# NATIONAL INSTITUTE FOR HEALTH AND CARE EXCELLENCE

## Health and social care directorate

## Quality standards and indicators

## Briefing paper

**Quality standard topic:** Antibiotics for neonatal infection

**Output:** Prioritised quality improvement areas for development.

**Date of Quality Standards Advisory Committee meeting:** 25 April 2014

## Contents

# 1 Introduction

This briefing paper presents a structured overview of potential quality improvement areas for antibiotics for neonatal infection. It provides the Committee with a basis for discussing and prioritising quality improvement areas for development into draft quality statements and measures for public consultation.

## *1.1 Structure*

This briefing paper includes a brief description of the topic, a summary of each of the suggested quality improvement areas and supporting information.

If relevant, recommendations selected from the key development source below are included to help the Committee in considering potential statements and measures.

## *1.2 Development source*

The key development source referenced in this briefing paper is:

Antibiotics for early-onset neonatal infection. NICE clinical guideline 149 (2012).

# 2 Overview

## *2.1 Focus of quality standard*

This quality standard will cover the use of antibiotics to prevent and treat infection in newborn babies (both term and preterm) from birth to 28 days in primary care (including community) and secondary care. It includes antibiotics that are given to newborn babies or to mothers during intrapartum care to prevent neonatal infection (antibiotic prophylaxis).

## *2.2 Definition*

Neonatal infection (infection onset within 28 days of birth) is a significant cause of mortality and morbidity in newborn babies. It may be considered in terms of early-onset neonatal infection (infection arising within 72 hours of birth) and late-onset neonatal infection (infection arising after 72 hours of birth).

An infection is a host response to the presence of micro-organisms such as bacteria. Infection may cause sepsis (a life-threatening condition caused by the body over-reacting to an infection) by triggering an inflammatory response which can cause changes in the body resulting in multiple organ damage and failure (severe sepsis).

## 2.3 Incidence and prevalence

Neonatal infection is present in 8 of every 1000 live births and 71 of every 1000 neonatal admissions. Of these infections 82% occurred in premature babies (less than 37 weeks) and 81% occurred in low birth weight babies (below 2500 grams).

Early-onset neonatal infection is present in 0.9 of every 1000 live births and 9 of every 1000 neonatal admissions. *Group B Streptococcus* (GBS) and *Escherichia coli* are the most common organisms identified, accounting for 58% and 18% of infections respectively.

Late-onset neonatal infection is present in 7 of every 1000 live births and 61 of every 1000 neonatal admissions. *Coagulase negative Staphylococci* (CoNS), *Enterobacteriaceae* and *Staphylococcus aurues* are the most common organisms identified accounting for 54%, 21% and 18% of infections respectively.[1]

Neonatal infection accounts for 10% of all neonatal mortality[2]. Early-onset neonatal infection, though less common, is often more severe and is a significant cause of mortality and morbidity in newborn babies.

## 2.4 Management

Prompt antibiotic treatment for neonatal infection can save lives. However the number of doses of antibiotics and the size of each dose should be minimised. In sick babies, healthcare professionals need to adjust the dose to treat suspected or proven infection. However, the vast majority of newborn babies who are given antibiotics do not have any infection. It has been suggested that antibiotics in the days after birth may increase the risk of illnesses such as eczema and asthma in later life, but these risks cannot be quantified. Widespread antibiotic use may also be associated with a risk of antimicrobial resistance. For these reasons, healthy babies should have minimal exposure to antibiotics. See appendix 1 for the associated care pathway and algorithms from NICE clinical guideline 149.

## 2.5 National Outcome Frameworks

Tables 1 and 2 show the outcomes, overarching indicators and improvement areas from the frameworks that the quality standard could contribute to achieving.

---

[1] Vergnano S, Menson E, Kennea N et al. (2011) Neonatal infections in England: The neonIN surveillance network. *Archives of Disease in Childhood: Fetal and Neonatal Edition* 96 (1): F9-F14. **NB:** This study classifies early-onset neonatal infection as onset within 48 hours. It calculates that using this figure reduces the prevalence of early-onset neonatal infection as part of all neonatal infection from 26% to 23%.

[2] Centre for Maternal and Child Enquiries (CMACE) Perinatal Mortality 2009: United Kingdom. CMACE: London, 2011.

**Table 1 NHS Outcomes Framework 2014–15**

| Domain | Overarching indicators and improvement areas |
|---|---|
| 1 Preventing people from dying prematurely | ***Overarching indicator***<br>1a Potential Years of Life Lost (PYLL) from causes considered amenable to healthcare<br>ii Children and young people<br>***Improvement areas***<br>**Reducing deaths in babes and young children**<br>1.6 ii Neonatal mortality and stillbirths |
| 4 Ensuring that people have a positive experience of care | ***Overarching indicator***<br>4b Patient experience of hospital care<br>***Improvement areas***<br>**Improving women and their families' experience of maternity services**<br>4.5 Women's experience of maternity services |
| 5 Treating and caring for people in a safe environment and protecting them from avoidable harm | ***Overarching indicator***<br>5a Patient safety incident reported<br>5b Safety incidents involving severe harm or death<br>5c Hospital deaths attributable to problems in care<br>***Improvement areas***<br>***Reducing the incidence of avoidable harm***<br>5.2 Incidence of healthcare associated infection (HCAI)<br>i MRSA<br>5.4 Incidence of medication errors causing serious harm<br>***Improving safety of maternity services***<br>5.5 Admission of full-term babies to neonatal care<br>***Delivering safe care to children in acute settings***<br>5.6 Incidence of harm to children due to 'failure to monitor' |

**Table 2 Public health outcomes framework for England, 2013–2016**

| Domain | Objectives and indicators |
|---|---|
| 4 Healthcare public health and preventing premature mortality | ***Objective***<br>Reduced numbers of people living with preventable ill health and people dying prematurely, while reducing the gap between communities<br>***Indicators***<br>*4.3 Mortality rate from causes considered preventable ** (NHSOF 1a)* |
| **Alignment across the health and social care system**<br>** Complementary to indicators in the NHS Outcomes Framework | |

# 3 Summary of suggestions

## *3.1 Responses*

Six stakeholders responded to the 2 week engagement exercise (27 February to 13 March 2014).

