Barts Health NHS
NHS Trust

TRUST CLINICAL GUIDELINE

Management of Children with Sickle Cell Disease

APPROVING COMMITTEE(S)	Clinical Policies Group – Chair's Action	Date approved:	April 2019
EFFECTIVE FROM	Jan 2019		
DISTRIBUTION	Paediatric haematology teams across sites, Paediatric Emergency medicine, Paediatric medicine and specialties (nephrology, urology, microbiology, endocrinology, surgery, gastroenterology, anaesthesia, orthopaedics, ophthalmology, ENT)		
RELATED DOCUMENTS	Paediatric resuscitation, paediatric haemoglobinopathy transfusion guidelines, blood transfusion guidelines for children and neonates, infection control, pain management and PCA policy, controlled drugs policy, safeguarding children, care of adolescents Barts Health Transition policy, Barts Health Sickle Acute pain pathway, Barts Health Sickle Pain protocols: intranasal diamorphine and oral morphine, buccal fentanyl and oral morphine, Barts Health Guidelines for monitoring and treatment of iron overload, East London and Essex Haemoglobinopathy shared care policy		
STANDARDS	National Haemoglobinopathy Peer Review Standards 2018, NICE: sickle cell acute pain episode: management of an acute painful sickle cell episode in hospital (2012), NHS Sickle Cell and Thalassaemia Screening ProgrammeNHS Sickle Cell and Thalassaemia Screening Programme Standards Implementation date 1 April 2017, SICKLE CELL DISEASE IN CHILDHOOD STANDARDS AND GUIDELINES FOR CLINICAL CARE 2nd edition October 2010,Caring for people with Sickle cell and thalassaemia syndromes:RCN competencies: a framework for nursing staff (2011), A sickle cell crisis? A report of the National Confidential Enquiry into Patient Outcomes and Death (2008), Transition: improving the transition of young people with longterm conditions (2006),TCD Scanning for Children with Sickle Cell Disease (2009)		
OWNER	Paediatric Haemoglobinopathy service Barts Health NHS Trust		
AUTHOR/FURTHER INFORMATION	Women and Children's CAG, Clinical Support services CAG		
SUPERCEDED DOCUMENTS	Paediatric sickle cell guidelines 2015		

REVIEW DUE	Jan 2022
KEYWORDS	Sickle cell, pain, acute chest syndrome, stroke, transfusion
INTRANET LOCATION(S)	http:// [file location]

CONSULTATION	*Barts Health*	Barts Health pain team, microbiology, acute medicine, emergency medicine
	External Partner(s)	

SCOPE OF APPLI	**Included in policy:** *For the groups listed below, failure to follow the policy may result in investigation and management action which may include formal action in line with the Trust's disciplinary or capability procedures for Trust employees, and other action in relation to organisations contracted to the Trust, which may result in the termination of a contract, assignment, placement, secondment or honorary arrangement.*
	All Trust staff and those working on an honorary contract within the Trust

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1 INTRODUCTION

1.1 The sickle cell disorders are a heterogeneous group of disorders affecting patients in whom haemoglobin S is the major haemoglobin. They include haemoglobin SS, SC, and S beta thalassaemia.

1.2 This clinical guideline has been compiled by the haemoglobinopathy team at Barts Health NHS trust. It has been formulated following reviews in service, based on current practice and research including published standards in the management of children with sickle cell disease.

1.3 It is intended for the guidance of in and out-patient management. Cases need to be assessed individually and the management tailored appropriately. The opinion of the Consultant Paediatric Haematologist or Paediatrician (with special interest in SCD) should be sought where necessary.

1.4 Contact details for the members of the Specialist Team

Contacts	
RLH 0207 377 7000 (Switchboard)	
David Kafuko	Network administrator, via email David.kafuko@nhs.net
Luke Shackleton	Paediatric Haematology secretary, x60352
Dr Banu Kaya (RLH)	Consultant Haematologist, x60352
Dr Paul Telfer (RLH)	Consultant Haematologist, x60352
Dr Filipa Barroso	Consultant Haematologist, x60338
Dr Andrea Simmons (RLH)	Consultant Paediatrician, x 60352
Paediatric Haematology SpR - Haematology (RLH)	Bleep 1239
Paediatric Haematology SpR- Paediatricis (RLH)	Bleep 0818
Paediatric SHO covering Haematology (RLH)	Bleep 1295
Kim Newell (RLH)	Lead Haematology CNS – X 40401 mob 07718271805
Isaac Amoh	Haematology CNS – X 40401, mob 07718271805

On call SHO (RLH)	Bleep 1207
Paediatric Day care	X41425 / 6
WXH 0208 539 5522 (Switchboard)	
Dr Farzana Bashir	paediatrician – x 5196
Medical day unit (Acorn Ward)	X 5844
Community Haemoglobinopathy nursing team and secretary	0208 430 7639 (24 hour answer phone)
NUH 0207 476 4000 (Switchboard)	
Dr Anjum Bahadur	Locum Consultant Paediatrician -020 7363 8086
	Sicke cell and Thalassaemia CNS – 020 7363 8914, or aircall through switchboard
Rainbow paediatric day unit	020 7363 8914

2 DEFINITIONS

Haemoglobinopathy	A group of inherited conditions where the pathology relates to abnormalities in haemoglobin production or function. Includes haemoglobin variants and thalassaemias.
Sickle cell disease	This encompasses a number of genotypes including Hb SS, Hb SC, Hb S/beta thalassaemia and some rarer compound heterozygote states where Hb S dominates and results in a clinically significant condition.
Child	Trust transition age for adult care is > age 16. For the purposes of this policy a child is a person less than 16 years old.
Adolescent	This includes teenagers and young adults age up to 20 years. Some of these will be managed in the paediatric service and some in adult service

3 ARRANGEMENTS FOR EMERGENCY ASSESSMENT, ADMISSION AND SPECIALIST ADVICE

3.1 Patients can access acute care via ED at NUH, WXH and RLH

3.2 Emergency Patients should be booked through reception and rapidly assessed

3.3 An electronic record of observation and clinical assessment should be made

3.4 Unwell patients should be managed in the resuscitation suite according to Trust resuscitation guidelines

3.5 Paediatric attending team (paediatic haematology team in the case of RLH) will be informed of acute presentation for urgent review

3.6 All patients will be rapidly moved to a cubicle for prompt treatment

3.7 Medical and Nursing staff will identify patient record on Cerner Millenium or shared drive as agreed locally to access treatment plan and follow guidance

3.8 For acute pain crisis, analgesia if required will be administered according to guidelines aiming for first dose within 30 minutes of presentation (Appendix 5)

3.9 A decision to deviate from the pathway should be made only following discussion with a senior paediatrician or haematologist

3.10 Prompt medical assessment will follow including electronic recording of presenting problem and documentation of treatment plan

3.11 Required analgesia and other urgent medication including antibiotics will be prescribed on medical drug chart (not ED chart) to avoid delay in administration of subsequent doses. If required the second dose of analgesia will be administered BEFORE patient is moved to the acute inpatient ward

3.12 If the patient is admitted as an outlier to another ward the patient will be transferred to a specialty ward within 48 hours according to Trust policy (RLH only)

3.13 In appropriate cases early discussion with the the paediatric haematology team at RLH with a view to transfer of acutely unwell patients from NUH or WXH to RLH can be considered

3.14 The admitting paediatric team remains responsible for the inpatient episode, at NUH and WUH, but the Lead Paediatrician with special interest in haemoglobinopathies should be informed of their admission and asked for advice

3.15 Out of hours (5pm -9am and weekends) patients of concern will be discussed with the Paediatric Haematology Consultant on call (RLH mobile via switchboard)

3.16 The paediatric haematology team at RLH sees all patients Monday to Friday

3.17 Unwell patients will be prioritised on the ward round for review

3.18 At evenings and weekends, patients will be seen by the on-call paediatric medical teams and discussed with the on-call Paediatric Consultant Haematologist at RLH if necessary

3.19 SCD patients at other E London and Essex Haemoglobinopathy Network hospitals can be discussed with RLH attending paediatric haematology consultant (Monday –Friday 9-5) or the on call paediatric haematology consultant out of hours and at weekends (via switchboard)

3.20 **Admission to hospital**

The following are indications for admission to hospital:

- Persistent temperature
- Pallor, lethargy, malaise, abdominal distension
- Pain requiring opiate analgesia
- Symptoms and signs suggesting acute chest syndrome, acute cerebrovascular event, sequestration syndrome, aplastic crisis and fulminant priapism (lasting>3hr)
- Any other significant illness

3.21 **Discharge from hospital**

3.22 Prior to discharge ALL cases must be discussed with the paediatric haematology SpRs / Consultants (senior medical team out of hours) at RLH, or paediatrician with special interest at NUH and WXH. Appropriate follow up should be arranged. A short supply of analgesia and antibiotics (including prophylactic penicillin) should be made available.

