

## Document Control

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## 2. Purpose

- 2.1. The purpose of this document is to detail the process for evidence based best practice for the management of suspected and proven neonatal sepsis (early and late onset)
- 2.2. The policy applies to the neonatal and obstetric multi-disciplinary teams

## 3. Definitions

- 3.1. CoNS - Coagulase-negative staphylococci
- 3.2. CRP - C-reactive protein
- 3.3. Early onset - Babies 72 hours old and under
- 3.4. GBS – Group B streptococcal infection
- 3.5. Late onset- Babies over 72 hours old
- 3.6. Nosocomial - Hospital-acquired infection
- 3.7. NEC – Necrotising enterocolitis
- 3.8. Newborn - Babies (babies under 72 hours old)
- 3.9. NEWS - Newborn Early Warning Score
- 3.10. ROM - Rupture of membranes
- 3.11. INR – International normalised ratio
- 3.12. SCU – Special Care Unit

## 4. Responsibilities

- 4.1. The Infection Prevention and Control Committee is responsible for:
  - Ensuring that the policy is approved after review and prior to publishing
  - Monitoring compliance with the policy
- 4.2. The Infection Prevention and Control Team are responsible for:
  - Provide support in the implementation of this guideline and any problems with compliance
- 4.3. The Consultant Paediatricians and Ward Managers are responsible for:
  - The implementation of this guideline
  - Ensuring that the guideline is adhered to.

#### 4.4. The Clinical Staff are responsible for:

Following the guidance and reporting any problems with compliance.

## 5. Contacting the Infection Prevention and Control Team

### 5.1. The Infection Prevention and Control Team can be contacted:

- In hours on 01271 322680 (ext 2680 internal at North Devon District Hospital), via bleep 011, or
- Out of hours by contacting the on-call Medical Microbiologist via North Devon District Hospital switchboard.
- Consultant Microbiologist bleep 193. Via switchboard after hours

## 6. Sepsis Management Guidelines (early and late onset) for Neonates

### Introduction

- 6.1.** Neonatal infection is a significant cause of mortality and morbidity in newborn babies. Neonatal sepsis accounts for 10% of all neonatal mortality. Neonatal infection is present in 8 of every 1000 live births and 71 of every 1000 neonatal admissions. Prompt antibiotic treatment can save lives.
- 6.2.** Immunological naivety, exposure factors and immaturity of host defences render neonates very susceptible to infection. The risk of sepsis in neonatal unit admissions is magnified by factors linked to prematurity and neonatal intensive care. Neonatal sepsis often develops rapidly with high mortality risk in the absence of specific therapy, demanding early empirical antibiotic therapy when sepsis is suspected.
- 6.3.** The term sepsis incorporates bacteraemia, pneumonia, meningitis, urinary tract, bone and joint infection. Common presenting features do not reliably localise the site of infection, and any of these may co-exist.
- 6.4.** Early and late onset sepsis are defined as presenting before and after the first 72 hours of birth. This division reflects distinct aetiologies, patterns of organ involvement and outcomes.

The general fatality rate of early-onset sepsis varies between 15 and 40% depending on the series reported.

The general fatality rate of late-onset sepsis is approximately 5%, although it is recognized that those infants who have a prolonged hospital course have a higher potential for morbidity and mortality.

## 7. Before delivery - Intrapartum antibiotics.

- See Trust guidelines for Indications for Antibiotics During Labour including Prevention of Group B Streptococcal Infection.
- If maternal colonisation with group B streptococcus is first identified after the birth but within the first 72 hours of life, ascertain if there are any concerns and if there are any other risk factors or clinical indicators of possible infection ([see appendix 1](#)). Use this assessment to direct management.

## 8. Care setting

- 8.1. All newborn babies with risk factors or suspicion of sepsis should be referred to a middle grade paediatrician or equivalent immediately and cared for in an area permitting close observations.
- 8.2. Investigations will take place usually in the neonatal unit. During this time the staff will assess the infant and taking into account the baby's clinical condition and needs. The baby will either be admitted to SCU or to Bassett Transitional Care (BABTC). See Trust guidelines for Transitional Care.
- 8.3. The baby has a set of medical notes generated and his/her details are entered onto Badger database.
- 8.4. If the baby is to be admitted to BABTC a nursing care plan for infection will be placed into the notes and a set of NEWS observations will be completed before the baby is transferred to the post-natal ward.
- 8.5. All intravenous antibiotics will be administered on SCU by the neonatal nurses.