Stakeholders were asked to suggest up to 5 areas for quality improvement. Specialist committee members were also invited to provide suggestions. The responses have been merged and summarised in table 3 for further consideration by the Committee.

Full details on the suggestions provided are given in appendix 4 for information.

**Table 3 Summary of suggested quality improvement areas**

| Suggested area for improvement | Stakeholders |
|---|---|
| **Information and support for identification** | AIMS, BAPM, MRSAA , RCM, SCM |
| **Risk factors for infection and clinical indicators of possible infection** | RCM, SCM |
| **Use of antibiotics**<br>• Intrapartum antibiotic prophylaxis (IAP)<br>• Antibiotic stewardship<br>• Antibiotics for suspected infection<br>• Duration of antibiotic treatment | BAPM, NHSEPSD, RCM, SCM |
| **Investigations before starting antibiotics in the baby**<br>• Diagnostic tests for neonatal infection and meningitis<br>• Prompt processing of laboratory investigations | BAPM, RCM, SCM |
| **Therapeutic drug monitoring for gentamicin** | BAPM, SCM, NHSEPSD |
| **Additional areas**<br>• Group B streptococcus (GBS) screening<br>• Primary care communication<br>• Use of antibiotics in late-onset neonatal infection<br>• Vancomycin prescribing | BAPM, BIA, RCM |
| AIMS, Association for Improvement in the Maternity Services<br>BAP, British Association of Perinatal Medicine<br>BIA, British Infection Association,<br>MRSAA, MRSA Action UK<br>NHSEPSD, NHS England Patient Safety Division<br>RCM, Royal College of Midwives<br>SCM, Specialist Committee Member | |

# 4 Suggested improvement areas

## *4.1 Information and support for identification*

### 4.1.1 Summary of suggestions

Stakeholders suggested that providing written as well as verbal information will support parents in the early identification of symptoms of early-onset neonatal infection and help them understand what action to take if necessary. This will facilitate early treatment for the baby which may improve clinical outcomes. This information should be provided to the parents while the baby is in hospital and on discharge where concerns about early-onset neonatal infection have been raised.

Providing this written as well as verbal information will ensure that parents are also informed when consent is requested to commence treatment.

### 4.1.2 Selected recommendations from development source

Table 4 presents recommendations that have been provisionally selected from the development source that may support potential statement development. These are presented in full after table 4 to help inform the Committee's discussion.

**Table 4 Specific areas for quality improvement**

| Suggested quality improvement area | Suggested source guidance recommendations |
|---|---|
| Information and support for identification | **Information and support**<br>NICE CG149 Recommendations 1.1.1.1 to 1.1.1.2 and 1.1.1.8 (KPI) to 1.1.1.10 |

**Information and support**

NICE CG149 – Recommendation 1.1.1.1

If clinical concerns about possible early-onset neonatal infection arise during pregnancy or in the first 72 hours after birth (for example, in relation to risk factors [see table 1 shown in Appendix 1 below] or clinical indicators [see table 2 shown in Appendix 1 below]):

- tell the baby's parents and carers
- explain the reason for concern (including the nature of early-onset neonatal infection)
- discuss the preferred options for management (for example, observation, investigations or antibiotic treatment)

- give the baby's parents and carers time to consider the information provided, and offer further opportunities for discussion if necessary.

NICE CG149 – Recommendation 1.1.1.2

If considering antibiotic treatment because of clinical concerns about possible early-onset neonatal infection, discuss:

- the rationale for the treatment
- the risks and benefits in the individual circumstances
- the observations and investigations that may be needed to guide clinical management (for example, when to stop treatment)
- the preferred antibiotic regimen and likely duration of treatment
- the impact, if any, on where the woman or her baby will be cared for.

NICE CG149 – Recommendation 1.1.1.8 (key priority for implementation)

If there have been any concerns about early-onset neonatal infection before a baby is discharged, advise the parents and carers verbally and in writing that they should seek medical advice (for example, from NHS Direct, their general practice, or an accident and emergency department) if they are concerned that the baby:

- is showing abnormal behaviour (for example, inconsolable crying or listlessness), **or**
- is unusually floppy, or
- has developed difficulties with feeding or with tolerating feeds, or
- has an abnormal temperature unexplained by environmental factors (lower than 36°C or higher than 38°C), or
- has rapid breathing, or
- has a change in skin colour.

NICE CG149 – Recommendation 1.1.1.9

When the baby is discharged from the hospital or midwifery-led unit (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.

NICE CG149 – Recommendation 1.1.1.10

If a baby has been treated for suspected or confirmed early-onset neonatal infection:

- inform the parents and carers about potential long-term effects of the baby's illness and likely patterns of recovery, and reassure them if no problems are anticipated

- take account of parents' and carers' concerns when providing information and planning follow-up.

### 4.1.3 Current UK practice

**Information and support**

No published studies on current practice were identified for this suggested area for quality improvement; feedback from parents was mentioned in the relevant stakeholder suggestion.

