematous
- Chronic recurrent multifocal osteomyelitis
- insidious onset
- pain worse at night
- unusual site e.g. clavicle, jaw, scapula
- associated with palmoplantar pustulosis, psoriasis
- Haematological malignancy
- prominent systemic complaints – fatigue, anorexia, weight loss
- Bone neoplasm
- diaphysis or flat bones
- pain worse at night
- Juvenile idiopathic arthritis
- onset over weeks
- symmetric joints
- SLE
- fever
- weight loss
- rash
- ulcers
- Reactive arthritis
- 2–3 weeks after GI or GU infection
- Post streptococcal
- 3–14 days after streptococcal infection
- polyarticular
- responds to NSAIDs

Osteomyelitis
- Ultrasound joint
- Plain X-ray AP and lateral of affected part
- If surgically explored or needle aspiration, tissue/pus for Gram stain and culture

Septic arthritis
- Ultrasound joint
- Aspiration of joint for Gram stain and culture
- interventional radiologist or orthopaedic registrar/consultant
- for sedation and analgesia contact paediatric registrar or on-call paediatric anaesthetist

Further investigations

Perform as soon as possible (must be within 36 hr)

- If plain X-ray normal, infection clinically localised and urgent MRI is available:
- consultant paediatrician or orthopaedic surgeon to authorise urgent MRI of bone
- if deep sedation or general anaesthetic required, contact on-call paediatric anaesthetist
- If plain X-ray normal, infection clinically localised and MRI not available, request ultrasound scan to look for fluid and synovial thickening in knee and hip joint
- If localising signs poor or possible multifocal infection, whole body MRI: discuss with paediatric orthopaedic consultant
- If cardiac murmur or multifocal *Staph. aureus*, request echocardiogram

IMMEDIATE TREATMENT

- Admit
- Nil-by-mouth and maintenance fluids IV
- Bed rest
- Refer immediately to orthopaedic and on-call paediatric registrar for urgent assessment
- Early involvement of on-call consultant orthopaedic surgeon

Antibiotics (see BNFc for neonatal doses)
- Commence following surgery, unless it will take >4 hr from admission to get to theatre

- Severe sepsis with organ dysfunction (e.g. hypotension, oxygen requirement, GCS <12, platelet <80, creatinine x 2 normal, abnormal LFTs)
  - after blood and urine cultures taken, ceftriaxone
- No organ dysfunction: as soon as possible (must be within 4 hr)
  - neonate dose – see **BNFc**
  - aged <3 months: ceftriaxone
  - aged 3 months–5 yr: cefuroxime
  - aged >5 yr: flucloxacillin
- Targeted antibiotic therapy
  - if organism identified, use narrowest spectrum possible with good bone/joint penetration
  - *Staph. aureus* sensitive to flucloxacillin
- Penicillin allergy
  - history of rash: cefuroxime
  - history of anaphylaxis or high risk MRSA: clindamycin capsules; co-trimoxazole suspension

Analgesia

- If necessary initially to allow splintage, use morphine IV (see **Analgesia** guideline)
  - elevate and splint affected limb
  - plaster backslab for peripheral joints
  - rest in skin traction on a pillow for proximal joints

Surgery

- Ask parent(s) to stay with child until consent obtained
- Resuscitate if severe sepsis
- Emergency theatres to be alerted as soon as possible
- Contact:
  - anaesthetic office to arrange paediatric anaesthetist
  - orthopaedic registrar to book patient onto suitable list
  - consultant paediatrician and orthopaedic surgeon

SUBSEQUENT MANAGEMENT

- Inform paediatric orthopaedic surgeon and consultant paediatrician

Uncomplicated septic arthritis i.e. not complicated by associated osteomyelitis

- Aspirate or drain joint in theatre
- Request long line insertion under GA and repeat any blood tests required
- If discharged for hospital at home IV treatment, change to ceftriaxone if sensitive or no organism isolated
- If treatment started **within 24 hr** of first symptoms and clinically improving, discuss with consultant about changing IV to oral antibiotics after 72 hr if:
  - recovery of joint movement
  - absence of pyrexia after 4-hrly monitoring for 48 hr
  - WCC <11, CRP and ESR falling on 2 successive specimens ≥24 hr apart
- If agreed by orthopaedic consultant, give oral antibiotic to complete treatment
  - no organism identified: co-amoxiclav [double dose i.e. severe infection dose (see **BNFc**)]
  - organism identified: narrowest spectrum with good bone penetration
    - if *Staph. aureus* sensitive to flucloxacillin: flucloxacillin oral (high dose) if capsules tolerated; **or** co-amoxiclav (double dose/severe infection dose) if can only take suspension
  - allergic to penicillin: clindamycin capsules; co-trimoxazole suspension
- Stop treatment only if CRP is normal: agree duration of treatment with orthopaedic consultant depending on individual case
- Uncomplicated usually 3–4 weeks (except hip – 6 weeks)

Early-presenting osteomyelitis

- If IV antibiotics started within 24 hr of onset of symptoms with a good clinical response as above, follow **Uncomplicated septic arthritis**

Established osteomyelitis or complicated septic arthritis

- Presentation >24 hr after onset of symptoms or partial treatment (e.g. oral antibiotics)
- Formal debridement in theatre with insertion of Hickman line

- Antibiotics IV as above. Discuss with orthopaedic consultant about switch to oral antibiotics after 14 days, if afebrile, pain free for 48 hr and CRP <20
- Continue oral antibiotics until all inflammatory markers are normal and clear evidence of healing established on radiographs
- Discuss duration of antibiotics with orthopaedic consultant in each case

Septic arthritis or osteomyelitis, deteriorating condition/failure to improve within 48 hr

- Inform orthopaedic team for exploration to drain pus
- Review culture result
- Discuss with consultant microbiologist and paediatrician
- Arrange for repeat blood cultures
- if culture positive target antibiotic therapy
- Complete or repeat any investigations listed above
- Consultant paediatric medical and orthopaedic review
- Exclude important differential diagnoses
- systemic inflammatory response as seen in juvenile chronic arthritis
- transient synovitis, associated with intercurrent infection
- acute leukaemia, septicaemia, multifocal disease, endocarditis, Ewing sarcoma
- Continuing problems with local sepsis
- return to theatre for further debridement and insertion of Hickman line

MONITORING TREATMENT

- Peripheral colour, warmth, movement of affected limb: hourly for first 4 hr then 4-hrly for 24 hr
- Respiratory rate, pulse, temperature 4-hrly
- If not improving:
- repeat blood cultures
- additional imaging for metastatic infection
- assess for deep vein thrombosis
- discuss with infectious diseases/microbiology about broadening antimicrobial spectrum

OVERWEIGHT AND OBESITY ● 1/3

RECOGNITION AND ASSESSMENT

Definition

- **BMI centile is the best indicator of fatness and classification of obesity in children**
- Use Royal College of Paediatrics and Child Health UK WHO growth charts for BMI centile – see https://www.rcpch.ac.uk/resources/body-mass-index-bmi-chart

BMI centile chart classification of obesity

Above 91st centile	Overweight
Above 98th centile	Very overweight (obese)
Above 99.6th centile	Severely obese
Above + 3.3 SD	Morbidly obese

History

- Age of onset
- peripubertal common (related to imbalance between calorie intake and expenditure)
- infancy onset or onset aged <5 yr is rarer and may suggest a genetic cause
- Bullying
- Low self-esteem and depressed mood
- Osmotic symptoms suggestive of diabetes mellitus:
- thirst
- nocturia
- ask about eating, exercise patterns and screen time

Significant features

- Acanthosis nigricans; thickened velvety darkened skin in neck and flexures suggestive of hyperinsulinemia
- Obstructive sleep apnoea
- night-time snoring with daytime somnolence
- Signs of steroid excess
- growth failure
- recent onset purple striae
- hypertension
- Early onset associated with vision/hearing problems/learning difficulties/hypogonadism, polydactyly suggest a genetic syndrome
- hepatomegaly
- Polycystic ovary syndrome, ask about:
- disordered periods
- hirsutism

Causes

- Primary or environmental
- imbalance between calories consumed and calories expended
- Secondary to genetic disorder
- chromosomal: Prader-Willi/Down syndrome
- autosomal recessive: Bardet-Biedl/Alström/Carpenter/Cohen syndrome
- mutations in leptin pathway – melanocortin 4 (MC4R), pro-opiomelanocortin gene (POMC)
- Secondary endocrine/metabolic:
- Cushing's syndrome
- autoimmune hypothyroidism
- hypothalamic obesity related to septo-optic dysplasia, hypothalamic damage during surgery

Indications for referral to secondary care

- Severe obesity (BMI >99.6th as per RCPCH BMI centile chart)
- BMI >98th centile plus possible secondary cause of obesity. Look for:
- short stature in relation to expected for parental height
- dysmorphic features
- learning difficulties
- Obesity with significant/high risk for comorbidities
- If involvement of safeguarding services required

Investigations

All

- Urine test for glucose
- Blood pressure
- Pubertal assessment (for hypogonadism in males)
- Thyroid function
- Random glucose, glycated haemoglobin (HbA_{1c})
- Lipid profile (total and HDL-cholesterol, triglycerides)
- Liver function

Second-line investigations

Perform if indicated by presence of significant features – see above

- Genetic studies, including microarrays for all children with extreme obesity especially onset of obesity aged <5 yr, extreme hyperphagia and/or family history of extreme obesity
- children with obesity and dysmorphic features and/or learning difficulties
- send genetic of obesity study specimen to regional genetics laboratory, Cambridge (see https://www.goos.org.uk/ for details and request form)
- 24 hr ambulatory blood pressure monitoring
- Calcium and phosphate (pseudohypoparathyroidism)
- If growth failure, hirsutism, hypertension, perform 24 hr urinary free cortisol
- If HbA_{1c} raised, perform oral glucose tolerance test
- If suspecting polycystic ovary syndrome assess:
- LH
- FSH (looking for LH greater than FSH)
- serum testosterone
- 17-hydroxy-progesterone
- sex hormone binding globulin
- prolactin
- pelvic ultrasound
- Sleep study

TREATMENT

- Lifestyle, diet and exercise advice – reduce calorie intake, increase calorie expenditure
- behaviour strategies: goal setting, create a supportive environment, address family behaviours, encourage getting enough sleep
- physical activity: ≥20 min, ideally 60 min of vigorous physical activity ≥5 days/week; reduce sedentary time and encourage active play and positive role model
- diet: flexible and individualised approach to reduce calorie intake; avoid nutritionally unbalanced diets; encourage reducing consumption of sugary drinks and sweets
- Bariatric surgery – only considered in exceptional circumstances if physiological maturity, in children with BMI ≥40 kg/m^2 or 35 kg/m^2 with comorbidities. To be carried out by specialist multidisciplinary team after extensive psychological and physical assessment
- Management of comorbidities

Type 2 diabetes

- Involve paediatric diabetes team within 24 hr
- Initial pharmacological treatment with metformin or insulin depends on metabolic status at presentation (please follow local guideline for Type 2 Diabetes management)
- Metabolically unstable patients (glycated Hb ≥8.5% and/or osmotic symptoms) will need insulin treatment immediately

Microalbuminuria

- Defined as albumin:creatinine ratio ≥3.5 mg/mmol (female) or 2.5 mg/mmol (male) in early morning urine sample, on 2 out of 3 samples
- Involve paediatric renal and diabetic teams for commencement of angiotensin receptor antagonist or ACE inhibitor

Hypertension

- Defined as average systolic or diastolic blood pressure >95th percentile for age, sex, and height percentiles
- confirm on ambulatory blood pressure monitoring

- First-line treatment: diet and exercise advice, limitation of dietary salt
- Second-line treatment: pharmacological treatment angiotensin receptor antagonist
- See **Hypertension** guideline

Dyslipidaemia
- Definitions:
- LDL-cholesterol ≥2.5 mmol/L
- HDL-cholesterol ≤0.91 mmol/L
- triglycerides ≥1.7 mmol/L
- confirm on fasting samples
- First-line treatment: dietetic advice
- Pharmacologic therapy with statin (usually reserved for familial hypercholesterolaemia)

Non-alcoholic fatty liver disease
- First-line treatment: diet and exercise advice
- Hepatic transaminases >2x upper limit of normal is a surrogate marker for fatty liver disease – refer to paediatric hepatologist

Polycystic ovary syndrome
- Defined by 2 out of 3 of following criteria:
- oligoovulation or anovulation
- biochemical or clinical evidence of hyperandrogenism
- multiple ovarian cysts on ultrasound scan
- Refer to adolescent gynaecology clinic and consider metformin if HbA_{1c} elevated

Obstructive sleep apnoea
- Oxygen desaturation while sleeping, diagnosed on oximetry monitoring
- discuss with consultant with respiratory interest regarding screening children who complain of snoring at night, and daytime somnolence
- First-line treatment: refer to ENT if confirmed sleep disordered breathing

Depression
- Low self-esteem
- Disordered body image
- Have a low threshold for referring to child and adolescent mental health services for assessment
- Consider requirement for safeguarding

MONITORING TREATMENT
- Regular follow-up and assessment
- best delivered in community rather than secondary care
- Principles include:
- setting realistic, achievable targets
- regular contact
- non-judgmental approach
- Complications i.e. type 2 diabetes require 3-monthly follow-up in secondary care
- Other complications require secondary care follow-up by paediatric team

SUBSEQUENT MANAGEMENT
- Primary obesity
- annual screen for complications
- Most secondary causes of obesity are chronic conditions that require specific management

FOLLOW-UP
- Children with:
- extreme obesity (BMI >99.6th centile for age and sex)
- secondary obesity

DISCHARGE
- GP follow-up once secondary obesity excluded
- if secondary obesity, involve paediatric team

PAIN ASSESSMENT AND MANAGEMENT ● 1/2

KEY POINTS FOR SUCCESSFUL PAEDIATRIC PAIN MANAGEMENT ARE:

- Pre-emptive pain relief – e.g. topical anaesthetic before procedure
- Regular analgesia, tailored to child, developmental age, type of pain and clinical setting
  - optimise dose and timing of each drug before adding another agent
  - appropriate adjuncts and non-pharmacological methods to reduce opioid requirement
- Administer via most appropriate route/formulation (ideally oral)
- Regular re-assessment of pain scores
- Regular adjustment of analgesic prescriptions according to requirements

ASSESSMENT

Flacc and R-flacc

- **Suggested age group 2 months−7 yr**
- Assess score in each of the 5 categories from 0−2
- Total gives a score between 0 and 10
- R-flacc adds further detail for patients with developmental delay

FLACC

Behavioural category	Score 0	Score 1	Score 2
Face	No particular expression or smile	Occasional grimace or frown, withdrawn, disinterested, sad, appears worried	Frequent to constant quivering chin, clenched jaw, distressed looking face, expression of fright/panic
Legs	Normal position or relaxed; usual tone and motion to limbs	Uneasy, restless, tense, occasional tremors	Kicking, or legs drawn up, marked increase in spasticity, constant tremors, jerking
Activity	Lying quietly, normal position, moves easily, regular, rhythmic respirations	Squirming, shifting back and forth, tense/guarded movements, mildly agitated, shallow/splinting respirations, intermittent sighs	Arched, rigid or jerking, severe agitation, head banging, shivering, breath holding, gasping, severe splinting
Cry	No cry (awake or asleep)	Moans or whimpers, occasional complaint, occasional verbal outbursts, occasional grunting	Crying steadily, screams or sobs, frequent complaints, repeated outbursts, constant grunting
Consolability	Content, relaxed	Reassured by occasional touching, hugging or being talked to, distractable	Difficult to console or comfort, pushing caregiver away, resisting care or comfort measures

WONG AND BAKER PAIN ASSESSMENT – SELF REPORT

- **Suggested age group ≥4 yr**

Wong-Baker FACES Foundation (2016). Wong-Baker FACES® Pain Rating Scale. Retrieved 20.07.16 with permission from http://www.WongBakerFACES.org

MANAGEMENT

Non-pharmacological interventions

- Physical sensory
  - repositioning physical activity

- heat/cold
- TENS
- sucking: breast-feeding/non-nutritive sucking/sucrose solution
- Psychological
- parental presence
- distraction (toys, bubbles etc)
- reassurance, explanation, information sharing
- play
- relaxation
- allow choices
- Environmental
- quiet, calm, child-oriented environment
- encourage normal sleep/rest periods
- Other
- play specialist referral
- use appropriate assessment tool for patients' developmental stage

Analgesia

- See also **Analgesia** guideline
- For dosages, see **BNFc**
- Simple analgesia (paracetamol, non-steroidal anti-inflammatory drugs (NSAIDs))
- Low dose oral morphine: 100 microgram/kg PRN 4-hrly
- High dose oral morphine: 200–300 microgram/kg 4-hrly
- NCA/PCA morphine or fentanyl
- consider fentanyl if:
  - renal failure
  - history of adverse effect with morphine e.g. nausea/vomiting, histamine release/wheals/urticaria, mood changes/bad dreams, teenage patient

Adjuncts

- Alpha-blockers
- clonidine 1 mg/kg oral
- useful if anxiety is a feature
- beware sedation and cardiac
- Gabapentinoids
- pregabalin
- gabapentin
- useful for neuropathic pain
- Licodine patch
- ?dose
- ?indication

Perioperative analgesia

- Regional techniques are recommended by APAGBI and RA-UK
- Paediatric plan A blocks available online
  https://www.ra-uk.org/index.php/plan-a-blocks-home/plan-a-paeds.html
  https://www.apagbi.org.uk/education-and-training/regional-anaesthesia
- See also **BNFc**

PALPITATIONS ● 1/2

Palpitations usually describes pounding sensation in chest and can cause great deal of anxiety to patients and parents. Most of the cases are benign but may occasionally signify an underlying cardiac arrhythmia

CAUSES

Non cardiac (includes sinus tachycardia, atrial or ventricular ectopic beats)

- Lifestyle factors (caffeinated drinks, smoking, alcohol, illicit drugs)
- Medications (beta-agonists, antihistamines, diet pills, decongestants)
- Fever
- Anxiety
- Dehydration
- Anaemia
- Thyrotoxicosis
- Hypoglycaemia

Cardiac

Arrhythmias

- Atrial or ventricular ectopic beats
- Supraventricular tachycardia
- Ventricular tachycardia

Heart disease

- Cardiomyopathy
- Mitral valve prolapse
- Aortic stenosis
- After surgery for congenital heart diseases

HISTORY

- Triggers, frequency and duration
- Onset and resolution (gradual/abrupt)
- Relevant history to exclude above mentioned causes of palpitations

RED FLAG SYMPTOMS

- Occurring during exercise
- Associated symptoms such as:
  - dizziness
  - pallor
  - fainting
  - nausea
  - sweating
  - chest pain
  - shortness of breath
- Family history of cardiac arrhythmias, fainting or sudden death

EXAMINATION

- Most cases have normal examination
- Examine radial/brachial pulse for rate and rhythm
- Blood pressure
- Look for anaemia, thyrotoxicosis, heart murmur

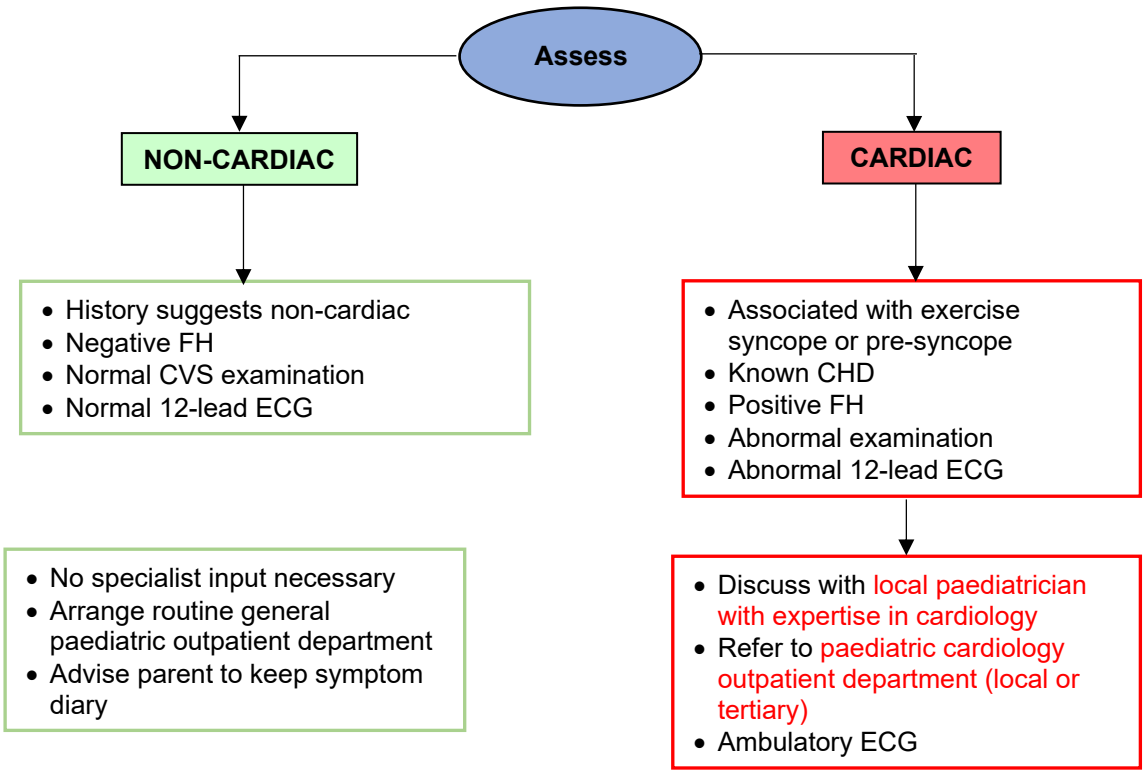
INVESTIGATIONS

12-lead ECG

- Specifically look for:
  - atrial and ventricular ectopics
  - heart block
  - delta waves
  - long QT interval
  - ventricular hypertrophy
  - see **ECG interpretation** guideline
- In indicated, perform blood tests to rule out:

- anaemia
- thyrotoxicosis
- dehydration
- Discuss 24–48 hr Holter monitoring as outpatient with senior

MANAGEMENT



PETECHIAL/PURPURIC RASHES ● 1/2

If sepsis likely, see* Sepsis *guideline
If meningitis likely, see* Meningitis *guideline
If fever, see Paediatric Pathways (https://bsac.org.uk/paediatricpathways/petechial-purpuric-rash.php)

RECOGNITION AND ASSESSMENT

Meningococcal disease symptoms and signs

Common non-specific

- Fever
- Vomiting/nausea
- Lethargy
- Irritable/unsettled
- Ill appearance
- Refusing food/drink
- Headache
- Muscle ache/joint pain
- Respiratory symptoms/signs or breathing difficulty

Less common non-specific

- Chills/shivering
- Diarrhoea, abdominal pain/distension
- Sore throat/coryza or other ear, nose and throat symptoms/signs

More specific

- **Sepsis**
  - non-blanching rash (tumbler test)
    - may be less visible in darker skin tones – check soles of feet, palms of hands and conjunctivae
  - altered mental state
    - includes confusion, delirium and drowsiness, and impaired consciousness
  - capillary refill time >2 sec
  - unusual skin colour
  - shock
  - hypotension
  - leg pain
  - cold hands/feet
- See **Sepsis (including meningococcal)** guideline

- **Meningitis**
  - stiff neck
  - back rigidity
  - bulging fontanelle
  - photophobia
  - Kernig's sign
  - Brudzinski's sign
  - unconsciousness
  - toxic/moribund state
  - paresis
  - focal neurological deficit including cranial nerve involvement and abnormal pupils
  - seizures
- See **Meningitis** guideline

High risk of meningococcal disease

- If any of the following occur at any point give take blood cultures then give ceftriaxone IV immediately
  - petechiae start to spread
  - rash becomes purpuric
  - signs of bacterial meningitis
  - signs of meningococcal septicaemia
  - appears ill to healthcare professional
- See **Sepsis (including meningococcal)** guideline

PETECHIAL/PURPURIC RASHES ● 2/2

UNEXPLAINED PETECHIAL RASH AND FEVER OR HISTORY OF FEVER

Investigations:

- Full blood count
- C-reactive protein (CRP)
- Coagulation screen
- Blood culture
- Whole-blood polymerase chain reaction (PCR) for *N. meningitidis*
- Blood glucose
- Blood gases

UNEXPLAINED PETECHIAL RASH AND FEVER OR HISTORY OF FEVER BUT NO HIGH RISK CLINICAL FEATURES

- If CRP raised and/or white blood cell count (especially neutrophil count) raised or below normal, treat with ceftriaxone IV immediately (indicates increased risk of meningococcal disease)
- although normal CRP and normal white blood cell count mean meningococcal disease less likely, they do not rule it out
- CRP may be normal and white blood cell count normal/low, even in severe meningococcal disease
- Monitor vital signs at least hourly over next 4–6 hr
- respiratory rate, heart rate, blood pressure, conscious level [Glasgow coma score and/or APVU], temperature, capillary refill time, and oxygen saturations
- If doubt remains, treat with antibiotics and admit

LOW RISK OF MENINGOCOCCAL DISEASE

- If assessed as low risk meningococcal disease and discharged after initial observation, advise parents/carers to return to hospital if child appears ill. (See **Meningitis Research Foundation observation sheet**: https://www.meningitis.org/healthcare-professionals/resources)
- Meningococcal disease unlikely in children presenting with non-spreading petechial rash without fever (or history of fever) and do not appear ill to healthcare professional – especially if rash present >24 hr. Consider:
- other possible diagnoses
- performing full blood count and coagulation screen

PLEURAL EFFUSION ● 1/3

RECOGNITION AND ASSESSMENT

Symptoms and signs

- Investigate for effusion if persistent pyrexia or unwell 48 hr after treatment started for pneumonia

Effusions to be referred to respiratory paediatrician

Differential diagnosis

- Uncomplicated pneumonia
- Malignancy
- Heart failure
- Pancreatitis
- Pulmonary embolism

Investigations

- FBC, clotting screen, U&E, LDH, protein, albumin, glucose, CRP
- Blood cultures
- If possible, sputum culture
- If recurrent infections, investigate for immune deficiency (first line: FBC, IgG, A, M, functional antibodies and HIV antibody)
- CXR PA or AP (no need for lateral)
- Ultrasound (US) scan to:
  - confirm presence of effusion
  - determine maximum depth in dependent position
  - differentiate between simple and complicated effusion (e.g. loculations, heterogeneous material)
  - localise effusion at time of drain insertion
- If history, CXR or US suggestive of malignancy, request CT chest
- If risk factors for coagulopathy or thrombocytopenia, check and correct before drain insertion
- Pleural fluid analysis for:
  - Gram stain and bacterial culture
  - differential cell count
  - cytology
  - AAFB and TB PCR and culture

If cause likely to be infective, it is not necessary to obtain sample for pleural fluid culture routinely before chest drain insertion.
If alternative cause suspected, try to avoid unnecessary chest drain insertion by obtaining diagnostic aspirate of pleural fluid for cytology

IMMEDIATE TREATMENT

Supportive

- ABC
- Oxygen and fluid resuscitation as indicated
- Analgesia

Antibiotic therapy

Type of effusion suspected	Choice of antibiotics
Effusion following community-acquired pneumonia	Cefuroxime IV + clindamycin IV (Penicillin allergy: clindamycin IV alone)
Effusion following hospital-acquired pneumonia, trauma, aspiration or in immune-compromised child	Piperacillin/tazobactam (Penicillin allergy: clindamycin IV)
Effusion possibly tuberculous	Discuss with TB team

- When organism sensitivities available, use narrow-spectrum antibiotics

Refer to respiratory paediatrician

- Early active treatment reduces length of illness
- Except small effusions (<2 cm deep) which are not enlarging or compromising respiratory function and do not need to be drained

- Underlying cavitating disease may lead to bronchopleural fistulae

Chest drain insertion

- Discuss with respiratory paediatrician, consultant paediatrician, paediatric anaesthetic team (usually general anaesthetic used) and PICU
- support may also be required from cardiothoracic team +/- interventional radiologist
- If possible, consider simultaneous insertion of long line during general anaesthetic
- Ensure vascular access before starting procedure
- CXR after drain insertion

Chest drain management

- Ensure nursing staff trained in care of children with chest drains
- Attach chest drain to low level suction (5–10 cm H_2O) via underwater seal
- If altitude chest drainage system used, set wall suction to 160 mmHg/22 kPa and set dial on drainage system to 20
- Keep underwater seal below level of chest at all times
- If >10 mL/kg/hr has been drained, clamp chest drain for 1 hr to prevent re-expansion pulmonary oedema
- **Never clamp a bubbling chest drain** – this indicates presence of pneumothorax
- If clamped and chest pain or breathlessness, unclamp immediately
- When there is a sudden cessation of fluid draining, the drain must be checked for obstruction (blockage or kinking) by flushing
- Ensure adequate analgesia (see **Analgesia** guideline) and encourage patient to move freely when well enough

Intrapleural fibrinolytics

- Indicated if thick fluid with loculations or pus
- Instill urokinase, as follows:
- ≥10 kg: urokinase 40,000 units in 40 mL sodium chloride 0.9%
- <10 kg: urokinase 10,000 units in 10 mL sodium chloride 0.9%
- administer via chest drain 12-hrly for 3 days (total 6 doses)
- clamp chest drain for 4 hr after instillation of urokinase, then drain for 8 hr
- Record fluid volumes into and out of pleural space carefully and accurately

SUBSEQUENT MANAGEMENT

Act on response to treatment and clinical assessment of patient

- Monitor symptoms and re-examine patients to assess progress
- Repeat CRP as needed
- if falling rapidly, continue with current regimen
- if not falling after 72 hr, treat as non-resolution (see below)
- Chase pleural fluid aspirate results
- if unexpected organisms grown, adjust antibiotic therapy with antibiotic sensitivities
- if differential cell count shows lymphocytosis, consider TB or malignancy as differential diagnosis and discuss with relevant subspecialties (Infectious/TB team or oncology) send aspirate for cytology and consider CT scan of chest
- Rationalise antibiotics based on culture reports. If no growth, continue empirical treatment until patient improves
- Remove chest drain when drainage minimal and in agreement with respiratory paediatrician: appose skin with Steri-Strips™ rather than sutures
- Continue IV antibiotics at least until afebrile. Change to oral co-amoxiclav (penicillin allergy: oral clindamycin) when clinical improvement obvious. Complete minimum 14 days antibiotics. Longer courses may be needed and will be decided by the respiratory paediatrician
- Continue antibiotics until CRP <10
- Encourage early mobilisation and exercise