## 9. Investigations when sepsis is suspected (before starting antibiotics)

- Blood tests
  - Blood culture – Always perform a blood culture before the first dose of antibiotics. Minimum recommended volume 0.5ml.
  - Full blood count.  
Differential white cell count (Normal WBC 10-30,000 x 10<sup>9</sup>/L) and percentage left shift (immature neutrophils/total neutrophil count).

### Note

*If >20% this is moderately predictive of sepsis.*

*A low WCC especially with neutropenia is also suspicious of sepsis.*

- C-reactive protein (CRP) concentration (this is then repeated 24 hours after commencing antibiotic therapy)  
CRP > 8 may be assumed as raised.

**Note**

*Serial CRP s may be useful. An isolated CRP or one done within 18 hours of onset may be misleading if negative*

- Blood gas
- Blood sugar
- Lumbar puncture (**consider**)

Neonatal meningitis occurs in 0.25-1.0 per 1000 live births. There should be a low threshold for lumbar puncture in all symptomatic neonates with suspected sepsis. However, lumbar puncture is not indicated in asymptomatic newborns undergoing evaluation for risk factors only.

Perform a lumbar puncture before starting antibiotics if it is thought safe to do it and:

- There is a strong clinical suspicion of infection
- There are clinical symptoms or signs suggesting meningitis

If a baby did not have a lumbar puncture at presentation and is receiving antibiotics consider performing a lumbar puncture if it is safe to do so and if the baby:

- Has a C-reactive protein concentration of 10mg/litre or more, or
- Has a positive blood culture or
- Does not respond to antibiotic treatment satisfactorily

Beyond the first 48 hours, lumbar puncture should be performed in all previously healthy neonates with suspected sepsis and no contraindication. Individual judgement by an experienced neonatal paediatrician is appropriate for suspected late onset sepsis in neonates receiving intensive therapy. Lumbar puncture should be deferred in neonates regarded as too unstable to tolerate the procedure, or where there is an absolute contraindication.

**Note** Antibiotic therapy should not be delayed for planned lumbar puncture. Additional methods of pathogen diagnosis (PCR or other antigen detection method) should be discussed with Clinical Microbiologist in all cases of abnormal CSF cell count and negative Gram-stain.

- Chest X-Ray

This is a routine component of neonatal septic screen, and is mandatory in all infants with respiratory distress, apnoea or continuing oxygen requirement.

**Note** An abdominal x-ray is indicated in the presence of abdominal signs suggestive of necrotising enterocolitis (NEC).

- Urine culture

Do not routinely perform urine microscopy or culture as part of the investigation for early onset neonatal infection

Urine culture is not required in suspected early onset sepsis. Beyond the first 48 hours, urine should be considered in all previously healthy neonates with suspected sepsis. When necessary, urine for culture should be obtained via supra-pubic aspiration following ultrasound confirmation of urine in bladder.

- Eye swabs for suspected infection

In babies with a purulent eye discharge take swabs urgently for microbiology using methods that can detect chlamydia and gonococcus. (see Trust Eye Care for Neonates Guidelines). Start systemic treatment for possible gonococcal infection while awaiting the swab results.

- Umbilical swabs for suspected infection

In babies with signs of umbilical infections perform a blood culture, take a swab for microscopy and culture and start antibiotic treatment (see appendix 4). If microbiology results do not show a gram-negative infection stop the gentamicin.

**Note**

Skin swabs for microscopy or culture are not required in the absence of clinical signs of localised infection.

## 10. Early onset sepsis

### 10.1. Organisms responsible for early onset sepsis

The predominant pathogens come from the maternal genital tract and are:

- Group B Streptococcus (GBS)
- E coli, other Streptococci,
- Haemophilus influenzae,
- Listeria monocytogenes.

### 10.2. Assessment of risk factors and clinical indicators to guide decision to treat.

Newborn babies should receive a comprehensive clinical assessment for the risks or indicators of early onset neonatal infection. This includes identifying any risk

factors or clinical indicators for early onset neonatal infections and performing a physical examination of the baby (with assessment of vital signs)

Use the tables 1 and 2 in [appendix 1](#) to direct antibiotic management decisions based on risk factors and clinical indicators.

- **If a baby has no red flags and only one risk factor or one clinical indicator** use clinical judgement and consider:
  - Safety of withholding antibiotics.
  - Necessity of monitoring by baby's vital signs and clinical condition. If monitoring is required use Newborn Early Warning Score chart for at least 12 hours. (at 0, 1 and 2 hours and then 2 hourly for 10 hours). This is performed by midwives if the baby is cared for on the postnatal ward by the mother.