## *4.2 Risk factors for infection and clinical indicators of possible infection*

### 4.2.1 Summary of suggestions

Stakeholders suggested that appropriate monitoring of babies will identify most cases of infection. Clinical parameters and risk factors should be used to identify infection and inform decisions on whether to commence or withhold antibiotic treatment.

### 4.2.2 Selected recommendations from development source

Table 5 presents recommendations that have been provisionally selected from the development source that may support potential statement development. These are presented in full after table 5 to help inform the Committee's discussion.

**Table 5 Specific areas for quality improvement**

| Suggested quality improvement area | Selected source guidance recommendations |
|---|---|
| Risk factors for infection and clinical indicators of possible infection | **Risk factors for infection and clinical indicators of possible infection**<br>NICE CG149 Recommendations 1.2.1.1, 1.2.1.2, 1.2.3.1 and1.2.3.2 (KPI) |

**Risk factors for infection and clinical indicators of possible infection**

NICE CG149 – Recommendation 1.2.1.1

Use table 1 [shown in Appendix 1 below] to identify risk factors for early-onset neonatal infection and table 2 to identify clinical indicators of early-onset neonatal infection.

NICE CG149 – Recommendation 1.2.1.2

Use tables 1 and 2 [shown in Appendix 1 below]to identify red flags (risk factors and clinical indicators that should prompt a high level of concern regarding early-onset neonatal infection).

NICE CG149 – Recommendation 1.2.3.1

If there are any risk factors for early-onset neonatal infection (see table 1 [shown in Appendix 1 below]) or if there are clinical indicators of possible early-onset neonatal infection (see table 2 [shown in Appendix 1 below]) perform a careful clinical assessment without delay. Review the maternal and neonatal history and carry out a physical examination of the baby including an assessment of the vital signs.

NICE CG149 – Recommendation 1.2.3.2 (key priorities for implementation)

Use the following framework based on risk factors and clinical indicators, including red flags (see tables 1 and 2), to direct antibiotic management decisions:

- In babies with any red flags, or with two or more 'non-red flag' risk factors or clinical indicators (see tables 1 and 2), perform investigations (see recommendations 1.5.1.1–1.5.1.3) and start antibiotic treatment. Do not delay starting antibiotics pending the test results (see recommendations 1.6.1.1–1.6.1.3).
- In babies without red flags and only one risk factor or one clinical indicator, using clinical judgement, consider:
  - whether it is safe to withhold antibiotics, and
  - whether it is necessary to monitor the baby's vital signs and clinical condition – if monitoring is required continue it for at least 12 hours (at 0, 1 and 2 hours and then 2-hourly for 10 hours).

### 4.2.3 Current UK practice

A study was carried out into the proposed use of the Newborn Early Warning (NEW) system. Using neonatal intensive care unit admissions records an audit found that only 48% (25/52) of newborn infants identified as being ‘at-risk’ had their observations recorded[3].

[3] Roland, D. Madar, J. Connolly, G. The Newborn Early Warning (NEW) system: development of an at-risk infant intervention system. Infant 2010; 6(4): 116-20.

## *4.3 Use of antibiotics*

### 4.3.1 Summary of suggestions

#### Intrapartum antibiotic prophylaxis (IAP)

Stakeholders suggested that timely use of IAP will reduce the incidence of early-onset *Group B streptococcus* (GBS). This should be offered to women who have risk factors associated. It was suggested that there is currently significant variation in the administration of IAP.

#### Antibiotic stewardship

Stakeholders suggested there is currently inappropriate use of antibiotics. This includes suboptimal dosage and inappropriate duration. It was also suggested that the use of broad spectrum antibiotics should be limited where possible. Inappropriate use can lead to harm for the baby, development of resistant organisms within a neonatal unit and prolonged hospital stay for mothers and babies.

#### Antibiotics for suspected infection

Stakeholders felt that NICE clinical guideline 149 is clear in the use of benzylpenicillin with gentamicin as the first-choice antibiotic regimen for empirical treatment for suspected infection. However it was suggested that neonatology services continue to use cephalosporin-based regimens as empiric therapy. This regimen may cause harm as well as increasing the microbial flora (MRSA, enterococci, drug-resistant gram-negative bacteria) of a neonatal unit.

#### Duration of antibiotic treatment

Stakeholders highlighted that NICE clinical guideline 149 provides recommendations when consideration should be given to the discontinuation of antibiotics. Stakeholders felt that many neonatology services had not followed this guidance and that the timescales provided by NICE (at 36 hours) were not met.

### 4.3.2 Selected recommendations from development source

Table 6 presents recommendations that have been provisionally selected from the development source that may support potential statement development. These are presented in full after table 6 to help inform the Committee's discussion.

**Table 6 Specific areas for quality improvement**

| Suggested quality improvement area | Suggested source guidance recommendations |
|---|---|
| Intrapartum antibiotic prophylaxis (IAP) | **Intrapartum antibiotics**<br>NICE CG149 Recommendations 1.3.1.1 (KPI) to 1.3.1.5 |
| Antibiotic stewardship | **Avoiding routine use of antibiotics in the baby**<br>NICE CG149 Recommendation 1.4.1.1 |
| Antibiotics for suspected infection | **Antibiotics for suspected infection**<br>NICE CG149 Recommendations 1.6.1.1 (KPI) to 1.6.1.8 |
| Duration of antibiotic treatment | **Duration of antibiotic treatment**<br>NICE CG149 Recommendation 1.7.2.1 (KPI) |

## Intrapartum antibiotics

NICE CG149 – Recommendation 1.3.1.1(key priority for implementation)

Offer intrapartum antibiotic prophylaxis using intravenous benzylpenicillin to prevent early-onset neonatal infection for women who have had:

- a previous baby with an invasive group B streptococcal infection
- group B streptococcal colonisation, bacteriuria or infection in the current pregnancy.