Non-resolution

- If no resolution of effusion after 3 days or further complications occur, consider CT scan of chest
- If no fluid draining, check for obstruction by flushing drain with normal saline 5–10 mL
- If drain cannot be unblocked, remove and replace if significant effusion remains
- Discuss referral for thoracotomy with respiratory pediatrician

PLEURAL EFFUSION ● 3/3

Surgery

- Discuss with paediatric thoracic surgeon if:
- effusion has not resolved
- child is still septic

DISCHARGE AND FOLLOW-UP

- Arrange review by respiratory paediatrician, initial appointment 6 weeks after discharge (CXR on arrival)
- if symptoms persist or recur, early referral to respiratory paediatrician

PNEUMONIA ● 1/3

If aged <1 month, refer to Neonatal guidelines

RECOGNITION AND ASSESSMENT

Definition

- Inflammation and consolidation of lung caused by bacterial, viral or mycoplasma infection
- Absence of clinical signs and normal CXR makes pneumonia unlikely
- Up to 35% of lower respiratory tract infections have single virus as causative organism
- Can be presenting illness in cystic fibrosis and immunodeficiency states

Symptoms and signs

- Cough
- Fever
- Irritability
- Poor feeding
- Vomiting
- Tachypnoea at rest (most useful sign)
- See Paediatric Pathways https://bsac.org.uk/paediatricpathways/

Awake or unsettled infants can have high respiratory rate on a single measurement; measure at rest and repeat

PV Staph.aureus pneumonia
Consider if preceding flu-like illness, haemoptysis, multilobular infiltrates, bone or joint infection, leukopenia/neutropenia or patient or close family contact has current, or a history of, recurrent boils/abscesses or skin infections
Discuss with microbiology/infectious diseases re further management and investigation

Table 1: WHO definition of tachypnoea

Age	Counted breath rate
<2 months	≥60/min
2–11 months	≥50/min
1–5 yr	≥40/min

- Bronchial breathing, inspiratory crackles
- Recession
- Abdominal pain (referred pleural pain)

Severe pneumonia

- ≥2 of following:
  - temp >38.5°C
  - respiratory rate >50 (>70 infant)
  - cyanosis
  - tachycardia, capillary refill time >2 sec
  - signs of dehydration
  - severe recession
  - not feeding
  - apnoea
  - difficulty breathing
  - nasal flaring
  - grunting

Investigations: usually NONE unless severe

- Chest radiography not advised if:
  - community-acquired pneumonia
  - not admitted to hospital
- Do not perform lateral X-ray routinely
- If pertussis suspected, pernasal swab for PCR or in charcoal transport medium (consult local microbiology laboratory for details)
- Pulse oximetry
- **If severe pneumonia:**
  - FBC, blood culture

- serum electrolytes (may have hyponatraemia owing to SIADH), CRP
- if mycoplasma pneumonia suspected, mycoplasma titre (indicate date of onset on request form) or PCR
- sputum if able to provide good quality specimen
- nasopharyngeal aspirate or nasal swab in viral transport medium for respiratory viruses
- Pleural fluid culture and pneumococcal PCR if aspirated
- pneumococcal antigen in urine

Differential diagnosis
- Bronchiolitis with atelectasis (usually aged <1 yr)
- Foreign body aspiration
- Tumour (‘round’ pneumonia)
- Empyema/lung abscess
- Tracheobronchitis
- Whooping cough

IMMEDIATE TREATMENT
See **Flowchart**

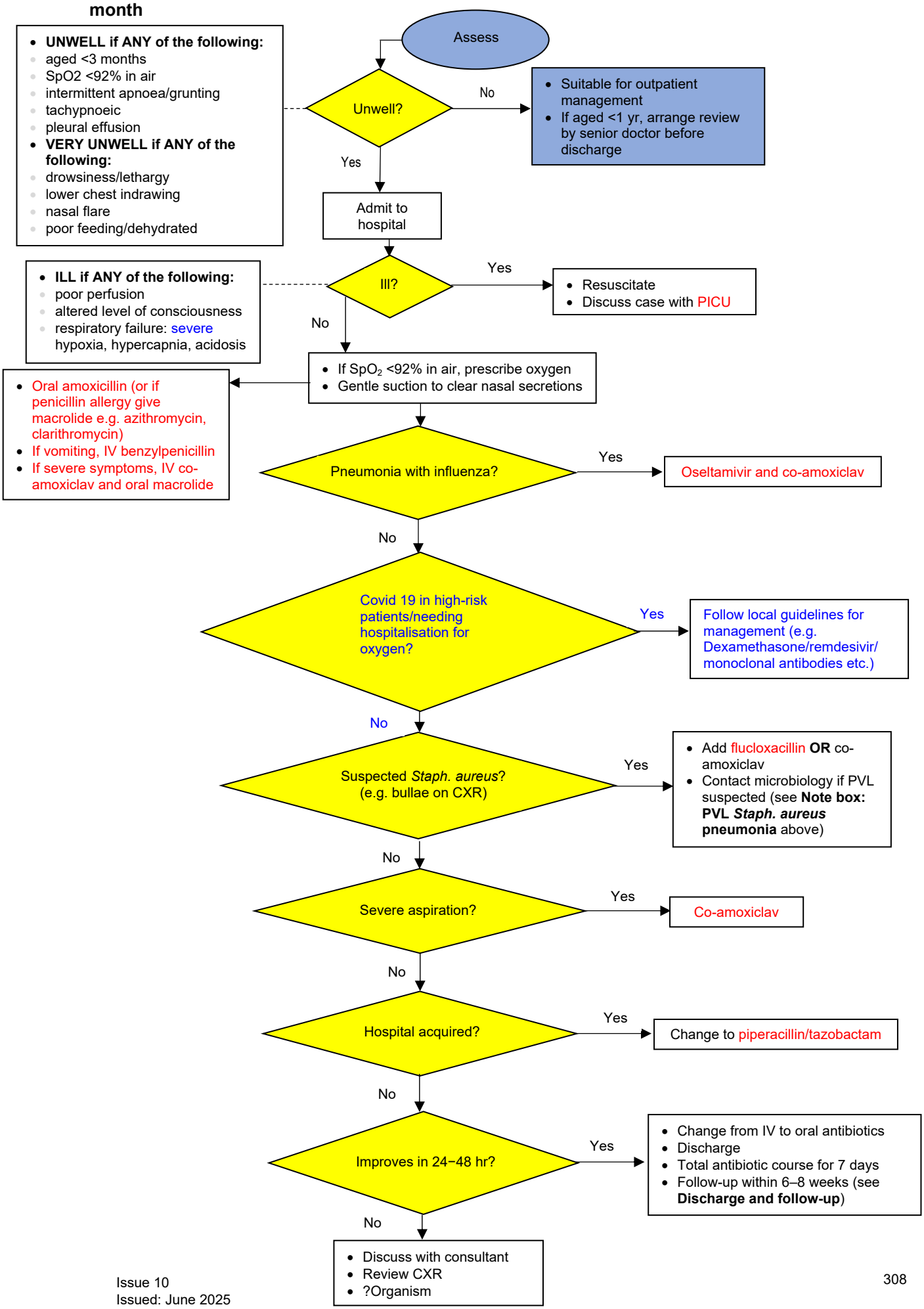
Pleural effusion
- See **Pleural effusion** guideline

SUBSEQUENT MANAGEMENT
- Change IV to oral within 24–48 hr
- If uncomplicated, total antibiotic course 7 days
- If complicated or staphylococcal pneumonia, treat for 14 days and 14–21 days for severe community-acquired pneumonia
- Consider physiotherapy once cough productive
- important if patient has neuromuscular impairment as results in poor clearance of secretions
- Maintain hydration
- oral fluids if tolerated
- if unable to take oral fluids use sodium chloride 0.9% with glucose 5% with potassium via IV infusion
- restrict IV fluid replacement to 80% maintenance
- monitor electrolytes

MONITORING TREATMENT
- Continuous SpO_2 monitoring if needing oxygen
- 1–4 hrly observation depending on severity of illness
- If no improvement in 24–48 hr, review diagnosis (repeat CXR) or treatment

DISCHARGE AND FOLLOW-UP
- Radiography follow-up if:
- ‘round’ pneumonia
- collapse
- persisting symptoms
- If previously healthy and recovering well radiography follow-up not required
- Hospital follow-up if:
- previous/recurrent lower respiratory tract infections
- failure to thrive
- GP follow-up for all others within 6–8 weeks
- Convalescent mycoplasma titre can be obtained at this visit (indicate date of onset on request form)

Flowchart: Management of community-acquired pneumonia in a previously well patient aged >1 month



PNEUMOTHORAX ● 1/3

RECOGNITION AND ASSESSMENT

Symptoms and signs

Tension pneumothorax (very rare)

- Severe dyspnoea
- Circulatory compromise
- Trachea +/- apex beat displaced
- Hyper-resonant percussion note
- Absent or decreased breath sounds on affected side

Important: Treat immediately (if not fully trained, get help)

- Give oxygen 15 L/min with mask with reservoir bag
- Insert a large bore cannula (14 or 16 G) ≥4.5 cm in length into 2nd anterior intercostal space, midclavicular line
- alternatively, cannula can be inserted into 5th intercostal space in mid-axillary line
- Insert chest drain mid-axillary line 5th intercostal space
- Remove emergency cannula when bubbling in underwater seal system confirms intercostal tube system functioning

Spontaneous pneumothorax

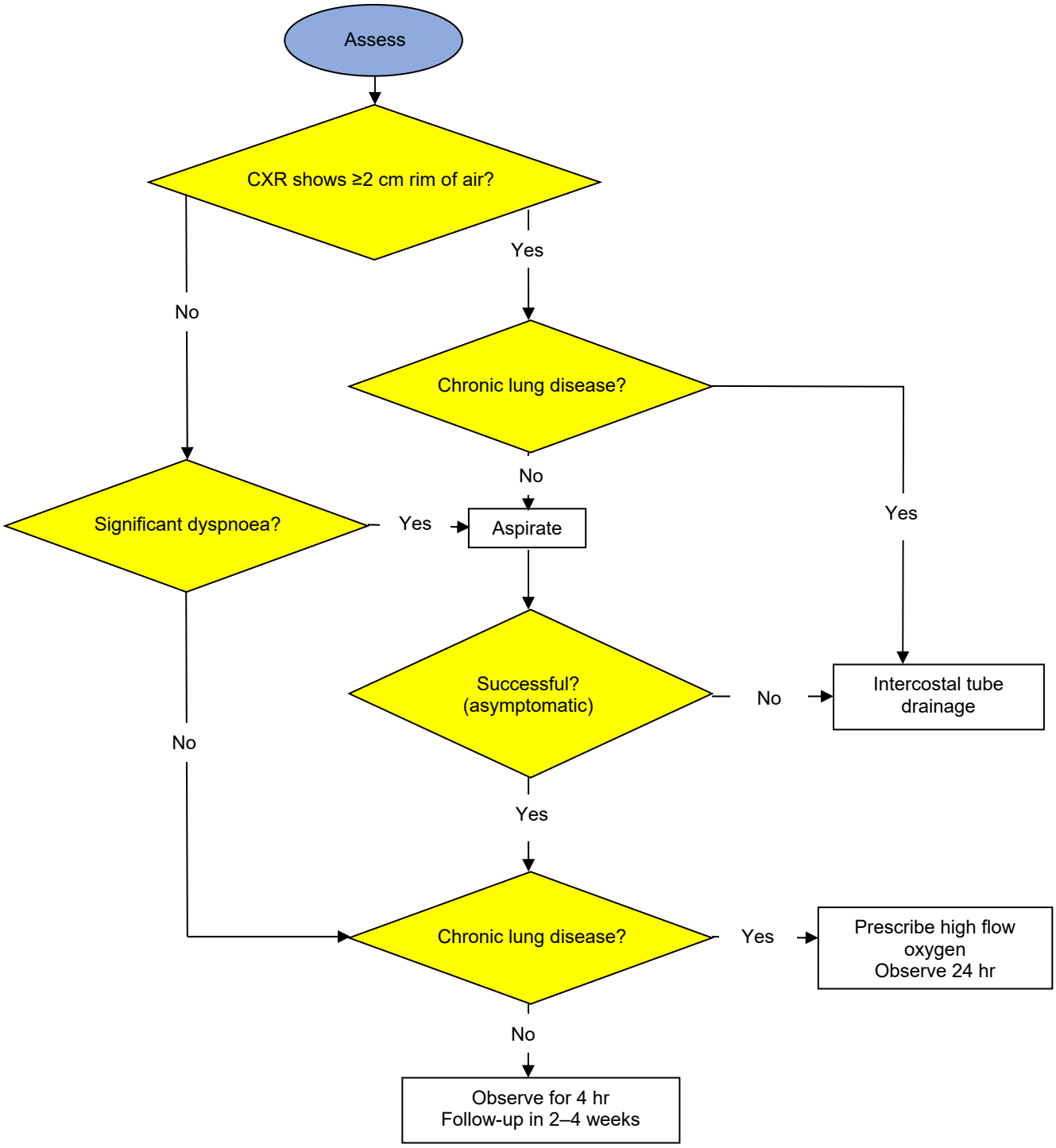
- Symptoms may be minimal
- Sudden onset, occasionally at rest
- Chest pain (unilateral)
- Dyspnoea
- Resonance on percussion, with reduced vocal fremitus and breath sounds (if moderate-large)

Investigations

- PA CXR
- If findings are unclear on PA, lateral (if possible, lateral decubitus) film may help
- If findings obscured by surgical emphysema or complex bulla disease, CT scan may help

BEWARE: suspected basal pneumothorax usually implies a bulla. CT scan will differentiate bullae from pneumothorax

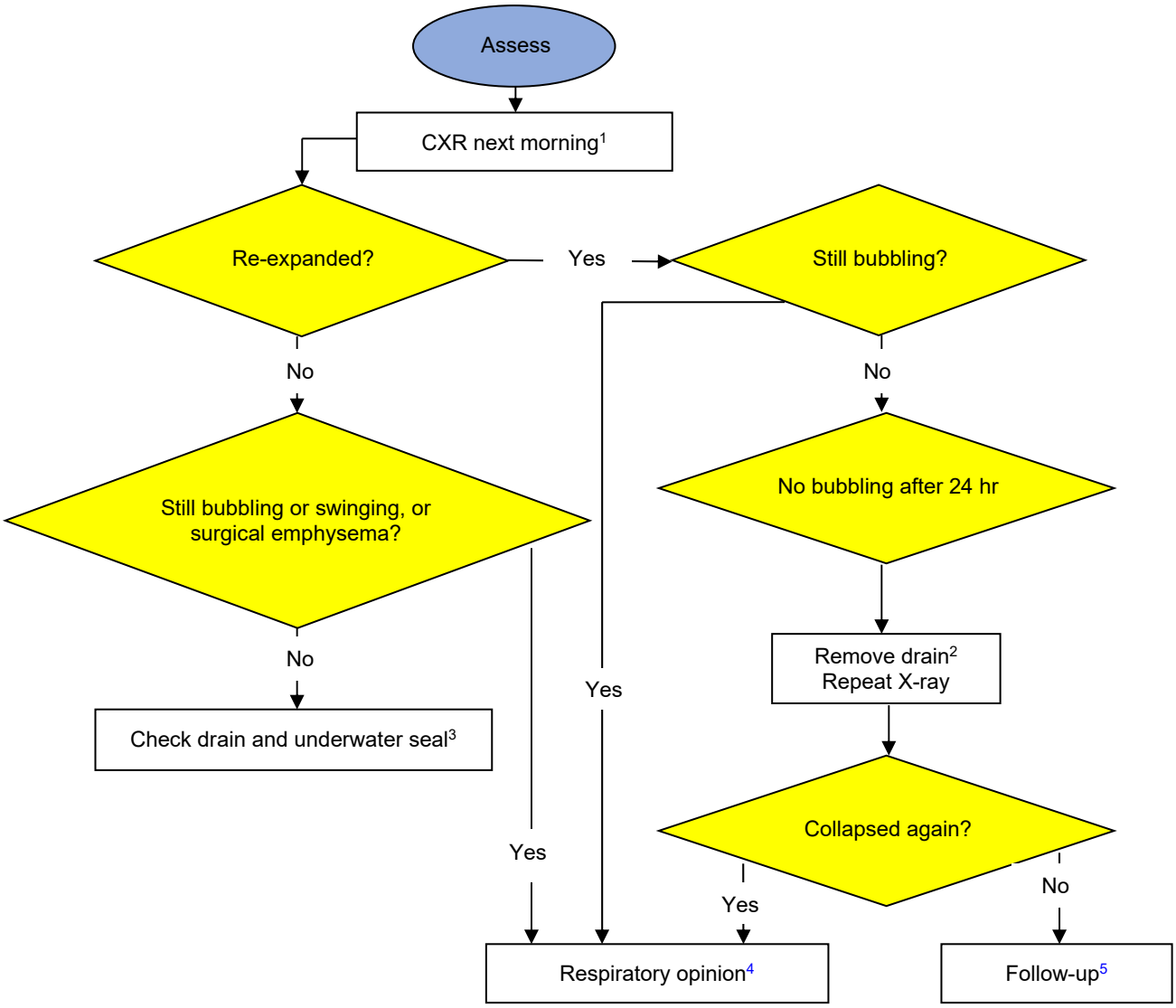
IMMEDIATE TREATMENT



- Aspirate: with cannula as above
- Suction not routinely required for chest drain
- Discuss all with respiratory paediatrician within 24 hr

PNEUMOTHORAX ● 3/3

Management of intercostal drains



- **1: CXR**
- keep underwater seal below level of chest at all times
- **2: Removal of chest drain:**
- bubbling stopped for at least 24 hr
- cut drain-securing suture
- withdraw tube while patient blows out through a straw
- close wound with Steri-Strips™
- **3: Check drain:**
- if lung not re-inflated and no bubbling in underwater bottle: Try to remove **block** or **kink**
- if unsuccessful, remove drain. Insert new drain through clean incision
- **4: Respiratory opinion**
- if no re-expansion, consider air leak, displaced/blocked tube, bronchopleural fistula, underlying pulmonary disease
- use high volume/low pressure suction, 1–2 kPa/Barr, (8–16 mmHg; 8–20 cm H_2O)
- if Altitude™ chest drainage system used, set wall suction to 160 mmHg (22 kPa) and set dial on drainage system to 20
- early thoracic surgery. Refer when pneumothorax fails to resolve after 5 days of above management or after 3 days if patient has chronic lung disease
- **5: Follow-up:**
- in 7–10 days, then with respiratory paediatrician
- patient given discharge letter and written advice to return immediately if deteriorates
- no air travel for 6 weeks and CXR changes resolved

POISONING AND DRUG OVERDOSE ● 1/4

Always follow your local child safeguarding policies and procedures.
The safety of children is everyone's responsibility

BACKGROUND

Toxbase

- Check **Toxbase** for poisoning and drug overdose management
- www.toxbase.org access and password available in A&E
- if further information required, contact UK National Poisons Information Service (NPIS) 0344 892 0111

The poisoned

- Toddlers (typically accidental poisoning)
- Aged <9 yr: household products most common cause of poisoning – vast majority accidental
- Aged 10–19 yr:
- drugs and alcohol more common
- >50% intentional

The poisoners

- Most childhood poisonings are accidental
- Intentional poisoning may be by the child or an adult
- Inadvertent poisoning may occur in a medical setting

The poison

- Children will eat and drink almost anything

RECOGNITION AND ASSESSMENT

Symptoms and signs

- Depressed respiration suggests centrally-acting drug
- Skin blisters (at pressure points) common after barbiturates and tricyclics
- Hypothermia after exposure or barbiturates
- Venepuncture marks and pinpoint pupils suggest opioid overdose
- Burns around mouth

Life-threatening features

- Coma
- Cyanosis
- Hypotension
- Paralytic ileus

Poison(s)/drug(s) information

- Ask patient, relatives, GP, ambulance crew. Retain any containers found
- if identification doubtful, ask parents to retrieve poison from home
- Ask about visitors to the house/visits to other houses (e.g. grandparents)
- Quantity ingested: difficult to quantify but parents may know how full a bottle should have been
- **assume child has ingested something even if found with a few tablets or an empty bottle**
- Time of ingestion, including multiple doses/staggered overdose
- Other possible poisons/drugs taken
- If child presents with no clear history to suggest button battery ingestion but symptoms e.g. haematemesis, haemoptysis and respiratory difficulties present, see **Known/suspected button battery ingestion**

Investigations

- Save blood and urine for toxicological analysis
- all suspected cases of paracetamol ingestion should have concentrations measured
- if history of ingestion, urgent measurement of plasma/serum concentration is essential in diagnosis and management of poisoning with ethylene glycol, iron, lithium, methanol, paracetamol, theophylline and salicylate
- Other investigations as recommended by **Toxbase** or clinical condition: U&E, blood gases and acid-base

Request plasma paracetamol concentration in all unconscious patients in whom drug overdose is considered

POISONING AND DRUG OVERDOSE ● 2/4

Always admit a child who is symptomatic or who has ingested iron, digoxin, aspirin or a tricyclic antidepressant

IMMEDIATE MANAGEMENT

Assess airway, breathing and circulation

- Maintain airway
  - if airway not protected, consider airway adjunct or intubation and ventilation
  - if cyanosed or rate and depth of respiration obviously low, arterial blood gases indicated
  - if $PaCO_2$ high or rising, mechanical ventilation indicated
- Correct hypotension
  - raise foot end of bed
  - if in haemodynamic shock, give IV bolus of sodium chloride 0.9% (10 mL/kg over 10 min). Assess and repeat if still in shock (see **Intravenous fluid therapy** guideline)
  - consider need for central venous pressure (CVP) monitoring

Neurological

- Control convulsions (follow APLS protocol)
  - if unconscious, treat as head injury until proved otherwise

Drug absorption

- Give antidote if appropriate (see **Toxbase**)
- If child has ingested potentially life-threatening amount of toxic agent within last hour give activated charcoal 1 g/kg (maximum dose 50 g) orally (disguised with soft drink/fruit juice) or via NG tube
  - do not give if child unconscious and airway cannot be protected
  - activated charcoal does not affect absorption of acids, alkalis, alcohols, cyanide, ethylene glycol, petroleum distillates, malathion, and metal salts including iron or lithium
- Do not give ipecacuanha, as it does not empty the stomach reliably and can be dangerous
- Do not perform gastric lavage or whole bowel irrigation unless specifically recommended by **Toxbase**, or after consultation with NPIS (0344 892 0111)
- Stop any regular medication that might enhance effect of substance taken in overdose

Button (disc) battery ingestion

See **Known/suspected button battery ingestion**

SUBSEQUENT MANAGEMENT

- Follow additional guidance on www.toxbase.org
- If unconscious, admit to a high-dependency nursing area with cardiac monitoring
- Supportive care alone required for majority of acutely poisoned patients
- If deliberate self-harm, follow local protocol for referral (see **Self-harm** guideline)
- Share information with other agencies as relevant e.g. school nurse, social services
- Give advice to seek further medical assistance if symptoms develop after discharge

Monitoring treatment

- Monitor conscious level, temperature, respiration, pulse and BP until these return to normal
- No need to monitor drug concentrations other than to guide use of measures to enhance drug elimination
- If unconscious, make full head injury observations
  - record pulse, respiratory rate, BP, pupil size and reaction, and level of consciousness hourly for ≥4 hr, then increase interval if stable

PSYCHIATRIC REVIEW

- All deliberate acute self-poisoning or drug overdose must be seen by local CAMHS team once medically stable, or before discharge

Safeguarding

- If not referred to social services complete information sharing form for all deliberate or accidental poisonings or overdoses

DISCHARGE AND FOLLOW-UP

- **When discharged from hospital patients should have:**
  - been conscious and alert with normal vital signs for ≥6 hr

- no evidence of significant organ dysfunction as a result of poisoning/drug toxicity
- been interviewed by a member of the CAMHS team where indicated
- follow-up appointment in CAMHS clinic (if recommended)
- follow-up appointment in paediatric clinic (if persistent sequelae of poisoning require review)

KNOWN/SUSPECTED BUTTON BATTERY INGESTION

Background

- Oesophageal button batteries are a surgical emergency
- easily lodged in the oesophagus
- Damage can occur within 2 hr
- mucosal surface allows conduction causing fluid hydrolysis and hydroxide build up, leading to obstruction, bleeding, perforation and fistulae and can cause significant morbidity and mortality
- damage tends to occur on negative side (narrowest) – may give indication of resultant complications

Presentation

Caution – may present in variety of ways; many children are asymptomatic and have history of ingestion only

- For any child presenting with history of ingestion, always ask about possibility of button battery and magnet ingestion
- if ingested, **DO NOT** use metal detector (this is for swallowed coins)

Symptoms

- May include:
- drooling
- regurgitation
- food/drink refusal
- stridor
- dysphaia
- chest discomfort
- haematemesis
- Can have atypical symptoms (e.g. Horner's syndrome)

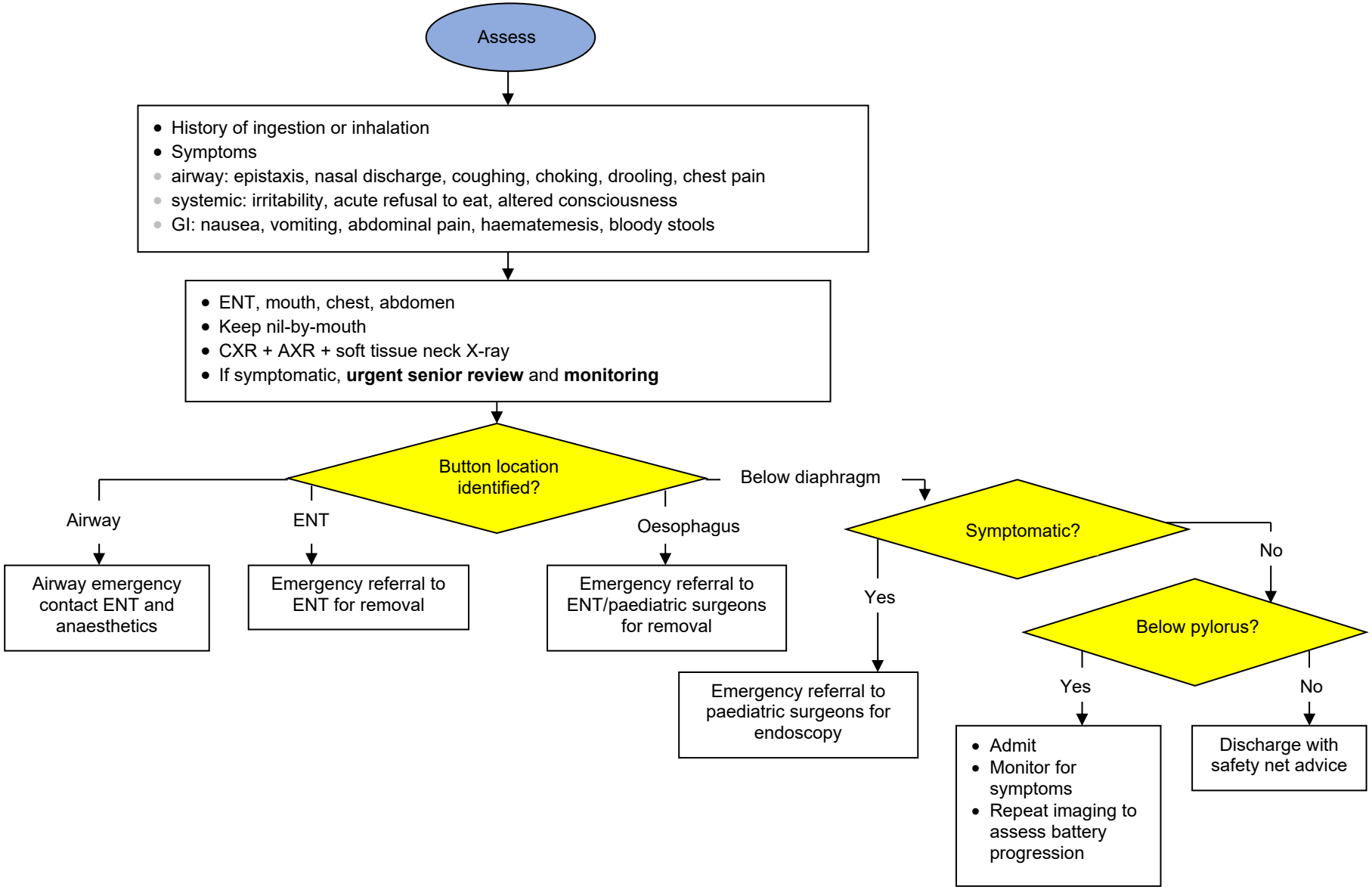
Investigations

- Examine nose and ears for foreign bodies
- CXR
- if AP/PA – halo sign
- if lateral – step sign
- Batteries can become lodged at:
- cricopharyngeus (C5)
- mid-oesophagus (T5)
- gastro-oesophageal junction (T10)
- duodeno-jejunal flexure (L2)
- If not seen on CXR perform AXR
- Lateral X-ray can help show direction negative pole is facing – **do not** delay transfer/removal to obtain lateral X-ray
- Monitor for erosion into trachea and aorta

Discharge

- Advise parents to attend A&E if symptoms develop in next 28 days: e.g. abdominal pain, GI bleeding

Management of retained button battery



POLYURIA AND POLYDIPSIA ● 1/2

INTRODUCTION

Polydipsia

- Excessive thirst that leads to consumption of larger than normal volumes of fluid
- Recommended daily fluid intake varies for neonates, infants and children and is based on age and gender
- Fluid intake may also be calculated based on weight using a simple formula (see **APLS** guidelines)
- Important to note fluid requirements increase depending on child's physical activity and environmental temperature
- Ask parents to offer child water only, rather than other drinks

Polyuria

- Defined as urine output >4 mL/kg/hr or 2 L/m^2/24 hr (150 mL/kg at birth, 110 mL/kg at aged 2 yr, 40 mL/kg/24 hr in older child and adults) by documenting 24 hr urine volume and fluid intake
- Often difficult to measure urine output and history of fluid intake is easier to obtain
- Establish pattern of drinking and urine output

In diabetes insipidus drinking and urination occur throughout 24 hr

HISTORY

- Take comprehensive history
- Look for red flags in history, e.g.:
  - dehydration
  - visual field loss
  - headache
  - irritability
  - restlessness
  - altered responsiveness
  - lethargy
  - recurrent vomiting
  - tachycardia and tachypnoea
  - weight loss

DIFFERENTIAL DIAGNOSIS

- Diabetes mellitus see **Diabetes new (non-ketotic)** guideline
- Diabetes insipidus
- Primary polydipsia
- UTI - see **Urinary tract infection** guideline
- Hypercalcaemia
- Hypokalaemia
- Renal failure
- Thyrotoxicosis