If clinical concern increases, consider performing necessary investigations and starting antibiotic treatment

If no further concerns arise during the period of observation reassure the family. If the baby is to be discharged, give verbal and written advice to the parents and carers ([see point 14](#))

- **If a baby has any red flags or two or more 'non-red' risk factors or clinical indicators :**
  - Perform investigations ([see 9](#)) prior to commencing antibiotics
  - Start antibiotics within one hour of decision to treat (do not wait for test results)

**Note** – *do not routinely give antibiotic treatment to babies without risk factors or clinical indicators for infection or laboratory evidence of possible infection.*

### 10.3. Perform clinical investigations ([see point 9](#))

Perform investigations in particular blood culture before administering antibiotics

### 10.4. Antibiotic Management for early onset sepsis ([see appendix 2](#))

- The first dose of antibiotics should be administered without delay- within one hour of the decision to commence therapy (without waiting for results).
- Time of decision to treat should be documented and conversation and information given to parents.
- Use benzylpenicillin with gentamicin unless microbiological surveillance data reveal local bacterial resistance patterns indicating a different antibiotic.

Follow Trust guidelines for gentamicin use.

- If there is microbiological evidence of Gram-negative bacterial sepsis, add another antibiotic to the benzylpenicillin and gentamicin regimen that is active against Gram-

negative bacteria (for example cefotaxime). If Gram –negative infection is confirmed stop benzylpenicillin.

- The use of broad-spectrum antibiotics – in particular amoxicillin and cefotaxime in combination has been shown to promote colonisation and outbreaks of multi-resistant organisms such as gram-negative bacilli (Isaacs 2000).

Although antibiotics are lifesaving in sepsis, they also have a detrimental effect on colonisation of the intestine with a normal microbiological flora. It is possible this is an important part of normal development, and that disruption in early life may have significant later consequences. This policy recognises there is a tension between early treatment for sepsis (which is beneficial) and unnecessary treatment (which is harmful). In general, babies with 'red flag' signs and symptoms need treating with antibiotics. Management is much less clear in babies who only have risk factors, or less specific indicators of infection. Ideally, this uncertainty should be shared with the parents.

### 10.5. Duration of Antibiotic Treatment [\(see appendix 4\)](#)

## 11. Late Onset Sepsis

**Late-onset neonatal sepsis** is defined as an infection occurring after the first 72 hours or 3 -7 days of life.

Hospital-acquired late-onset infection occurs in about 20% of very low birth weight infants. Gram-positive organisms predominate, coagulase-negative staphylococci (CoNS) accounting for approximately half of all cases.

### 11.1. Organisms in late onset infection

- Gram-positive organisms
  - Coagulase-negative staphylococci
  - Staphylococcus aureus
  - Enterococci
  - Streptococcus spp
- Gram-negative organisms
  - E coli
  - Klebsiella species
  - Pseudomonas spp

### 11.2. Assess Risk factors and clinical indicators for late onset infection [\(see appendix 3\)](#)

The source of infection in late onset sepsis is either nosocomial (hospital-acquired) or community-acquired and neonates usually present with septicaemia, pneumonia or

meningitis. The rate of infection is generally inversely related to birth weight and gestational age.

Factors that might increase the risk of community-acquired late onset infection include:

- poor hygiene,
- poor cord care,
- bottle-feeding, and
- prelacteal feeds (that is any food except mother's milk provided to a newborn before initiating breastfeeding ).

### 11.3. Perform Clinical investigations [\(see point 9\)](#)

Clinical investigations as for early onset but other tests may include:

- Blood culture may be taken through central line (instead or in addition to a peripheral line)
- Line tips, endotracheal tube tips etc sent for microscopy
- Urine by suprapubic aspirate or catheter.

### 11.4. Antibiotic Management for late onset sepsis [\(see appendix 3\)](#)

### 11.5. Duration of treatment [\(see appendix 4\)](#)

## 12. Fungal sepsis

Transmission of *Candida* may be vertical (from maternal vaginal infection) but it is usually late onset and nosocomial.

*Candida* septicaemia carries a 25-50% mortality risk. Features are generally indistinguishable from those of bacterial sepsis. Fungal sepsis should be considered in susceptible neonates who have failed to respond to antibiotics.

There is limited evidence to support the use of oral and topical antifungal prophylaxis in preterm neonates and at present this is not part of routine practice in the UK.