NICE CG149 – Recommendation 1.3.1.2

If the woman decides to take intrapartum antibiotic prophylaxis, give the first dose as soon as possible and continue prophylaxis until the birth of the baby.

NICE CG149 – Recommendation 1.3.1.3

Consider intrapartum antibiotic prophylaxis using intravenous benzylpenicillin to prevent early-onset neonatal infection for women in preterm labour if there is prelabour rupture of membranes of any duration.

NICE CG149 – Recommendation 1.3.1.4

Consider intrapartum antibiotic prophylaxis using intravenous benzylpenicillin to prevent early-onset neonatal infection for women in preterm labour if there is suspected or confirmed intrapartum rupture of membranes lasting more than 18 hours.

NICE CG149 – Recommendation 1.3.1.5

Offer benzylpenicillin as the first choice for intrapartum antibiotic prophylaxis. If the woman is allergic to penicillin, offer clindamycin unless individual group B streptococcus sensitivity results or local microbiological surveillance data indicate a different antibiotic.

**Avoiding routine use of antibiotics in the baby**

NICE CG149 – Recommendation 1.4.1.1

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

**Antibiotics for suspected infection**

NICE CG149 – Recommendation 1.6.1.1 (key priority for implementation)

Use intravenous benzylpenicillin with gentamicin as the first-choice antibiotic regimen for empirical treatment of suspected infection unless microbiological surveillance data reveal local bacterial resistance patterns indicating a different antibiotic.

NICE CG149 – Recommendation 1.6.1.2

Give benzylpenicillin in a dosage of 25 mg/kg every 12 hours[2]. Consider shortening the dose interval to 8-hourly based on clinical judgement (for example, if the baby appears very ill).

NICE CG149 – Recommendation 1.6.1.3

Give gentamicin in a starting dosage of 5 mg/kg.

NICE CG149 – Recommendation 1.6.1.4

If a second dose of gentamicin is to be given (see recommendation 1.7.2.1) it should usually be given 36 hours after the first dose. The interval may be shortened, based on clinical judgement, for example if:

- the baby appears very ill
- the blood culture shows a Gram-negative infection.

NICE CG149 – Recommendation 1.6.1.5

Decide on subsequent gentamicin doses and intervals taking account of blood gentamicin concentrations (see recommendations 1.8.1.1–1.8.2.3).

NICE CG149 – Recommendation 1.6.1.6

Record the times of:

- gentamicin administration
- sampling for therapeutic monitoring.

NICE CG149 – Recommendation 1.6.1.7

Regularly reassess the clinical condition and results of investigations in babies receiving antibiotics. Consider whether to change the antibiotic regimen taking account of:

- the baby's clinical condition (for example, if there is no improvement)
- the results of microbiological investigations
- expert microbiological advice, taking account of local surveillance data.

NICE CG149 – Recommendation 1.6.1.8

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.

**Duration of antibiotic treatment**

NICE CG149 – Recommendation 1.7.2.1 (key priority for implementation)

In babies given antibiotics because of risk factors for infection or clinical indicators of possible infection, consider stopping the antibiotics at 36 hours if:

- the blood culture is negative, and
- the initial clinical suspicion of infection was not strong, and
- the baby's clinical condition is reassuring with no clinical indicators of possible infection, and
- the levels and trends of C-reactive protein concentration are reassuring.

### 4.3.3 Current UK practice

**Intrapartum antibiotics**

Using data from the Neonatal Infection Surveillance Network (NeonIN) a study into the prevention of GBS infection found that in 48 cases of GBS over 4 years, risk factors in the mother were present in 67% (32) of cases. Of these only 19% (6) were treated with adequate IAP. The study concluded that if all women identified with risk

factors had received adequate IAP, 23 cases may have been prevented[4]. Although this study took place in 2009, before the introduction of the Royal College of Obstetricians and Gynaecologists Green-top guideline 36 and NICE clinical guideline 149, stakeholders suggested that the prevalence of early-onset GBS has not changed.

### Antibiotic stewardship

In their work into improving antibiotic prescribing in neonatal units Russell et al found that the widespread use of broad spectrum antibiotics will increase the local persistence of resistant organisms in maternity or neonatal units. This was demonstrated by a study into the incidence and risk factors for the carriage of multi-resistant enterobacteriaceae strains (MRE; defined as being resistant to three or more classes of antibiotic) and the extent of the persistence of resistant strains following discharge. This found that 62 of 124 babies (50%) had acquired MRE by discharge. Russell et al also felt that a substantial increase in the incidence of allergic and autoimmune disease in young children over the past three decades could be linked to obstetric practices and inappropriate antibiotic use[5].

### Antibiotics for suspected infection

Russell et al described a recent audit on empiric antibiotic use. Although nearly 70% of UK neonatal units chose narrow spectrum penicillin/gentamicin combinations for presumed early onset infection (as recommended by NICE clinical guideline 149), 19% used a cephalosporin, either alone or in combination with a penicillin. For late onset infection, the choice of empiric antibiotic combinations was more diverse[5].

### Duration of antibiotic treatment

While the length of treatment for antibiotics will vary depending on several factors such as the type of organism, antibiotic levels achieved, presence of indwelling catheters or clinical response, there is considerable variation in practice throughout the NHS[6]. Further in their review Russell et al found that the prolonged routine use of empirical antibiotic therapy (more than 5 days), amongst neonates less than 1000 grams at birth has been associated with increased risk of death and necrotising enterocolitis.[5]

---

[4] Vergnano S, Embleton ND, Collinson A, Menson E, Bedford Russell AR, Heath P. Missed opportunities for preventing GBS infections. Arch Dis Child, Fetal Neonatal Ed, 9(1):F72-3. Epub May 2009.