3.23 **Follow up options**

- early outpatient appointment if less unwell.
- review within 1-2 weeks on ambulatory unit (RLH) or OPC. All discharges from RLH out of hours must be notified to the paediatric haematology team the following day. At Whipps Cross and NUH the Lead Paediatrician should be informed by email of attendance

3.24 **Routine Baseline Investigations:**

- FBC, reticulocyte count
- U+Es, Creatinine, LFTs, LDH
- CRP
- G+S
- Red cell phenotype (if not known)

In older children presenting with an uncomplicated vaso-occlusive sickle cell crisis, a finger prick test for FBC may be done in the first instance. Note however, all patients on hydroxycarbamide (hydroxyurea) and chelation therapy with Desferrioxamine, Deferipone or Exjade must have routine baseline investigations as above. Other tests may be indicated based on presentation.

- CXR (respiratory symptoms/signs)
- Urine dipstick/culture, blood, throat, nose, sputum, stool, wound, CSF culture, NPA (as dictated by symptoms)
- Mycoplasma /Chlamydia serology/urinary pneumococcal antigen (respiratory symptoms/signs)
- Parvovirus serology (IgM) / DNA (Pallor/falling Hb/low reticulocyte count)
- CT/MRI/MRA head (CNS symptoms/signs)
- Arterial/capillary blood gases (respiratory distress / metabolic compromise)
- Hb S level (Acute chest syndrome/stroke in new patient or patients on transfusion programme)
- Yersinia serology/stool culture (patients on desferrioxamine with diarrhoea /abdominal pain)
- Serum amylase (abdominal symptoms/signs)
- Plain abdominal film /USS abdomen (abdominal symptoms/signs, features of girdle syndrome, sequestration, cholecystitis)
- USS limb / MRI limb/ limb/joint x-ray (suspected osteomyelitis)

ACUTE COMPLICATIONS

4 Acute anaemia

- All patients with SCD have haemolytic anaemia resulting in low steady state Hb
- An acute drop in haemoglobin can be for many reasons
- Most patients are able to tolerate 10-20g/L drop in Hb (e.g., during a simple pain event) however a significant drop in haemoglobin requires investigation and may require treatment
- Causes include sequestration, haemolysis related to VOC or G6PD deficiency, transfusion reactions or aplastic crisis
- The reticulocyte count will provide diagnostic information as well as guiding treatment

4.1 Aplastic Crisis

Presentation:

- Onset of profound anaemia over 1 – 3 days with reticulocytopenia and without sequestration.
- Due to transient marrow hypoplasia induced by parvovirus.

Investigation:

- As per routine baseline investigations, in addition:
- Parvovirus DNA and antibody titres.

Management:

- If there is no reticulocyte response or the patient is cardiovascular compromised consider transfusion.
- Immunity appears to be lifelong.

5 FEVER, INFECTION AND OVERWHELMING SEPSIS

5.1 Sickle cell patients are particularly susceptible to severe overwhelming blood borne infections

5.2 Important organisms to consider are Streptococcus Pneumoniae, E coli and Salmonella species. The use of prophylactic penicillin has decreased the incidence of pneumococcal infections

5.3 Always look for a focus of infection when the patient is febrile and organise cultures

5.4 FIRST LINE ANTIBIOTCS:

5.5 Any child with two temperatures of 38.0°C and one at 38.5°C, but who appears mild to moderately ill should receive IV antibiotics:

- >6 months: IV Ceftriaxone 50 mg / kg/ once daily
- 1-6 months: IV Cefotaxime 150 mg / kg / day in 3 divided doses.

5.6 If signs of chest infection as well as the above add in oral Clarithromycin (to cover mycoplasma, for dosage see BNFC). Also do mycoplasma titres, if it is positive a 10 day course is required, otherwise stop

5.7 Patients who are clinically well and are afebrile should continue penicillin prophylaxis. If the child then enters either category 5.12 or 5.13 (see above) they should start on IV antibiotics

5.8 Any child with a sequestration syndrome, chest syndrome, or septic, must receive high dose IV antibiotics:

- >6 months: IV Ceftriaxone 80mg / kg once daily (max 4g/day). Consider dose reduction after 24 hours or when clinically stable. (First dose can be cefotaxime in ED)
- 1-6 months: IV Cefotaxime 200 mg / kg / day in 3 divided doses, after 3 days reduce to 50 mg / kg / day

5.9 Pyrexia associated with chelation therapy

- Patients on chelation therapy with desferrioxamine presenting with pyrexia and/or diarrhea /abdominal pain should be treated for Yersinia Enterolitica with oral

ciprofloxacin. Stool for culture and Yersinia serology should be organised. Chelation therapy must be stopped.

- Note risk of neutropenic sepsis with deferiprone (agranulocytosis) and Exjade (cytopenia).

6 ACUTE PAIN EPISODE

6.1 This is the most frequent complication of sickle cell disease and a common reason for presentation to hospital. Typically the child will present with limb, back or chest pain. A trial of simple analgesia may have been instituted by the family.

6.2 An enquiry into this as well as potential precipitating factors should be made e.g., coryzal symptoms, dehydration, over exertion.

6.3 The mainstay of the management of sickle cell crisis is supportive and includes

- Pain relief
- Fluid replacement

6.4 **Pain Management and PCA – please see separate pain management protocol**

Fluid replacement

6.5 Many patients with sickle cell disorders have reduced tubular concentrating ability and continued fluid loss without adequate replacement causes a reduction in plasma volume with an increased blood viscosity and aggravation of sickling.

6.6 Children with sickle cell disease need individualised fluid regimes. They are often dry and will need additional fluids; conversely overzealous fluid replacement may make the situation worse by precipitating cardiac failure.

Hyperhydration is not recommended

6.7 The oral / enteral route is always preferred. However, in those who are unable to tolerate this due to pain, abdominal / respiratory problems, IV fluids may be required in accordance with the paediatric IV fluid guidelines. Intravenous therapy should be stopped once the patient is stable and pain is controlled.

6.10 Adequate oral intake should be documented and fluid balance carefully monitored.

7 ACUTE SPLENIC and HEPATIC SEQUESTRATION

7.1 Acute Splenic Sequestration (More common in young children)

7.2 Presentation:

- Sudden onset of tachypnoea, pallor, abdominal pain, and splenic enlargement.
- Precipitated by fever, dehydration, and hypoxia.
- Rapid sequestration of red cells can lead to a sudden fall of the hemoglobin and death from hypoxic cardiac failure with pulmonary oedema.
- May have a more insidious onset.

7.3 Investigation:

- FBC + reticulocyte count
- G+S (+red cell phenotype if not previously performed)
- Blood-culture
- U&Es, creatinine, LFTs, CRP
- Store serum for virology

7.4 Management:

- Assess the need for volume expansion and site a cannula.
- Crystalloid should be used with caution as this may exacerbate heart failure.
- Organise for phenotypically matched red cell transfusion without delay (if in extremis uncross matched O negative).
- Broad-spectrum antibiotics to cover pneumococcus and haemophilus:- see antibiotics section.
- Patients with recurrent splenic sequestration should be considered for splenectomy after prior administration of Pneumovax, Men C and Hib Vaccines

7.5 Hepatic Sequestration

7.6 Less common than splenic sequestration in children but treated in the same way.

8 ACUTE CHEST SYNDROME

8.1 **THIS IS A MEDICAL EMERGENCY**

- It is not possible to tell the difference between an acute chest syndrome and a chest infection; early transfusion is important and frequently life saving

Background

- The acute chest syndrome is a common acute complication in SCD
- It can be a de novo presentation, or evolve during the course of a severe acute painful episode
- It can progress rapidly to respiratory failure and death
- The disease process may involve pulmonary fat embolism and acute vaso-occlusion of the pulmonary vessels by sickled red blood cells.
- Exchange blood transfusion is the most effective treatment for ACS, and if done at an early stage, can reverse ACS and prevent severe adverse effects.