INVESTIGATIONS

- Blood glucose
- Plasma calcium
- Renal function
- Electrolytes
- Thyroid function tests
- Urinalysis
  - glucose
  - osmolality
  - specific gravity
  - leucocytes
  - nitrates
- Measure morning paired plasma and urine osmolality before performing formal water deprivation test – may confirm diabetes insipidus or normality and avoid test
  - urine osmolality >750 mosm/kg at any time practically excludes diabetes insipidus and water deprivation test **not necessary** (see **Table 1**)
- Cortisol deficiency will interfere with ability to excrete water and may mask diabetes insipidus

- to exclude cortisol deficiency, carry out synacthen test (see synacthen test protocol) before performing water deprivation test in any patient at risk
- Thyroid or adrenal reserve should be normal or adequately replaced before carrying out water deprivation test

Table 1: Probability of diabetes insipidus

	Unlikely	Likely	Possible
Serum osmolality	<270 mosm/kg	>300 mosm/kg	270–300 mosm/kg
Plasma sodium	<137 mmol	>150 mmol	137–150 mmol
Urine osmolality	>600 mosm/kg	<300 mosm/kg	300–600 mosm/kg
Urine output	<1 L/m^2/24 hr	>2 L/m^2/24 hr	1–2 L/m^2/24 hr
Water deprivation test	Not indicated	Not indicated	Indicated/consider – discuss with endocrine consultant

Water deprivation test is a dangerous test and must be performed in a controlled environment
Do not request/perform test without discussion with paediatric endocrinology consultant/consultant with special interest

POST-OPERATIVE NAUSEA AND VOMITING AGED ≥2YR ● 1/1

AT RISK

- History of travel sickness or post-operative nausea/vomiting
- Pre-operative pain
- Opioid analgesics
- Post pubertal girls
- >30 min surgery
- Age risk increases from aged 3 yr and rises throughout childhood

Prophylaxis

- Ondansetron (if QT prolonged, consider alternative) 150 microgram/kg (maximum 4 mg) IV over 3–5 min **or**
- Ondansetron oral: 150 micrograms/kg (maximum total dose 4 mg). Give 6–8 hrly (maximum 3 times in 24 hr)

HIGH RISK

- Tonsillectomy
- Adenoidectomy
- Strabismus surgery
- Major ear surgery

Prophylaxis

- Ondansetron 150 microgram/kg IV over 3–5 min (maximum 4 mg) **and**
- Dexamethasone (base) 150 microgram/kg IV over 3–4 min (maximum 6.6 mg)

PERSISTENT NAUSEA (>1 EPISODE VOMITING)

Ondansetron within last 8 hr

- If not already given within last 8 hr – dexamethasone (base) 150 microgram/kg IV slowly (maximum 6.6 mg)
- Contraindicated in tumour lysis syndrome; use droperidol (aged 2–17 yr) 25 microgram/kg IV max 1.25 mg (not if prolonged QT interval)
- Metoclopramide (risk of extrapyramidal effects e.g. acute dystonic reactions in children), cyclizine (IV/oral) and prochlorperazine (oral/buccal/IM) are less effective in children
- P6 acupressure
- If tolerance of oral fluids is mandatory before discharge from day case surgery, post-operative vomiting may be increased

No ondansetron within last 8 hr

- Ondansetron (if QT prolonged, consider alternative) 150 microgram/kg (maximum 4 mg) IV over 3–5 min **or**
- Ondansetron oral: 150 micrograms/kg (maximum total dose 4 mg). Give 6–8 hrly (maximum 3 times in 24 hr)

STIMULATION OF P6 ACUPRESSURE POINT

- P6 acupressure point:
- 1/6 distance from wrist crease to elbow crease or 2–3 finger breadths proximal to wrist crease, between the 2 prominent tendons in centre of forearm
- Apply gentle pressure with fingertip

Avoidance of dehydration and hypoglycaemia can reduce post-operative nausea and vomiting

PRE-OPERATIVE FASTING ● 1/1

PRINCIPLES

- Do not fast patients for longer than necessary for their safety under general anaesthesia
- Do not deny fluids for excessively long periods; allow patients to drink within these guidelines
- Use theatre time efficiently

Give all children clear fluids up to 1 hr pre-operatively. Liaise closely with theatre to discover approximate time of patient's operation

POLICY

- Solid food and milk (including formula) up to 6 hr before elective surgery
- Breast milk up to 4 hr before elective surgery
- Encourage patients to take clear oral fluids up to 1 hr before elective surgery
- clear fluids do **not** include fizzy drinks

PROCEDURE

All children aged ≥1 yr

Morning operating lists

- No solid food after midnight
- Water or diluted squash to be offered on admission to ward

Afternoon operating lists

- Light breakfast (including toast, or small bowl of cereal), to finish before 0730 hr
- Water or diluted squash to be offered on admission to ward

Infants/children aged <1 yr

Morning operating lists

- Last formula milk feed before 0230 hr
- Last breast milk feed before 0430 hr
- Water or diluted squash to be offered on admission to ward

Afternoon operating lists

- Last formula milk feed before 0700 hr
- Last breast milk feed before 0900 hr
- Water or diluted squash to be offered on admission to ward

Nursing and medical staff should ensure all children are encouraged to drink clear fluids (e.g. water or diluted squash) until 1 hr before anaesthesia/surgery

PYLORIC STENOSIS ● 1/1

SYMPTOMS

- Condition where passage (pylorus) between stomach and small bowel (duodenum) becomes narrower
- Presents in babies as non-bilious projectile vomiting
- usually aged 2–6 weeks
- Untreated can lead to weight loss, dehydration and constipation with metabolic alkalosis
- Often positive family history, boys>girls

DIAGNOSIS AND INVESTIGATIONS

- Test feed can be performed during examination – may be possible to feel thickened pyloric muscle as small hard lump on right side of baby's stomach
- muscles around stomach can sometimes be seen moving from left to right as they try to push milk through pylorus (visible peristalsis)
- If initial test feed not performed or negative, arrange urgent US scan of abdomen
- Check capillary blood gas for metabolic alkalosis and chloride levels

REFERRAL

- If diagnosis confirmed, discuss child with paediatric surgery team to arrange transfer and surgical correction
- Not an emergency operation, and will normally be carried out after correction of dehydration and alkalosis; can be done locally while awaiting transfer
- Give parents pyloric stenosis information leaflet if available (e.g. https://www.gosh.nhs.uk/conditions-and-treatments/conditions-we-treat/pyloric-stenosis/)

FLUID MANAGEMENT

- Keep child nil-by-mouth
- Insert nasogastric tube and put it on free drainage
- Monitor gastric aspirates volumes every 4 hr and replace with sodium chloride 0.9% with potassium chloride 10 mmol per 500 mL over next 4 hr
- Commence maintenance IV fluids
- volume 150 mL/kg/day at highest known weight
- choice of fluid is sodium chloride 0.9% with glucose 5% + potassium chloride 10 mmol/500 mL
  - more potassium may be required depending on serum potassium levels
- Check U&E, blood gas and chloride levels 6–8 hrly

AFTER SURGERY

- Post operatively babies usually discharged home directly from hospital
- No local follow-up indicated unless required for other reasons

RENAL CALCULI ● 1/4

RECOGNITION AND ASSESSMENT

Definition

- Presence of crystalline material within urinary tract

Symptoms and signs

- Non-specific recurrent abdominal pain
- Dysuria or painful micturition
- Classical renal colic
- Urinary infection (particularly *Proteus* spp)
- Persistent pyuria
- Macroscopic or microscopic haematuria
- Passage of gravel/stones
- Renal failure

Initial investigations

- Renal ultrasound scan
- KUB AXR
- Urine microscopy, pH and culture

Further investigations

- DMSA scan
  - to determine function when calculi multiple or large
- Repeat renal ultrasound scan
  - to see if stones have been passed
  - to monitor progress of stones
  - 6 weeks after treatment (see below)

IMMEDIATE TREATMENT

- Analgesia for severe pain (see **Analgesia** guideline)
- If obstruction present, urgent referral to paediatric urology
- Cefalexin oral if symptomatic for urinary tract infection, adjusted once sensitivities available
  - antibiotic treatment unlikely to eradicate organism in presence of stones

OUTPATIENT MANAGEMENT

Investigations in patients with proven renal calculi

- Blood sample for:
  - creatinine
  - calcium
  - phosphate
  - parathyroid hormone (if calcium raised)
  - uric acid
  - venous bicarbonate
  - pH (warm arterialised capillary sample to coincide with urine pH)
- Random mid-stream urine
  - microscopy, culture and sensitivity
- Early morning urine (first voided specimen) and 24 hr collection (request ‘urinary stone screen’ and record height and weight on request form) for:
  - calcium
  - oxalate
  - citrate
  - uric acid
  - cystine
  - creatinine
  - pH (to coincide with blood pH)
  - if 24 hr urine collection unsuccessful request:
    - calcium:creatinine ratio
    - oxalate:creatinine ratio
    - urate:creatinine ratio

Stone analysis

- May give useful information about aetiology
- If stone passage is frequent or associated with symptoms, ask parents to strain urine

Table 1: Characteristics of urinary stones

Type	Appearance	Causes	Radio-opaque*
Magnesium ammonium phosphate	Very soft, white, toothpaste consistency or gravel fragments	• Infection with urea-splitting organisms, especially in children with urinary stasis	No
Calcium oxalate	Hard grey-brown rough surface	• Hypercalciuria (any cause) • Hyperoxaluria	Yes
Calcium phosphate	Large, smooth, pale, friable	• Infection • Renal tubular acidosis • Vitamin D toxicity • Idiopathic hypercalciuria • Immobilisation • Hyperparathyroidism • Sarcoidosis	Yes
Cystine	Pale-yellow, crystalline Maple syrup	• Cystinuria	Yes
Uric acid	Hard, yellow	• Lesch-Nyhan syndrome • Dietary • Induction in haematological malignancies	No
Xanthine	Smooth, soft, brown yellow	• Xanthinuria	No
Dihydroxyadenine	Friable, grey-blue	• Adenine phosphoribosyl transferase deficiency	No

* Radiolucency depends on amount of calcium in the stone and individual patient can have >1 type of stone, each with different radiolucencies

Interpretation of results

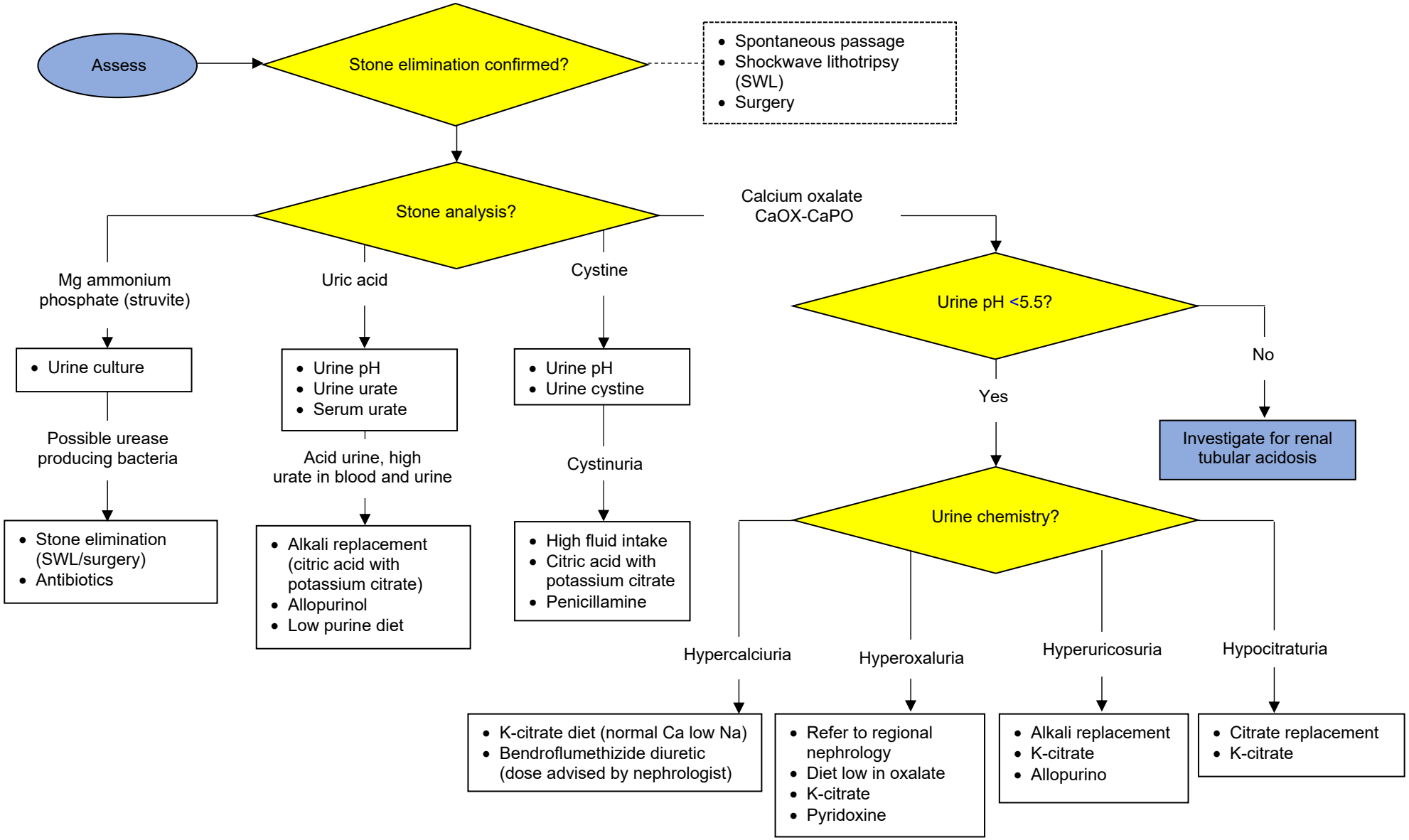
- Urinary pH
  - pH <5.3 in presence of normal capillary pH and bicarbonate excludes distal renal tubular acidosis
  - when above criteria not met, a more formal test of renal acidification required in those with nephrocalcinosis or in recurrent stone formers
  - pH >6 with capillary bicarbonate <18 mmol/L is seen in mild distal tubular acidosis
- Calcium:creatinine (mmol/mmol) ratio consistently >0.7 indicates hypercalciuria
  - absorptive hypercalcuria – normal fasting calcium:creatinine ratio raised post-milk
  - renal hypercalcuria – calcium:creatinine ratio raised fasting and post-milk
- Oxalate:creatinine (mmol/mmol) ratio is age-dependent, and suggestive of hyperoxaluria if it exceeds following thresholds:
  - aged <6 months: 0.35
  - aged 6–11 months: 0.2
  - aged 1–2 yr: 0.18
  - aged 3–6 yr: 0.11
  - aged 7–14 yr: 0.08
  - aged >14 yr: 0.065
- Uric acid/creatinine (mmol/mmol) ratio is age-dependent, and suggestive of hyperuricaemia if it exceeds following thresholds:
  - aged <1 yr: 1.5
  - aged 1–2 yr: 1.26
  - aged 3–6 yr: 0.83
  - aged 7–10 yr: 0.67
  - aged 11–14 yr: 0.45
  - aged >14 yr: 0.4
- Magnesium:creatinine ratio <0.2 may increase stone formation
- Calcium:citrate ratio <0.6 may increase stone formation

- Citrate:creatinine ratio
- Cystine, if present, is indicative of cystinuria
- Overall solubility index (RS value)
  - negative value: stable urine
  - value 0–1: metastable (liable to precipitate if seeded)
  - value >1: spontaneous precipitation

TREATMENT

- Treat any metabolic disorder identified by above investigations, seek advice from regional nephrology service
- Keep urine free from infection, particularly in those with history of *Proteus mirabilis* infection by prompt treatment if symptomatic
- Advise liberal fluid intake
  - adolescent 3 L/day
  - pre-puberty (school age) 1.5 L/day
- Additional measures for recurrent stone formation or idiopathic hypercalciuria (in order):
  - dietary assessment to optimise oxalate, vitamin C, calcium, and vitamin D intake
  - reduced sodium intake in idiopathic hypercalciuria, if sodium excretion >3 mmol/kg/day
  - high fibre diet with cellulose or whole wheat flour to reduce calcium and oxalate absorption
- For specific treatments – see **Algorithm for metabolic investigations** and discuss with regional nephrology service

Algorithm: Renal stone metabolic investigations



RENAL INVESTIGATIONS ● 1/3

PROTEIN EXCRETION

- As a diagnostic indicator in any child thought to have an underlying renal disorder
- To monitor progress in renal disorders
- Normally glomerular, rarely tubular in origin
- Investigate as below in patients with persistent proteinuria where cause is unknown
- Request protein:creatinine ratio (**must** be first urine specimen voided in the morning)

Protein:creatinine ratio

- Performed on first urine specimen voided in the morning
- Upper limit of normal 20 mg/mmol
- Significant proteinuria >100 mg/mmol
- Heavy proteinuria (nephrotic) >200 mg/mmol

Albumin:creatinine ratio

- Request albumin:creatinine ratio if need to confirm glomerular proteinuria

Timed urine collection

- Only appropriate for older patients (out of nappies)
- Night-time collection to rule out orthostatic proteinuria
  - empty bladder at bedtime and discard sample
  - collect all urine passed during the night
  - empty bladder on rising in morning and collect urine
  - record time from bladder emptying at night to bladder emptying in morning
- Calculate protein output as mg/m^2/hr (see **BNFc** for surface area)
- Upper limit of normal = 2.5 mg/m^2/hr
- Heavy proteinuria >40 mg/m^2/hr

Tubular proteinuria

- Request retinol binding protein (RBP): creatinine ratio; elevation confirms tubular proteinuria

OSMOLALITY

- Used to exclude urinary concentrating disorders
  - patients with polyuria (may present as wetting or excessive drinking)
- Test early morning urine after overnight fast; >870 mOsm/kg virtually excludes a concentrating defect
  - if concern re diabetes insipidus, do water deprivation test during the day

SODIUM EXCRETION

- Fractional sodium excretion (FE_{Na}) assesses capacity to retain sodium
  - ensure normal sodium intake (dietitian to advise)
  - stop any existing supplements 6 hr before taking samples
  - document weight loss after supplements stopped, may provide useful supporting evidence
  - random urine sample for urinary sodium (UNa) and creatinine (UCr)
  - blood sample immediately after voiding for plasma sodium (PNa) and creatinine (PCr)
  - enter results into equation (using same units for U and P; 1000 micromol = 1 mmol)
  - $$\text{FENa} = \frac{\text{UNa} \,.\text{PCr}}{\text{PNa} \,.\text{UCr}} \times 100$$
  - normal values for FENa
    - aged 0–3 months <3%
    - aged >3 months <1%

PLASMA CREATININE

- Mean and upper limit dependent on height but can be determined roughly from child's age if height not available

GLOMERULAR FILTRATION RATE (GFR)

- Serial measurements of GFR (in mL/min/1.73 m^2) predict rate of deterioration when renal function impaired

Table 1: Mean GFR by age

Age	Mean GFR (mL/min/1.73 m^2)	Range (2 SD)
Up to 1 month	48	28–68
1–6 months	77	41–103
6–12 months	103	49–157
1–2 yr	127	63–191
2–12 yr	127	89–165

Plasma creatinine method

- Estimates GFR in children with reasonable accuracy from P_{Cr} and height, using following formula:

$$\text{GFR (mL/min/1.73 m}^2) = \frac{30^* \times \text{height (cm)}}{P_{Cr}\ (\mu\text{mol/L})}$$

*check local laboratory method of creatinine measurement as constant may vary

- Not suitable for children:
- aged <3 yr
- with muscle disease/wasting

ULTRASOUND

Indications

- To identify structural abnormalities of urinary tract or to monitor growth (e.g. in a child with a solitary kidney)

Table 2: Normal values for renal ultrasound measurement

Age	Length (mm)	Range (mm)
Up to 3 months	45	35–60
3–6 months	50	50–60
6–9 months	55	52–60
9–12 months	58	54–64
1–3 yr	65	54–72
3–6 yr	75	64–88
6–9 yr	80	73–86
9–12 yr	86	73–100

ISOTOPE SCANS

Dynamic imaging (MAG3)

Indications

- To assess obstruction in dilated system
- To assess drainage 6 months after pyeloplasty
- Indirect voiding cystography in older children before and/or after surgical correction of reflux

Operational notes

- Request via nuclear medicine
- SHO or nurse required to insert venous cannula in young children
- Consider sedation if child has had previous problems lying still during examinations
- Maintain good hydration
- When assessing obstruction in dilated system or outcome of pyeloplasty, give furosemide 0.5 mg/kg (maximum 40 mg per dose) slow IV bolus over 3 min (maximum rate 4 mg/min), 15 min before giving isotope. Helps to differentiate genuine obstruction from isotope pooling, provided function of affected kidney not severely impaired
- Do not use furosemide for indirect cystography

Static imaging (^{99m}Tc-DMSA)

Indications

- To assess differential function between kidneys and within duplex kidneys
- To locate an ectopic kidney
- To identify renal scars after recovery from urine infection

- atypical UTI aged <3 yr or recurrent UTI any age

Operational notes

- Request via nuclear medicine
- Scan kidney 2–6 hr after injection
- Sedation rarely required
- Delay DMSA for 4–6 months after infection to avoid false positive

X-RAY IMAGING

Micturating cystourethrogram (MCUG)

- To assess bladder for vesicoureteric reflux (VUR), to view urethra

Indications

- Atypical or recurrent UTI aged <6 months
- Recurrent or atypical UTI in children aged >6 months, but <3 yr if:
- dilatation on ultrasound
- poor urine flow
- non-*E. coli* infection
- family history of VUR

Operational notes

- **Patients already taking prophylactic antibiotics:** double dose on day before, day of the test and day after
- **Patients not on antibiotics:** give treatment dose covering day before, day of the test and day after
- Urethral catheter will be passed in X-ray department

DIAGNOSIS

- Intensely itchy infection of skin, particularly at night, caused by *Sarcoptes scabiei* mite
- Sites of infection include web spaces, wrists, axillary areas, breasts (particularly nipples), peri-umbilical, penis, scrotum, buttocks
- Infants may have rash affecting: face, scalp, palms, soles
- Co-existing skin disorders, e.g. eczema, may be present and exacerbated by infection
- reaction to scabies mite, saliva, faeces/eggs and typically occur 2–6 weeks after first infected; can occur at a site some distance away from where mites are burrowing

COMPLICATIONS

- Bacterial infection with group A *Streptococcus*, *Staphylococcus aureus*, or both

MANAGEMENT

- All household and close contacts to be treated at same time, whether infected or not
- Treatment usually obtained from GP and need for it to put in discharge letter
- Advise to change bed linen, clothes (including underwear), nightclothes and towels, clean in hot wash, vacuum bedroom, wear clean clothes next day
- Always confirm diagnosis of scabies in children aged <6 months with dermatology team

TREATMENT

Permethrin 5% cream

- Not recommended for pregnant contacts or aged <2 months
- Apply thinly to whole body, neck down and wash off after 8–12 hr includes face, neck, scalp and ears in infants and if these areas are affected in older children
- If hands washed within 8 hr, reapply
- Repeat treatment after 1 week

Guide to quantity (be aware of weight and size of child)

- Adults and children aged >12 yr usually 1 x 30 g tube/person but adults and larger patients may require an additional tube i.e. 2 x 30 g tubes (60 g maximum dose for an application)
- Aged 5–12 yr: up to ½ tube (15 g)
- Aged 1–5 yr: up to ¼ tube (7.5 g)
- Aged 2 months–1 yr: ⅛ tube (3.75 g)
- **Note**: In cases where head, neck, scalp and ears are treated dosage may be increased to ensure total body coverage

Malathion 0.5% aqueous lotion (Derbac M)

- May be easier in babies and infants compared to cream (permethrin 5%)
- Apply using sponge/brush to whole body from the chin downwards, including between fingers and toes, soles of feet and genitalia; include scalp, face and ears and in aged <2 yr avoid eyes and mouth
- If hands are washed with soap within 24 hr retreat them
- Apply once weekly for 2 doses and wash off each application after 24 hr
- **Note:** Malathion is not licensed for use aged <6 months except under medical supervision which requires referral to dermatology

Other treatment

- Antihistamines (chlorphenamine) may be prescribed to reduce itching
- Emollients useful for troublesome itching post treatment
- Treat eczema in usual way (see protocol)
- If secondary infection, prescribe flucloxacillin oral

RESIDUAL RASH AFTER TREATMENT

- Do not reapply lotion, as treatment potentially neurotoxic, following over treatment
- If treatment unsuccessful, consider other diagnoses. Refer for dermatology opinion
- Itching often persists for a few weeks, warn and reassure parents – consider emollients
- Nodular lesions (scabetic) may persist for several months after successful treatment
- Provide patient information leaflet: https://www.skinhealthinfo.org.uk/condition/scabies/
- Provide link to patient information website: https://patient.info/skin-conditions/skin-rashes/scabies

ASSESSMENT

Sedation and anaesthesia belong to spectrum of impaired consciousness. Sedated patient needs to be able to maintain following vital functions without assistance:

- Protection of airway, swallowing, cough reflex
- Respiration
- Cardiovascular stability

Cautions

Discuss with anaesthetist before sedation if any of following present:

- Abnormal airway (including large tonsils)
- Sleep apnoea
- Respiratory failure
- Respiratory disease with significant functional compromise
- Active respiratory tract infection
- Cardiac failure
- Raised intracranial pressure
- Decreased conscious level
- Neuromuscular disease
- Bowel obstruction
- Significant gastro-oesophageal reflux
- Renal impairment
- Liver impairment
- Previous adverse reaction to sedation
- Very distressed child

Potential difficulties

Sedation can be difficult in children:

- Taking anti-epileptics (can result in increased or reduced effect of sedating drug)
- Already taking sedating drugs
- With behavioural difficulties

PREPARATION FOR SEDATION

Information required

- Age
- Weight
- Procedure for which sedation required
- Previous sedation history
- Other drugs being taken
- Other major diagnoses and implications in terms of respiratory function and upper airway competence
- Current health, including coughs, colds, pyrexia
- Oral intake status

Consent for sedation (all cases)

Discuss with parent(s):

- Unpredictable response to medication
- Paradoxical excitation
- Failure of sedation (may need repeat dose or general anaesthetic at future date)
- Over-sedation
- problem maintaining airway
- aspiration

Fasting for sedation

- Low doses of sedative agents can be used without a period of fasting, but aim for light meal/milk
- Allow normal clear fluids

For short, painless procedures (e.g. CT or X-ray), give infants aged <4 months normal milk feed only and allow them to sleep naturally

EQUIPMENT

- Portable oxygen
- Portable suction

- Appropriately sized face mask and self-inflating resuscitation bag
- 2 healthcare professionals trained in airway management with patient during sedation
- Reversal agents are easily accessible and appropriate dose is identified in advance

DRUG CHOICE

Sedation drugs

Drug	Route	Onset	Duration	Dose	Comments
Chloral hydrate	• Oral • Rectal	15–20 min	45 min–2 hr	• Night sedation: 30 mg/kg • Pre-anaesthesia: 50 mg/kg • Scans: 70 mg/kg ◦ max single dose 1 g	• More efficacious in infants <15 kg or aged <18 months
Melatonin	• Oral	30 min	2–5 hr	• Aged ≤5 yr: 5 mg • Aged >5 yr: 5–10 mg	• Use for sedation before EEG and MRI • Use 5 mg initially, if no response, give further 5 mg
Temazepam	• Oral	45–90 min	up to 4 hr	• Aged 12–18 yr: 10–20 mg 1 hr before procedure	• Only if aged ≥12 yr • CT, MAG3 scan
Midazolam	• Oral	30 min	1–2 hr	• Aged 1 month–18 yr: 500 microgram/kg (max 20 mg)	• Have flumazenil ready to give for all routes
	• Rectal	15–30 min	1–2 hr	• Aged 6 months–12 yr: 300–500 microgram/kg (max 20 mg)	
	• Buccal	15 min	1–2 hr	• Aged ≥3 yr: ◦ 12–16.9 kg: 2.5 mg ◦ 17–30.9 kg: 5 mg ◦ 31–40 kg: 7.5 mg ◦ 40.1–50 kg: 10 mg ◦ >50 kg: use alternative route/drug • Aged 6 months–9 yr: 200–300 microgram/kg (max 5 mg) • Aged >10 yr: 6–7 mg	• Buccal and IV routes – consultant led only (anaesthetist or PICU) • Ensure availability of flumazenil • IV preparation can be given orally diluted in juice • IV cannulation (+ local anaesthetic cream) • More suitable for older children (not suitable for infants) • Not for CT scan • Care with obese children – consider using ideal rather than actual body weight
	• IV	2–3 min	1–2 hr	• 25–50 microgram/kg over 2–3 min, 5–10 min before procedure. If necessary, dose can be increased in small steps to max total dose per course as per **BNF** • Aged 1 month–5 yr: max 6 mg per course • Aged 6–11 yr: max 10 mg per course • Aged 12–17 yr: max 7.5 mg per course	
Morphine Sulphate 10 mg/5 mL oral solution	• Oral	30 min	2–3 hr	• Aged >1 yr: 200–300 microgram/kg (max 10 mg)	• May be combined with midazolam 500 microgram/kg oral for painful procedures (e.g. changing burns dressings)

MONITORING

- Keep under direct observation
- Once asleep or if aged <1 yr, monitor SpO_2 and heart rate continuously
- Record SpO_2, heart rate and colour every 15 min
- Discontinue once conscious level returned to normal

SUBSEQUENT MANAGEMENT

Failed sedation

- Only repeat maximum dose of initial dose after expected period of onset if patient spat out initial dose
- If repeat dose fails:
- call anaesthetist who may give IV sedation (apply local anaesthetic cream), **or**
- reschedule procedure for later time/date under general anaesthetic
- If change in breathing pattern or concern of aspiration, CXR may be required; call for review by paediatric registrar or consultant

Paradoxical excitement

- Do not attempt further drug dose
- Discuss with anaesthetist on-call to reschedule at a more convenient time for general anaesthetic

SELF-HARM ● 1/2

Always follow your local child safeguarding policies and procedures.
The safety of children is everyone's responsibility

RECOGNITION

- Self-harm can take a number of forms, including:
- cutting or burning
- self-poisoning with medicines or tablets
- punching objects to induce injury
- self-strangulation
- pulling out hair or eyelashes
- scratching or picking at skin
- inhaling or sniffing harmful substances
- swallowing non-food substances
- inserting objects into the body either through orifices or the skin
- head banging
- deliberately restricting oral/fluid intake