The various presentations of *Candida* infections in the newborn can be separated into the following categories [6]:

- Mucocutaneous candidiasis
- Systemic candidiasis typically due to localized infections that progress to disseminated infections and multiorgan involvement

### 12.1. Organism

*Candida* species (*C albicans*, *C parapsilosis* and *C tropicalis*),

### 12.2. Risk factors

See risk factors for late onset sepsis

Other risk factors in addition:

- Broad spectrum antibiotic use
- Evidence of tracheal *Candida* colonisation

Other clinical indicators in addition:

- Skin and mucous membranes - thrush, nappy rash or other areas
- Eyes - Candida endophthalmitis
- Heart - cardiac murmurs, petechiae, skin abscesses, hepatomegaly and splenomegaly.
- Kidney - urinary tract infection

### 12.3. Investigations

In addition to [point 9](#)

- Swab (microscopy) for skin lesions
- Ophthalmological examination,
- Echocardiogram
- Renal ultrasound

### 12.4. Management for candida systemic infection ([see appendix 3](#))

### 12.5. Management for candida skin and mucosa infections

- Miconazole gel (care should be taken with administration to avoid choking)
- Nystatin suspension or cream
- Consider treating baby both orally and topically
- Consider treating mother if she is breast feeding

## 13. Differential diagnosis

Metabolic conditions, congenital heart disease, and perinatal viraemia (especially herpes simplex and enteroviruses) can present with clinical features indistinguishable from neonatal sepsis.

## 14. Parental communication and information

- Keep the parents/carers fully informed of risk factors, clinical concerns, baby's condition, options for management, any contact details of support organisations, how to respond to concerns and any long term effects (see NICE guidance).
- Gain fully informed consent from parents (where possible) prior to commencing or changing any treatment.
- Where management is uncertain for example
- Parents or carers of babies in whom early onset neonatal infection has been a concern are given written information about neonatal infection. This is documented. There are 4 information leaflets available:
  - 'Infection in Newborns' Trust parent information leaflet [http://www.northdevonhealth.nhs.uk/patientinformation/obstetrics/infection\\_in\\_newborns.pdf](http://www.northdevonhealth.nhs.uk/patientinformation/obstetrics/infection_in_newborns.pdf)
  - GBS parent information leaflets available. <http://gbss.org.uk/leaflets-downloads/leaflets-printed/#84> on gbss.org.uk website

- Congratulations on your baby's safe arrival (2015/04) – an introductory leaflet about group B Strep aimed at families where a healthy baby has been born and GBS has been found on a surface swab during or after delivery.
- Understanding your baby's group B Strep infection (2015/05) – an introductory leaflet about group B Strep aimed at parents of a baby diagnosed with GBS infection.
- When the baby is discharged from the hospital (or in the immediate postnatal period in the case of babies born at home), inform the parents and carers and the baby's GP, verbally and in writing, if the baby is considered to be at increased risk of infection

## 15. Monitoring Compliance with and the Effectiveness of the Guideline

### Standards/ Key Performance Indicators

Key Performance indicators on which to base care in the Special Care Unit are:

- Nice Neonatal Quality Standards.
  - NICE quality standard [QS75] Neonatal Infection
- NHS Toolkit for High Quality Neonatal Services
- National Neonatal Audit Programme
- NHS Standard Contract for Neonatal Critical Care

### Process for Implementation and Monitoring Compliance and Effectiveness

- Staff are informed of new guideline. There is an expectation that staff are responsible to keep updated on any improvements to practice and deliver care accordingly.
- Data is collected by use of Badger data base and can be used to generate output for clinical and operational benchmarking.
- Number of central line days and related infection are monitored via Specialised CQUINN Neonatal Critical Care Dashboard and the Neonatal Audit Project. Results are compared across Neonatal Units by the South West Neonatal Network.
- Incidents are monitored by the neonatal governance team and neonatal network. Incidents are reported by the Datix system and South West Neonatal Network incident reporting process.
- Non-adherence is reviewed and action plans made if required. There is a review of related incidents and complaints on a weekly basis by the Infection Control Teams, plus presentation of these cases where appropriate in the monthly incident report at IPCC. Discussion and reviews occur at Directorate meetings, Governance meetings and Ward meetings. Learning and action plans are cascaded at these meetings and improvements implemented. Key findings and learning points will be disseminated to relevant staff.

- Assessment of hand hygiene compliance as listed in the monthly dashboard to IPCC presented by the Infection Control Teams.