Warning symptoms

- Tachypnoea
- Pain on breathing
- Cough
- Pain in the chest wall
- Pain within the chest

Warning signs

- Increasing respiratory rate
- Increasing pulse rate
- New fever

- Decreasing oxygen saturations (preferably on room air)
- Chest examination: New crepitations, signs of consolidation

Check

Check past history of ACS and transfusion history

8.2 Investigations:

- As per routine baseline investigations, in addition:
- Hb S% (only new patients and those on transfusion program)
- Capillary blood gas
- Chest X-ray (Presence of new infiltrate on CXR is one of the criteria for diagnosis of ACS. However, sometimes these changes are delayed. May be difficult to differentiate ACS from bacterial/viral pneumonia and atelectasis. Severe ACS associated with bilateral opacification starting from lower zones)
- Sputum and blood cultures
- Serum/urine for atypical screen (mycoplasma AB, urine pneumococcal antigen)
- NPA
- Throat swab for mycoplasma PCR

8.3 Management:

- **Prompt recognition of acute chest syndrome is paramount**
- **Pay attention to the National Early Warning Score (NEWS)**
- **DISCUSS WITH PAEDIATRIC HAEMATOLOGIST AT RLH TO PLAN FOR TRANSFUSION THERAPY (SIMPLE TOP UP OR EXCHANGE)**
- **Inform blood bank that transfusion/exchange transfusion may be needed and ask if there will be problems in supplying blood urgently – if delay, escalate to paediatric haematologist and transfusionist on call**
- IV fluids as in painful event whilst awaiting transfusion (watch carefully for fluid overload, usually no more than 50% maintenance, interrupt during top up transfusion and reduce fluids when exchange transfusion is completed)
- Analgesia: Will need to involve pain team. Adequate analgesia required to enable chest expansion, but without causing over-sedation. RLH protocol is for fentanyl i.v. PCA in severe cases. Fentanyl is a potent opiate with a relatively short half- life so is easier to titrate. i.v. morphine often causes over-sedation and many patients are tolerant of morphine through previous use.
- Treat underlying infection (Ceftriaxone 80mg/kg plus clarithromycin, see BNFC)
- Maintain target oxygenation (>94%) and monitor with pulse oximetry
- Regular bronchodilators by nebuliser
- Prevent further atelectasis using incentive spirometry
- Early PCCU / CATS / anaesthetic referral (AVOID NIV outside of critical care setting)
- Transfusion (as discussed below).

8.11 **Transfusion**:

- Decisions regarding transfusion should be made by the Paediatric haematologist.
- Transfusion commonly results in impressive improvement within hours
- The aim of transfusion is to maintain Hb 90-110 g/dl (not above 110g/dl) and reduce HbS%

to <30%.

- Simple transfusion is indicated for patients with:
    - mild or moderate chest syndrome, particularly with falling Hb levels
- Exchange transfusions are used to:
    - reduce the Hb S concentration rapidly;
    - Whilst avoiding the problems associated with increased fluid volume and viscosity.
- Exchange transfusion is indicated when there is evidence of:
    - clinical deterioration
    - worsening CXR changes
    - hypoxia
    -
- Blood should be requested urgently from blood bank, giving the information that patient has SCD, requires blood matched for ABO, full rhesus and Kell antigens.

  If there is a documentation of red cell allo-antibodies, blood should be negative for the relevant antigen.

  Blood does not have to be fresh (<10 days old).

  Blood bank may wish to request new stock of blood units from the regional blood centre, but it is important to avoid a severe delay in blood issue, and if suitable stock is available on site, these should be used.

Transferring patients to specialist centre at RLH

- Local consultant should discuss with the attending Consultant or on call paediatric haematology consultant
- A teleconference meeting should be organised with the transfer team(CATS or STRS), local paediatrician and the attending consultant / paediatric haematology consultant to make arrangements for appropriate local support and transfer
- Transfer will be organised to PICU (6C) for level 2-3 paediatric cases but transfer to the ward may be appropriate for more stable patients
- If patient is considered too unstable to transfer, advice will be to undertake for management including manual exchange transfusion at local site with telephone advice from consultant.

Complications related to ACS

There is a higher risk of posterior reversible leuco-encephalopathy (PRES) syndrome following ACS. BP should be carefully monitored and treatment considered if BP >95% systolic. Nifedine for short acting BP control may be considered. Amlodipine can help to control peresistent hypertension.

9 ABDOMINAL PAIN DUE TO BILIARY COLIC / SEPSIS / GRIRDLE SYNDROME

Presentation/Investigation/Management

- Biliary colic+/- biliary sepsis or girdle syndrome
- Investigations include U+Es /LFT/amylase/lipase/USS abdomen /plain abdominal film
- Girdle syndrome presents with severe abdominal pain, abdominal distension, hepatomegaly, reduced bowel sounds, this should be managed as for ACS
- All biliary complications should be discussed with the paediatric

gastroenterology/hepatobiliary team

- Manage with IV fluids, IV antibiotics (ceftriaxone +/- metronidazole), analgesia, consider ERCP/MRCP

10 ACUTE NEUROLOGICAL COMPLICATIONS

- Sickle cell patients are at risk of a number of neurological complications:
  Acute ischaemic stroke, Acute haemorrhagic stroke, Silent cerebral ischaemia/infarction, Cerebral venous thrombosis, Posterior reversible leuco-encephalopathy, Subarachnoid haemorrhage, CNS infections, Cognitive deficits.
- These may present as: acute severe headaches, transient ischaemic attacks, seizures, visual impairment, speech disturbance, acute altered cognition.

10.1 Arterial Ischaemic Stroke (AIS)

The risk of overt AIS has significantly reduced following transcranial doppler (TCD) screening but can still occur. There is an increased risk following acute chest syndrome, severe acute anaemia and other life threatening complications.

10.2 Presentation:

- There is often a significant delay between stroke onset and diagnosis in children usually because of failure to recognise the significance of the acute clinical presentation. The commonest clinical presentation of childhood arterial ischaemic stroke (AIS) is acute hemiparesis. About 20%of AIS is referable to the posterior circulation and here clinical signs may include ataxia, vertigo and vomiting. Seizures occur in 20% of children.
- Acute neurological signs may not be clear cut in a child with AIS due to sickle cell disease, who present more commonly with ‘soft signs’ and there should be a low threshold to suspect the diagnosis in this group of children.

- **Any new neurological signs (including seizure) in children with sickle cell disease should be evaluated as potentially being a stroke**

1. Brain MRI with DWI and head/neck MRA is recommended for the investigation of children with clinical stroke.
2. Brain MRI should be undertaken as soon as possible after presentation. If brain MRI will not be available within 48hrs, CT is an acceptable initial alternative.
3. Brain Imaging should be undertaken urgently in children with clinical stroke who have a depressed level of consciousness at presentation or whose clinical status is deteriorating.
4. Consider transthoracic cardiac echocardiogram within 48hours after presentation in all children with arterial ischaemic stroke.
5. Consider investigating for another underlying prothrombotic tendency. This should include evaluation for protein C and protein S deficiency, activated protein C resistance, increased lipoprotein {a}, increased plasma homocysteine, factor V leiden, prothrombin G20210A and MTHFR TT677 mutations and antiphospholipid antibodies.

10.3 Management: ABC

- **Blood pressure should be maintained at an adequate level to optimise cerebral perfusion.**
- Adapted from RCP guidelines:

    a) All children with stroke should have regular assessment of conscious level and vital signs.

    b) Urgent exchange transfusion should be undertaken to reduce %HbS to < 30% and raise haemoglobin to 100g/L (avoid >110g/L).

    c) If the patient has had a neurological event in the context of severe anaemia (eg splenic sequestration or aplastic crisis), or if exchange transfusion is going to be delayed for more than 4 hours, urgent top-up blood transfusion should be undertaken.

10.4 **Multidisciplinary assessment:** Adapted from RCP guidelines

- As soon as possible after admission, all children following stroke should have an evaluation of:
    - swallowing safety
    - feeding and nutrition
    - communication
    - pain
    - moving and handling requirements
    - position requirements
    - risk of pressure ulcer
- All children affected by stroke should have a multidisciplinary assessment within 72hours of admission to hospital.

10.5 Secondary Prevention

1. Regular blood transfusion (every 3 to 6 weeks) should be undertaken to maintain the HbS% < 30% and the Hb 100 -110g/L.
2. Transfusion may be stopped after 2 years in patients who experience stroke in the context of a precipitating illness, eg, aplastic crisis and whose repeat vascular imaging and trans cranial doppler velocities are normal at this time
3. After 3 years a less intensive regime maintaining HbS < 50% may be sufficient for stroke prevention.
4. Those who cannot receive blood transfusions because of allo-immunisation , auto-antibody formation, lack of vascular access or non-compliance with transfusion or chelation may be considered for treatment with hydroxycarbamide.
5. Addition of aspirin (for dosage see BNFC), neuro-revascularisation procedures and bone marrow transplantation should be considered.

10.6 Posterior leuco-encephalopathy (PRES) syndrome

This is a clinico-radiological diagnosis characterised by headache, visual impairment, acute focal neurology and seizures. There is usually hypertension. This is particularly seen following ACS and can be recurrent.

The MR head imaging is characteristic.

Awareness with careful monitoring of fluid balance to avoid excess fluid loading and monitoring of BP is important.

BP control may be required. Nifedine for short acting BP control may be considered. Amlodipine can help to control peresistent hypertension, see section on cardio-respiratory complications.

11 PRIAPISM

- A sustained, painful and unwanted erection of the penis. The mean age at which priapism occurs is 12 years and by the age of 20, as many as 89% of males with SCD will have experienced one or more episodes of priapism.
- Typically, priapism affects the corpora cavernosae, very rarely the corpus spongiosum may be affected. Penile ischaemia and acidosis begin to occur about 6 hours into a sustained priapic episode.