ASSESSMENT

- Identifying behaviour, intended behaviour or suicidal/self-harming thoughts
- have they experienced remorse or regret about the incident
- who knows about the behaviour
- how often this occurred
- If at risk from others
- Stressors e.g. bullying, bereavement, relationships
- difficulties, abuse, sexuality issues
- General health
- Use of drugs and alcohol
- Education
- Family and social issues
- support network available
- child protection issues

MANAGEMENT

- If available in your trust, contact CAMHS crisis or liaison team for advice; otherwise admit overnight
- If transferred to A&E under section 136 of Mental Health Act for immediate treatment, child will be accompanied by police officer; contact CAMHS crisis team/CAMHS doctor on-call for advice on management
- See **Poisoning and drug overdose** guideline
- Advise carers to remove all medications or other means of self-harm
- Manage child protection issues according to local policy and procedures. On-call consultant available 24 hr for child protection advice
- Assess risk/need for ongoing psychological treatment or support and psychiatric observation levels required whilst on ward
- Obtain valid consent for a referral to CAMHS from parent/other adult with parental responsibility or the young person if they are deemed to have capacity (Gillick competence). Clearly document in medical records who obtained consent, who gave consent and when it was obtained (i.e. name, date and time)

Documentation

- Clearly document assessment in notes with any decisions made and reasons

REFERRALS

Criteria for referral to priority referral team (PRT)

- Deliberate self-harm (e.g. overdose, self-strangulation, serious cuts)
- Deliberate harm from substance misuse (e.g. poisoning from excessive alcohol and/or illicit drugs if **intention** was to self-harm)
- Mental health symptoms:
- depression/low or elevated mood with active suicidality
- psychotic symptoms
- aggression or severe agitation

- low weight anorexia nervosa i.e. BMI <17.5 or accompanied by rapid weight loss
- Make referral as soon as possible to facilitate same day review

DISCHARGE AND FOLLOW-UP

- Discharge when medically fit **and** psychologically stable as assessed by PRT
- Discuss with CAMHS to ensure child has an agreed management plan in place
- If there are safety concerns, refer to children's social care
- Ensure health professionals i.e. GP and school nurse are aware of admission and management plan

SEPSIS (INCLUDING MENINGOCOCCAL) ● 1/4

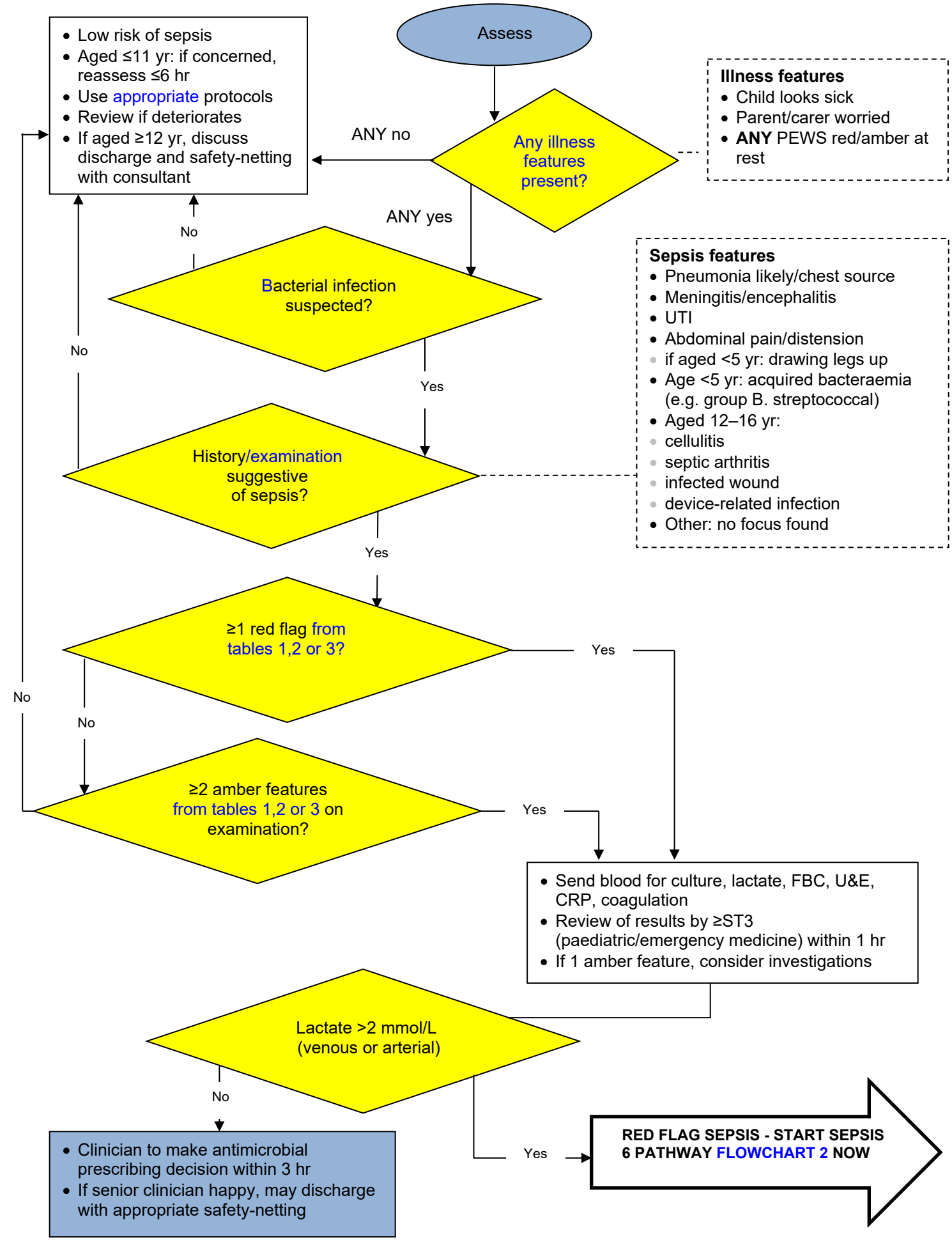


Table 1: Assessment of sepsis severity (aged <5 yr)

Parameter	High risk (red flag)	Moderate risk (amber)
Behaviour	• Looks ill to health professional • Unresponsive to social cues • Difficult to rouse • Weak, high-pitched or continuous cry	• Abnormal response to social cues • Not smiling • Reduced activity • Very sleepy • Abnormal behaviour
Respiratory	• SpO_2 <90% in air or new need for oxygen • Grunting respiration • Apnoea • Severe tachypnoea ◦ aged <1 yr: >60 breaths/min ◦ aged 1–2 yr: >50 breaths/min ◦ aged 3–4 yr: >40 breaths/min	• SpO_2 <91% OR nasal flaring • Moderate tachypnoea ◦ aged: <1 yr: 50–59 breaths/min ◦ aged: 1–2 yr: 40–49 breaths/min ◦ aged: 3–4 yr: 35–39 breaths/min
Heart rate	• Severe tachycardia ◦ aged <1 yr >160 bpm ◦ aged 1–2 yr: >150 bpm ◦ aged 3–4 yr: >140 bpm • Bradycardia <60 bpm	• Moderate tachycardia ◦ <1 yr: 150–159 bpm ◦ 1–2 yr: 140–159 bpm ◦ 3–4 yr: 130–139 bpm
Urine output	• Not passed urine in last 18 hr	• Reduced urine output (<1 mL/kg/hr if catheterised)
Temperature	• <36°C • Aged <1 month and fever • Aged 1–3 months with fever and appears unwell	• Aged 1–3 months with WCC <5 or >15 x 10^9/L and fever • Aged <3 months and temp >38°C
Other	• Non-blanching rash • Mottled, ashen or blue	• Immunocompromised • Pale or flushed • Capillary refill ≥3 sec • Leg pain • Cold extremities

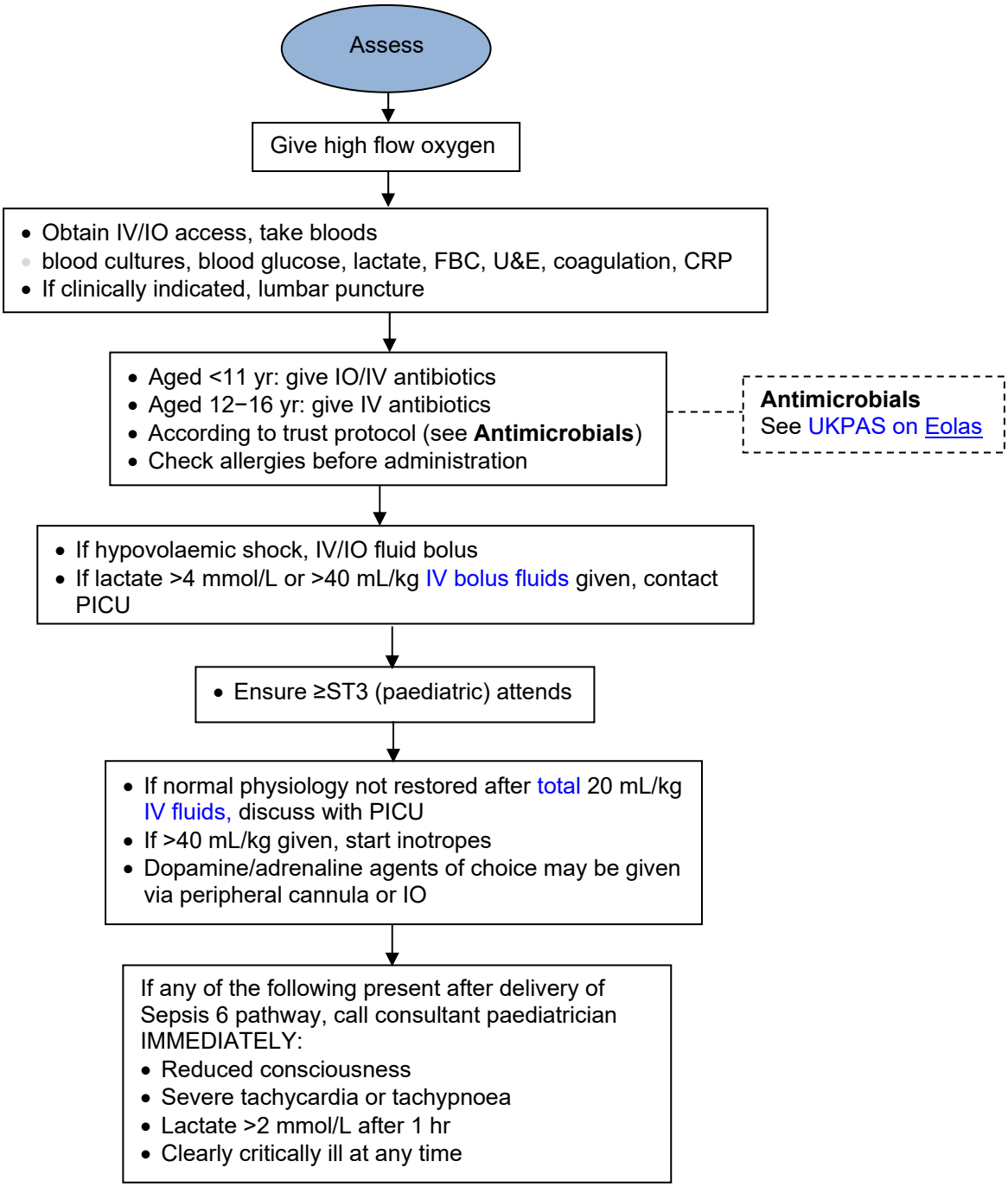
Table 2: Assessment of sepsis severity (aged 5–12 yr)

Parameter	High risk	Moderate risk
Behaviour	• Looks very ill to health professional • Objective changes in behaviour or mental state • Does not wake if roused or will not stay awake	• Behaving abnormally • Not wanting to play • Significantly decreased activity • Parental concern
Respiratory	• SpO_2 <90% or new need for oxygen • Severe tachypnoea ◦ aged 5 yr: >29 breaths/min ◦ aged 6–7 yr: >27 breaths/min ◦ aged 8–11 yr: >25 breaths/min	• SpO_2 <92% in air • Moderate tachypnoea ◦ aged 5 yr: 27–28 breaths/min ◦ aged 6–7 yr: 24–26 breaths/min ◦ aged 8–11 yr: 22–24 breaths/min
Heart rate	• Severe tachycardia ◦ aged 5 yr: >130 bpm ◦ aged 6–7 yr: >120 bpm ◦ aged 8–11 yr: >115 bpm • Bradycardia <60 bpm	• Moderate tachycardia ◦ aged 5 yr: 120–129 bpm ◦ aged 6–7 yr: 110–119 bpm ◦ aged 8–11 yr: 105–114 bpm
Urine output	• Not passed urine in last 18 hr	• Reduced urine output (<1 mL/kg/hr if catheterised)
Temperature	• <36°C	
Other	• Non-blanching rash • Mottled, ashen or blue	• Immunocompromised • Capillary refill ≥ 3 sec • Leg pain • Cold extremities

Table 3: Assessment of sepsis severity (aged 12–16 yr)

Parameter	High risk	Moderate risk
Behaviour	• Responds only to voice or pain • Unresponsive • Acute confusional state	• Parents concerned about mental status • Acute deterioration in functional ability
Respiratory	• SpO_2 <90% or new need for oxygen • Severe tachypnoea (>25 breaths/min)	• Moderate tachypnoea (21–24 breaths/min)
Heart rate	• Severe tachycardia (>130 bpm)	• Moderate tachycardia (91–130 bpm) • New dysrhythmia
Blood pressure	• ≤90 mmHg OR >40 below normal	• 91–100 mmHg
Urine output	• Not passed urine in last 18 hr • Urine output <0.5 mL/kg/hr	• Not passed urine in last 12 hr
Temperature		• <36°C
Other	• Non-blanching rash • Mottled, ashen or blue	• Immunocompromised • Clinical signs of infection of wound, device or skin • Trauma or surgical procedure ≤6 weeks

Flowchart 2: Sepsis 6 pathway



SIALORRHEA ● 1/4

DEFINITION
- Sialorrhea, also known as drooling or ptyalism
- Debilitating condition which occurs when there is excess saliva in mouth beyond lip margin

RECOGNITION AND ASSESSMENT
Signs and symptoms

Anterior sialorrhea
- Excessive drooling beyond lip margin:
- constant drooling results in chronic wet clothing/bibs
- may be worse at night (wet bedding every morning)

Posterior sialorrhea
- Child observed to:
- constantly visibly choke
- cough
- prone to repeated episodes of aspiration pneumonia

HISTORY
- Swallow difficulties
- tearing
- gagging
- choking
- Diurnal variation
- Associated neurological symptoms
- Tonsillar symptoms
- acute tonsillitis
- chronic tonsillar hypertrophy
- Gastro-oesophageal reflux symptoms

EXAMINATION
- Full general and neurological examinations including cranial nerves to rule out underlying medical cause
- Ear nose and throat
- If necessary, refer to speech and language therapy for swallow assessment

IMMEDIATE TREATMENT
- Suction – secretions are acutely compromising airway/ventilation

SUBSEQUENT MANAGEMENT
- Address cause (may be multifactorial and patient specific)
- dabbing and avoid swiping to dry mouth/chin
- improved positioning
- practical aids, including bibs/bandanas and appropriate seating
- speech therapy
- behaviour therapy
- physiotherapy
- dental assessment
- medication
- surgery

MEDICATION
Principal drug treatments:
- Glycopyrronium bromide
- licensed for chronic pathological drooling
- may have fewer side effects
- generally first-line over hyoscine hydrobromide
- Consider individual factors when choosing treatment option
- If glycopyrronium bromide/hyoscine hydrobromide fail discuss botulinum toxin injections with consultant

Table 1
Glycopyrronium bromide and hyoscine hydrobromide patch

	Advantages	Disadvantages
Glycopyrronium bromide	• Licensed for chronic pathological drooling • Permits consistent dose administration which can be titrated to weight and response • Long duration of action • Fewer central or cardiac side effects • Limited ability to cross the blood-brain barrier (less sedating) • Less constipating	• Slower in onset • Oral formulation
Hyoscine hydrobromide patch	• Ease of administration for child and parent • Maintenance of steady state concentrations • Lower incidence of systemic side effects compared to other anticholinergics	• Off-licence use • May cause skin reactions • Transdermal patches if cut into smaller sizes lead to inconsistent delivery of hyoscine • Crosses blood-brain barrier (increased CNS side effect profile – namely drowsiness and dizziness)

- Multiple formulations (including generic formulations) of glycopyrronium
- prescribe specific brand and strength due to differences of bioavailability between formulations/brands
- If switching from hyoscine patch to glycopyrronium allow a wash-out period of 3 days

First line
Glycopyrronium bromide
- Tablet and generic liquid (1 mg/5 mL) formulations are available
- Sialanar® (glycopyrronium bromide) preferred option – specifically formulated for children

Sialanar® (Glycopyrronium bromide)
- Indicated for symptomatic treatment of severe sialorrhea in children and adolescents aged 3–17 yr with chronic neurological disorders
- difference in bioavailability between Sialanar® and other generic brands; Sialanar® has approximately 25% higher bioavailability

Prescribe and administer Sialanar® as a brand specific medication [prescribe glycopyrronium bromide (Sialanar®) 400 microgram/mL]

Always discuss swapping alternative generic formulations on like-to-like basis with medical prescriber or pharmacist

- If giving via nasogastric tube: following administration flush tube with 10 mL water
- 1 mL of glycopyrronium bromide (Sialanar®) 400 micrograms/mL = 320 micrograms of active ingredient glycopyrronium
- Starting dose approximately 16 micrograms/kg 8-hrly
- may be increased in steps of 16 micrograms/kg 8-hrly on weekly basis until efficacy achieved without any undue side effects
- see **Table 2** for calculating doses according to weight
- Dose based on child's weight and titration: see **Table 2** for starting dose (level 1)
- continue titration until efficacy balanced with undesirable effects
- Maximal dose = 80 microgram/kg/dose 8-hrly **OR** 6 mL 8-hrly (2.4 mg glycopyrronium bromide)

- Once efficacy achieved, monitor effect on 3-monthly basis
- To switch from hyoscine patch to Sialanar®: allow washout period of 3 days from hyoscine patch being removed, then commence dose level 1 (see **Table 2**)
- Administer Sialanar® either 1 hr before/2 hr after meal
- In event of acute kidney injury, decrease dose by 30%

Generic formulations of glycopyrronium bromide

- If admitted on generic formulation, state strength and brand on drug chart
- Normal dose of glycopyrronium tablets and generic liquid (1 mg/5 mL) to start at 20 micrograms/kg/dose 8-hrly, increasing weekly in steps of 20 micrograms/kg/dose 8-hrly according to response. Maximum dose 100 microgram/kg 8-hrly (maximum 3 mg)

Second line

Hyoscine hydrobromide patch/tablets/oral solution

Hyoscine patch

- Also known as scopolamine hydrobromide, or scopoderm patch,
- May be used off-licence for management of hypersalivation
- Considerable variation in efficacy between individuals – many find useful, especially with short-term use
- many experience more side effects compared to glycopyrronium bromide
- 1 patch usually placed behind ear – ideally in hairless area, where it can be observed for adverse skin reactions
- Cutting patch not recommended – matrix is disrupted leading to inconsistent delivery of hyoscine (as well as potential for side-effects)
- if dose <1 patch required place occlusion dressing on skin, place patch placed with half over dressing, then place another dressing over patch
- **BNFc** recommend if cut, rather than using an occlusion dressing, patch be cut with scissors along full thickness ensuring membrane not peeled away
- Scopoderm 1.5 mg patches may be prescribed – contain hyoscine 1 mg that is released over 72 hr
- aged <3 yr: 250 micrograms (¼ patch) every 72 hr
- aged 3–9 yr: 500 micrograms (½ patch) every 72 hr
- aged ≥10 yr: 1 mg (1 patch) every 72 hr

- ***MHRA alert has been issued as there have been small number of reports of serious and life-threatening anticholinergic side effects, including hyperthermia associated with hyoscine hydrobromide patches, particularly when used outside licence***
- ***This is likely related to ability of hyoscine to cross blood brain barrier while glycopyrronim bromide doesn't cross blood brain barrier***
- In ***view of this glycopyrronium bromide (Sialanar®) may be preferred first line as it has licensed use for drooling***

Hyoscine oral

- **See BNFc**
- aged 2–11 yr: 10 micrograms/kg/dose 6-hrly (maximum 300 micrograms per dose)
- aged 12–17 yr: 300 micrograms/day

Normal renal function

Table 2: Sialanar® (400 microgram/mL glycopyrronium bromide) (8-hrly doses)

Weight (kg)	Dose level 1 (~12.8µg/kg)* mL	Dose level 2 (~25.6µg/kg)* mL	Dose level 3 (~38.4µg/kg)* mL	Dose level 4 (~51.2µg/kg)* mL	Dose level 5 (~64µg/kg)* mL
13–17	0.6	1.2	1.8	2.4	3†
18–22	0.8	1.6	2.4	3.2	4†
23–27	1	2	3	4	5†
28–32	1.2	2.4	3.6	4.8	6†
33–37	1.4	2.8	4.2	5.6	6†
38–42	1.6	3.2	4.8	6†	
43–47	1.8	3.6	5.4	6†	
≥48	2	4	6†		

*refers to µg/kg glycopyrronium

†Maximum individual dose in this weight range

Renal impairment

- Mild-moderate: (eGFR <90–≥30 mL/min/1.73m^2)
- See **Table 3**
- Reduce dose by 30%
- Contraindicated in patients with severe renal impairment (eGFR <30 mL/min/1.73m^2), including those with end-stage renal disease requiring dialysis

Table 3: Mild-moderate renal impairment (8-hrly doses)

Weight (kg)	Dose level 1 (~8.8µg/kg)* mL	Dose level 2 (~17.6µg/kg)* mL	Dose level 3 (~27.2µg/kg)* mL	Dose level 4 (~36µg/kg)* mL	Dose level 5 (~44.8µg/kg)* mL
13–17	0.4	0.8	1.2	1.7	2.1†
18–22	0.6	1.1	1.7	2.2	2.8†
23–27	0.7	1.4	2.1	2.8	3.5†
28–32	0.8	1.7	2.5	3.4	4.2†
33–37	1	2	2.9	3.9	4.2†
38–42	1.1	2.2	3.4	4.2†	
43–47	1.2	2.5	3.8	4.2†	
≥48	1.4	2.8	4.2†		

* refers to µg/kg glycopyrronium

†Maximum individual dose in this weight range

MONITORING

- Inpatient review response to anti-secretion medication weekly
- Increase doses as above/**BNFc**
- Observe for side effects

DISCHARGE AND FOLLOW-UP

- Secretion management to be overseen by named experienced healthcare provider
- Review at each outpatient follow-up
- If necessary, offer interim telephone follow up for minor adjustments in dosing
- Copy all relevant healthcare providers involved in secretion into correspondence e.g.:
- ear nose throat
- speech and language
- physiotherapy
- community paediatrics
- neurology

STATUS EPILEPTICUS IN HOSPITAL SETTING ● 1/2

See also APLS guidelines, if available in your location

Table 1: Management of status epilepticus

Step	Time from start of seizure (min)	Action	Comments
1	0	• Assess ABC, GCS, pupils • Obtain IV/IO access and bloods	• Administer high flow oxygen 15 L/min • Check blood glucose ◦ if <3 mmol/L treat with 2 mL/kg of 10% dextrose followed by maintenance
2	5	Confirm seizure clinically • Buccal midazolam − if no access • If IV access available – lorazepam 100 micrograms/kg (max 4 mg) ◦ if lorazepam is not available diazepam emulsion 0.3−0.4 mg/kg (IV/IO) (max 10 mg)	• Midazolam can be given by parents, carers or ambulance crew in non-hospital settings
3	15	• Give second dose of lorazepam 100 micrograms/kg (max 4 mg) IV (or first dose if midazolam has already been given)	• To take place in hospital setting • Call for help • Start to prepare levetiracetam • Re-confirm epileptic seizure • Continuous re-assessment of ABC, GCS, pupils
4	25	• 1st choice – levetiracetam 40 mg/kg (max 2.5 g) IV/IO over 5 min (except neonates) • 2nd choice – phenytoin 20 mg/kg (max 2 g) IV/IO given over 20 min • For neonates up to 44 weeks CGA use phenobarbital 20 mg/kg (max 1 g) IV/IO over 20 min • Consider paraldehyde 0.8 mL/kg (max 20 mL) PR	• Reassess 10 min post levetiracetam
5	45	• If seizures continue 10 min after levetiracetam or encephalopathic or GCS <8/15 • Refractory status epilepticus-C all anesthetist/intensivist • Rapid sequence induction-follow local/regional guidelines • Contact PICU/regional transport service	• Whilst preparing for intubation if seizures continue – consider giving phenytoin/ levetiracetam/phenobarbital (choose drug that has NOT been given previously) • Consider treatable causes – hypoglycemia/electrolyte abnormalities/infection

Table 2: Diazepam rectal maximum 20 mg

Neonate (age)	Dose (0.5 mg/kg)
1 month – 1yr	5 mg
2–11 yr	5–10 mg
12–17 yr	10–20 mg

Table 3: Midazolam buccal maximum 10 mg

Neonate up to 44 weeks CGA (age)	Dose (0.3 mg/kg)
1−2 months	0.3 mg/kg
3−11 months	2.5 mg
1−4 yr	5 mg
5−9 yr	7.5 mg
10−17 yr	10 mg

Table 4: Anti-convulsant doses

Anti-Convulsant	Dose	Maximum dose	Route of administration	Duration of administration
Lorazepam	0.1 mg/kg	4 mg	IV/IO	>1 min
Diazepam emulsion	0.3−0.4 mg/kg	10 mg	IV/IO	
Levetiracetam	40 mg/kg	2.5 g	IV/IO	>5 min (except neonates)
Phenytoin	20 mg/kg	2 g	IV/IO	>20 min
Paraldehyde	0.8 mL/kg	20 mL	PR	
Phenobarbital	20 mg/kg	1 g	IV/IO	>20 min

SYNCOPE ● 1/4

Common complaint in paediatric population; estimated that up to 15% of children aged 8−18 yr will experience at least one syncopal episode

HISTORY

- In most cases diagnosis will be clear with a thorough history
- Obtained from patient and reliable eyewitness
- See **Causes** for summary of differential diagnosis and clinical features that should be explored in the history

CAUSES

Autonomic

Vasovagal (simple or neurally-mediated) syncope

- Age group: 10–16 yr (uncommon aged <6 yr)
- Circumstances and activity before syncope:
  - prolonged standing
  - hot/humid environment
  - crowded places
  - shortly after rising in morning
  - sight of blood, pain, fear, anxiety
  - dehydration
  - tiredness
  - being unwell
- Prodromal symptoms – **very common**
  - dizziness
  - nausea
  - pallor
  - sweating
  - blurred vision
  - headache
  - light-headedness
- Injury from fall – **extremely uncommon**

Orthostatic hypotension

- Age group: 10–16 yr (uncommon aged <6 yr)
- Definition:
  - drop in systolic BP >20 mmHg and/or diastolic BP >10 mmHg within 3 min of upright position (without moving)
- Circumstances and activity before syncope:
  - prolonged bed rest
  - dehydration
  - drugs (diuretics, antihypertensives, vasodilators)
- Prodromal symptoms – **very common**
  - light-headedness
  - dizziness
  - blurred vision
- Injury from fall – **extremely uncommon**

Postural orthostatic tachycardia syndrome (POTS)

- Age group: usually teenage girls
- Definition:
  - increase in heart rate >30 bpm (or heart rate >120 bpm) within 10 min of standing
- Prodromal symptoms **– very common**
  - dizziness
  - light-headedness
  - nausea
- Other symptoms:
  - exercise intolerance
  - chronic fatigue
- Injury from syncope – **extremely uncommon**

Situational syncope
- Circumstances and activity before syncope:
- micturition
- cough
- vomiting

Reflex anoxic syncope (reflex anoxic seizures)
- Age group: toddlers (aged 1–4 yr)
- Circumstances and activity before syncope:
- sudden pain or unexpected distress
- prolonged crying
- breath-holding
- Prodromal symptoms − **uncommon**
- Other symptoms:
- abnormal limb movements or posture
- urinary incontinence
- confusion/tiredness post event
- Injury from syncope: **common** (usually mild)

Cardiac
Arrhythmias
- Tachyarrhythmia:
- supraventricular tachycardia
- atrial flutter
- atrial fibrillation
- ventricular tachycardia – seen with long QT syndrome
- arrhythmogenic right ventricular dysplasia (ARVD)
- Bradyarrhythmia:
- complete heart block
- asystole
- pacemaker malfunction

Obstructive lesions
- Aortic stenosis
- Pulmonary stenosis
- Hypertrophic cardiomyopathy
- Pulmonary hypertension
- Mitral stenosis
- Constrictive pericarditis
- Tamponade

Myocardial dysfunction
- Coronary artery anomalies
- Cardiomyopathies
- ARVD

Red flags for cardiac syncope
- Exertional syncope associated with:
- swimming
- loud noises
- chest pain
- palpitations
- supine position
- Known congenital or acquired heart disease
- Family history
- sudden death aged <40 yr
- inherited cardiac conditions
- conduction disorders
- early ischaemic heart disease (aged <30 yr)
- Other characteristics:

- absence of prodromal symptoms
- injury can be common

Neurological
Causes
- Epilepsy/seizure activity
- Migraine
- Tumours

Clinical features
- Prodromal symptoms: absent (usually)
- Injury from syncope: common
- Other symptoms:
- abnormal movements/posture
- abnormal eye movements
- urinary incontinence
- post-ictal confusion/sleepiness
- focal neurology
- preceding headache

Psychiatric
Causes
- Panic attacks
- Medically unexplained or “psychogenic” syncope

Clinical features
- Prodromal symptoms: variable
- Hyperventilation or tingling sensation of extremities
- Multiple daily episodes
- Stress factors

Metabolic
Causes
- Hypoglycaemia
- Electrolyte disturbances
- Eating disorders
- Drugs/toxins

Clinical features
- Relevant past medical history present (e.g. diabetes eating disorder)

EVALUATION
- Detailed history and examination
- Baseline observations including heart rate and blood pressure
- If orthostatic hypotension or POTS suspected, measure heart rate and blood pressure in lying position (supine ≥10 min) and standing position at 3 min, 5 min and 10 min (without movement)
- Perform 12-lead ECG in ALL patients (see **ECG interpretation** guideline)
- rate
- rhythm
- evidence of pre-excitation
- heart block
- ventricular hypertrophy
- QTc interval