## 16. Associated Documentation

- 16.1. NDHT Eye care guidelines for neonates
- 16.2. NDHT Indication for Antibiotics during Labour including Prevention of Group B Streptococcal Infection Guidelines
- 16.3. NDHT Infection Prevention and Control Operational Policy
- 16.4. NDHT Maternal Sepsis during pregnancy, labour and the post-labour period (Including maternal fever, choriomnionitis and endometritis following miscarriage)
- 16.5. NDHT Neonatal and Childrens ward operational SOP
- 16.6. NDHT Paediatric and neonatal Gentamicin 5mg/kg Guideline
- 16.7. NDHT Pathology specimen acceptance policy
- 16.8. NDHT Preterm per-labour rupture of membrane
- 16.9. NDHT Spontaneous rupture of membrane at term
- 16.10. Maternal sepsis and antibiotic guidelines for Obstetric indications
- 16.11. NDHT Standard Infection Control Precautions Policy
- 16.12. NDHT Transitional care guidelines
- 16.13. NICE 2007 Clinical guideline 47. Feverish illness in children
- 16.14. NICE 2007 Clinical guideline 54. Urinary tract infection in children
- 16.15. NICE 2008 Clinical guideline 70. Induction of labour
- 16.16. NICE 2010 Clinical guideline 102. Bacterial meningitis and meningococcal septicaemia.
- 16.17. NICE 2011 Clinical guideline 132. Caesarean section

## 17. References

- Austin NC, Darlow B. Prophylactic oral antifungal agents to prevent systemic candida infection in preterm infants. Cochrane Database Syst Rev 2003; 1. BATTERY JP. Blood cultures in newborns and children: optimising an everyday test. Arch. Dis. Child. 2002; 87: F25 – F28

- Carr R, Modi N, Dore et al. G-CSF or GM-CSF for treating or preventing neonatal infections (Cochrane Review). The Cochrane Database of Systematic Reviews 2003, Issue 3
- E. de Man P, Vehoeven B, Verbrugh H et al. An antibiotic policy to prevent emergence of resistant bacilli. *Lancet* 2000; 355: 973-978
- GBSS (Group B Strep Support), (2007). [on-line] Preventing GBS infection in newborn babies. [www.gbss.org.uk](http://www.gbss.org.uk) (accessed 3/6/08).
- Health P, Balfour G, and Weisner A, Efstratiou A, Lamagni T, Tighe H, O'Connell L, Cafferkey M, Verlander N, Nicoll A and McCartney A, (2004). Group B streptococcal disease in UK and Irish Infants less than 90 days of age. *Lancet* 24 vol 363 (9405) :292
- Interim Best Practice Recommendations for the Prevention of Neonatal Grp B Strep Infection in UK. June 2001. PHLS Group B Streptococcus Working Group
- Isaacs D. Rationing antibiotic use in the neonatal unit. *Arch Dis Child* 2000; 82: F1-F2
- Karlowicz M, Buescher E, Surka A. Fulminant neonatal sepsis in a neonatal intensive care unit, 1988-1997, and the impact of avoiding empiric vancomycin therapy. *Pediatrics*, 2000; 106: 1387-1390.
- Locksmith et al, (2000) Maternal and neonatal infection rates with three different protocols for prevention of Grp B Strep disease. *Am J Obstet Gynecol*. 1999; 80: 416-422
- Luck S, et al, (2003) Estimated early onset group B streptococcal neonatal disease. *Lancet* 2003;361:p 1953-4
- May M, A J Daley, S Donath et al. Early onset neonatal meningitis in Australia and New Zealand, 1992–2002. *Arch. Dis. Child*. 2005; 90: F324 - F327
- McGuire W, Clerihew L, Fowlie P. Infection in the preterm infant. *BMJ* 2004; 329: 1277-1280
- McGuire W, Clerihew L, Austin N. Prophylactic intravenous antifungal agents to prevent mortality and morbidity in very low birth weight infants. *Cochrane Database Syst Rev* 2003; 1
- Neonatal Resource Service (2013) [on-line] Neonatal Sepsis [https://www.unitedhealthcareonline.com/ccmcontent/ProviderII/UHC/en-US/Assets/ProviderStaticFiles/ProviderStaticFilesPdf/Tools%20and%20Resources/Policies%20and%20Protocols/Medical%20Policies/Clinical%20Guidelines/Neonatal\\_Resource\\_Services\\_Clinical\\_Guideline\\_Neonatal\\_Sepsis.pdf](https://www.unitedhealthcareonline.com/ccmcontent/ProviderII/UHC/en-US/Assets/ProviderStaticFiles/ProviderStaticFilesPdf/Tools%20and%20Resources/Policies%20and%20Protocols/Medical%20Policies/Clinical%20Guidelines/Neonatal_Resource_Services_Clinical_Guideline_Neonatal_Sepsis.pdf) (accessed 25/10/15)
- Newborn Services Clinical Guideline (2008) Antibiotics for neonatal sepsis <http://www.adhb.govt.nz/newborn/Guidelines/Infection/AntibioticsForNeonatalSepsis.htm> (accessed 19/10/15)
- NICE 2006 Clinical guideline 37. Post natal care.
- NICE 2007 Clinical guideline 55. Intrapartum care
- NICE 2008 Clinical guideline 62. Antenatal care
- NICE 2012 Clinical guideline 149. Antibiotics for early –onset neonatal infection
- Nice (2013) [On-line] CKS. Candida oral guidelines. <http://cks.nice.org.uk/candida-oral#!scenario> (accessed 25/10/15)
- NICE 2014 QS75 Neonatal Infection
- Ohlsson A, Lacy JB. Intravenous immunoglobulin for preventing infection in preterm and/or low birth-weight infants (Cochrane Review). In: The Cochrane Library, Issue 2, 2003