[5] Russell AB, Sharland M, Heath PT (2012) Improving antibiotic prescribing in neonatal units: Time to act. *Archives of Disease in Childhood: Fetal and Neonatal Edition* 97 (2): F141-F146.

[6] Turner MA, Visintin C, Mugglestone M et al. (2012) Antibiotics for the treatment and prevention of neonatal early onset infection: Nice guideline. *Archives of Disease in Childhood* 97: A382

## *4.4 Investigations before starting antibiotics in the baby*

### 4.4.1 Summary of suggestions

**Diagnostic tests for neonatal infection and meningitis**

Stakeholders felt that diagnostic tests for neonatal infection and meningitis require improvement. Having more reliable tests would enable the appropriate use of antibiotics at the correct time. In particular stakeholders suggested that the use of lumbar punctures for the diagnosis of neonatal meningitis is variable.

**Prompt processing of laboratory investigations**

Stakeholders suggested that confirmation or exclusion of neonatal infection in a prompt manner will reduce the likelihood of poor parental experience and unnecessary delays in treatment. These results may also enable healthcare professionals to exclude the use of antibiotics and thus improve antibiotic stewardship.

### 4.4.2 Selected recommendations from development source

Table 7 presents recommendations that have been provisionally selected from the development source that may support potential statement development. These are presented in full after table 7 to help inform the Committee's discussion.

**Table 7 Specific areas for quality improvement**

| Suggested quality improvement area | Suggested source guidance recommendations |
|---|---|
| Diagnostic test for neonatal infection and meningitis | **Investigations before starting antibiotics in the baby**<br>NICE CG149 Recommendations 1.5.1.1, 1.5.1.2 (KPI) and 1.5.1.3 |
| Prompt processing of laboratory investigations | **Investigations before starting antibiotics in the baby**<br>NICE CG149 Recommendations 1.5.1.7 and 1.5.1.8 |

**Investigations before starting antibiotics in the baby**

NICE CG149 – Recommendation 1.5.1.1

When starting antibiotic treatment in babies with risk factors for infection or clinical indicators of possible infection, perform a blood culture before administering the first dose.

NICE CG149 – Recommendation 1.5.1.2 (key priority for implementation)

Measure the C-reactive protein concentration at presentation when starting antibiotic treatment in babies with risk factors for infection or clinical indicators of possible infection.

NICE CG149 – Recommendation 1.5.1.3

Perform a lumbar puncture to obtain a cerebrospinal fluid sample before starting antibiotics if it is thought safe to do so and:

- there is a strong clinical suspicion of infection, or
- there are clinical symptoms or signs suggesting meningitis.

  If performing the lumbar puncture would unduly delay starting antibiotics, perform it as soon as possible after starting antibiotics.

NICE CG149 – Recommendation 1.5.1.7

In babies with a purulent eye discharge take swab samples urgently for microbiological investigation, using methods that can detect chlamydia and gonococcus. Start systemic antibiotic treatment for possible gonococcal infection while awaiting the swab microbiology results.

NICE CG149 – Recommendation 1.5.1.8

In babies with clinical signs of umbilical infection, such as a purulent discharge or signs of periumbilical cellulitis (for example, redness, increased skin warmth or swelling), perform a blood culture, take a swab sample for microscopy and culture, and start antibiotic treatment with intravenous flucloxacillin and gentamicin (see recommendation 1.6.1.3)[1]. If the microbiology results indicate that the infection is not due to a Gram-negative infection, stop the gentamicin.

### 4.4.3 Current UK practice

#### Diagnostic tests for neonatal infection and meningitis

No published studies on current practice were identified for this suggested area for quality improvement.

#### Prompt processing of laboratory investigations

No published studies on current practice were identified for this suggested area for quality improvement.

## *4.5 Therapeutic drug monitoring for gentamicin*

### 4.5.1 Summary of suggestions

Stakeholders suggested that monitoring of gentamicin prescribing would reduce gentamicin prescribing errors.

### 4.5.2 Selected recommendations from development source

Table 8 presents recommendations that have been provisionally selected from the development source that may support potential statement development. These are presented in full after table 8 to help inform the Committee's discussion. Recommendations in NICE CG149 on therapeutic drug monitoring for gentamicin are presented in terms of measuring trough and peak concentrations of gentamicin in the bloodstream. See the Glossary below for definitions.

**Table 8 Specific areas for quality improvement**

| Suggested quality improvement area | Suggested source guidance recommendations |
|---|---|
| Therapeutic drug monitoring for gentamicin | **Therapeutic drug monitoring for gentamicin**<br>**Trough concentrations**<br>NICE CG149 Recommendations 1.8.1.1 to 1.8.1.5<br>**Peak concentrations**<br>NICE CG149 Recommendations 1.8.2.1 to 1.8.2.3 |

**Trough concentrations**

NICE CG149 – Recommendation 1.8.1.1

If a second dose of gentamicin is to be given (see recommendation 1.6.1.4) measure the trough blood gentamicin concentration immediately before giving the second dose. Consider the trough concentration before giving a third dose of gentamicin.

NICE CG149 – Recommendation 1.8.1.2

Hospital services should make blood gentamicin concentrations available to healthcare professionals in time to inform the next dosage decision (for example, within 30 hours of sampling).

NICE CG149 – Recommendation 1.8.1.3

Consider repeating the measurement of trough concentrations immediately before every third dose of gentamicin, or more frequently if necessary (for example, if there has been concern about previous trough concentrations or renal function).