MANAGEMENT
- Vasovagal syncope/orthostatic intolerance group with normal examination and normal 12-lead ECG:
- reassurance and life-style advice (avoid dehydration, avoid extreme heat, increase fluid and salt intake in diet)
- if frequent/debilitating symptoms or patient/parental anxiety, refer to paediatric cardiology outpatients

- Red flags for cardiac causes (see **Red flags for cardiac syncope**), abnormal cardiovascular examination or abnormal 12-lead ECG:
- if present discuss with local paediatrician with expertise in cardiology or specialist paediatric cardiology tertiary centre
- all patients to be seen in paediatric cardiology outpatients

INTRODUCTION

- Children with tracheostomies:
  - can be more prone to respiratory infections
  - may have comorbidities that increase hospital attendance
- Tracheostomy related emergencies are associated with significant morbidity and potential mortality
- Majority of tracheostomy related complications are preventable
  - may be reduced by careful clinical evaluation and maintaining satisfactory daily tracheostomy care
- Caregivers of child with long term tracheostomy will likely be experts in its management and are able to provide information needed
- Tracheostomy most commonly indicated for:
  - facilitation of long term ventilation
  - craniofacial abnormality
  - multifactorial upper airway obstruction
  - discrete site of anatomical upper airway obstruction e.g. subglottic stenosis

TRACHEOSTOMY TUBE

- External flange – sits against skin of anterior neck
- Inner piece or cannula – attached to flange and passes through stoma in neck (see **Figure 1**)
- External 15 mm universally sized connection – fits all standard anaesthetic and resuscitation equipment
- Paediatric tracheostomy tubes do not usually have an inner tube
- Most tubes are made of flexible material e.g. silicone and may/may not have a cuff (see **Figure 2**)
- Cuffed tubes will need care and inflation as per manufacturer instruction – some use air, others water
- Always secure tracheostomy tubes in place with tracheostomy tapes around neck
- Each tracheostomy tube size (internal diameter) will come in neonatal and paediatric version – reflects need for different lengths

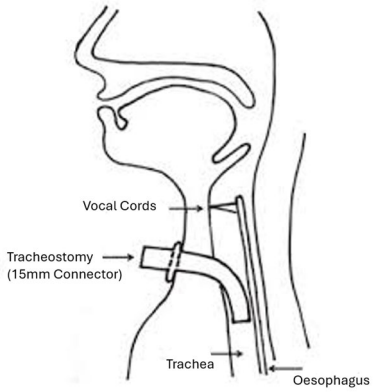


Figure 1 Sagittal diagram of tracheostomy tube *in-situ*

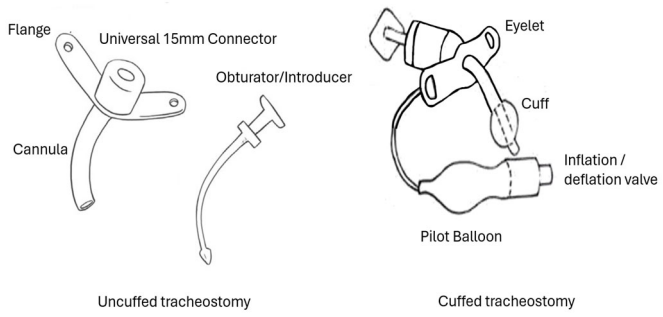


Figure 2 Parts of tracheostomy tube

DAILY TRACHEOSTOMY CHECKS

Tapes

- With child in sitting position, check tension of tapes
  - should only be possible to slide 1 small finger between tapes and back/side of neck
  - if using velcro tapes, complete risk assessment (some young children can unpick – velcro risk of dislodging tracheostomy tube)

Resuscitation
- Each hospital will have their own mandatory requirements for staff resuscitation qualification
- It is critical all paediatric staff have basic knowledge of tracheostomy care
- Utilise National Tracheostomy Safety Project guidance (availble at https://tracheostomy.org.uk/)

Airway
- Use correct and precise suction technique specfic to patient tracheostomy and document on bedhead sign
- Suction catheter size = 2 x tracheostomy ID e.g. size 8 Fr for size 4 mm tracheostomy
- Suction length is needed to clear end of tracheostomy tube (check patient specific tube)
- avoid regular deep suctioning as this can cause tracheal trauma and granulation

Care of stoma site
- Children with skin conditions are at higher risk of complications
- regular assessments, cleaning, and protective dressings help reduce risks
- caution with large dressings or neckerchiefs as these can unintentionally hide loose or dislodged tracheostomy tube

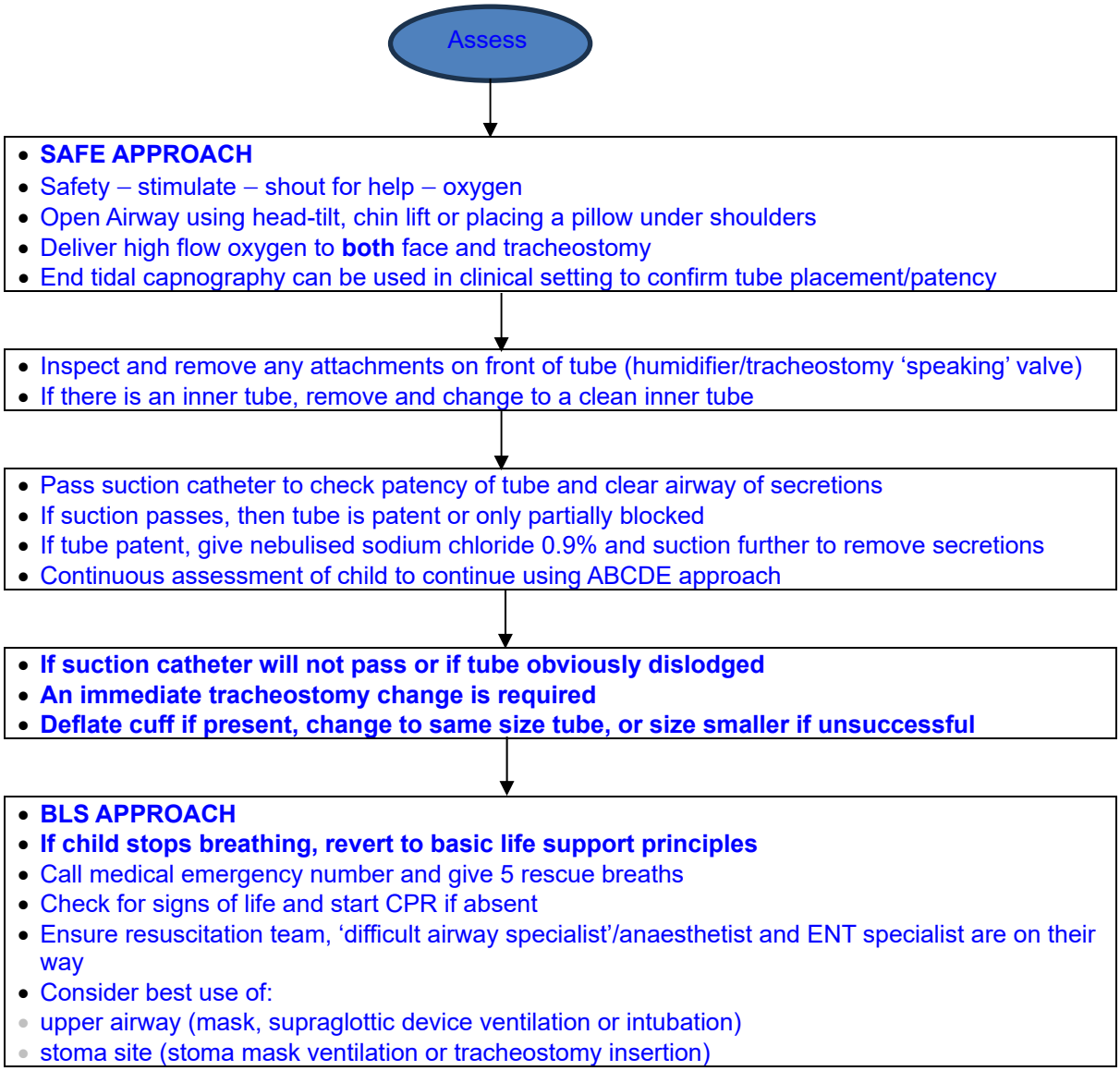
Humidity
- Active (heated) or passive heat moisture exchange (HME) to be in place at all times – keeps tube clear and airways moist
- Use active humidification as much as possible before first tube change at 7 days post-operatively
- after first tube change, it may be possible to use HME device, (‘Swedish nose’) to help retain natural humidity
- If secretions are becoming thick, saline nebulisation can be helpful to loosen them
- also review hydration state, medication (e.g., hyoscine dose reduction required), or infection status

Emergency box
- To be with child at all times
- Ensure correctly stocked with
- scissors (to cut existing tapes in emergency tube change)
- tracheostomy tube (same size and smaller size)
- syringe and water vial (for cuffed tubes – check manufacturer’s instructions)
- lubrication
- tracheostomy tapes
- suction catheters

Tube changes (planned)
- Weekly, monthly or if soiled/blocking tube
- Newly formed tracheostomy to be changed only by ENT team until stoma site healed and safe
- If unsure ask ENT team for advice
- Only competent and trained persons to perform tracheostomy tube change

EMERGENCIES
Most common emergencies that occur in relation to tracheostomy tubes are:
- Blockages
- Displacement/accidental decannulation

Algorithm 1: Basic tracheostomy airway management



SUBSEQUENT MANAGEMENT

- Following tracheostomy admit to ICU/HDU/specialist ENT ward
- While stoma is healing and risk of complications high, cares provided day and night include:
  - regular nebulisers
  - humidification
  - suctioning
  - stoma care
- Member of ENT team performs first tube change at approximately 7 days post-operatively
  - if appropriate stomal maturation has occurred, *stay* sutures will be removed, (not stomal maturation sutures)
  - **then** if safe, nursing and medical staff with the appropriate training can perform tube changes and begin parental education

One-way tracheostomy valve

- Previously known as 'speaking valve'
- May be used following agreement of multi-disciplinary team (MDT), and specialist assessment by one-way tracheostomy valve competent practitioner using an agreed decision-making tool
- For tracheostomy only assessment – includes speech and language therapy
- For tracheostomy ventilated assessment – includes speech and language therapy and respiratory physiotherapy

- Allows inspiration through tracheostomy tube but expired air is redirected past tracheostomy tube, through upper airway and out through nose and mouth
- Has multi system benefits including but not limited to:
- airway resensitisation and rehabilitation
- restoring physiological positive end expiratory pressure (PEEP)
- voice/vocalisation
- swallowing
- secretion management including cough

DISCHARGE AND FOLLOW-UP

- Before discharge, caregivers will be fully trained in tracheostomy care including:
- suctioning
- tube changes
- basic life support
- Arrange regular ENT follow-up
- Decannulation will be discussed by ENT team if and when safe for patient – it is planned, gradual process managed in hospital setting

TRAVEL • 1/4

WHEN TO SUSPECT IMPORTED ILLNESS

- Fever >37.5°C after travel to high risk area in previous 12 months

INFECTION CONTROL

- Side room until diagnosed
- If high consequence infectious disease (HCID) suspected contact microbiology and infectious diseases services immediately
- strict infection control measures are essential including use of PPE, dependent on HCID suspected

UK guidance on HCID – see https://www.gov.uk/guidance/high-consequence-infectious-diseases-hcid#definition-of-hcid

COMMONEST CAUSES OF FEVER IN RETURNING TRAVELLERS

- Diarrhoeal illness
- Malaria
- Dengue fever
- Enteric fever
- Respiratory infections

TRAVEL HISTORY

- Location and duration of travel, including stop-overs
- Reason for travel
- Sources of food and water
- Activities undertaken whilst travelling, including sex for appropriate ages
- History of insect bites and any animal contacts
- Recommended vaccinations received before travelling
- Recommended malaria prophylaxis received and course adherence
- Any illness while abroad and treatment used while travelling (especially antibiotics)
- Illnesses in fellow travellers, and contacts whilst abroad

POSSIBLE INFECTIONS

By region

Table 1: Infections by region (https://www.gov.uk/government/collections/migrant-health-guide)

Location of travel	Disease
Sub-Saharan Africa	• Malaria • Viral haemorrhagic fevers • Meningococcal infection • Typhoid fever • Schistosomiasis • Amoebiasis • Rickettsial infection
Asia	• Malaria • Dengue fever • Typhoid fever • Chikungunya • Emerging viral infections
Middle East	• Brucellosis • Leishmaniasis • Middle east respiratory syndrome (MERS)
South America/Caribbean	• Dengue fever • Coccidioidomycosis • Chagas' disease
North America	• Rocky Mountain spotted fever
Australia	• Q fever
Mainland Europe	• Tick-borne encephalitis

By incubation period

Table 2: Infections by incubation period

<14 days	2–6 weeks	>6 weeks
• Malaria • Dengue fever • Enteric fevers • Diarrhoeal illness • Meningococcal/pneumococcal infection • Rickettsial infection • Leptospirosis • Yellow fever • Viral haemorrhagic fever • Emerging respiratory viruses	• Malaria • Enteric fever • Hepatitis A and E • Acute schistosomiasis • Leptospirosis • Amoebic liver abscess • Infectious mononucleosis • Toxoplasmosis • Viral haemorrhagic fever	• Malaria • TB • Hepatitis B • Visceral leishmaniasis • Schistosomiasis • Amoebic liver abscess • Brucellosis • Visceral larva migrans

By clinical features

- See **Table 3** for clinical features

INVESTIGATIONS

- Label forms with travel history risk
- FBC, U&E, LFTs, CRP, ESR and coagulation
- Blood film for malarial parasites – repeat 3 films 12 hr apart (perform if travel to malaria region within previous 12 months, even if prophylaxis taken)
- Malarial rapid diagnostic test; has high specificity and sensitivity but gives no information on level of parasitaemia in malaria
- Urine microscopy and culture
- Stool microscopy and culture
- Blood culture [important for typhoid fever: fill maximum volume of blood for bottle and repeat daily before starting antibiotics (unless septic shock)]
- CXR (pneumonia/TB)
- If respiratory illness suspected, viral swab for PCR

ADDITIONAL INVESTIGATIONS

- If LFTs deranged, hepatitis serology
- PCR for dengue virus
- Sputum sample for TB (including PCR)
- HIV antibody
- LP
- EDTA save for PCR
- Serum save

TREATMENT

- Seriously ill child – manage according to APLS principles, broad spectrum antibiotics and early discussion with paediatric ID team
- Antibiotic resistance may be more common in some countries so early microbiology/paediatric ID advice is essential (advice can also be gained from the Imported Fever Service following discussion with local teams)
- Malaria (see **Malaria** guideline)

REMEMBER

- Most patients presenting with fever in the returning traveller have a mild, self-limiting or easily treatable febrile illness commonly seen in the UK
- Importance of infection control and recognition of HCID
- Consider disease outbreaks and emerging viral infections
- Consider important non-infectious causes of fever and systemic illness e.g. Kawasaki disease, juvenile idiopathic arthritis, SLE, leukaemia, lymphoma, haemophagocytic lymphohistiocytosis (see **Fever of unknown origin** and **Febrile illness** guidelines)
- If not responsive to treatment remember to consider anti-microbial resistance particularly if was treated with antibiotics or received healthcare whilst abroad

- Notify Public Health England (PHE) (see **Notifiable infectious diseases and food poisoning** guideline)

UNACCOMPANIED ASYLUM-SEEKING CHILDREN

- Review of physical, dental, sexual and women's health, mental health and social, educational and developmental needs
- Height, weight and blood pressure measurement
- FBC, renal and liver profile, bone profile, vitamin D level, cholesterol, HbA_{1C}

Infection screen

- Blood: serology *Schistosoma*, *Strongyloide*s, hepatitis B surface antigen (active infection), hepatitis C antibody, HIV screen, syphilis, tuberculosis (IGRA or Mantoux)
- Urine: *Chlamydia* and gonorrhoea NAAT (when appropriate)
- Stool: parasitic examination

Table 3: Infections by clinical syndrome

Abdominal pain	Arthropathy	CNS	Diarrhoea	Eosinophilia	Haemorrhage
• Enteric fevers (typhoid and para-typhoid) • Adenovirus • Liver abscess	• Chikungunya virus • Dengue fever • Pyogenic septic arthritis • Acute rheumatic fever • Human parvovirus B19	• Meningitis • Enteroviral infection • Malaria • Arboviral meningo-encephalitis • Rabies • Japanese encephalitis virus • West Nile virus • TB	• Shigellosis • Salmonellosis • Amoebiasis • Campylobacter • *Clostridioides difficile* • *E.coli* infection • Rotavirus	• Schistosomiasis • Ascariasis • Strongyloidiasis	• Dengue fever • Yellow fever • Lassa fever • Rift Valley fever • Viral haemorrhagic fever • Meningococcal infection

Hepatitis	Lymphadenopathy	Pneumonia/respiratory	Rash	Recurrent/relapsing fever
• Hepatitis A, B and E • Leptospirosis • Infectious mononucleosis • Amoebiasis	• Toxoplasmosis • EBV • CMV • HIV • Brucellosis • TB	• Pneumococcal infection • COVID-19 (SARS-CoV-2) • Influenza • RSV • TB • Histoplasmosis • Adenovirus • Legionellosis • Q fever • Diphtheria • Anthrax • Emerging viral infections	**Maculopapular** • Dengue fever • Chikungunya • Measles • Rubella • Enterovirus • Yellow fever • Rickettsial infection **Petechial/purpura** • Meningococcal infection • Rickettsial infection **Erythema multiforme** • Drug reactions **Vesicular** • Chicken pox • Rickettsial infections • Herpes virus **Erythema nodosum** • TB	• Malaria • Relapsing fever • Enteric fever • Brucellosis • Q fever • Leptospirosis • Familial Mediterranean fever

TUBERCULOSIS ● 1/5

RECOGNITION AND ASSESSMENT

History is most important factor in diagnosing tuberculosis (TB)

Asymptomatic high risk
- Contact with TB
- From a country with prevalence >150/100,000
- See https://worldhealthorg.shinyapps.io/tb_profiles
- Increased susceptibility
  - aged <2 yr
  - immune suppression including HIV
  - steroids
  - treatment with ant-TNF biologics
- Refer to TB team for screening for latent TB

Symptoms

Suspect TB when following symptoms persist for weeks:
- Persistent, non-remitting cough for 2–4 weeks
- Weight loss
- Failure to thrive
- Lack of energy
- Fever and sweats
- Lymph nodes, especially if painless and matted
- Headache or irritability for >1 week
- Limp, stiff back
- Joint swelling
- Abdominal distension

Symptoms may be non-specific in infants (increased susceptibility)

Signs
- Delayed growth: plot weight and height on growth chart and compare with earlier records
- Fever
- Wasting
- Lymphadenopathy
- Chest signs
- Cardiac tamponade
- Ascites
- Meningism
- Ophthalmoplegia
- Conjunctivitis
- Limited flexion of spine
- Kyphosis
- Swollen joint
- Cold abscess

Family and social history
- Ask about travel and about recent contact with any family member (specifically grandparent or parent) who has:
  - chronic cough
  - previous treatment for TB, especially multi-drug resistant (MDR) TB, failed/defaulted TB treatment, or recurrent TB
  - travelled to regions/countries with a high prevalence of TB/MDR TB
  - recently died

INVESTIGATIONS
- Suspected latent TB: Consider:
  - tuberculin purified protein derivative (PPD) skin test (Mantoux)
  - interferon-gamma release assay (IGRA e.g. QuanitFERON® TB Gold or T-SPOT® TB).

- positive results are NOT diagnostic of TB disease, and negative results do NOT exclude it. These tests may still be useful as part of the overall picture in symptomatic children
- Suspected TB disease: discuss with expert in paediatric TB, even if rapid diagnostic tests (AFB and PCR) and TST or IGRA are negative

Pulmonary TB
- CXR: look for hilar lymphadenopathy, apical consolidation, pleural effusion, miliary nodules
- Sputum: send ≥3 (1 early morning) for AFB and TB culture in cooperative child, expectoration may require physio +/- nebulised sodium chloride 0.9% as necessary (with FFP3 mask and HEPA filtered ventilation if available)
- If unable to provide sputum specimen, send gastric aspirate (for TB culture only as microscopy is unreliable) early morning before feed, daily for 3 days
- if no aspirate, rinse stomach with small volumes of sodium chloride 0.9% (5 mL aliquots maximum 20 mL)
- do not send saliva
- Discuss broncho-alveolar lavage for AFB and TB culture via bronchoscopy with respiratory consultant
- Request 1 TB PCR test per specimen type in addition to AFB and culture

Pleural effusion
- CXR (preferably PA erect film)
- 3 x respiratory sample (deep cough sputum, induced sputum or gastric aspirate)
- Pleural biopsy for histology and microbiology (AFB, M. tb PCR and TB culture)
- Pleural fluid AFB, M tb PCR, TB culture, cytology and adenosine deaminase
- Discuss with cardiothoracic surgeons

Lymphadenopathy
- If single node, excision biopsy
- If large matted nodes, ultrasound scan +/- simultaneous guided aspiration (discuss before scan)
- Lymph node aspirate: fine needle aspiration biopsy (FNAB; 23 G needle)
- low risk, high yield with sedation and local anaesthetic
- Send aspirate in 2 separate bottles:
- 1 to microbiology for AFB, TB culture and PCR with no preservative
- 1 to histology in 10% formalin
- If atypical mycobacterial infection suspected, excision biopsy

Meningism
- MRI: preferred (CT if GA required but too sick to tolerate)
- CSF: AFB, TB culture, cytology, PCR and adenosine deaminase − requires 4 mL of CSF for PCR

Bone/joint pain
- Plain X-ray initial imaging modality. CT and/or MRI, may be needed to evaluate extent and bone destruction – discuss with paediatric radiologist
- Biopsy/aspiration important for diagnosis and sensitivities
- Spinal TB: LP

Abdominal distension
- Ultrasound then CT abdomen
- Ascites/bowel/lymph node biopsy AFB, PCR, TB culture, cytology, adenosine deaminase

Pyuria
- Urinalysis: if blood and leucocytes present, send for PCR and culture
- non-tuberculous acid-fast bacteria common in urine
- Ultrasound kidneys
- Early morning urine culture

Pericardial effusion
- Echocardiogram
- Pericardial fluid AFB, TB culture and PCR, cytology, adenosine deaminase

Disseminated (including miliary)
- CT thorax and ultrasound abdomen

- LP (CT or MR first if CNS signs or symptoms)
- Bronchial wash
- Blood for TB culture
- Bone marrow biopsy if diagnosis uncertain

IMMEDIATE MANAGEMENT

Discuss treatment with local TB team and lead paediatrician for TB

- If clinical signs and symptoms consistent with diagnosis of TB, start treatment – do not wait for culture results
- Send specimens for microscopy and culture before starting treatment unless life-threatening disease
- Inform Public Health through TB nurse team, who will organise CXR and Mantoux/IGRA for all close and visiting contacts
- Inform infection prevention team: advise anyone with cough to avoid visiting ward
- Admission not mandatory but useful to ensure adherence with treatment. If supervision can be guaranteed, allow treatment at home, contact TB nurse team before discharge
- If sputum +ve and hospitalisation necessary, strict barrier nurse in single room for 2 weeks or until discharge
- Patient should wear a surgical mask if leaves room
- Masks, gowns and barrier nursing unnecessary unless MDR TB or aerosol generating procedure
- Negative pressure room for aerosol generating procedure if TB considered (e.g. nebuliser)

TREATMENT

Refer all cases of suspected or proven TB (mycobacterium TB) to paediatric infectious diseases team

- If contact with drug-resistant TB discuss with paediatric ID before starting treatment
- See https://app.eolasmedical.com/knowledge **UKPAS**
- **Liquid formulations:**
  - rifampicin 100 mg/5 mL
  - isoniazid 50 mg/5 mL
  - pyrazinamide, ethambutol liquids made as special formulations
- **Tablets:**
  - isoniazid tablets or orodispersible tablets 100 mg
  - rifampicin capsules 300 mg
  - pyrazinamide tablets 500 mg
  - ethambutol tablets 100 mg and 400 mg
- **Fixed dose combination tablets in UK:**
  - Rifinah® 150/100 (150 mg rifampicin, 100 mg isoniazid)
  - Rifinah® 300/150 (300 mg rifampicin, 150 mg isoniazid)
  - Rifater® (120 mg rifampicin, 50 mg isoniazid, 300 mg pyrazinamide)
  - Voractiv® (150 mg rifampicin, 75 mg isoniazid, 400 mg pyrazinamide, 275 mg ethambutol)

Table 1

Drug	mg/kg	Range (mg)	Maximum
Isoniazid (H)	10	10–15	300 mg
Rifampicin (R)	15	10–20	600 mg*
Pyrazinamide (Z)	35	30–40	1.5 g (body weight <50 kg) 2 g (body weight ≥50 kg)
Ethambutol (E)	20	15–25	

* **BNFc** recommends maximum total daily dose of 450 mg for <50 kg, while WHO recommends up to 600 mg for all body weights

Table 2: Active TB 1st 2 months

Body weight (kg)	Rifinah® 150/100	Voractiv®	Isoniazid 50	Pyrazinamide 500	Ethambutol 400	Total tablets
15–20	1	1	1	–	–	3
20–25	2	–	–	1½	1	4½
25–30	1	2	–	–	–	3
30–35	1	2	1	½	–	4½
35–40	1	3	–	–	–	4
40–45	1	3	–	–	–	4
45–70	–	4	–	–	–	4
>70	–	5	–	–	–	5

Table 3: Active TB continuation phase and latent TB

Body weight (kg)	Rifinah (R/H) 150/100	Rifinah (R/H) 300/150	Total tablets
10–15	1		1
15–20	1½		1½
20–25	2		2
25–30	2½		2½
30–35	3		3
35–40	1½	1	2½
>40		2	2

- Duration of therapy
  - latent TB: RH 3 months **OR** H 6 months **OR** R 4 months
  - non-CNS TB: RH 4−6 months (first 2 months add ZE)
  - CNS TB: RH 12 months (first 2 months add ZE)
  - see https://www.who.int/health-topics/tuberculosis and https://www.nice.org.uk/guidance/ng33
- Add pyridoxine 10 mg (neonates 5 mg) to prevent isoniazid neuropathy
- Pericardial TB: add prednisolone 1 mg/kg/day (maximum 40 mg/day)
- Inform patient/parents of both common (gastrointestinal upset, rash) and rare but important side effects (staining of secretions, signs of hepatotoxicity)
- Advise patient/parents and GP of indications for seeking advice: fever, malaise, vomiting, jaundice or unexplained deterioration. Consider co-existent viral hepatitis. If AST/ALT level rises to 5x normal, stop treatment and seek advice re alternate regimen

SUBSEQUENT MANAGEMENT

- HIV test − see **HIV testing** guideline
- Other drugs may be necessary once sensitivities available: if resistant, seek specialist advice

MONITORING TREATMENT

- If baseline ALT/AST raised but ≤2x normal, repeat at 2 weeks; if falling only recheck if fever, malaise, vomiting, jaundice or unexplained deterioration
- If ALT/AST >2x, monitor weekly for 2 weeks then 2-weekly until normal, check viral hepatitis serology
- Stop treatment only if ≥5x normal
- If on ethambutol and unable to report visual problems, check visual evoked response

DISCHARGE AND FOLLOW-UP

- If tolerating treatment and adherence guaranteed, discharge
- If TB meningitis or concerns about adherence, will need direct or video observed therapy, organised through TB nurse team
- Review to ensure adherence:
  - at least monthly for first 2 months
  - 2-monthly until treatment complete
  - for 3 months after end of treatment
  - further as clinically indicated

LATENT TB

Asymptomatic close contact with positive TST/IGRA, OR aged <2 yr with index case with pulmonary TB, OR new entrant from high-incidence country with positive TST/IGRA

- If immunocompromised discuss with TB specialist
- If treatment for latent TB indicated but not taken: CXR and clinical review at 3 and 12 months
- If treating for latent TB: test for HIV, hepatitis B and C

Neonate with contact with respiratory TB

- Assess for active disease
- Treat with isoniazid for 3 months then Mantoux
- if ≥5 mm: reassess for active disease; if not active TB, continue isoniazid total 6 months
- if <5 mm, IGRA:
  - if both -ve stop isoniazid and refer to TB nurse team for BCG
  - if +ve, reassess for active disease
  - if not active TB, continue isoniazid for total 6 months

Aged >2 yr

Mantoux:

- If ≥5 mm assess for active TB: if not active TB, treat for latent TB
- If <5 mm and contact smear +ve: after 6 weeks repeat Mantoux and do IGRA
- if both -ve: stop isoniazid
- if either +ve: assess for active TB
  - if not active TB: complete treatment for latent TB

URINARY TRACT INFECTION ● 1/4

RECOGNITION AND ASSESSMENT

Treat symptomatic urinary tract infection (UTI) in infants promptly to reduce risk of renal scarring

Table 1: Symptoms and signs

Age group		Most common	Intermediate	Least common
Infants aged <3 months		• Fever • Vomiting • Lethargy • Irritability	• Poor feeding • Failure to thrive	• Abdominal pain • Jaundice • Haematuria • Offensive urine
Infants ≥3 months and children	**Pre-verbal**	• Fever	• Abdominal pain • Loin tenderness • Vomiting • Poor feeding	• Lethargy • Irritability • Haematuria • Offensive urine • Failure to thrive
	Verbal	• Frequency • Dysuria	• Dysfunctional voiding • Changes to continence • Abdominal pain • Loin tenderness	• Fever • Malaise • Vomiting • Haematuria • Offensive urine • Cloudy urine

Risk factors for UTI and serious underlying pathology

- The following should always be recorded in suspected cases of UTI:
  - poor urine flow in males
  - history suggesting recurrent UTI
  - recurrent fever of uncertain origin
  - antenatally diagnosed renal or urinary tract abnormality
  - family history of vesico-ureteric reflux (VUR)
  - constipation
  - dysfunctional voiding (i.e. any of: frequency, urgency, urge incontinence)
  - enlarged bladder
  - abdominal mass
  - evidence of spinal lesion
  - poor growth
  - high blood pressure (see **Hypertension** guideline)

Investigations

- Dipstick test fresh urine for leukocytes and nitrites in:
  - all symptomatic children (see **Table 1**)
  - all unexplained febrile admissions with temperature >38°C
  - with an alternative site of infection but who remain unwell
- Culture urine if:
  - aged <3 yr
  - a single positive result for leukocyte esterase or nitrite
  - recurrent UTI
  - infection that does not respond to treatment within 24–48 hr
  - clinical symptoms and dipstick tests do not correlate
  - suspected pyelonephritis
- If child seriously unwell, measure serum electrolytes, take blood cultures and insert cannula