11.1 Triggers

- fever
- dehydration
- cold exposure
- full bladder
- REM sleep
- Alcohol
- sexual arousal

11.2 Stuttering priapism

- Recurrent
- Pain of variable intensity
- Erection lasting < 3 hours
- Penis may not be fully erect
- Low risk of cavernosal fibrosis and impotence
- Risk of subsequent fulminant attack

11.3 Fulminant priapism

- Severe pain
- Duration >3 hours
- Penis fully erect
- High risk of cavernosal fibrosis and impotence
- Urgent intervention indicated

11.4 General principles of management of priapism

- Attempt to urinate
- Try warm bath

- Try Vigorous exercise
- Hydration
- Analgesia-usually parenteral opiates
- Sedation may be required in severe cases

11.5 Acute management of fulminant priapism (See diagram below)

General points

- Many patients are not aware that priapism is a complication of sickle disorders and may be reluctant to discuss it. Stuttering priapism is under-diagnosed, symptoms should be specifically asked for at outpatient clinic visits.
- It is vital to attend for treatment as early as possible. Delay may increase the risk of cavernosal fibrosis and impotence. Discuss WXH patients with Lead Clinician in hours or Paediatric Heamatology team at RLH out of hours. Discuss with urology team.

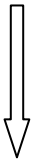
Management of Fulminant Priapism

Hydration: IV fluids, consider saline bolus

Analgesia: morphine (see PCA and MST protocols)

Sedation: consider diazepam 2-5mg tds, (max dosage see BNFC)

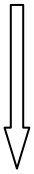
X-match blood, check FBC, renal profile



No detumescence within 30 mins

Top-up transfusion

Follow transfusion guidelines



No detumescence within 2 hours

Theatre for:

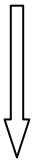
Intracavernosal Etilefrine

5mg undiluted (0.5ml)
NB Monitor BP and pulse

If no response, BP and pulse maintained,

Side effects of etilefrine includes hypertension tachycardia CVA

Relative contra-indication Cerebrovascular disease



Winter's Cavernosal-shunt

Consider- epidural

-Suprapubic catheter

If no response

Consider proximal shunts

Consider exchange transfusion

No detumescence

11.6 Management of Stuttering Priapism

Indication: Stuttering Priapism – prophylaxis and treatment

Diagnosed if: recurrent pain of variable intensity, erection lasts <3hours. Penis may not be fully erect, low risk of cavernosal fibrosis/impotence, risk of subsequent fulminant attack.

General point: It is vital to treat as early as possible to reduce the risk of cavernosal fibrosis and impotence.

Availability: Named patient medicine, hospital pharmacy only

- Preparations kept in Pharmacy
- Etilefrine injection 10mg in 1ml
- Etilefrine 25mg capsules
- Etilefrine 5mg tablets

11.7 Dose: INJECTION

Paediatrics age <16 years – Acute Fulminant Priapism, lasting >4hrs 5mg (0.5ml) undiluted injected by intra-cavernosal route.

Adults/>16yrs: 5-10mg undiluted, by intra-cavernosal injection under local anesthetic (done by Urology team).

11.8 Dose: ORAL

Paediatrics - Treatment **and** prophylaxis

- 0.5mg/kg at night OR 0.25mg/kg bd (depending on when onset of symptoms is more common e.g. night only or throughout the day and night).
- Continue for a total 4 weeks and then stop/wean depending on recurrences.
- Monitor blood pressure (follow up at 1 week and then monthly).

11.9 Monitoring:

- During therapy, patients should be seen weekly on acute assessment unit or outpatient clinic (or in local doctors surgery if prior agreement has been obtained) for assessment of response and of side effects.
- Blood pressure should be checked and treatment stopped if blood pressure above 90th centile for age (See PEWS CHART) or experiencing increased headaches or any symptoms suggestive of TIA.

11.10 Other treatment options

For prophylaxis against stuttering and fulminant episodes consider:

- Flutamide 250 mg tds
- Casodex 150 mg OD
- Zoladex 3.6 mg s/c monthly

Note: that these treatments are expected to cause impotence for the duration of therapy. For more information on Etilefrine see appendix 5. All patients should be referred for urology input.

12 PROTEINURIA / HAEMATURIA

12.1 Definition

- Early morning albumin / creatinine ratio > 3.0 mg/mmol or > 1+ proteinuria in a dilute urine specimen
- Nephrotic syndrome: proteinuria ≥ 3+ on dipstick (UA/UC >200mg/mmol), oedema, plasma albumin <25g/l, ± hyperlipidaemia.
- Haemastix positive does not necessarily mean there will be proteinuria

12.2 Aetiology

- Transient, orthostatic, glomerulonephritis, nephrotic syndrome, tubulo- interstitial disease

13 SICKLE CELL NEPHROPATHY

- Possibly due to mesangial phagocytosis of sickled cells, an immune complex mediated process, glomerular hypertrophy or glomerular injury by hyperfiltration. Kidneys show focal segmental glomerulosclerosis. May progress to full blown nephrotic syndrome and end stage renal failure

13.1 Investigations:

Urine

- urine albumin/creatinine ratio on first morning urine and pm ambulatory sample
- urine microscopy and culture
- urinalysis for blood and glucose

Blood

- FBC, renal profile

Radiology

- Renal tract ultrasound

13.2 Once orthostatic proteinuria has been excluded

- ESR , EMU osmolality
- Autoimmune/ vasculitic screen

- DMSA scan

13.2 Management:

- STOP NSAIDS, review all medication (including chelation). Use codeine phosphate (12yrs+) or dihydrocodeine (<12yrs) instead for mild /moderate pain, monitor BP

13.3 When to refer to Nephrology and indications for biopsy

- Duration > 6 months
- Excretion > 1 gm / 24 hours
- Family history of renal disease
- Macroscopic haematuria
- Sustained hypertension
- Renal failure
- Hypocomplementaemia
- Age less than 1 year or greater than 10 years
- Hypertension, proteinuria, increasing severe anaemia, and haematuria predict renal failure in Sickle cell patients

CHRONIC COMPLICATIONS

14 OUTPATIENT MANAGEMENT

14.1 The Aims of the Clinic are to:

- Monitor progress of the children: medical, educational and psychosocial
- Establish baseline observations for comparison in acute illness
- Educate parents and children in the management of sickle related disease
- Genetic counseling

14.2 New Patients

- Usually referred following neonatal screening, but also patients presenting from overseas

14.3 Registration:

- FBC, reticulocyte count
- Haemoglobinopathy screen (sickle solubility test, Hb electrophoresis, Hb A2 and F estimation By HPLC), G6PD screen
- Blood group, red cell phenotype/genotype
- Take full family history including names, ages and address(es) and plans for future children
- Parents and all siblings should have a full blood count, haemoglobinopathy screen
- Explain to parents the probable diagnosis and its implications, including genetic counselling
- Demonstrate splenic palpation
- Provide written information including on the National Haemoglobinopathy Registry
- At each visit the sickle cell clinic proforma should be followed for documentation of the consultation (Sickle Cell clinical database or paper version can be used)
- Measure height and weight document on growth chart, pulse oximetry, examine the child

including for palpable splenomegaly

- Faltering growth should be managed with the nutrition team and nutritional intervention considered
- Document any sickle-related or other illness since last visit, immunisation status, school progress and attendance and holiday plans. Ask about bed-wetting, priapism (boys). Sleep study should be organized for symptoms of upper airways obstruction. Enquire about learning/ behavioral concerns, discuss at psychosocial MDT. Healthy lifestyle advice should be given
- Ensure regular supply of penicillin V, folic acid provided by GP. Discuss use of analgesics and ensure GP prescribes supply. For newly diagnosed infants, the first prescription (1/12 supply) should be given from the hospital

14.4 Arrange follow up:

- monthly until age 12 months
- – 6 monthly ages 1-3
- monthly thereafter, unless clinical indication for earlier review
- monthly for children with Hb SC disease if clinically stable
- **ALL CHILDREN WILL REQUIRE A MINIMUM OF AN ANNUAL REVIEW WHICH SHOULD BE COMPLETED BY THE CONSULTANT** (see below and see shared care agreement)

14.5 Screening investigations

- Transcranial doppler screening (TCD) should be organised for all children with homozygous sickle cell disease or HbS/thalassemia over the age of 2 at least annually (more frequently depending on results – see TCD screening protocol).
- Screening for pulmonary hypertension should occur 5 yearly from age 16 with echocardiogram. An echocardiogram might be required earlier than this for investigation of hypertension, unexpected heart murmur, disproportionate cardiomegaly or on the advice of the cardiologist. Screening for chronic sickle lung disease should be organised 5 yearly from age 16. Those patients with recurrent acute chest syndrome or asthma should be referred for respiratory input. Patients with suspected snoring and sleep disordered breathing should be referred for sleep study and ENT input if there is tonsillar/adenoidal hypertrophy.
- Screening for sickle nephropathy should be organised annually with BP monitoring and urinalysis from age 10 and urine protein creatinine ratio (UPCR) organised for those with significant proteinuria. See table below for other screening investigations.