NICE CG149 – Recommendation 1.8.1.4

Adjust the gentamicin dose interval, aiming to achieve trough concentrations of less than 2 mg/litre. If the course of gentamicin lasts more than three doses a trough concentration of less than 1 mg/litre is advised.

NICE CG149 – Recommendation 1.8.1.5

If an intended trough concentration measurement is not available, do not withhold the next dose of gentamicin unless there is evidence of renal dysfunction (for example, an elevated serum urea or creatinine concentration, or anuria).

**Peak concentrations**

NICE CG149 – Recommendation 1.8.2.1

Consider measuring peak blood gentamicin concentrations in selected babies such as in those with:

- oedema
- macrosomia (birthweight more than 4.5 kg)
- an unsatisfactory response to treatment
- proven Gram-negative infection.

NICE CG149 – Recommendation 1.8.2.2

Measure peak concentrations 1 hour after starting the gentamicin infusion.

NICE CG149 – Recommendation 1.8.2.3

If a baby has a Gram-negative or staphylococcal infection, consider increasing the dose of gentamicin if the peak concentration is less than 8 mg/litre.

### 4.5.3 Current UK practice

NHS England patient safety division published evidence from the National Reporting and Learning System (NRLS) on safer use of intravenous gentamicin for neonates.

Between April 2008 and April 2009 a review of neonatal medication incidents reported to the NRLS identified 507 patient safety incidents relating to the use of intravenous gentamicin. Side effects of gentamicin administration included vestibular and auditory damage and nephrotoxicity.

## *4.6 Additional areas*

### 4.6.1 Summary of suggestions

The improvement areas below were suggested as part of the stakeholder engagement exercise. However they were felt to be either outside the remit of the quality standard referral and the development source (NICE guidance) or require further discussion by the Committee to establish potential for statement development.

There will be an opportunity for the QSAC to discuss these areas at the end of the session on 25 April 2014.

**Group B streptococcus (GBS) screening**

Stakeholders suggested that GBS carriage by the mother is a recognised risk factor for early-onset GBS. As a result knowing the GBS status of the woman would enable health professionals to be aware of the any further risk factors for early-onset GBS. NICE clinical guideline 62 on antenatal care and RCOG Green-top guideline 36, have concluded however that routine screening of all pregnant women for GBS carriage not be recommended, as it is still unclear whether more good than harm is achieved by this.

**Primary care communication**

A stakeholder felt that primary care staff should be aware of the risks of infection when a baby is discharged from hospital. This lack of information may lead to assumptions in primary care that can lead to harm. Our development source (CG149) does not contain recommendations relating to this.

**Use of antibiotics in late-onset neonatal infection**

Stakeholders noted that the use of antibiotics in late-onset neonatal infection (after 72 hours) was not addressed by the development source, NICE clinical guideline 149. They felt this area was important because similar issues around antibiotic stewardship are present in late-onset prescribing.

**Vancomycin prescribing**

A stakeholder suggested that vancomycin prescribing needs to be limited. This would prevent the emergence of resistant organisms. Our development source (CG149) does not contain recommendations relating to this.

## Appendix 1: Additional information

**Table 1 Risk factors for early-onset neonatal infection, including 'red flags'**

| Risk factor | Red flag |
|---|---|
| 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°C, or confirmed or suspected chorioamnionitis | |
| Parenteral antibiotic treatment given to the woman 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 [This does not refer to intrapartum antibiotic prophylaxis] | Yes |
| Suspected or confirmed infection in another baby in the case of a multiple pregnancy | Yes |

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

| Clinical indicator | 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 | |
| Abnormal heart rate (bradycardia or tachycardia) | |
| Signs of respiratory distress | |
| Respiratory distress starting more than 4 hours after birth | Yes |
| Hypoxia (for example, central cyanosis or reduced oxygen saturation level) | |
| Jaundice within 24 hours of birth | |
| Apnoea | |
| Signs of neonatal encephalopathy | |
| Seizures | Yes |
| Need for cardio–pulmonary resuscitation | |
| Need for mechanical ventilation in a preterm baby | |
| Need for mechanical ventilation in a term baby | Yes |
| Persistent fetal circulation (persistent pulmonary hypertension) | |
| Temperature abnormality (lower than 36°C or higher than 38°C) unexplained by environmental factors | |
| Signs of shock | Yes |
| Unexplained excessive bleeding, thrombocytopenia, or abnormal coagulation (International Normalised Ratio greater than 2.0) | |
| Oliguria persisting 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 (for example, affecting the skin or eye) | |

## Appendix 2: Key priorities for implementation (CG149)

Recommendations that are key priorities for implementation in the source guideline and that have been referred to in the main body of this report are highlighted in grey.

### *Information and support*

If there have been any concerns about early-onset neonatal infection before a baby is discharged, advise the parents and carers verbally and in writing that they should seek medical advice (for example, from NHS Direct, their general practice, or an accident and emergency department) if they are concerned that the baby:

- is showing abnormal behaviour (for example, inconsolable crying or listlessness), **or**
- is unusually floppy, or
- has developed difficulties with feeding or with tolerating feeds, or
- has an abnormal temperature unexplained by environmental factors (lower than 36°C or higher than 38°C), or
- has rapid breathing, or
- has a change in skin colour.