Collection of specimens

- Collect urine before antibiotics unless severe sepsis [see **Sepsis (including meningococcal)** guideline]
- **Clean catch** in sterile container is recommended method:
  - in babies too young to co-operate, eliciting lateral abdominal reflex may provoke micturition
  - collect mid-stream urine in those old enough to co-operate
- Pad urine specimens can be used in babies and young children (only useful if negative)
  - make sure nappy area thoroughly cleaned before applying pad
  - urine extracted from specially designed pads with a syringe

- always follow manufacturer's instructions
- do not use cotton wool balls or 'home made' equipment
- for urinalysis (do not send for culture: if +ve nitrites and +ve leukocytes collect another urine sample by clean method)
- In severe sepsis, catheterise for diagnostic urine collection

Handling specimens

- Use plain, white top, sterile bottles for hospital-collected samples
- Use borate only when child large enough to fill bottle
- During working hours, transfer specimens to laboratory within 2 hr
- out-of-hours, keep specimen in fridge at 4°C until laboratory open
- state date and time of collection on specimen bottle

Interpretation of results

Always take clinical symptoms into account when interpreting results

- **Children aged ≥3 yr:** use dipstick to identify possible UTI

Table 2

Leucocyte esterase	Nitrate	Action
Positive	Positive	Send urine sample for culture. Start antibiotic treatment for UTI
Negative	Positive	Send urine sample for culture. If fresh sample tested, start antibiotic treatment
Positive	Negative	Send urine sample for microscopy and culture. Only start antibiotic treatment for UTI if good clinical evidence of UTI
Negative	Negative	Do not send urine sample for culture unless recommended in indications for culture. Do not start treatment for UTI

Microscopy of fresh sample

- Indications:
- aged <3 yr with fever
- aged >3 yr, fever with:
  - specific urinary symptoms
  - history of recurrent UTI
  - seriously ill
  - leukocyte esterase or nitrite on urinalysis (see **Interpretation of results**)
- Very useful method of confirming acute infection
- bacteria and leukocytes (UTI)
- bacteria only (UTI presumed if symptomatic, but may be contaminant)
- leukocytes only (treat if symptomatic)
- no bacteria or leukocytes (no UTI if culture results also negative)
- Pyuria
- normal $<10 \times 10^6$/L
- vulvitis, vaginitis or balanitis can also give rise to high counts
- viruses (echovirus, adenovirus and CMV) can cause sterile pyuria
- Colony counts
- organism count $>10^5$ organisms/mL pure growth of single organism confirms infection in properly collected and stored mid-stream sample
- certainty reduced to 80% with pad urine
- low counts do not exclude infection

IMMEDIATE TREATMENT

If child systemically unwell, do not delay treatment while trying to obtain urine specimen

- Ensure good hydration with maintenance fluids
- Empirical antibiotics (narrow spectrum as soon as organism and sensitivities known)
- If pyelonephritis: systemic illness (fever >38°C or loin pain/tenderness)
- aged <3 months: cefotaxime 50 mg/kg (see **BNFc** for dosing interval) **OR** ceftriaxone 50 mg/kg once daily

- aged ≥3 months: co-amoxiclav oral if tolerated or IV for 7 days (see **BNFc** for dose depending on route of administration)
  - if penicillin allergy give high dose (see **BNFc** for dosing) cefuroxime IV 8-hrly (unless severe type 1 allergic reaction), or gentamicin IV (once daily dosage regimen) over 30 min for 48 hr minimum (follow local antibiotic guidelines)
  - if shocked refer to **Sepsis (including meningococcal)** guideline
  - ongoing treatment depends on response
- if cystitis: minor systemic disturbance, give cefalexin oral for 3 days (see **BNFc** for dose)
- high rates of trimethoprim resistance (no longer empirical first line)
- when child on prophylaxis already, always give an alternative antibiotic for acute infection

SUBSEQUENT MANAGEMENT

Imaging

Dependent on age and type of infection (see table below)

- Simple UTI: responds within 48 hr
- Atypical UTI:
- seriously ill child
- poor urine flow
- abdominal or bladder mass
- raised creatinine
- septicaemia
- failure to respond to treatment within 48 hr
- infection with organisms other than *E. coli*
- Recurrent UTI:
- ≥2 episodes of UTI with acute pyelonephritis/upper UTI
- 1 episode of UTI with acute pyelonephritis/upper UTI **plus** ≥1 episode or UTI with cystitis/lower UTI
- ≥3 episodes or UTI with cystitis/lower UTI

Table 3

Test	Simple UTI	Atypical UTI	Recurrent UTI
Aged 0–6 months			
US during acute infection	No	Yes	Yes
US within 6 weeks	Yes	No	No
DMSA	No	Yes	Yes
MCUG (micturating cysto-urethrography)	No	Yes	Yes
Aged 6 months–3 yr			
US during acute infection	No	Yes	No
US within 6 weeks	No	No	Yes
DMSA	No	Yes	Yes
MCUG	No	No	No
Aged >3 yr			
US during acute infection	No	Yes	No
US within 6 weeks	No	No	Yes
DMSA	No	No	Yes
MCUG	No	No	No

- Renal and bladder USS 6 weeks after infection when not indicated urgently (see above)
- Bladder scan pre/post micturition helpful to exclude incomplete bladder emptying (older child)
- DMSA (dimercaptosuccinic acid) scan 4–6 months after infection
- If child has subsequent UTI while awaiting DMSA, review timing of test and consider doing it sooner
- MCUG (micturating cysto-urethrography) after infection is treated
- also required where there are voiding problems or abnormalities on US scan requiring further investigation (discuss with consultant)
- requires 3 days of prophylactic antibiotics, usually nitrofurantoin aged ≥3 months 1 mg/kg once a day at night time. (maximum 100 mg, avoid in G6PD deficiency or renal impairment) **OR** cefalexin aged <3 months 12.5 mg/kg at night according to previous culture sensitivities, with test on middle day or following MCUG
- MCUG for neonates with hydronephrosis give a single dose of gentamicin IV 5 mg/kg over 3–5 min just before MCUG (avoid MCUG in neonates with UTI)

DISCHARGE AND FOLLOW-UP

Routine cases

- Home when:
  - symptoms mild, or severe symptoms controlled
  - taking oral antibiotics and tolerating them
- Discuss and advise to avoid risk factors at discharge:
  - constipation
  - poor perineal hygiene in girls
  - low fluid intake
  - infrequent bladder emptying
- Repeat urine test not required in asymptomatic children
- Prompt treatment of recurrences with co-amoxiclav (check previous culture sensitivities)
- Outpatient review
  - check BP (see **Hypertension** guideline)
  - not required for simple UTI
  - in 8–10 weeks where ultrasound imaging has been indicated

Prophylactic antibiotics

- Not required following first simple UTI
- Required for:
  - proven grade 3+ reflux until out of nappies during the day (provided infections well controlled)
  - urinary tract obstruction pending surgical management
  - any child with frequent symptomatic infections (>3 UTIs per year)
  - aged >3 months: trimethoprim **or** nitrofurantoin prophylaxis

Surgical management

- Antireflux surgery not routinely indicated in VUR
  - refer for antireflux surgery for obstructive mega-ureters with reflux
  - refer for antireflux surgery if failure to control infections with prophylaxis in grade 3+ reflux
  - refer all neuropathic bladder patients
- Circumcision may be considered for recurrent UTI in males with structurally abnormal urinary tracts

Management of children with renal scars

- No follow-up for minor unilateral parenchymal defect unless recurrent UTI or family history or lifestyle risk factors for hypertension
- In cases of significant scarring:
  - annual BP measurement (see **Hypertension** guideline)
  - females must book early when pregnant and inform obstetric team
- Where scarring bilateral:
  - annual BP measurement (see **Hypertension** guideline)
  - assessment of urinary protein excretion and renal function every 3–4 yr
  - long-term follow-up in the renal clinic
  - transfer to adult service

VANCOMYCIN ● 1/2

INDICATIONS

- MRSA, and infections with other drug-resistant Gram-positive bacteria (e.g. coagulase-negative staphylococci, *Enterococcus faecium*)
- Neutropenic sepsis, combined with meropenem as second line treatment
- As an anti-Gram-positive agent in patients with severe penicillin allergy
- Teicoplanin is alternative, particularly for coagulase negative staphylococcal infection

DOSE

- Frequency of administration varies with corrected gestational age (CGA) (gestation + age in weeks) as it is removed exclusively by the kidneys

29–34 weeks' CGA

- 15 mg/kg 12-hrly adjusted according to trough levels

≥35 weeks' CGA–aged 18 yr

- 15 mg/kg 8-hrly, adjusted according to trough levels (up to maximum initial dose 1g 8-hrly)

Patients 1yr – 18yr with renal impairment and eGFR 30–50 mL/min/1.73m^2

- 15 mg/kg 12-hrly. Take a level at 24hr

Patients with eGFR <30 mL/min/1.73m^2 or <1 yr

- Seek specialist advice

PRESCRIBING

- Prescribe in antibiotic section of drug chart
- specify time of administration using 24 hr clock
- Avoid in renal impairment
- In obese children initial dose should be based on total body weight
- Avoid if on furosemide/other nephrotoxic medication
- Correct dehydration first

ADMINISTRATION

- Give over ≥60 min, at a rate ≤10 mg/min to avoid anaphylactoid reactions
- Dilute with sodium chloride 0.9% or glucose 5%, to maximum concentration of 5 mg/mL for peripheral administration
- If fluid restriction can be administered at concentration of 10 mg/mL **centrally**
- For severe, deep seated infections consider continuous infusion (see **Table 1: Vancomycin infusion rates**)
- **loading infusion**: vancomycin 15 mg/kg over 1 hr
- **maintenance infusion**: concentration 4.17 mg/mL (vancomycin 125 mg in 30 mL glucose 5%) – start immediately after loading infusion complete

Table 1: Vancomycin infusion rates

Serum creatinine (micromol/L)	Postmenstrual age	Daily dose for continuous infusion over 24 hr (mg/kg/day)	Infusion rate (mL/hr)
<40	≥40 weeks	50	0.5 × weight
<40	<40 weeks	40	0.4 × weight
40–60	All	30	0.3 × weight
>60	All	20	0.2 × weight

MONITORING

General monitoring

- Daily creatinine and urea levels, and urine output (vancomycin is nephrotoxic)

Therapeutic monitoring

- Microbiology laboratory tests levels between 08:30–16:00 hr
- Measure levels immediately before third dose (before second dose if concerns about renal function)

VANCOMYCIN ● 2/2

- Do not withhold next dose if awaiting results (unless concerns about renal function due to increase creatinine and urea, or reduced urine output)
- Therapeutic trough levels required to maintain efficacy
- Pre-dose trough levels should usually be 10–15 mg/L [15–20 mg/L for less sensitive (e.g. MRSA) organisms]
- If level below desired therapeutic level, reduce time between dosing to next dose interval e.g. if 8-hrly give 6-hrly and repeat levels before third dose
- If level >20 mg/L but <25 mg/L increase time between dosing to next time interval and repeat levels on third dose, e.g. if 8-hrly increase to 12-hrly
- If level >25 mg/L: do not administer further doses but check levels every 12 hr until 10-15 mg/L (use time since last dose as dose interval)
- Dose interval should be reduced when restart
- For those on a continuous infusion measure level 24 hr after start of infusion. The sample can be taken at any time during the dosing interval. (Ensure the sample site is away from the infusion site (i.e. not the same arm if administering vancomycin peripherally)
- Steady state levels should be 20–25 mg/L

VITAMIN D DEFICIENCY ● 1/2

Routine screening for vitamin D is not recommended

RECOGNITION AND ASSESSMENT

Symptoms and signs

Rickets

- Progressive bowing of legs (bowing of legs can be a normal finding in toddlers)
- Progressive knock knees, wrist swelling
- Rachitic rosary (swelling of the costochondral junctions)
- Craniotabes (skull softening with frontal bossing and delayed fontanelle closure)
- Delayed tooth eruption and enamel hypoplasia
- Unexplained bone pain
- Muscular weakness (e.g. difficulty climbing stairs, waddling gait, difficulty rising from a chair or delayed walking)
- Tetany due to low serum calcium/seizures due to low serum calcium (usually in infancy)
- Infantile cardiomyopathy

Abnormal investigations

- Low serum calcium or phosphate, high alkaline phosphatase (≥local age-appropriate reference range)
- Radiographs: showing osteopenia, rickets or pathological fractures

Chronic disease that may increase risk of vitamin D deficiency

- Chronic renal disease, chronic liver disease, on antiepileptics
- Malabsorption syndromes (e.g. coeliac disease, Crohn's disease, cystic fibrosis)

Bone diseases in children where vitamin D deficiency should be corrected before specific treatment is given

- Osteogenesis imperfecta
- Idiopathic juvenile osteoporosis
- Osteoporosis secondary to glucocorticoids, inflammatory disorders, immobility and other metabolic bone conditions

PREVENTION OF VITAMIN D DEFICIENCY

- 90% of vitamin D in body is made from sunlight
- Safe sunlight exposure: April–October approximately 10 min exposure 1100–1500 hr
- Vitamin D rich food e.g. mushroom, egg yolk, oily fish, red meat etc.
- Daily vitamin D supplementation for breast fed infants, people with dark skin and those with low/no exposure to sun
- All others, consider daily vitamin D supplements 400 IU (10 microgram) during autumn and winter

Table 1: Interpretation of vitamin D levels

Serum 25-OHD		Vitamin D status	Management
nmol/L	ug/L		
<25	<10	Deficient	Treatment dose of vitamin D followed by preventive dose of vitamin D and lifestyle advice
25–50	10–20	Insufficient	Prevention dose of vitamin D and lifestyle advice
50–75	20–30	Adequate	Lifestyle advice
>75	>30	Optimal	None

NUTRITIONAL RICKETS

- Treatment for vitamin D insufficiency (vitamin D 25−50 nmol/L)
- Advise on dietary source of vitamin D
- Safe sunlight exposure for 10 min during 1100−1500 hr
- Ensure dietary calcium is adequate
- Vitamin D 400−600 IU daily for children from aged 1 month–18 yr

VITAMIN D DEFICIENCY ● 2/2

Table 2: Treatment of vitamin D deficiency (vitamin D <25 nmol/L)

Age	Daily dose (units) for 12 weeks	Single oral dose IU	Example of preparations
0–6 months	3000	50,000	Thorens solution 10,000 unit/mL
>6 month–12 yr	6000	150,000	Colecalciferol capsules 400, 1000
>12 yr	10,000	300,000	Colecalciferol capsules10,000, 20,000

INDICATIONS FOR REFERRAL TO SECONDARY CARE

- Repeated low serum calcium concentration with/without symptoms (irritability, brisk reflexes, tetany, seizures or other neurological abnormalities)
- Underlying complex medical disorders (e.g. liver disease, intestinal malabsorption)
- Deformities or abnormalities probably related to rickets
- Poor response to treatment despite good adherence (level of 25-OHD <50 nmol/L after 12 weeks of adherent therapy)
- Persisting low serum phosphate or low/high alkaline phosphatase

Administration

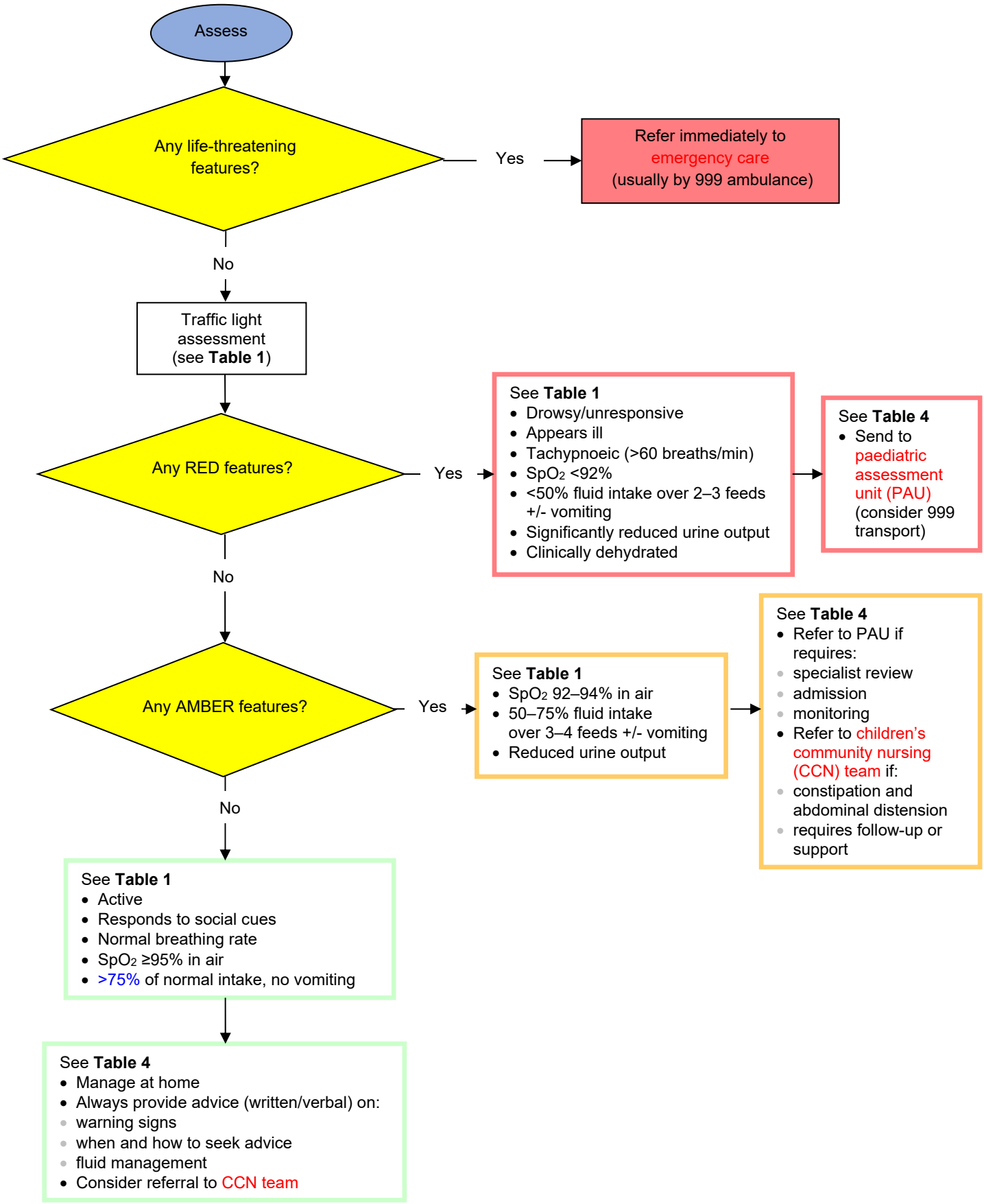
- **Ensure elemental calcium intake 500 mg daily/500 mL formula milk/day (aged 6 months–5 yr)**
- If insufficient calcium intake, low calcium in the blood, prescribe calcium carbonate tablet as per **BNFc** formulary (Cacit® 1.25 g effervescent tablet = 500 mg of elemental calcium = 12.5 mmol of calcium)
- All children who can swallow normal food can take the small colecalciferol available as 400,1000,10,000 and 20,000 unit capsule
- children who have swallowing difficulties (aged <1 yr or disabled), a liquid preparation may be used but is less palatable e.g. Thorens solution 10,000 units/mL (one drop = 200 units)
- If non-compliant give larger dose less frequently:
- aged >12–18 yr: cholecalciferol capsule 20,000 units once every 2 weeks for 12 weeks (6 doses)
- Cholecalciferol and ergocalciferol liquid preparation doses are equivalent (i.e. 1:1)

MONITORING

- **Regular monitoring not required unless treated for <25 nmol/L**
- At end of treatment for vitamin D deficiency check bone profile, vitamin D
- If 25-OHD >50 nmol/L and bone profile normal
- give advice lifestyle advice as safe sun exposure, oily fish, egg, mushroom, vitamin D fortified food and prevention dose of vitamin D 400−600 IU for 6 months
- If recommended nutritional intake 400 units/day (10 microgram/day) unlikely to be met, give routine supplementation of vitamin D as multivitamin formulation e.g. healthy start vitamin drops, vitamin D tablet with various strength can be available over the counter (1 microgram = 40 IU)
- those patient groups are:
  - exclusively breastfed infant aged 1–6 months
  - aged >6 months–5 yr taking <500 mL formula feed/day
  - not spending substantial time outdoors
  - wearing concealing clothing
  - dark skin
- If 25-OHD <50 nmol/L:
- consider poor compliance, drug interactions and underlying disease e.g. renal disease, liver disease and malabsorption
- if poor compliance suspected, consider high-dose treatment if aged >12–18 yr (e.g. 300,000 units as single or divided dose)
- **If unimproved symptoms/signs despite satisfactory 25-OHD concentration: unlikely to be related to vitamin D deficiency**
- **Alfacalcidol should not be used for the treatment of simple vitamin D deficiency**

ABDOMINAL PAIN (COMMUNITY) ● 1/4

Algorithm



ABDOMINAL PAIN (COMMUNITY) ● 2/4

If GP review in a specific time period clinically appropriate but falls outside of in-hours GP service, advise patient/family to call NHS 111 (at an agreed time interval/level of deterioration − depending on concerns); provide letter detailing clinical findings and concerns to assist out-of-hours GP assessment

ASSESSMENT

Table 1: Traffic light system to identify severity of illness

	Green Low risk	Amber Immediate risk	Red High risk
Activity	• Active • Responds normally to social cues		• Drowsy • No response to social cues
Respiratory rate	• Respiratory rate normal (breaths/min): ◦ infant: 40 ◦ toddler: 35 ◦ pre-school: 31 ◦ school age: 27		• All ages >60 breaths/min
SpO_2 in air	• ≥95%	• 92–94%	• <92%
Feeding/ hydration	• >75% of normal intake – no vomiting	• 50–75% fluid intake over 3–4 feeds +/- vomiting • Reduced urine output	• <50% fluid intake over 2–3 feeds +/- vomiting • Significantly reduced urine output • Clinically dehydrated
Circulation	• CRT <2 sec • Heart rate normal (bpm): ◦ aged <1 yr: 120–170 ◦ aged 1–2 yr: 80–110 ◦ aged 2–5 yr: 70–110 ◦ aged >5 yr: 70–110		• Heart rate (bpm): ◦ aged ≤1 yr: >190 ◦ aged >1 yr: >140
Other	• Negative urine dipstick	• Fever [see **Fever (community)** guideline] • Abdominal distension • Sexually active/missed period • Palpable abdominal mass • Localised pain • Jaundice • Yellow vomit • Severe/increasing pain	• Abdominal guarding/rigidity • Bile (green) stained vomit • Blood stained vomit • 'Red currant jelly' stool • Trauma associated • Acute testicular pain

Table 2: Signs and symptoms of specific illness (common causes of abdominal pain by age)

Aged <2 yr	Aged 2–12 yr	Aged >12–16 yr
• Gastroenteritis • Constipation • Intussusception • Infantile colic • UTI • Incarcerated inguinal hernia • Trauma • Pneumonia • Diabetes	• Gastroenteritis • Acute appendicitis • Mesenteric adenitis • Constipation • UTI • Pneumonia • Diabetes • Testicular torsion • Onset of menstruation • Psychogenic • Trauma	• Mesenteric adenitis • Acute appendicitis • Menstruation • Mittelschemerz • Ovarian cyst torsion • UTI • Pregnancy • Ectopic pregnancy • Testicular torsion • Psychogenic trauma • Pneumonia • Diabetes

Table 3: Signs/symptoms of specific illness (diagnoses to be considered)

Illness	Signs/symptoms
Gastroenteritis	• Vomiting • Diarrhoea (can occur in other conditions e.g. intussusception, pelvic appendicitis, pelvic abscess and inflammatory bowel disease)
Intestinal obstruction e.g. intussusception or volvulus	• Bile-stained vomit • Colicky abdominal pain • Absence of normal stool/flatus • Abdominal distension • Increased bowel sounds • Visible distended loops of bowel • Visible peristalsis • Scars • Swellings at site of hernia orifices and of external genitalia • Stool containing blood mixed with mucus
Infective diarrhoea	• Blood mixed with stools • Ask about travel history and recent antibiotic therapy
Inflammatory bowel disease	• Blood in stools (may have signs of obstruction)
Midgut volvulus (shocked child)	• Bilious vomiting
Henoch schönlein pupura	• Blood in stools • Typical rash
Haemolytic uraemic syndrome	• Blood in stools
Lower lobe pneumonia	• Fever • Cough • Tachypnoea • Desaturation
Poisoning	• Ask about: ◦ history of possible ingestions (including batteries) ◦ drugs and other toxic agents available at home
Irreducible inguinal hernia	• Examine inguino-scrotal region
Torsion of testis	• If suspected contact surgeon (preferably urologist) immediately – surgical emergency
Jaundice	• Hepatitis may present with pain due to liver swelling
UTI	• Carry out routine urine analysis for children presenting with abdominal pain
Bites and stings	• Ask about possibility of bites and stings • Adder envenomation can result in abdominal pain and vomiting
Peritonitis	• Refusal/inability to walk • Slow walk/stooped forward • Pain on coughing or jolting • Lying motionless • Decreased/absent abdominal wall movements with respiration • Abdominal distension • Abdominal tenderness – localised/generalised • Abdominal guarding/rigidity • Percussion tenderness • Palpable abdominal mass • Bowel sounds – absent/decreased (peritonitis) • Associated non-specific signs – tachycardia, fever
Constipation	• Infrequent bowel activity • Foul smelling wind and stools • Excessive flatulence • Irregular stool texture • Passing occasional enormous stools or frequent small pellets withholding or straining to stop passage of stools (use Bristol stool chart – see https://eric.org.uk/childrens-bowels/constipation-in-children/

	• Soiling/overflow • Abdominal distension • Poor appetite • Lack of energy • Unhappy, angry or irritable mood and general malaise
If post-menarchal female	• Suggest pregnancy test • Consider ectopic pregnancy, pelvic inflammatory disease or other STD • Other gynaecological problems • Mittelschmerz • Torsion of the ovary • Pelvic inflammatory disease • Imperforate hymen with hydrometrocolpos
Known congenital pre-existing condition	• Previous abdominal surgery (adhesions) • Nephrotic syndrome (primary peritonitis) • Mediterranean background (Familial Mediterranean fever) • Hereditary spherocytosis (gallstones) • Cystic fibrosis (meconium ileus equivalent) • Cystinuria • Porphyria

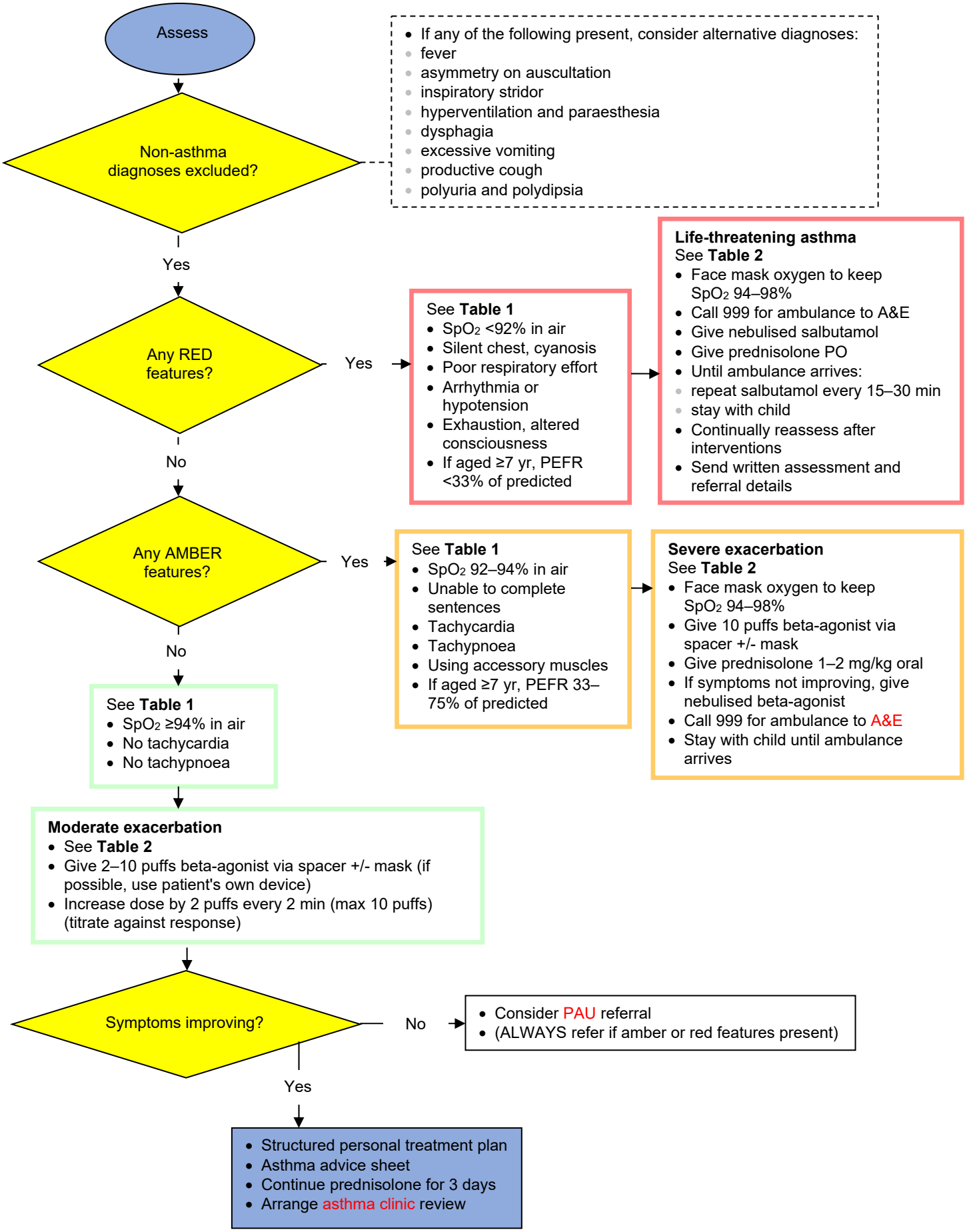
MANAGEMENT

Table 4: Management of abdominal pain (community)

Green Low risk	Amber Immediate risk	Red High risk
• Child to be managed at home with appropriate care and advice • Provide verbal/written information about warning signs and when to seek further advice (use **Abdominal pain advice sheet**) e.g. https://www.what0-18.nhs.uk/professionals/gp-primary-care-staff/safety-netting-documents-parents/abdominal-pain • If additional support required with constipation or gastroenteritis refer to CCN team • Request additional support from CCN team if required	• Refer to PAU if: ◦ abdominal pain and jaundice ◦ requires: – surgical/gynaecology review – admission – further investigation/period of constant monitoring • Refer to CCN team if: ◦ constipation and abdominal distension but no other amber features ◦ requires additional follow-up/support at home	• Send to PAU for urgent assessment