14.6 Communication with patient / MDT

- Copies of correspondence should be sent to patient, local centre, GP and community services. This will have contact details of the lead consultants. Patient information sheet detailing services provided and list of contacts should be made available to new patients. Patient information should be made available covering discussion in clinic e.g. TCD.

14.7 Annual review

- This should be done by a consultant Haematologist or Paediatrician with specialist interest
- It should include review and documentation of acute episodes and complications over the previous year, current medication, transfusion parameters, iron monitoring and iron chelation therapy for those on regular transfusion

- Checking to ensure that routine screening investigations and vaccinations are up to date.
- Discussion of disease-related issues relevant to the patient and family
- If appropriate, a discussion of treatment options including hydroxycarbamide, transfusion and bone marrow transplantation should be undertaken.
- Routine investigations at annual review are shown in the accompanying table.
- The relevant information is prompted by use of the out-patient clinic proforma contained on the RLH Sickle Cell Clinical database

14.8 Site specific issues

- **Royal London patients-** done at Royal London. Information entered on clinical database and sent to patient and GP. Record available on Cerner millennium.
- **Whipps Cross patients-** done at Whipps Cross. Recorded on specific proforma files in patient notes. Record available on Cerner millennium.
- **Newham patients**- done at Newham. Recorded in standard clinical record. Record available on Cerner millennium.

14.9 Policy for DNA

- Patients who DNA on 3 consecutive occasions or young infants on the first appointment should be followed up by the community team and a letter sent to GP and patient. Referral of children who move to another region should be organised by the local / specialist centre and community teams ensure appropriate community input.

15 PREVENTION OF INFECTION IN CHILDREN

15.1 Antibiotic prophylaxis for prevention of pneumococcal disease:

15.2 ALL children with Sickle Cell Disease (including HbSS, HbSC, HbS/Beta thalassaemia) are prescribed Penicillin V by the age of 3 months. This should be taken lifelong.

Dosage:

- 3 months to 5 years 125 mg Penicillin V suspension b.d.
- 5 years and onwards 250 mg Penicillin V suspension/tablets b.d.

15.3 Try to get the children taking tablets as soon as possible (crushed and mixed with some fruit juice). Pharmacies may be prepared to prescribe the dry suspension, or to receive a batch of request prescriptions from the surgery to avoid collecting a repeat prescription for the suspension every week.

15.4 .For those children who are genuinely allergic to Penicillin, Erythromycin is prescribed instead.

Dosage:

- < 2 years 125 mg Erythromycin o.d.
- 2-8 years 250 mg Erythromycin o.d.
- > 8 years 250-500 mg Erythromycin o.d.

- Prescriptions should be given by GP.

15.5 Pneumococcal immunisation:

15.6 Conjugate Pneumococcal vaccine = Prevenar (PCV)

This is part of the universal immunisation programme and will be offered routinely at two, four and thirteen months of age.

15.7 Pneumovax

- All children with Sickle Cell Disease should receive Pneumovax at 2 and 5 years and 5 yearly thereafter. To be given in the outpatient clinic or by GP

- Those children > age 5 not vaccinated should receive 1 dose of prevenar followed by pneumovax 1 month later.
- Children < age 5 not vaccinated: follow BNFC prevenar catch-up guidelines.

15.8 Routine childhood immunisation programme:

Follow standard NHS guidance

15.9 Prevention of Haemophilus Influenza type b:

Older children (over 1 year) who have not previously been immunised should be offered a single dose of Hib vaccine (to be given by GP)

15.10 Prevention of Meningococcal disease:

- If missed, give 2 doses 1 month apart between ages 4 months and 2 years.
- Other children and adults who have not previously been immunised should receive a single dose of Meningococcal C conjugate vaccine (to be given by GP).
- If traveling to countries where Meningitis A is endemic they should be offered quadrivalent meningitis A, C, Y, W135 vaccine (to be given by GP), if not already vaccinated at the age of 14 as part of the universal vaccination program

15.11 Influenza vaccine:

Should be given every year in October/November (to be given by GP).

15.12 Pnemococcal and Haemophilus Septicaemia/Meningitis

- Consider pneumococcal / haemophilus septicaemia or meningitis in any febrile sickle cell child.
- Treat with IV antibiotics without waiting for culture results.
- See antibiotic guidelines.

15.13 Malaria

- Needs urgent anti-malarial therapy appropriate to the zone of infection.
- Inquire about travel history.
- Contact Microbiologist or Hospital for Tropical Diseases (via switchboard) for up-to-date information.
- Transfusion is often necessary as haemoglobin may fall significantly due to increased

haemolysis.

15.14 Malaria prevention:

Children with Sickle Cell Disease are at increased risk of severe malaria if traveling to endemic areas

Many children in East London visit West Africa. Parasite resistance to standard prophylaxis is common and specific advice is especially important. GP to supervise prophylaxis

Regimes vary depending on destination and resistance patterns (consult Hospital for Tropical diseases or Travel clinic)

Chemoprophylaxis should be started before travel and be continued after return. G6PD status should be checked before starting

15.15 Hepatitis B vaccination:

All non-immune children with Sickle Cell Disease should be vaccinated against Hepatitis B in line with the routine national childhood vaccination programme. Those children not born in the UK should be vaccinated at the earliest opportunity.

Vaccinations are recorded in the hospital records and the Child Health Records Booklet.

16 BONE AND JOINT PROBLEMS

16.1 Osteomyelitis

Osteomyelitis causative organisms:

- Salmonella species
- Staph aureus, Haemophilus influenzae
- E-Coli and other Gram -ve bacteria (such as Klebsiella spp.)
- Enterobacter spp
- Mycobacterium spp

16.2 Diagnosis of osteomyelitis:

This is difficult in sickle cell disease. Signs and symptoms could be similar to acute pain crisis. Clinical distinction can be difficult especially with the increased use of antibiotics in painful vaso-occlusive crises.

16.3 Clinical Features:

These usually include: pain, swelling, tenderness. Usually the child is systemically unwell. The commonest sites are the femur, tibia, humerus. Remember that fever may be modest. Presentation could be acute or occur over a period of a few weeks. Suspect osteomyelitis if pain is unusual and does not resolve as expected.

16.4 Investigations:

- FBC, CRP , aeorobic /anaerobic blood cultures

- Stool samples (Salmonella)
- Throat swabs for M, C&S
- NPA for virology if viral infection is suspected
- Bone, pus or tissue samples should be sent to Microbiology for M,C&S and FB, and for 16S rDNA molecular studies.

16.5 Radiology:

X-ray: Early changes include osteopenia and periostitis, periosteal reactions. Similar changes are also seen in acute pain crisis. Early X-rays are then of limited value. X-ray changes do not appear until about 10 days after infection.

Ultrasound: Rapid, non- invasive and easy to target areas of maximum pain. Changes are non-specific and findings are similar to those seen in acute pain crisis.

MRI: Useful in monitoring treatment.

No single imaging technique can reliably distinguish acute infection from infarction

16.6 Treatment:

- Intravenous therapy: start treatment with Intravenous Ceftriaxone +/- Intravenous Flucloxacillin (for dosage see BNFC). This usually depends on culture resultsIntravenous therapy should be between 7 – 14 days., Gram negative bacteria, anaerobic bacteria.

- Oral therapy: again duration and type of antibiotic depends on certainty of diagnosis and culture results. Ciprofloxacin is well absorbed orally and can be used orally or intravenously for Salmonella positive cases. Use Augmentin and Clindamycin (for dosage see BNFC) in culture negative cases (common, especially if prior use of antibiotics). Augmentin provides cover for Salmonella and they both provide cover for staphylococcus.Clindamycin has good bone penetration.

- Decisions over the total length of treatment will depend on the certainty of diagnosis and clinical course, and will need involvement of the orthopaedic and microbiology teams. Treatment of osteomyelitis including IV therapy course is usually for a total of 6 weeks.

- Under no circumstances must surgery be contemplated without prior discussion with the on call haematology / oncology consultant. Most patients will require blood transfusion prior to general anaesthetic – see policy for general anaesthesia.

- In suspected sepsis, hydroxycarbamide (hydroxyurea) and chelation therapy should be stopped due to the risk of cytopenia.

16.7 Avascular Necrosis of the Shoulders and Hips

This complication should be suspected particularly in older children with persistent pain affecting the hip, shoulder, knee, leg or groin. Pain may be worse on movement though also occurs at rest. Often there is restriction of movement at the hip and shoulder joint.

16.8 Diagnosis:

An x-ray should be considered in those patients with persistent / prolonged or recurrent pain.

MRI may show early changes.

16.9 **Management**: **Analgesia.**

- Adequate rest, avoidance of prolonged weight bearing.