- Plymouth NICU, Lilley J, (2011). Guidelines for Group B Streptococcus.
- Ray B, Mangalore J, Harikumar C et al. Is lumbar puncture necessary for evaluation of early neonatal sepsis? Archives of Disease in Childhood 2006;91:1033-1035
- Roen J, Rench M, Kozinetz C et al. Endotracheal colonisation with Candida enhances risk of systemic Candidiasis in very low birth weight neonates. Journal of Pediatrics 1994; 124: 789-94
- RCOG (2012). Green Top 36 [on-line]Prevention of early onset neonatal group B streptococcal disease. (accessed 25/10/15)
- Schrag et al. Group B streptococcal disease in the era of intrapartum antibiotic prophylaxis. NEJM. 2000; 342: 15-20
- Schrag et al. Prevention of Perinatal Group B Streptococcus disease. Revised guidelines from the CDC. Aug 2002
- Schuchat A. Group B Streptococcus. Lancet 1999; 353: 51-56
- Truro NICU. (2006). Guidelines on the management of GBS infection (or risk of GBS infection) Intrapartum and Neonatal Patients.
- Tybulewicz A, Clegg S, Fonfé G et al. Preterm meconium staining of the amniotic fluid: associated findings and risk of adverse clinical outcome. Archives of Disease in Childhood,2004;89:F328
- WHO (2014) CC newborn Neonatal Sepsis [on-line]  
[https://www.google.co.uk/?gws\\_rd=ssl#q=late+onset+neonatal+sepsis+guidelines&start=10](https://www.google.co.uk/?gws_rd=ssl#q=late+onset+neonatal+sepsis+guidelines&start=10) (accessed 19/10/15)
- UCSF 2004 Candidiasis in the Newborn Guidelines. [on-line]  
[https://www.ucsfbenioffchildrens.org/pdf/manuals/44\\_Candidiasis.pdf](https://www.ucsfbenioffchildrens.org/pdf/manuals/44_Candidiasis.pdf) (accessed 25/10/15)

**Appendix 1 – Risk factors and clinical Indicators for early-onset neonatal infection**

Use the tables 1 and 2 to direct antibiotic management decisions based on risk factors and clinical indicator including red flags.

1. If a baby has **no red flags** and only one risk factor or one clinical indicator use clinical judgement and consider:
  - Safety of withholding antibiotics. (this should be discussed with the parents including the potential detrimental effect of use of antibiotics e.g. on the colonisation of the intestinal flora)
  - Necessity of monitoring by baby's vital signs and clinical condition for at least 12 hours via NEWS (RCOG 2012 recommends 24 hours)
  
2. If a baby has **any red flags or two or more 'non-red' risk factors** or clinical indicators :
  - Perform investigations prior to commencing antibiotics
  - Start antibiotics within one hour of decision to treat

<b><u>Table 1</u></b>	<b>RED FLAG</b>
<b>RISK FACTORS</b>	
Invasive group B streptococcal infection in a previous baby	
Maternal group B streptococcal colonisation, bacteriuria or infection in the current pregnancy	
Prelabour rupture of membranes	
Preterm birth following spontaneous labour (before 37 weeks' gestation)	
Suspected or confirmed rupture of membranes for more than 18 hours in a preterm birth	
Intrapartum fever higher than 38 <sup>0</sup> C, or suspected or confirmed chorioamnionitis	
Parenteral antibiotic treatment given to the mother for confirmed or suspected invasive bacterial infection (such as septicaemia) at any time during labour, or in the 24 hour periods before and after the birth (not referring to intrapartum antibiotic prophylaxis)	
Suspected or confirmed infection in another baby in the case of a multiple pregnancy	