ACUTE ASTHMA (COMMUNITY) ● 1/3

Algorithm



ACUTE ASTHMA (COMMUNITY) ● 2/3

Lower threshold for admission if:
Attack in late afternoon/night
Recent hospital admission/previous severe attack
Concern re social circumstances/ability to cope at home

ASSESSMENT

Table 1: Assessment of asthma severity

Green (Moderate)	Amber (Severe)	Red (Life-threatening)
• SpO_2 ≥94% in air • If aged ≥7 yr, PEF >75% best/predicted • Speech/feeding normal • Heart rate (bpm): ◦ aged 2–5 yr: ≤140 ◦ aged 5–12 yr: ≤125 ◦ aged >12 yr: ≤110 • Respiratory rate (breaths/min): ◦ aged 2–5 yr: ≤40 ◦ aged 5–12 yr: ≤30 ◦ aged >12 yr: ≤25	• SpO_2 92–94% in air • If aged ≥7 yr, PEF <75% and >33% best/predicted • Cannot complete sentences/too breathless to talk • Heart rate (bpm) ◦ aged 2–5 yr: >140 ◦ aged 5–12 yr: >125 ◦ aged >12 yr: >110 • Respiratory rate (breaths/min): ◦ aged 2–5 yr: >40 ◦ aged 5–12 yr: >25 ◦ aged >12 yr: >30 • Use of accessory muscles	• SpO_2 <92% • If aged ≥7 yr, PEF <33% best/predicted • Silent chest, cyanosis • Poor respiratory effort • Arrhythmia or hypotension • Exhaustion, altered consciousness

MANAGEMENT

Table 2: Management of acute asthma (community)

Green (Moderate)	Amber (Severe)	Red (Life-threatening)
• Give 2–10 puffs of beta-agonist via spacer (with face mask aged ≤3 yr using tidal breathing) • Use patient's own spacer where available • Increase beta-agonist dose by 2 puffs every 2 min up to 10 puffs according to response • Consider prednisolone PO 1–2 mg/kg once daily: ◦ aged 2–4 yr: max 20 mg ◦ aged 5–11 yr: max 30–40 mg ◦ aged ≥12 yr: max 40–50 mg for ≥5 days	• Give oxygen via face mask/nasal prongs to achieve SpO_2 94–98% • Give beta-agonist 10 puffs via spacer +/- face mask **OR** • Nebulised beta-agonist driven by 6–8 L oxygen • Salbutamol ◦ aged 2–4 yr: 2.5 mg ◦ aged ≥5 yr: 5 mg) **OR** • Terbutaline ◦ aged 2–4 yr: 5 mg ◦ aged 5–11 yr: 5–10 mg ◦ aged ≥12 yr: 10 mg • Give prednisolone 1–2 mg/kg PO once daily: ◦ aged 2–4 yr: max 20 mg ◦ aged 5–11 yr: max 30–40 mg ◦ aged ≥12 yr: max 40–50 mg	• Give oxygen via face mask to achieve SpO_2 94–98% • Call 999 for emergency ambulance to emergency department • Give nebulised beta-agonist driven by 6–8 L oxygen: • **EITHER** Salbutamol ◦ aged 2–4 yr: 2.5 mg ◦ aged ≥5 yr: 5–10 mg • **OR** Terbutaline ◦ aged 2–4 yr: 5 mg ◦ aged 5–11 yr: 5–10 mg ◦ ≥12 year: 10 mg • **AND** Ipratropium ◦ aged 2–11 yr: 250 microgram every 20–30 min for first 2 hr, then 250 microgram every 4–6 hr as required ◦ aged ≥12 yr: 500 microgram every 4–6 hr as required • Give prednisolone 1–2 mg/kg PO once daily, up to: ◦ aged 2–4 yr: 20 mg ◦ aged 5–11 yr: 30–40 mg ◦ aged ≥12 yr: 40–50 mg • Repeat beta-agonist (salbutamol/terbutaline) up to every 15–30 min while waiting for ambulance to arrive • Continually assess child after each intervention

		• Ensure continuous oxygen delivery to maintain SpO_2 >94% • Stay with child while waiting for ambulance to arrive • Send written assessment and referral details

ADMINISTRATION OF MEDICATION VIA SUBCUTANEOUS OR INTRAMUSCULAR ROUTE ● 1/2

INTRODUCTION

- Safely administer medication via subcutaneous or intramuscular route within community
- Perform procedure within nurse's scope of professional practice and competency
- Ensure patient clinically well to receive prescribed medication

EQUIPMENT

- Prescription and medication administration record
- Apron and non-sterile gloves
- Sharps box
- Medication
- either prefilled syringe or medication to be reconstituted for reconstitution
- Appropriate syringe size and needle
- Chlorhexidine 2% in 70% alcohol skin wipe
- Plaster
- Gauze
- Anaphylaxis kit

PROCEDURE

General

- Discuss procedure with parent and child/young person
- Gain verbal consent (from young person if age appropriate)
- Check drug and dose against prescription – ensure correct route, dose and drug prescribed
- consider use of topical anaesthetic as appropriate to minimise procedural pain
  - EMLA cream
  - ethyl spray/ice packs
- Decontaminate hands as per Trust policy. See **Infection Prevention** guideline
- Collect all necessary equipment for procedure and place in close proximity
- Don apron and gloves and ensure anaphylaxis kit available
- Use prefilled syringe or appropriate pen device
- If reconstitution of drug necessary
- select appropriate size IV syringe and use filter needle for glass vials
- discard needles used for drawing up directly into sharps bin
- use appropriate sized needle for route of administration
- Position child/young person in comfortable, relaxed position in safe and secure
- if necessary with parent/nurse support

Subcutaneous administration

- Bunch a fold of skin
- Insert needle at 45º angle
- Administer drug
- Release skin
- Withdraw needle
- Wipe clean with gauze
- If leaking, apply gentle pressure
- Record administration
- Note site where given

Intramuscular administration

- Stretch skin
- Insert needle at 90º angle in dart-like fashion
- Leave one third of needle shaft exposed
- It is not necessary to aspirate syringe after needle introduced into muscle
- Administer drug slowly
- Withdraw needle and apply gentle pressure with gauze
- Record administration
- Note site where given
- Dispose of used needles and IV syringes immediately after use into appropriate sharps bin

ADMINISTRATION OF MEDICATION VIA SUBCUTANEOUS OR INTRAMUSCULAR ROUTE ● 2/2

- Dispose all other waste and decontaminate hands as per Trust policy

AFTERCARE

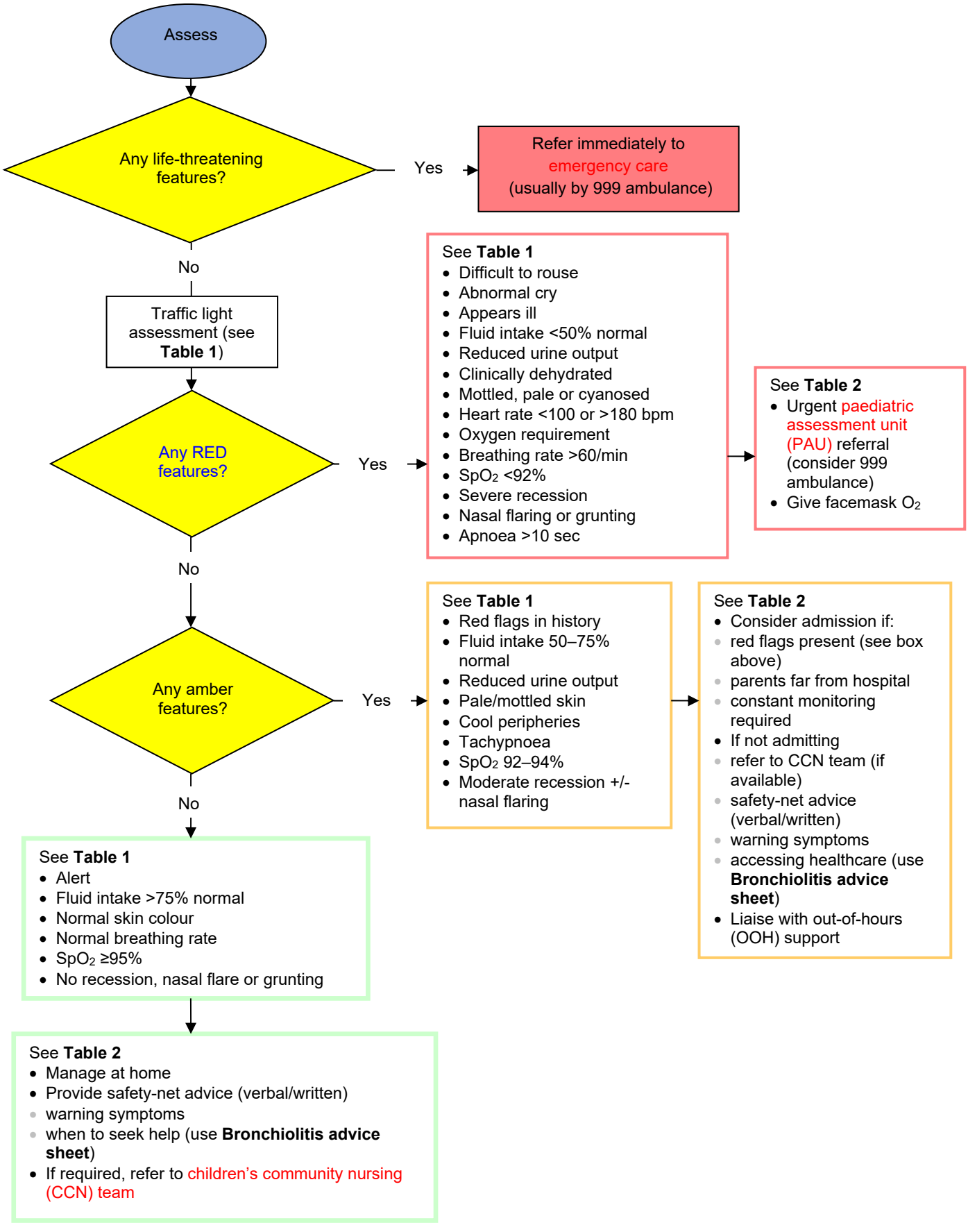
- Stay with patient in home ≥10 min post administration to monitor for any possible reaction

COMPLICATIONS

- Brusing/bleeding
- Pain at injection site
- Nerve/blood vessel damage
- Infection
- Anaphylactic reaction

BRONCHIOLITIS AGED <2 YR (COMMUNITY) ● 1/3

Algorithm



BRONCHIOLITIS AGED <2 YR (COMMUNITY) ● 2/3

If GP review in a specific time period clinically appropriate but falls outside of in-hours GP service, advise patient/family to call NHS 111 (at agreed time interval/level of deterioration – depending on concerns); provide letter detailing clinical findings and concerns to assist out-of-hours GP assessment

Table 1: Traffic light system to identify severity of illness

	Green Low risk	Amber Immediate risk	Red High risk
Behaviour	• Alert • Normal	• Irritable • Not responding normally to social cues • Decreased activity • No smile	• Unable to rouse • Wakes only with prolonged stimulation • No response to social cues • Weak, high pitched or continuous cry • Appears ill to healthcare professional
Feeding/ hydration	• >75% of normal intake – no vomiting	• 50–75% fluid intake over 3–4 feeds +/- vomiting • Reduced urine output	• <50% fluid intake over 2–3 feeds +/- vomiting • Significantly reduced urine output • Child clinically dehydrated
Circulation	• Normal colour skin, lips and tongue • Moist mucous membranes	• Pale/mottled skin • Pallor colour reported by parent/carer • Cool peripheries	• Pale/mottled/ashen blue • Cyanotic lips and tongue • Tachycardia >180 bpm or bradycardia <100 bpm
Respiratory rate	• Aged <1 yr: <50 breaths/min • Aged ≥1 yr: <40 breaths/min • No respiratory distress	• Aged <1 yr: 50–60 breaths/min • Aged ≥1 yr: 40–60 breaths/min	• All ages >60 breaths/min
SpO_2 in air	• ≥95%	• 92–94%	• <92%
Chest recession	• None	• Moderate	• Severe
Nasal flaring	• Absent	• May be present	• Present
Grunting	• Absent	• Absent	• Present
Apnoea	• Absent	• Absent	• Present ◦ for 10–15 sec **OR** ◦ shorter if accompanied by a sudden decrease in saturations/central cyanosis or bradycardia

Signs and symptoms

- Rhinorrhea (runny nose)
- Cough
- Poor feeding
- Vomiting
- Pyrexia
- Respiratory distress
- Apnoea
- Inspiratory crackles +/- wheeze
- Cyanosis

Red flags

- When deciding whether to admit child take into account following risk factors for more severe bronchiolitis:
  - chronic lung disease (including bronchopulmonary dysplasia)
  - haemodynamically significant congenital heart disease
  - aged <3 months

- premature birth, particularly <32 weeks
- neuromuscular disorders
- immunodeficiency

MANAGEMENT

Table 2: Management of bronchiolitis (community)

Green Low risk	Amber Immediate risk	Red High risk
• Can be managed at home with appropriate care and advice • Always provide verbal/written information about warning signs and when to seek further advice (use **Bronchiolitis advice sheet** https://www.nhs.uk/conditions/bronchiolitis/) • Refer to CCN team for additional support if required	• Consider admission according to clinical and social circumstance – see **Red flags** • Consider distance to healthcare in case of deterioration • Refer to PAU if: ◦ SpO_2 92–94% **OR** ◦ concerns about dehydration **OR** ◦ baby/child needs constant monitoring **THEN** • If follow-up, monitoring and support at home required, refer to CCN team • Provide safety-net for parents ◦ written or verbal information on warning symptoms and accessing further healthcare (use **Bronchiolitis advice sheet** https://www.nhs.uk/conditions/bronchiolitis/) • Liaise with other professionals to ensure parent/carer has direct access to further assessment e.g. OOHs	• Send child for urgent assessment to PAU/refer urgently to emergency department (consider 999 call) • Commence oxygen support

CAPILLARY BLOOD SAMPLING ● 1/1

INTRODUCTION

- To ensure safe and effective capillary blood sampling in the community
- Procedure to be performed within nurse's scope of professional practice and competency
- Patient clinically stable, well hydrated, no broken skin and non-oedematous

EQUIPMENT

- Gloves and apron
- Single use lancet (appropriate for age and size of the child/young person)
- Vaseline
- Blood bottles
- Plaster
- Blood form
- Gauze
- Chlorhexidine 2% in 70% alcohol skin wipe

PROCEDURE

- Discuss procedure with parent and child/young person
- Gain verbal consent (from young person if age appropriate)
- Check sensitivities to plaster
- Prepare all necessary equipment (see above)
- Decontaminate hands as per Trust policy
- Don apron and gloves
- Select most appropriate digit, ensuring it is clean and warm
- if necessary, further clean entry site with skin alcohol wipe and allow to air dry
- Apply thin layer of yellow soft paraffin to aid ease of blood collection
- Puncture dermis layer of the skin using a single use lancet
- Gently compress digit and hold skin under tension
- avoid squeezing digit too tightly – dilutes specimen with plasma and increases likelihood of haemolysis
- Continue until sufficient blood obtained
- When blood collection procedure complete, apply firm pressure to site with gauze to stop bleeding and apply plaster
- Mix sample to avoid sample clotting
- Label bottle and blood form with patient details and place in blood bottle in clear envelope
- Dispose of all waste and sharps as per trust policy
- Deliver blood samples to relevant laboratory for processing and investigation
- all samples to be transported in designated sealable red plastic transport boxes to reduce risk of spillage and contamination

AFTERCARE

- Obtain blood sample results in a timely manner and liaise with professionals documenting full name of professional to whom you provided the results to
- Inform parents of results as appropriate
- If >2 specimen types required, consider venepuncture as a more accurate alternative (paediatric phlebotomy service, Heartlands Hospitals)

COMPLICATIONS

- Unable to obtain sufficient sample
- Infection due to breaking of skin
- Excessive bleeding
- Fainting
- Inaccurate results
- Sample clotting requiring repeat bloods
- Incorrectly labelled blood bottle

CHILD DEVELOPMENT (COMMUNITY) ● 1/2

RED FLAGS

Age	Red flags
All	• Parental concerns • Apathy and inactivity • Irritability, head banging, feeding problems • Regression (loss of previous skills) • Abnormal head size or growth • Dysmorphic features
10 weeks	• Not smiling
6 months	• Persistent ◦ primitive reflexes ◦ squint ◦ hand regard or fisting • Hand preference • Disinterest in people, toys or sounds
10 months	• Not sitting unassisted • No double syllable babble • No localisation to sound • No pincer grip • Poor eye contact
18 months	• No vocalisation • <6 words • Persistent drooling or mouthing • Abnormal grasp or posture • Not walking independently (excluding bottom shuffling)
2−3 yr	• No 2 word sentences • Lack of social eye contact • No focused play • Not pointing to indicate wants • Not sharing interests without an underlying ‘want’ • Repetitive play and rigid routines
>4 yr	• Lack of to-and-fro conversation • Obsessive interests • Hyperactivity and impulsiveness • Poor attention span (e.g. unable to sit for meals or watch full cartoon video)
>6 yr	• Specific problems with reading, writing, spelling (disproportionate to skills in speaking, memory, maths) • Difficulties with writing, dressing or using cutlery beyond expectations for age

NORMAL DEVELOPMENT

Useful resources

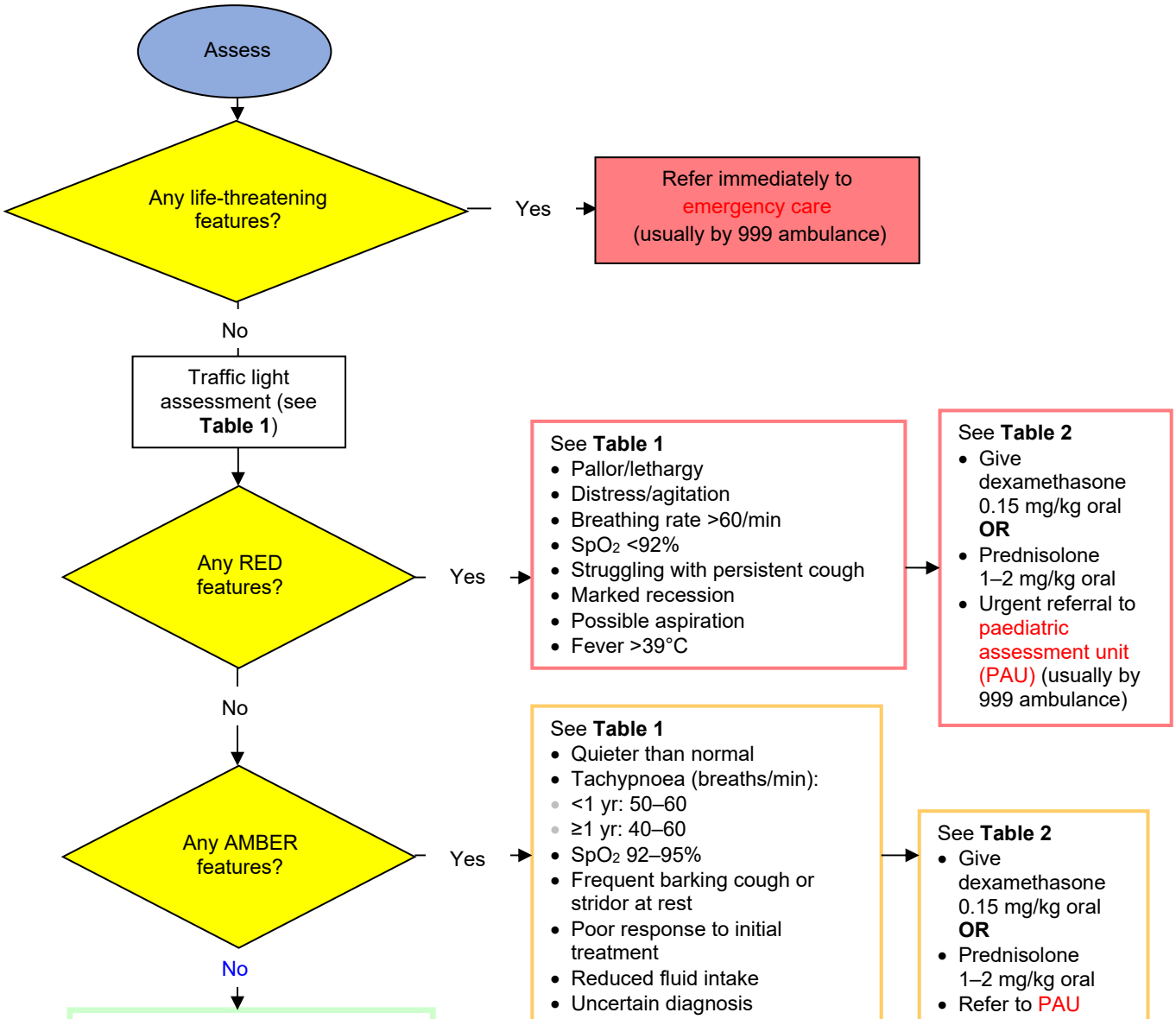
- A systematic approach to developmental examination (with videos) PediNeuroLogic Exam https://neurologicexam.med.utah.edu/pediatric/html/home_exam.html
- Denver II Developmental Screening Test (PDF) https://www.ccmedical.org/forms/1428352937_171971.pdf

Normal developmental milestones

Age	Gross motor	Fine motor and vision	Hearing, speech and cognition	Social and play
Birth	• Flexed posture • Complete head lag • Normal tone • Symmetrical limb movements	• Primitive reflexes only	• Cries	• Responds to touch and voice • Face regard • Responds to light
6 weeks	• Partial head control	• Primitive reflexes still strong • Eyes and head follow a face 180°	• Some vocalisation	• Smiling
4 months	• Good head control • Elbow press-ups	• Holds rattle and shakes it	• Goos and gaas	• Laughs
6 months	• Full press-up • Sits with support	• Fist grasp and transfers	• Single syllable babble	• Explores objects with mouth
9 months	• Gets to sitting • Rolls over • Pulls to stand	• Finger-tip grasp • Index finger approach to small object	• Double syllable babble	• Waves bye-bye • Plays peek-a-boo • Finger feeding • Wary of strangers
12 months	• Walks one hand held	• Pincer grasp	• 2−3 words with meaning	• Holds spoon
15 months	• Walks alone • Climbs stairs holding hand	• 2 cube tower	• Points to several body parts	• Casting • Drinking from cup
18 months	• Runs • Climbs on chair	• 4 cube tower	• 10 words	• Spoon feeds • Imitative play
2 yr	• Climbs stairs (2 feet/step) • Kicks ball	• 8 cube tower • Copies vertical line	• 2 word sentences	• Help with dressing • Imaginative play
3 yr	• Climbs stairs (1 foot/step) • Pedals tricycle	• Builds bridge • Copies circle • Threads beads	• Uses short sentences • Knows colours • Likes stories	• Dresses self • Eats with fork and spoon
4 yr	• Runs fast • Hops	• Copies cross and square • Draws 3-part man	• >5 word sentences • Counts to 4	• Eats unassisted • Takes turn in play
5 yr	• Skips	• Draws triangle	• Follows complex commands • Understands opposites	• Ties shoe laces • Plays games by rules

CROUP AGED 3 MONTHS – 6 YR (COMMUNITY) ● 1/2

Algorithm



CROUP AGED 3 MONTHS – 6 YR (COMMUNITY) ● 2/2

If GP review in a specific time period clinically appropriate but falls outside of in-hours GP service, advise patient/family to call NHS 111 (at agreed time interval/level of deterioration – depending on concerns); provide letter detailing clinical findings and concerns to assist out-of-hours GP assessment

ASSESSMENT

Table 1: Traffic light system to identify severity of illness

	Green Low risk	Amber Immediate risk	Red High risk
Colour	• Normal		• Pallor/lethargy
Activity	• Child alert	• Quieter than normal	• Distress/agitation
Respiratory rate	• Aged <1 yr: <50 breaths/min • Aged ≥1 yr: <40 breaths/min	• Aged <1 yr: 50–60 breaths/min • Aged ≥1 yr: 40–60 breaths/min	• All ages >60 breaths/min
SpO_2 in air	• ≥96%	• 92–95%	• <92%
Cough	• Occasional barking cough • No stridor	• Frequent barking cough and stridor at rest	• Struggling with persistent cough
Chest recession	• None	• Subcostal and retrosternal recession	• Marked subcostal and retrosternal recession
Other	• CRT <2 sec	• Poor response to initial treatment • Reduced fluid intake • Uncertain diagnosis • Significant parental anxiety or late evening/night presentation • No access to transport/ long way from hospital	• History of possible foreign body aspiration • Temperature ≥39°C

MANAGEMENT

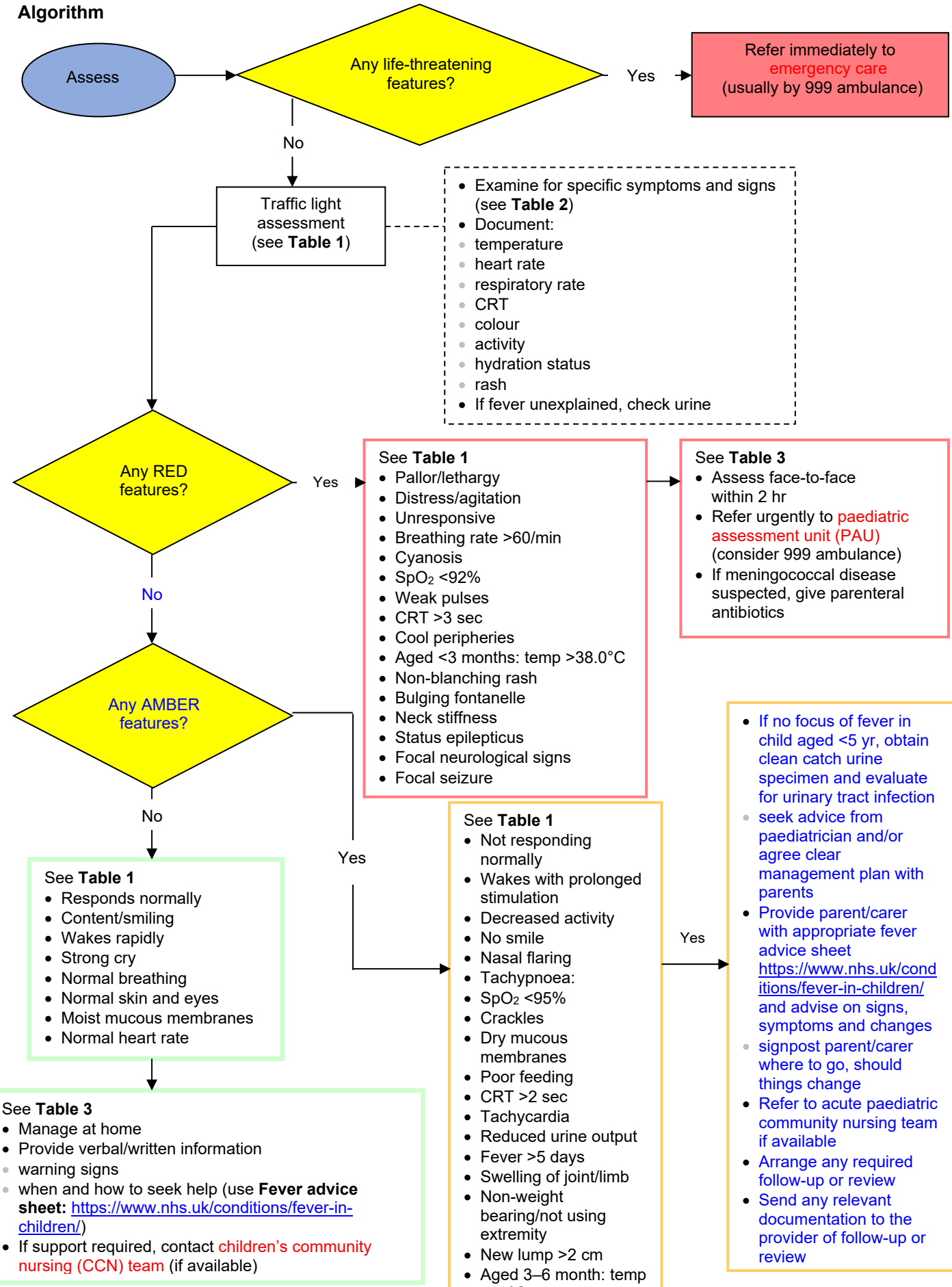
Table 2: Management of croup (community)

Green Low risk	Amber Immediate risk	Red High risk
• Give single dose dexamethasone 0.15 mg/kg oral **OR** • Prednisolone 1–2 mg/kg oral • If residual symptoms of stridor present next day, consider giving 2nd dose • Can be managed at home with appropriate care and advice • Always provide verbal/written information about warning signs and when to seek further advice (use **Croup advice sheet**) • Refer to CCN team for additional support if required	• Give single dose dexamethasone 0.15 mg/kg oral **OR** • Prednisolone 1−2 mg/kg oral • Refer to PAU	• Give single dose dexamethasone 0.15 mg/kg oral **OR** prednisolone 1–2 mg/kg oral • Send child for urgent assessment to PAU (usually by 999 ambulance)

- Croup advice sheet (NHS Choices): https://www.nhs.uk/conditions/croup/

FEVER ● 1/3

Algorithm



If GP review in a specific time period clinically appropriate but falls outside of in-hours GP service advise patient/family to call NHS 111 (at agreed time interval/level of deterioration − depending on concerns); provide letter detailing clinical findings and concerns to assist out-of-hours GP assessment

ASSESSMENT

Table 1: Traffic light system to identify severity of illness

	Green Low risk	Amber Immediate risk	Red High risk
Colour	• Normal colour of skin, lips and tongue	• Pallor reported by parent/carer	• Pallor/lethargy
Activity	• Responds normally to social cues • Content/smiles • Stays awake/ awakens quickly • Strong normal cry/not crying	• Not responding normally to social cues • Wakes only with prolonged stimulation • Decreased activity • No smile	• Distress/agitation
Respiratory rate	• Normal breathing	• Nasal flaring • Tachypnoea (breaths/min) ◦ aged 6–12 months: >50 breaths/min ◦ aged >1 year: >40 breaths/min • SpO_2 <95% in air • Crackles in chest	• All ages >60 breaths/min
Circulation and hydration	• Normal skin and eyes • Moist mucous membranes	• Dry mucous membranes • Poor feeding in infants • CRT >3 sec • Tachycardia (bpm): ◦ aged 1 yr: >160 bpm ◦ aged 2–4 yr: >150 bpm ◦ aged ≥5 yr: >140 bpm • Reduced urine output	• SpO_2 <95%
Other	• No amber or red signs/symptoms	• Fever >5 days • Swelling of limb/joint • Non weight bearing/not using extremity • New lump >2 cm • Aged 3–6 months: temp >39°C • Rigors	• Aged 0–3 months: temp >38°C • Non-blanching rash • Bulging fontanelle • Neck stiffness • Status epilepticus • Focal neurological signs • Focal seizure