- Refer for physiotherapy, consider hydrotherapy.
- Program of gradual non weight bearing exercise – particularly swimming, cycling.
- All cases should be discussed and referred for orthopaedic assessment.
- Consider review of Hydroxyurea (hydroxycarbamide) therapy if thought to be precipitated / exacerbated by this.
- Consider transfusion program in those requiring surgery, debilitated by pain or restricted movement as may prevent progression of damage. Review transfusion program at 6 monthly intervals.

17 EYE PROBLEMS

Patients should be made aware of sickle cell related eye complications. Routine ophthalmological screening is not indicated; however community optician's review should be encouraged. Patients / parents should be advised to report changes in visual acuity, altered / distorted vision, presence of floaters as a matter of urgency and referral made to Paediatric ophthalmology clinic for assessment.

All patients on iron chelation therapy should have annual screening in the ophthalmology clinic for chelation associated cataract / retinopathy formation, see chelation guidelines.

18 GROWTH AND PUBERTAL DELAY

Suboptimal growth and pubertal delay is not uncommon in SCD. There are many factors which may contribute to this including inadequate nutrition and calorie intake and poor disease control.

At each clinic visit height/weight should be documented on the growth chart.

Children with fussy eating habits and inadequate calorie intake should be referred for dietetics input. Additionally children with faltering growth, and/or pubertal delay should be referred for review in the joint haematology/endocrine clinic. Fortification of diet, addition of supplements or consideration of PEG feeding may be necessary. If not already on sickle modifying treatments this should be considered to achieve good disease control.

19 NOCTURNAL ENURESIS

Nocturnal enuresis is a common and challenging problem in SCD

Causes include:

hyposthenuria leading to nocturnal polyuria, decreased bladder capacity or nocturnal bladder overactivity, increased arousal thresholds, and sleep disordered breathing

Management:

Behavioral strategies, e.g., scheduled urination (max x2 / night) and restricting fluids prior to bedtime (2 hours prior)

Bed wetting alarms

Medical management: see appendix 2.

20 CARDIO-RESPIRATORY COMPLICATIONS

20.1 Cardiorespiratory complications

Cardiorespiratory complications seen in SCD include:

- Acute chest syndrome (ACS), see section 8
- Asthma/ bronchial hyper-responsiveness/ obstructive lung defect
- Abnormal pulse oximetry
    - Obstructive sleep apnoea syndrome (OSAS) and sleep disordered breathing (SDB)
    - Chronic hypoxaemia
- Other abnormal pulmonary function test
- Essential hypertension and Pulmonary Hypertension
- Thromboembolism / Pulmonary embolism

There is no clear evidence of chronic lung problems following acute chest syndrome but some adults develop chronic, restrictive lung disease possibly as a consequence of repeated episodes of acute chest syndrome

No association between acute chest syndrome and pulmonary hypertension

20.2 Asthma:

Asthma is more common in children with SCD compared to matched controls (prevalence of varies from 17-24%)

Presence of asthma is associated with higher rates of vaso-occlusive morbidity such as painful episodes and ACS

Asthma is a risk factor for mortality in SCD

Wheezing is common in SCD, and may or may not be associated with a diagnosis of asthma in this population

Airway obstruction and airway reactivity are also common but are also poor indicators of asthma in SCD

Both wheezing and pulmonary function test evidence of airway abnormalities may be important markers of SCD severity

20.3 Abnormal pulse oximetry:

Long term consequences unclear and linked to several complications of SCA including central nervous system events and cognitive dysfunction

Associated with history of acute chest syndrome but association with pain events unclear

Causes:

Daytime, nocturnal, post exercise

Low haemoglobin, low fetal haemoglobin, higher haemolytic rate

Obstructive sleep apnea usually due to tonsillar and adenoidal hypertrophy

Cardio-respiratory disease

20.4 Sleep disordered breathing (SDB) and Obstructive Sleep Apnoea Syndrome (OSAS):

27% in our cohort of 1-4 year olds

Associated with adverse health outcomes such as behavioral problems, daytime sleepiness, cognitive deficits, cardiovascular changes, and reduced quality of life

Nocturnal hypoxaemia is associated with increased vaso-occlusive and neurological morbidity in SCA

20.5 Essential and Pulmonary Hypertension:

Essential hypertension is sometimes seen in children with SCD and may represent early vasculopathy.

Cases should be referred for cardiology opinion prior to inititating antihypertensives unless acutely indicated. Renal opinion may be required if there are any concerns with renal HT.

Nifedipine, amplodipine or ACE inhibitors can be considered.

Pulmonary hypertension is rare in children and defined as mPAP ≥25mmHg at rest (RH cath) occurs in ~10% of adults with SCD but 25% have TRVmax >2.5m/s

This is a combination of pre (hypoxia, haemolysis, TE) and post capillary PHT (L Vent dysfunction-relative systemic HT, chronic anaemia)

Treatment is aimed at prevention.

20.6 Monitoring and management of cardio-respiratory complications:

Routine oximetry in clinics

Meticulous history and examination to exclude asthma, OSAS, recurrent ACS

Aggressive management of SCD- low threshold for hydroxycarbamide (or chronic transfusion programme)

20.7 Prompt investigation and treatment of OSAS:

- Systematic clinical assessment of day-time pulse oximetry (calibrated for HbSS) and history of nocturnal snoring and SDB
    - Presence of large tonsils or history of recurrent tonsillitis

      Refer for tonsillectomy
    - Oximetry studies/polysomnography in others and refer for tonsillectomy if abnormal
    - Repeat Oximetry studies/polysomnography along with history of SDB and snoring 6-12 months after adenotonsillectomy
- Refer for CPAP therapy if persistent OSAS despite tonsillectomy
- CPAP treatment often poorly tolerated

Referral and treatment of asthma, with parental education about allergen avoidance, optimise living conditions

21 TRANSFUSION IN SICKLE CELL DISORDERS

21.1 See haemoglobinopathy transfusion guidance also.

21.2 Anaemia alone in an otherwise well child is not an indication for transfusion unless Hb falls to 50 g/L or lower, in which case discuss with the haematologist with details of previous results. Check reticulocyte counts. Use Kell compatible, Rhesus compatible blood matched for antibody status.

21.3 Simple or 'top-up' transfusion:

Indicated for acute anaemia e.g. aplastic, sequestration crisis or acute bleeding. To calculate volume of packed cells required use guide below:

- If pre-transfusion Hb 95-100g/L transfuse 10ml/kg
- If pre-transfusion Hb 90-94g/L transfuse 12ml/kg
- If pre-transfusion Hb <90g/L transfuse 15ml/kg

Note:

- Do not transfuse to above 110g/dl,
- The volume transfused should be capped at 2 units for children > 50kg
- Document indication for transfusion clearly in notes

21.4 Chronic transfusion programme in day unit setting:

Definition: Repeated transfusions to keep Hb S < 30% over a period of time.

Transfuse at 3 to 4 week intervals to suppress erythropoiesis and keep Hb S <30%. Aim for Hb no more than 110g/L . Patients vary in the frequency and amount of blood required to suppress Hb S production. In children with SC disease it is usually necessary to start with an exchange transfusion, in other children with HbSS (particularly those with a high initial haemoglobin level) exchange may be necessary at times.

21.5 Prior to commencing transfusion programme potential complications of transfusion must be discussed and documented.

- Transfusional iron overload.
- Transfusion transmitted infection – aim for Hepatitis B /C + HIV screen prior to starting.
- Transfusion reactions.
- Ensure hepatitis B vaccination status satisfactory.

21.6 Monitor:

- Hb, Hb S%, Red cell alloantibodies monthly
- Serum ferritin every 3 months
- Start iron chelation when Serum ferritin is 1000ug/L or after 10 transfusions (See Chelation protocol, appendix 5)
- Annual viral screen (HIV, hepatitis B & C) + check immunity to Hep B vaccination –anti-HBs Ab (done in January every year)

22 HYDROXYCARBAMIDE USE IN SICKLE CELL DISORDERS

- See appendix

23 POLICY FOR GENERAL ANAESTHESIA

- All children with SS and SC disease should be discussed with the departments of Paediatric Haematology and Anaesthesia when they are booked for surgery so that a coordinated plan can be made for their care.
- It is the responsibility of the surgical team to ensure a bed is organised and the patient admitted.
- These patients should be scheduled early on the operating list to ensure they are not likely to be cancelled, and to avoid prolonged fasting time.
- Care should be taken to avoid factors which may precipitate the development of a crisis. These include hypoxia, dehydration, acidosis, cold and pain. The majority of crises in the perioperative period occur postoperatively.
- All patients should receive overnight IV hydration the evening prior to surgery requiring a general anaesthetic. If a child has very difficult venous access, the responsible anaesthetist/1061 should be contacted. 3-4 hourly oral hydration should be administed overnight to achieve full maintenance volume, and maintenance fluids should be administered in theatre after cannulation achieved.
- All transfusions will be organised by the paediatric haematology team.
- A valid G & S sample must be organised for all patients. A Hb S % is not necessary pre surgery unless exchange transfusion, see below.