**Table 2 Clinical indicators of possible early-onset neonatal infection (observations and events in the baby). Including red flags.**

<u>Table 2</u> CLINICAL INDICATORS	RED FLAG
Altered behaviour or responsiveness	
Altered muscle tone (for example floppiness)	
Feeding difficulties (for example feed refusal)	
Feed intolerance, including vomiting, excessive gastric aspirates and abdominal distension	
Signs of respiratory distress	
Respiratory distress starting more than 4 hours after birth	
Hypoxia (for example central cyanosis or reduced oxygen saturation level)	
Jaundice within 24 hours of birth	
Apnoea	
Signs of neonatal encephalopathy	
Seizures	
Need for cardio-pulmonary resuscitation	
Need for mechanical ventilation in a pre-term baby	
Need for mechanical ventilation in a term baby	
Persistent foetal circulation (persistent pulmonary hypertension)	
Temperature abnormality (lower than 36 <sup>0</sup> C and higher than 38 <sup>0</sup> C) unexplained by environmental factors	
Signs of shock	
Unexplained excessive bleeding, thrombocytopenia, or abnormal coagulation (INR greater than 2.0)	
Oliguria (persistent beyond 24 hours after birth)	
Altered glucose homeostasis (hypoglycaemia or hyperglycaemia)	
Metabolic acidosis (base deficit of 10 mmol/litre or greater	
Local signs of infection (eye, skin, umbilicus)	

## Appendix 2 – Treatment for early onset Sepsis following assessment of risk factors

1. Assess using risk factors and clinical indicators (see appendix 1)
2. Give information to parents and gain fully informed consent for procedures and treatment, (include possible detrimental effects and safety of withholding antibiotics)
3. Perform investigations
4. Administer antibiotics within in one hour of decision to treat
5. For guidance on dosing please refer to BNF for Children or discuss with microbiologist

- **Note** - The use of broad-spectrum antibiotics – in particular amoxicillin and cefotaxime

Type of Sepsis	Empirical therapy
Early onset septicaemia	<p><b>Benzypenicillin and Gentamicin</b></p> <p>Starting dose Penicillin 25mg/kg every 12 hours and Gentamicin 5 mg/kg every 36 hours</p>
2nd Line antibiotics	<p>Please agree this after discussion with consultant microbiologist</p> <ul style="list-style-type: none"> <li>• Microbiological evidence of Gram-negative bacterial sepsis, add cefotaxime.</li> <li>• If Gram –negative infection is confirmed stop benzylpenicillin.</li> </ul>
Neonatal meningitis	<ul style="list-style-type: none"> <li>• <b>Pathogen unknown</b></li> </ul> <p>Amoxicillin and Cefotaxime</p> <ul style="list-style-type: none"> <li>• <b>Gram negative</b></li> </ul> <p>Cefotaxime only</p> <ul style="list-style-type: none"> <li>• <b>Gram positive</b></li> </ul> <p>Amoxicillin and Cefotaxime and seek microbiologist advice</p> <ul style="list-style-type: none"> <li>• <b>Group B streptococcus positive</b></li> </ul> <p>Benzylpenicillin 50mg/kg 12 hourly for at least 14 days, with Gentamicin 5mg/kg 36 hourly</p>
<b>Listeria</b>	Amoxicillin and gentamicin

in combination – has been shown to promote colonisation and outbreaks of multi-resistant organisms such as gram-negative bacilli (Isaacs 2000).

## Appendix 3 – Treatment for late onset Hospital Acquired Sepsis

### 1. Assess using risk factors and clinical indicators below (these are not exclusive)

Risk Factors	Clinical Indicators
<ul style="list-style-type: none"> <li>• Low birth weight</li> <li>• Prematurity               <ul style="list-style-type: none"> <li>○ patent ductus arteriosus,</li> <li>○ bronchopulmonary dysplasia (BPD)</li> <li>○ necrotising enterocolitis (NEC).</li> </ul> </li> <li>• Admission in intensive care unit</li> <li>• Mechanical ventilation</li> <li>• Invasive procedures</li> <li>• Invasive neonatal therapy, (especially indwelling intravenous catheters)</li> <li>• Administration of parenteral fluids, and use of stock solutions</li> </ul>	<ul style="list-style-type: none"> <li>• Hypothermia or fever (former is more common in preterm low birth weight infants)</li> <li>• Lethargy, poor cry, refusal to suck</li> <li>• Poor perfusion, prolonged capillary refill time</li> <li>• Hypotonia, absent neonatal reflexes</li> <li>• Brady/tachycardia</li> <li>• Respiratory distress, apnoea and gasping respiration</li> <li>• Hypo/hyperglycaemia</li> <li>• Metabolic acidosis.</li> <li>• Generally looking unwell</li> </ul>