Table 2: Signs and symptoms of specific illness – diagnoses to be considered

Meningococcal disease	• Non-blanching rash, particularly with ≥1 of the following: ◦ ill-looking child ◦ lesions >2 mm in diameter (purpura) ◦ CRT >3 sec ◦ neck stiffness
Meningitis	• Neck stiffness • Bulging fontanelle • Decreased level of consciousness • Convulsive status epilepticus • Classic signs (neck stiffness, bulging fontanelle, high-pitched cry) are often absent in infants with bacterial meningitis
Herpes simplex encephalitis	• Focal neurological signs • Focal seizures • Decreased level of consciousness

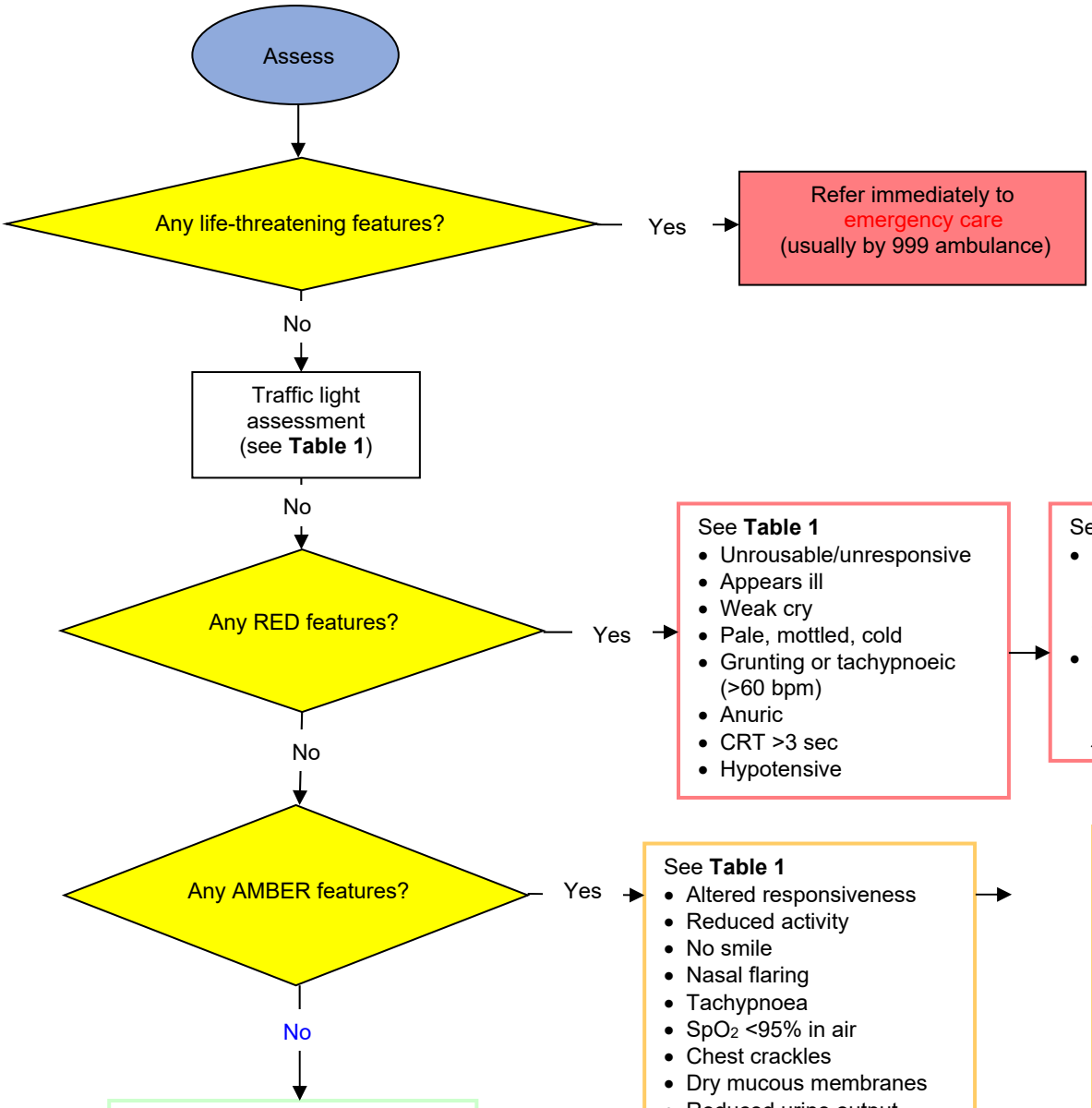
Pneumonia	• Tachypnoea: ◦ aged 0–5 months: >60 breaths/min ◦ aged 6–12 months: >50 breaths/min ◦ aged >12 months: >40 breaths/min • Crackles in chest • Nasal flaring • Chest 'indrawing' • Cyanosis • SpO_2 <95%
Urinary tract infection aged >3 months (consider in any child aged <3 months with fever)	• Vomiting • Poor feeding • Lethargy • Irritability • Abdominal pain/tenderness • Urinary frequency/dysuria • Offensive urine/haematuria
Septic arthritis/osteomyelitis	• Swelling of limb/joint • Not using an extremity • Non weight bearing
Kawasaki disease	• Fever >5 days and ≥4 of the following: ◦ bilateral conjunctival injection ◦ change in upper respiratory tract mucous membranes (e.g. injected pharynx, dry cracked lips or strawberry tongue) ◦ change in peripheral extremities (e.g.: oedema, erythema or desquamation) ◦ polymorphous rash ◦ cervical lymphadenopathy • In rare cases, incomplete/atypical Kawasaki disease may be diagnosed with fewer features than above

MANAGEMENT

Table 3: Management of fever (community)

Green Low risk	Amber Immediate risk	Red High risk
• Can be managed at home with appropriate care and advice • Always provide verbal/written information about warning signs and when to seek further advice (use **Fever advice sheet:** https://www.nhs.uk/conditions/fever-in-children/) • Refer to CCN team for additional support if required	• If assessed remotely, child must be seen face-to-face by GP/ANP • Consider: ◦ referral to PAU for continuous monitoring ◦ referral to CCN team for support and follow-up monitoring ◦ referral to PAU if likely to need overnight admission • Always provide verbal/written information about warning signs and when to seek further advice (use **Fever advice sheet:** https://www.nhs.uk/conditions/fever-in-children/) • Liaise with other professionals to ensure parent/carer has direct access to further assessment e.g. GP out-of-hours	• Send child for urgent assessment to PAU • If assessed remotely, send child to be assessed in face-to-face setting within 2 hr **or** • If indicated refer urgently to PAU by appropriate mode of transport • If meningococcal disease suspected administer parenteral antibiotics and refer urgently to PAU

GASTROENTERITIS (COMMUNITY) ● 1/4



If GP review in a specific time period clinically appropriate but falls outside of in-hours GP service, advise patient/family to call NHS 111 (at agreed time interval/level of deterioration − depending on concerns); provide letter detailing clinical findings and concerns to assist out-of-hours GP assessment

ASSESSMENT

Table 1: Traffic light system to identify severity of illness

	Green Low risk	Amber Immediate risk	Red High risk
Activity	• Responds normally to cues • Content/smiles • Stays awake/awakens quickly • Strong normal cry/not crying	• Altered response to social cues • Decreased activity • No smile	• Not responding normally to/no response to social cues • Appears ill to healthcare professional • Unable to rouse/if roused does not stay awake • Weak, high pitched or continuous cry
Skin	• Normal skin colour • Normal turgor		• Pale/mottled/ashen blue • Cold extremities
Respiratory	• Normal breathing	• Nasal flaring • Tachypnoea (breaths/min): ◦ aged 6–12 months: >50 ◦ aged >1 year: >40 • SpO_2 <95% in air • Crackles in chest	• Grunting • Tachypnoea: ◦ all ages >60 breaths/min
Hydration	• Moist mucous membranes (except after a drink) • Normal urine	• Dry mucous membranes (except after a drink) • Reduced urine output	• No urine output
Circulation	• CRT ≤2 sec • Heart rate normal • Peripheral pulses normal	• CRT 2–3 sec • Tachycardia (bpm): ◦ aged <1 yr: >160 ◦ aged 2–5 yr: >150 ◦ aged >5 yr: >130 • Peripheral pulses weak	• CRT >3 sec
Blood pressure	• Normal	• Normal	• Hypotensive
Eyes	• Normal eyes	• Sunken eyes	

CAUTIONS

Atypical symptoms

Consider alternative diagnoses in presence of following signs and symptoms:

- Temperature:
  - aged <3 months: ≥38°C
  - aged ≥3 months: ≥39°C
- Shortness of breath
- Altered conscious state
- Neck stiffness
- Abdominal distension or rebound tenderness
- History/suspicion of poisoning
- Bulging fontanelle (in infants)
- Non-blanching rash
- Blood and/or mucus in stools
- Bilious (green) vomit
- Severe/localised abdominal pain
- History of head injury
  - consider non-accidental injury

Children at increased risk of dehydration

- Aged <1 yr (especially aged <6 months)
- Low birth weight
- ≥6 diarrhoeal stools in past 24 hr
- Vomited ≥3 times in last 24 hr
- Not been offered/unable to tolerate supplementary fluids before presentation
- Infant stopped breastfeeding during illness
- Signs of malnutrition

Stool microbiology advice

- Recently been abroad
- Diarrhoea has not improved by day 7

MANAGEMENT

GP fluid challenge

- Fluid should be clear, ideally oral rehydration solutions e.g. Dioralyte™
- If child is breastfed continue breastfeeding
- Seek review if:
  - not taking fluids
  - not keeping fluids down
  - becoming more unwell
  - reduced urine output

Table 2: Treatment of gastroenteritis (community)

Green Low risk	Amber Immediate risk	Red High risk

• Can be managed at home with appropriate care and advice
• Always provide verbal/written information about warning signs and when to seek further advice (use **Gastroenteritis advice sheet** https://www.nhs.uk/conditions/diarrhoea-and-vomiting)
• If required, refer for additional support from CCN team
• Preventing dehydration:
  ◦ continue breastfeeding or other milk feeds
  ◦ encourage fluid intake
  ◦ discourage fruit juices and carbonated drinks [especially children at increased risk of dehydration (see **Children at risk of dehydration**)]
  ◦ see **Stool microbiology advice**
	• If assessed remotely, child must be seen face-to-face by GP/ANP
	• If blood in stool or suspicion of septicaemia, or if child is immunocompromised, refer to PAU
	• If poor oral intake refer to PAU
	• If borderline toleration of oral feeds or social concerns, refer to CCN team
	• If tolerating oral feeds child may be managed at home
	• Always provide verbal/written information about warning signs and when to seek further advice (use **Gastroenteritis advice sheet** https://www.nhs.uk/conditions/diarrhoea-and-vomiting) Liaise with other health professionals to ensure parent/carer has direct access to further assessment e.g. OOHs
	• If prolonged gastroenteritis consider referral to hot clinic for paediatrician assessment at PAU
	• Fluid advice if sent home:
	  ◦ give oral rehydration solution (see **GP fluid challenge**)
	  ◦ continue breastfeeding
	  ◦ consider supplementing with usual fluids (including feeds/water, but not fruit juices or carbonated drinks)
		• Send child for urgent assessment to PAU. Consider mode of transport (999 to ED)
		• En-route parents should be encouraged to give child fluids often and in small amounts (including milk feeds/water but no fruit juices/carbonated drinks)

	• if after 2 hr child not tolerating feeds, attend PAU • refer to **Stool microbiology advice** • give **Children's oral fluid challenge advice sheet**	

Table 3: Normal maintenance fluid volumes for children not dehydrated and rehydration volumes for children at risk of/clinically dehydrated

- See **APLS – Recognition of a sick child** guideline **'APLS aide-memoire boys and girls'** for typical weight for age

Weight (kg)	Maintenance fluid volume (mL/hr)	Rehydration fluid volume (mL/10 min)
2	8	6
3	12	8
4	16	12
5	20	14
6	24	16
7	28	20
8	32	22
9	36	24
10	40	28
11	42	30
12	44	32
13	46	34
14	48	38
15	50	40
16	52	42
17	54	44
18	56	46
19	58	50
20	60	52
21	61	54
22	62	56
23	63	58
24	64	60
25	65	64

GASTROSTOMY TUBE/LOW PROFILE DEVICE ● 1/1

INTRODUCTION

- Purpose of procedure: to ensure safe and effective access and/or change of gastrostomy tube/low profile device (button)
- Procedure to be performed within nurse's scope of professional practice and competency
- Ensure appropriate timing of intervention of change of gastrostomy tube/low profile device (button)
- Liaise with specialist services as required

EQUIPMENT

- Appropriate replacement gastrostomy device (G tube/low profile device)
- Gloves and apron
- 5 mL Luer slip syringe x 2
- Lubricant
- Gauze
- Water for balloon
- pH strips
- Extension tube
- Enteral syringes
- Measuring device (if necessary)

PROCEDURE

- Discuss procedure with parent and child/young person
- Gain verbal consent (from young person if age appropriate)
- Decontaminate hands as per Trust policy
- Collect all necessary equipment (see above)
- Check expiry date and integrity of equipment
- Position child/young person in a comfortable, relaxed position in a safe and secure way if necessary, with parent/nurse support
- Access balloon port on gastrostomy device to be removed using 5 mL Luer slip syringe
  - remove water in balloon whilst holding gastrostomy device securely in place
  - remove gastrostomy device by placing fingers either side and pulling gently
- Insert new gastrostomy device into stoma using water-based lubrication gel to ease insertion
  - if required use an introducer to aid insertion
  - inflate balloon with appropriate amount of water – depending on size of device/as per individual care plan
- Following procedure check position of gastrostomy tube/low profile device by aspirating tube or attaching appropriate extension set and check pH is ≤5.5 when position confirmed flush with water
- Dispose all waste and decontaminate hands as per Trust policy

AFTERCARE

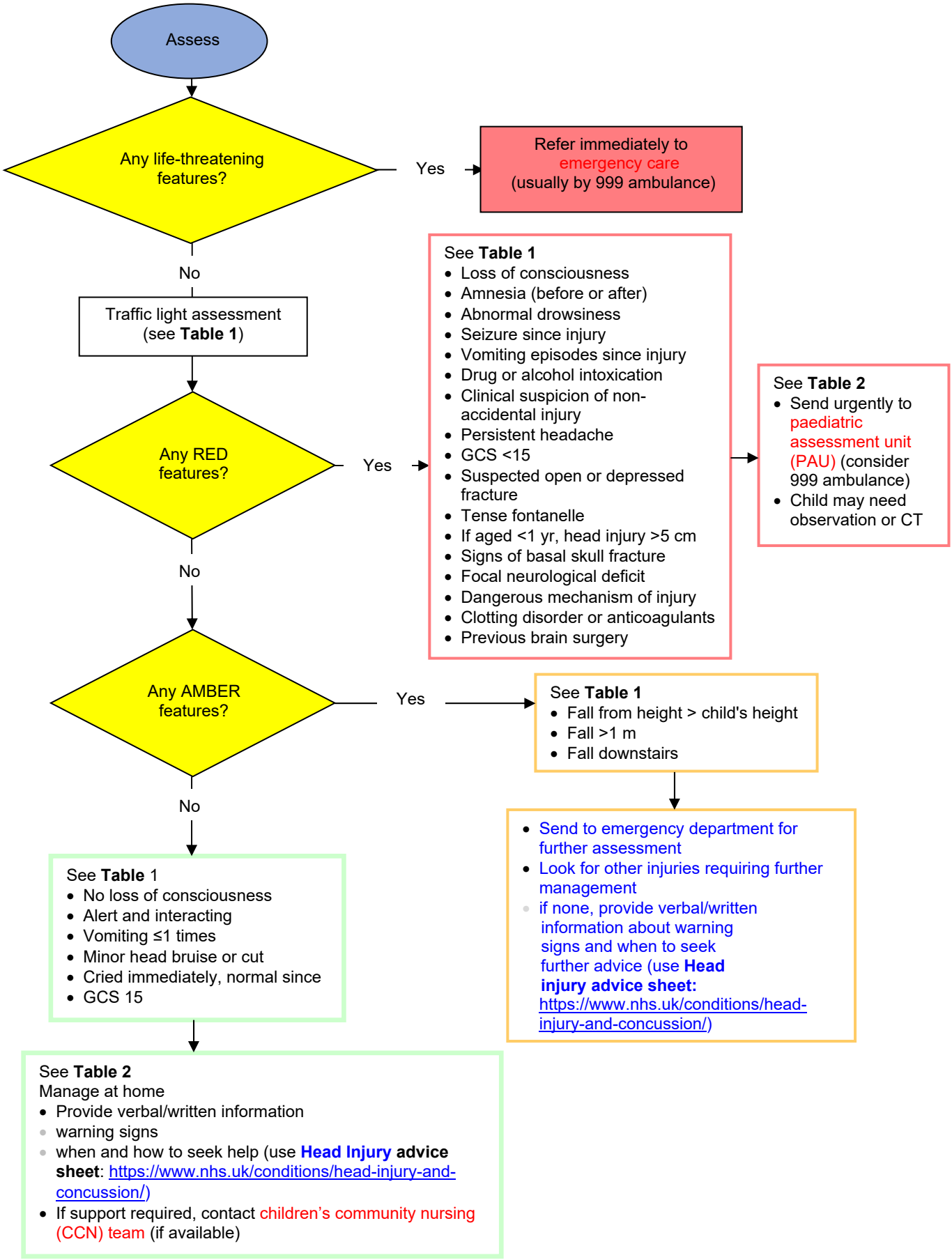
- Regular review size of low-profile device (button)
  - remeasure using measuring device to ensure appropriate size and fit as needed
- Document new device on nursing records including LOT number and expiry date
- Observe stoma for:
  - infection
  - over granulation
  - inflammation
  - leakage
- Ensure appropriate action taken. i.e. swab/prescription request for treatment
- Change device 3–6 monthly

COMPLICATIONS

- Aspirate pH reading too high (possibly indicating tube misplacement)
- Gastrostomy tube can be accidentally removed due to balloon malfunction/by physical force, increasing risk of stoma closure
  - unable to reinsert gastrostomy tube/low profile device
  - stoma at risk of closure – urgent medical attention required
  - risk of infection around stoma site

HEAD INJURY (COMMUNITY) ● 1/2

Algorithm



HEAD INJURY (COMMUNITY) ● 2/2

If GP review in a specific time period clinically appropriate but falls outside of in-hours GP service advise patient/family to call NHS 111 (at agreed time interval/level of deterioration − depending on concerns) and provide letter detailing clinical findings and concerns to assist out-of-hours GP assessment

ASSESSMENT

Table 1: Traffic light system to identify severity of illness

Green Low risk	Amber Immediate risk	Red High risk
• Has not been knocked unconscious at any time • Is alert and interacts with you • Has vomited, but only once • Has bruising/minor cuts to the head • Cried immediately but is otherwise normal • GCS 15 (see **Glasgow coma score** guideline)	• Has fallen from a height greater than child's own height • Has fallen from >1 m • Has fallen downstairs and no red high risk features	• Any loss of consciousness as a result of injury • Amnesia for events before and after injury • Abnormal drowsiness • Seizure since the head injury • Vomiting episodes since the injury • Drug or alcohol intoxication • Clinical suspicion of non-accidental injury or any safeguarding concerns • Persistent headache since the injury • Aged >1 yr: GCS 14 • Aged <1 yr: GCS (paediatric <15 on assessment) • 2 hr post-injury: GCS <15 • Suspicion of open/depressed skull injury or tense fontanelle • Aged <1 yr: presence of bruise, swelling or laceration of >5 cm on head • Any sign of basal skull fracture: ◦ haemotympanum 'panda' eyes ◦ cerebrospinal fluid leakage from ears/nose ◦ bruising over mastoid process (Battle's sign) • Focal neurological deficit • Dangerous mechanism of injury: ◦ high speed road traffic collision ◦ fall from >3 m ◦ high speed injury from projective/object • Has blood clotting disorder/on anti-coagulants • Any previous brain surgery

Glasgow coma score

- See **Glasgow coma score** guideline

MANAGEMENT

Table 2: Management of head injury (community)

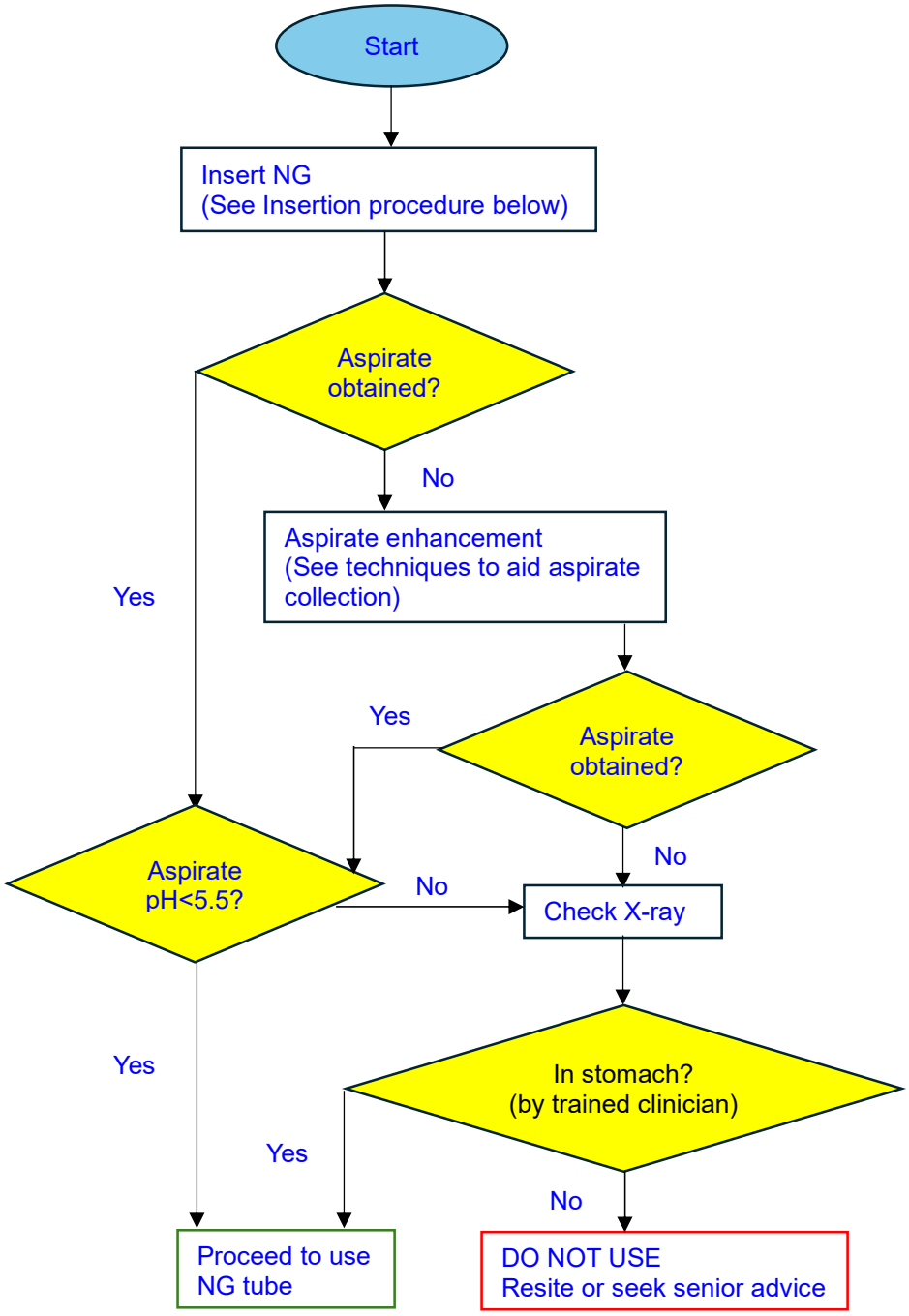
Green Low risk	Amber Immediate risk	Red High risk
• Can be managed at home with appropriate care and advice • Always provide verbal/written information about warning signs and when to seek further advice (use **Head injury advice sheet:** https://www.nhs.uk/conditions/head-injury-and-concussion/) • Request additional support from CCN team if required	• Look for other injuries requiring further management • If none, provide verbal/written information about warning signs and when to seek further advice (use **Head injury advice sheet:** https://www.nhs.uk/conditions/head-injury-and-concussion/)	• Send child for urgent assessment at PAU • Consider mode of transport (999 to emergency department) • Child likely to need a period of neurological observation in hospital or head CT • Head injury with alcohol consumption – if GCS altered refer to PAU

NASOGASTRIC TUBE PLACMENT AND MANAGEMENT ● 1/4

Fine bore nasogastric (NG) tube placement and management in children and infants (excluding neonates)

PURPOSE

- To provide guidelines and procedures for placement, confirmation, ongoing management, and removal of fine bore NG tube in children and infants (excluding neonate)
- Full NPSA flowchart: https://rightdecisions.scot.nhs.uk/media/cd4pxbyi/decision-tree-for-nasogastric-tube-placement-checks-in-children-and-infants.jpg



Insertion Procedure

Preparation

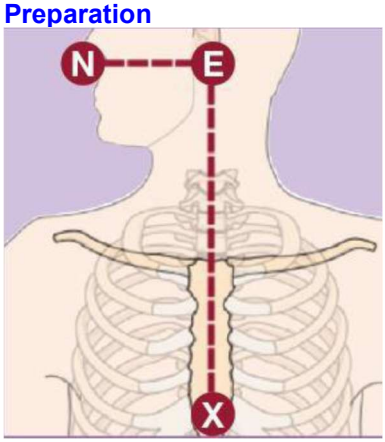


Figure 1: Nose ear xiphisternum

- **NEX measurement**
- primary method for estimating the length of NG tube to be inserted is the "Nose ear xiphisternum" (NEX) measurement
  - involves placing exit port of tube at the tip of the nose, extending it to earlobe, and then to xiphisternum
  - document the NEX length in the notes
- **Tube specifications**
- NG tubes used for feeding must be fully radio-opaque, have visible length markings, and be licensed for enteral feeding
- do not use drainage tubes (e.g., Ryles tube) for feeding or medication administration
- **Guidewires**
- if guidewire is present, ensure it is easy to move and firmly engaged before insertion
  once removed, **never reinsert** to prevent perforation
- if X-ray is required, tube is radio-opaque without guidewire

Procedure for insertion

- Obtain written consent (see **Consent and documentation** below)
- Explain the procedure
- Ensure child is comfortable and supported in an upright position (avoiding head tilt backwards)
- Measure NEX length
- Check nostril patency, using natural anatomy for passage
- If safe to do so (i.e. no unsafe swallow), encourage swallowing (sips of water/dummy) to close the epiglottis
- Insert to NEX length
- **Stop immediately** if child becomes distressed, cyanotic, or has an unresolved cough

Confirmation of placement

Mandatory Before Use: Crucially, NG tube position MUST be confirmed before any feeding, medication, or flush is administered

pH testing

- First-line method for confirming NG tube placement in the stomach is testing the pH of aspirated gastric contents
- **pH between 0 and 5.5** is considered a reliable indicator that tube is **not in the lung**.
- However, it **does not definitively confirm gastric placement**, as the tube could be in the oesophagus (which carries a higher risk of aspiration)

X-ray as confirmation

- If aspirate cannot be obtained after employing various techniques (see **Techniques to aid aspirate collection** below) or if pH is ≥6, an X-ray is required to confirm position of NG tube in the stomach

Unreliable methods

- These are **PROHIBITED** and should **NOT** be used which include: auscultation ("Whoosh test")
- interpretation of aspirate appearance
- observation for bubbling at the end of the tube
- use of litmus paper (specifically requires CE marked pH paper for gastric aspirate)
- absence of respiratory distress
- appearance of the tube

Techniques to aid aspirate collection

- If aspirate is difficult to obtain initially, attempt specific techniques sequentially, re-attempting aspiration after each step:
- child's position: to right side, left side and sitting up
- inject 1−5 mL of air into the tube
- wait for a few min
- advance/withdraw the tube by 1−2 cm
- provide mouthcare (if nil-by-mouth) or a drink (if safe swallow)

Ongoing position re-confirmation:

- Re-confirm NG tube position regularly during ongoing use, not just after initial insertion. This includes:
- before starting/restarting feeds
- before each bolus feed/medication
- at least once every 24 hr
- before administering medication (if no feed)
- after episodes of coughing, retching, or vomiting
- if the external length changes
- if there is any suspicion of displacement.

Factors affecting pH

- Feeds and medication can alter gastric pH, making interpretation less reliable
- Stop continuous feeds for 1 hr before rechecking pH

Risk assessment for ongoing tubes (limited use):

- Risk assessment process can be used to re-confirm the position of an existing NG tube when aspirate cannot be obtained or pH is ≥6, before resorting to X-ray
- This assessment involves checking:
- tube length is same as last confirmed
- no events likely to cause displacement to have occurred (coughing vomiting, suction physiotherapy, etc.)
- visually checking for coiling
- ensuring the fixation tape/device is secure
- ensuring a good amount of aspirate is obtained (at least 2mls)

It is never safe to risk assess a newly inserted NG tube for use

Risks and contraindications

- Inadvertent placement in the lungs
- Displacement into the lungs
- Reflux and aspiration
- Rarely, oesophageal/gastric perforation
- Contraindications include:
- base of skull fractures/unstable cervical spine injuries
- intestinal obstruction
- tracheoesophageal fistula/pharyngeal pouch
- altered anatomy

Consent and documentation

- Informed consent is required
- if child cannot provide valid consent, decision is based on their best interests, with discussion with family/representatives where appropriate

- Document all decisions, discussions, and procedures, including insertion attempts, confirmation methods, and ongoing checks, thoroughly in the medical records

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These guidelines are advisory, not mandatory. Every effort has been made to ensure accuracy. The authors cannot accept any responsibility for adverse outcomes

Suggestions for improvement and additional guidelines would be most welcome by Partners in Paediatric, please contact via www.partnersinpaediatrics.org

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