23.1 Transfusion Recommendation for Elective Surgery:

- A three tiered approach is recommended:

    1. **Low risk surgery** short procedures with minimal risk of perioperative complications, e.g. grommets or GA for scans in children who have no other risk factors:
        - **Hb should be ≥ 70g/L.**
    2. **Intermediate risk surgery:** tonsillectomy, splenectomy, laparoscopic cholecystectomy, hip/knee replacements. History of obstructive sleep apnoea. Children with a history of recurrent chest problems or other chronic health problems:
        - **Simple transfusion to an Hb of 110g/L, regardless of HbS levels.**
    3. **High-risk surgery:** thoracic, major upper abdominal surgery or neurosurgery and children with a history of severe sickle related problems e.g. previous CVA. Consider in eye surgery, surgery involving tourniquets:
        - **Transfuse or exchange transfuse to reduce the HbS level to <30%.**
        - **Total Hb Should not be > 110g/L.**

- Children with sickle cell disease may be difficult to exchange transfuse and will require early consultation. Exchange transfusion is difficult to perform, particularly in

small children and should not be carried out unless absolutely necessary.

- Children and their parents should be involved in the decision to transfuse whenever possible.
- Children requiring emergency surgery should be treated similarly if time allows. If this is not possible, blood should be cross- matched and standing by in case of perioperative problems requiring emergency exchange transfusion.
- All patients must be discussed with the Haematology team at presentation.

24 COMMON SURGICAL PROCEDURES

24.1 Adenotonsillectomy

- This is normally indicated for children with tonsillar / adenoidal hypertrophy and confirmed obstructive sleep apoea (OSA) demonstrated on sleep study.
- The input of the ENT team and respiratory teams will be required when planning for this procedure.
- Children with severe OSA and/or additional risk factors (eg cerebrovascular disease, chronic lung disease etc) should also be discussed with PCCU for management prior to the procedure.

24.2 Laparoscopic cholecystectomy

- This is indicated for children with recurrent biliary colic,/ cholecystitis.
- A thromboprophylaxis risk assessment should be carried out and treatment instituted as appropriate, (see trust thromboprophylaxis policy).

24.3 Splenectomy

- This is normally indicated for children with recurrent splenic sequestration (>2 episodes requiring transfusion therapy or 1 life threatening episode) or chronic hypersplenism. Cholecystectomy could be considered at the same time for those children with recurrent biliary colic / cholecystitis.
- A thromboprophylaxis risk assessment should be carried out and treatment instituted as appropriate, (see trust thromboprophylaxis policy).
- If not previously vaccinated, 1 month prior to scheduled splenectomy the patient should receive pneumococcal, HiB conjugate, Men C conjugate. 5 yearly pneumococcal vaccination and penicillin prophylaxis should be recommended.
- Thrombocytosis is common post splenectomy. For sustained platelet counts >$1000x10^9$ low dose aspirin should be considered.

25 USE OF INCENTIVE SPIROMETRY (I.S)

25.1 Patient Selection

All patients of 5 years of age or older who fulfill one or more of the following criteria:

- Acute chest or back pain above the diaphragm
- Receiving opiate analgesia
- Clinical signs of respiratory infection
- Consultant in change or patient specifically requests
- Reduced mobility due to pain

25.2 Incentive Spirometry (I.S.) programme

- 10 maximal inspirations using an incentive spirometer every 2 hours between 08.00 hr and 22.00 hr and while awake at night.
- Completion of I.S. record sheet including measurement of pain scale and Sa02 prior to I.S. and recording of maximum inspiratory capacity achieved following I.S.
- I.S. carried out with the patient sitting in an upright position.
- Patients requiring >35% oxygen should continue with 02 therapy via nasal specs during I.S. breathing.

26 BONE MARROW TRANSPLANTATION

- Bone marrow transplantation should be discussed as a curative intervention for all patients.
- Tissue typing of patients, parents and siblings should be carried out if clinical indication for transplantation.
- Bone marrow transplantation could be considered for patients on sickle modifying intervention:
    - for primary or secondary stroke prevention
    - recurrent acute chest syndrome
    - avascular necrosis
    - recurrent severe acute pain / chronic pain
    - considered for parental preference
- A thorough discussion and explanation of BMT procedure, benefits and risks should be offered to parents of Children with a clinical indication for BMT, a histocompatible sibling.
- If there is willingness proceed, the child and family should be formally referred to St Mary's Hospital, Paddington, giving summary of medical condition, relevant investigations, and a copy of the HLA typing results.

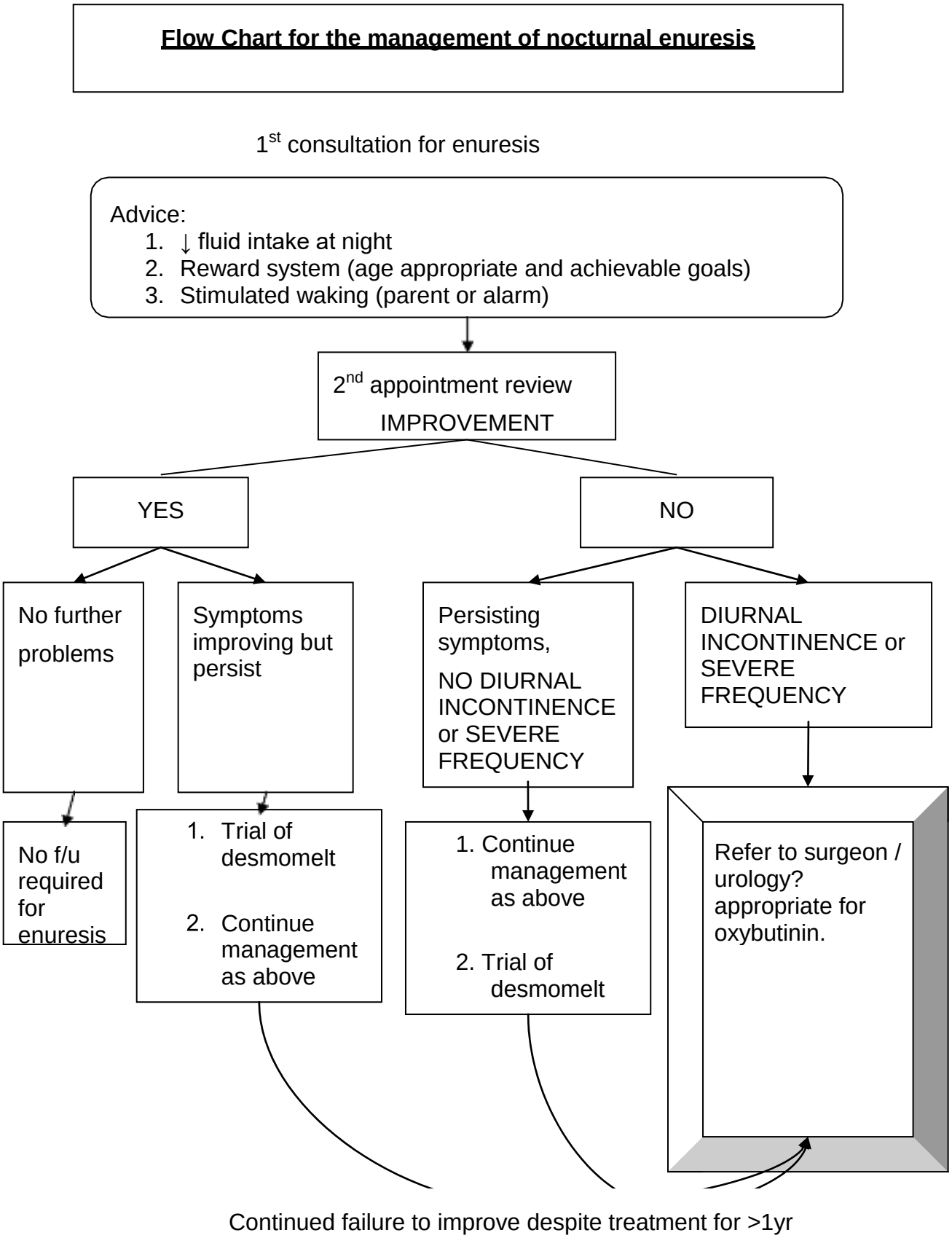
Adolescent Transition

Please see trust and haemoglobinopathy transition policy.