### 2. Give parents information and gain fully informed consent for procedures and treatment

### 3. Perform investigations

### 4. Administer antibiotics within one hour of decision to treat

Suspected or proven sepsis	Recommended Antibiotics
Late onset septicaemia and umbilical infection	Flucloxacillin and Gentamicin
For Enterococci, Strep faecalis (suspected NEC), Listeria or Group B Streptococcus	Add Amoxicillin
Suspicion of anaerobic infection (e.g. intra-abdominal sepsis, NEC).	Add Metronidazole
Coagulase negative Staphylococcal sepsis, (especially if infant unwell or central line infection with line staying in). <b>Discuss with microbiologist.</b>	Consider Vancomycin
Candidiasis	Amphotericin B
Meningitis <b>Discuss with microbiologist.</b>	Change to Cefotaxime

**Appendix 4 – Duration of Antibiotic Treatment****Discuss with microbiologist if there are any queries**

<b>Duration of treatment</b>	
<b>5 days</b>	<ul style="list-style-type: none"> <li>• Treat for 5 days if babies are well and infection was suspected only but consider stopping at 36 hours and on a daily basis thereafter.</li> </ul>
<b>At 36 hours</b> <b>Consider stopping if</b>	<ul style="list-style-type: none"> <li>• The blood culture is negative, and</li> <li>• The initial clinical suspicion of infection was not strong, and</li> <li>• The baby's clinical condition is reassuring with no clinical indicators of possible infection, and</li> <li>• The level and trends of C-reactive protein concentration are reassuring</li> </ul>
Continue for <b>more than 36 hours</b> Use clinical judgement daily to consider stopping according to	<ul style="list-style-type: none"> <li>• The level of the initial clinical suspicion of infection</li> <li>• The baby's clinical progress and current condition, and</li> <li>• The levels and trends of C-reactive protein concentration.</li> </ul>
<b>7 days</b>	Treat for 7 days: <ul style="list-style-type: none"> <li>• If babies have positive blood cultures</li> <li>• Pneumonia</li> <li>• Septicaemia</li> </ul>
<b>More than 7 days</b>	Treat for more than 7 days: <ul style="list-style-type: none"> <li>• If The baby has not fully recovered, or</li> <li>• This is advisable based on the pathogen identified (<b>refer to microbiologist</b>)</li> <li>• Urinary Tract Infection</li> <li>• Meningitis</li> <li>• Candidiasis (<b>refer to microbiologist</b>)</li> </ul>
<b>Other</b>	
<b>5 days</b>	Skin conditions
<b>5-7 days</b>	Conjunctivitis
<b>7-10 days</b>	Oral candida

Appendix 5 – Does this baby need antibiotics?

**Risk Factors**

**RED FLAG**

- Maternal IV antibiotics for invasive bacterial infection 24 hours either side of birth
- Suspected or confirmed infection in twin/triplet

**NON-RED FLAG**

- GBS in previous baby
- confirmed GBS in this pregnancy (swab/HVS/urine)
- Prelabour ROM
- Preterm ROM >18 hours
- Prematurity <37 weeks
- Maternal fever >38° OR suspected/confirmed chorioamnionitis

**SIGNS & SYMPTOMS**

**NON-RED FLAG**

- Altered behaviour or responsiveness
- Altered muscle tone
- Feeding difficulties
- Feed intolerance inc. vomiting
- Abnormal HR
- Signs of resp distress
- Hypoxia
- Jaundice within 24 hours
- Apnoea
- Neonatal encephalopathy
- CPR at birth
- Mechanical ventilation (preterm)
- PPHN
- Temperature abnormality (<36° or >38°)
- Excessive bleeding (low platelets) or INR >2
- Oliguria longer than 24 hours
- Unstable BMs
- Metabolic acidosis (base deficit ≥10)
- Local signs of infection

**RED FLAG**

- Respiratory distress starting ≥4 hours after birth
- Seizures
- Mechanical ventilation (term)
- Signs of shock

≥ 1 RED FLAG

≥ 2 NON-RED FLAGS

1 NON-RED FLAG

Are there any signs or symptoms?

YES

NO

**NEWS OBS AND CONSIDER ANTIBIOTICS**

1 NON-RED FLAG

Are there any risk factors?

YES

≥ 2 NON-RED FLAGS

≥ 1 RED FLAG

**SCREEN AND TREAT FOR SUSPECTED INFECTION**