[recommendation 1.1.1.8]

### *Risk factors for infection and clinical indicators of possible infection*

Use the following framework based on risk factors and clinical indicators, including red flags (see tables 1 and 2), to direct antibiotic management decisions:

- In babies with any red flags, or with two or more 'non-red flag' risk factors or clinical indicators (see tables 1 and 2), perform investigations (see recommendations 1.5.1.1–1.5.1.3) and start antibiotic treatment. Do not delay starting antibiotics pending the test results (see recommendations 1.6.1.1–1.6.1.3).
- In babies without red flags and only one risk factor or one clinical indicator, using clinical judgement, consider:
  - whether it is safe to withhold antibiotics, and
  - whether it is necessary to monitor the baby's vital signs and clinical condition – if monitoring is required continue it for at least 12 hours (at 0, 1 and 2 hours and then 2-hourly for 10 hours).

[Recommendation 1.2.3.2]

If a baby needs antibiotic treatment it should be given as soon as possible and always within 1 hour of the decision to treat.

[Recommendation 1.2.3.4]

### *Intrapartum antibiotics*

Offer intrapartum antibiotic prophylaxis using intravenous benzylpenicillin to prevent early-onset neonatal infection for women who have had:

- a previous baby with an invasive group B streptococcal infection
- group B streptococcal colonisation, bacteriuria or infection in the current pregnancy.

[Recommendation 1.3.1.1]

### *Investigations before starting antibiotics in the baby*

Measure the C-reactive protein concentration at presentation when starting antibiotic treatment in babies with risk factors for infection or clinical indicators of possible infection.

[Recommendation 1.5.1.2]

### *Antibiotics for suspected infection*

Use intravenous benzylpenicillin with gentamicin as the first-choice antibiotic regimen for empirical treatment of suspected infection unless microbiological surveillance data reveal local bacterial resistance patterns indicating a different antibiotic.

[Recommendation 1.6.1.1]

### *Investigations during antibiotic treatment*

In babies given antibiotics because of risk factors for infection or clinical indicators of possible infection, measure the C-reactive protein concentration 18–24 hours after presentation.

[Recommendation 1.7.1.1]

### *Decision 36 hours after starting antibiotic treatment*

In babies given antibiotics because of risk factors for infection or clinical indicators of possible infection, consider stopping the antibiotics at 36 hours if:

- the blood culture is negative, and

- the initial clinical suspicion of infection was not strong, and
- the baby's clinical condition is reassuring with no clinical indicators of possible infection, and

the levels and trends of C-reactive protein concentration are reassuring.

[Recommendation 1.7.2.1]

Consider establishing hospital systems to provide blood culture results 36 hours after starting antibiotics to facilitate timely discontinuation of treatment and discharge from hospital.

[Recommendation 1.7.2.2]

## *Care setting*

When deciding on the appropriate care setting for a baby, take into account the baby's clinical needs and the competencies necessary to ensure safe and effective care (for example, the insertion and care of intravenous cannulas).

[Recommendation 1.9.1.2]

## Appendix 3: Glossary

**Peak gentamicin concentration** The level of gentamicin in the baby's bloodstream shortly after administration. The blood sample is usually taken about 1 hour after giving the drug. High peak concentrations of gentamicin are necessary to kill bacteria.

**Therapeutic monitoring** A process of measuring the concentration of a drug in the bloodstream, to avoid excessive levels that might be associated with adverse effects or to ensure adequate levels for therapeutic effect.

**Trough gentamicin concentration** The level of gentamicin in the baby's bloodstream shortly before a further dose is given. High trough gentamicin concentrations may be associated with an increased risk of adverse effects.

## Appendix 4: Suggestions from stakeholder engagement exercise

| ID | Stakeholder | Suggested key area for quality improvement | Why is this important? | Why is this a key area for quality improvement? | Supporting information |
|---|---|---|---|---|---|
| 001 | Association for Improvements in the Maternity Services | Key area for quality improvement 1 | Quality of parental consent | Because it is the subject of a number of critical<br>Comments and pleas for assistance on our help line from parents who have, or have had, babies in neonatal care units. | A number of parents report that they are simply told, not asked, that their babies will be receiving antibiotics. Others, who are concerned, especially about adverse effects of prophylactic use, have asked questions. Instead of being met with replies to questions and discussions, they are met with threats to report them to social services, and they are regarded as unco-operative, instead of concerned, parents. These are often young, first-time parents who are struggling to come to terms with what for them is the great responsibility of caring for and taking decisions for a child for the rest of its life. They are also struggling to feel that this is THEIR child, which many parents find they do not have until they get it |

| ID | Stakeholder | Suggested key area for quality improvement | Why is this important? | Why is this a key area for quality improvement? | Supporting information |
|---|---|---|---|---|---|
| | | | | | home. We find a wide variation between units in their attitudes to parents. However young and vulnerable the child, it still belongs to the parents, and behaviour which disempowers and disrespects them has long term adverse effects on their willingness to consult and be frank with health care professionals in future – as we know from many reports. This is the beginning of a family, and controlling approaches do not set that family on the right path. CONSENT IS A CRUCIAL PART OF THE QUALITY STANDARD and therefore needs to be stated – just as eg NICE guidelines stress that screening and interventions are OFFERED to pregnant women |
| 002 | British | 1. Ensuring that | Timely IAP will reduce the | There are many examples of missed | Vergnano S, Embleton |