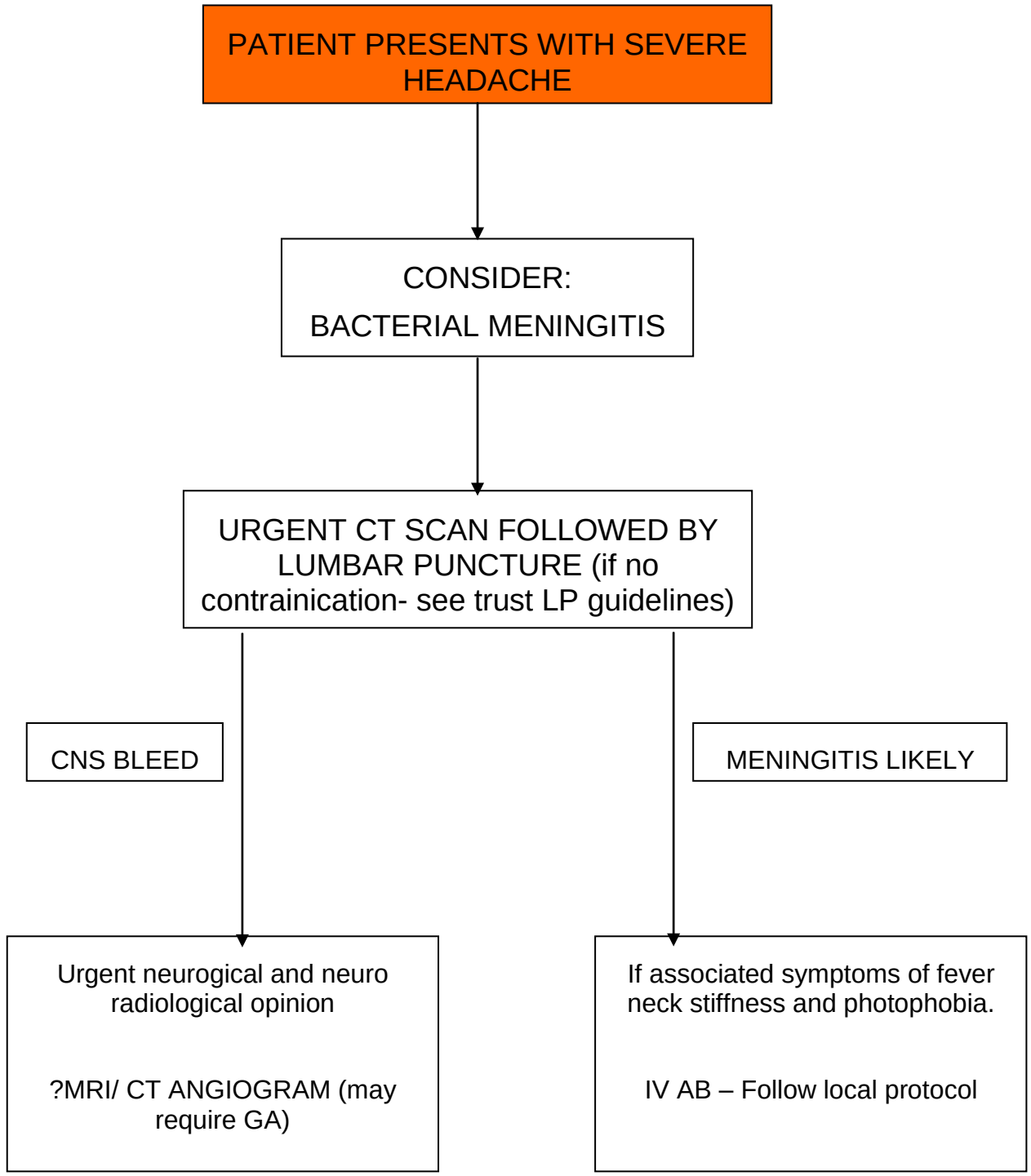
Appendix 1: Annual Investigations Table

INVESTIGATION OR INTERVENTION	IST APPT	1YR	2YRS	3YRS	4YRS	5YRS	6YRS	7-15YR, ANNUAL	16-19 YRS
FBC/ Retics/ Biochem/ LDH	●	●	●	●	●	●	●	●	●
HbS/F level	●	●	●	●	●	●	●	●	
G6PD level	●								
Blood group and full red cell phenotype	●								
HepBSAg, HepC Ab HIV A/B * Annual in transfused pts		●							
Transcranial dopplers			●	●	●	●	●	●	●
Urine Prot/Creat ratio/ BP monitoring								● Age 10+	
Pulmonary function tests/ ECHO / R heart pressure/ TR jet velocity									●
Immunisation									
Pneumovax			●			●		● Age 10 and 15	
Hepatitis B		● full course							

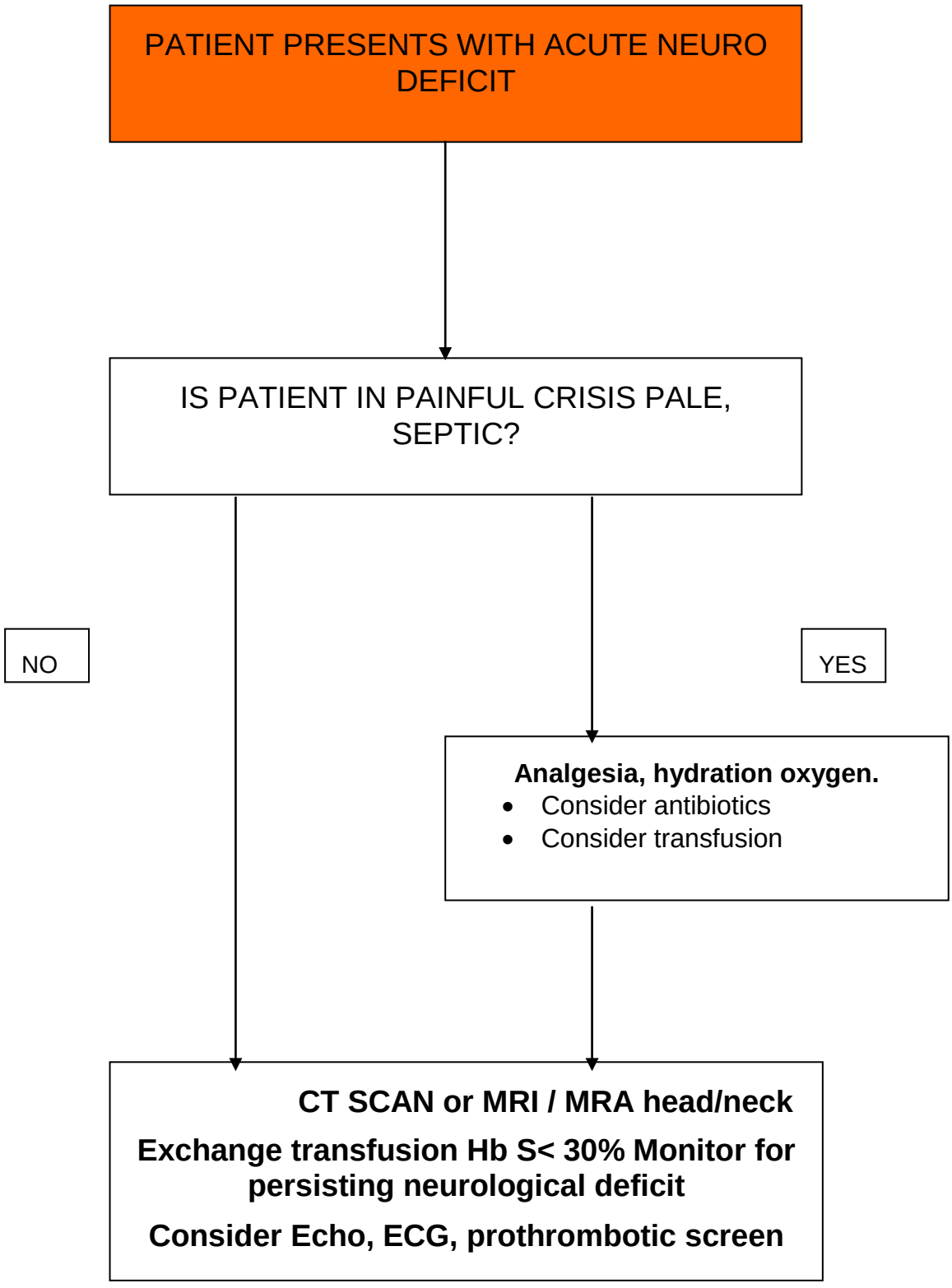
Appendix 2: Management of Nocturnal enuresis



Appendix 3: Flow chart of patients presenting with severe headache



Appendix 4: Acute Neuro Deficit



Appendix 5: Supporting Documents

Click links below to access supporting documents

- Paediatric Haemoglobinopathy Transfusion Policy

- Guidelines for Monitoring and Treatment of Iron Overload

- Hydroxycarbamide Dosing and Monitoring Guidelines

- Network Guidelines for the Inpatient Specialist Management of Acutely Unwell Children with Haemoglobinopathies

- TCD Scanning policy for East London and Essex Network

- Paediatric GP Information Sickle Cell

- **Children Acute Sickle Pain Pathway**

Paediatric Acute Sickle Cell P...

- **Blood Transfusion Guidelines for Children and Neonates**

transfusion guidelines for c...