| ID | Stakeholder | Suggested key area for quality improvement | Why is this important? | Why is this a key area for quality improvement? | Supporting information |
|---|---|---|---|---|---|
| | Association of Perinatal Medicine | appropriate intrapartum antibiotic prophylaxis (IAP) is offered to women with the risk factors described in the NICE guidelines in timely manner | incidence of EOGBS infection. | opportunities for GBS prevention | ND, Collinson A, Menson E, Bedford Russell AR, Heath P. Missed opportunities for preventing GBS infections. Arch Dis Child, Fetal Neonatal Ed, 9(1):F72-3. Epub 2009 May 12. |
| 003 | British Association of Perinatal Medicine | 2. Ensuring parents of babies where EONI has been suspected are informed on discharge in writing & orally of signs & symptoms to watch for in their newborn baby & should any arise what action to take | Early identification of symptoms plus parents knowing what action to take will facilitate early treatment of infection in the baby | There is insufficient written information for parents and healthcare workers | Parents survey and feedback |
| 004 | British Association of Perinatal Medicine | 3. For women with prelabour rupture of membranes and/or those in threatened preterm labour, should establish the mother's GBS carriage status | GBS carriage is a recognised risk factor for EOGBS infection, as are preterm labour and prolonged rupture of membranes. Lack of knowledge about a women's GBS status does not mean carriage is absent, just that we don't know. So a woman whose GBS status is unknown in preterm labour could have 2 risk factors present (one known, the other unknown). | Knowledge of pregnant women's GBS status is useful to shape her intrapartum care and her baby's postpartum care, giving health professionals the opportunity to respond more appropriately based on knowledge of the presence or absence of GBS carriage. The RCOG guidelines for GBS prevention, NICE intrapartum and NICE Early onset neonatal infection guidelines are all inconsistent | RCOG Green top guidelines/ NICE intrapartum and early onset neonatal infection guidelines |

| ID | Stakeholder | Suggested key area for quality improvement | Why is this important? | Why is this a key area for quality improvement? | Supporting information |
|---|---|---|---|---|---|
| 005 | British Association of Perinatal Medicine | 4. Diagnostic tests for infection require improvement:<br>Increased use of molecular technology and appropriate culture medium eg enriched media for GBS | Diagnosis of neonatal infection is limited by inadequate/ poorly reliable tests. Blood cultures may be negative when there is evidence of infection. | This results in inappropriate antibiotic administration: either over use which in ELBW babies leads to greater risk of NEC or death, or stopping or withholding antibiotics that could be life-saving. More commonly, there is inappropriate overuse.<br>Excess use of antibiotics leads to increased risks of antibiotic resisitance and also facilitates immune dysregulation in later childhood which leads to atopy/ asthma and autoimmune disease. | Luck S, Torry M, d'Agapeyeff K,et al. Estimated early-onset group B streptococcal neonatal disease. Lancet. 2003, 7;361(9373):1953-4<br>Cotten CM, Taylor, S, Stoll B, et al. Prolonged Duration of Initial Empirical Antibiotic Treatment Is Associated With Increased Rates of Necrotizing Enterocolitis and Death for Extremely Low Birth Weight Infants. Pediatrics, 2009;123:58-66.<br>Bedford Russell AR, Murch SH. Could peripartum antibiotics have delayed health consequences for the infant? BJOG 2006;113:758-765 |
| 006 | British Association of Perinatal Medicine | 5. Antibiotic stewardship | Inappropriate Antibiotics may be prescribed for inappropriate reasons, in suboptimal doses and for inappropriate duration.<br>Important to limit use of broad spectrum antibiotics when can | Accountability in antibiotic prescribing | Antibiotic stewardship literature |

| ID | Stakeholder | Suggested key area for quality improvement | Why is this important? | Why is this a key area for quality improvement? | Supporting information |
|---|---|---|---|---|---|
| | | | use narrow spectrum | | |
| 007 | British Association of Perinatal Medicine | 6. Mandatory National surveillance of infection isolates, resistance profiles and of antibiotic prescribing | To be able to monitor infection types and their resistance profiles in relation to antibiotic use vs need.<br>To guide narrow-spectrum antibiotic use | To reduce antibiotic pressure which drives resistance and facilitates immune dysregulation<br>To reduce inappropriate use of broad spectrum antibiotics | de Man P, Verhoeven BAN, Verbrugh HA, et al. An antibiotic policy to prevent emergence of resistant bacilli. Lancet, 2000;355:973-978.<br>Vergnano S, Menson E, Kinnea N, Embleton ND, Bedford Russell AR, Watts T, Robinson MJ, Collinson A, Heath P. Neonatal Infections in England: the NeonIn surveillance network. Arch Dis Child, Fetal Neonatal Ed, 2011;96:F9-F14. Epub ahead of print 27th September 2010 |
| 008 | British Association of Perinatal Medicine | 7. Gentamicin prescribing | Reduction in gentamicin prescribing errors<br>1:500 will have MMAG1->5 gene mitochondrial gene mutation leading to sensorineural hearing loss | To reduce errors.<br>To test for mitochondrial gene mutation prior to administration | Safer use of intravenous gentamicin for neonates NPSA/2010/PSA001<br>09 February 2010.<br>Stickland MD, Kirkpatrick CM, Begg EJ, et al. An extended interval dosing method for gentamicin in neonates. J Antimicrob |

| ID | Stakeholder | Suggested key area for quality improvement | Why is this important? | Why is this a key area for quality improvement? | Supporting information |
|---|---|---|---|---|---|
| | | | | | Chemother, 2001;48:887-93.<br>24. Rao SC, Ahmed M, Hagan R. One dose per day compared to multiple doses per day of gentamicin for treatment of suspected or proven sepsis in neonates. Cochrane Database of Systematic Reviews 2006, Issue 1. Art. No.: CD005091. DOI: 10.1002/14651858.CD005091.pub2 |
| 009 | British Association of Perinatal Medicine | 8. Vancomycin prescribing | Needs to be limited<br><br>Administration method needs to uniform | To prevent emergence of resistant organisms including VRE (Vancomycin resistant enterococci)<br>Need to have trough vancomycin level > 2-3 x MIC of organism at all times: can only be achieved by continuous infusion | Van Houten MA, Uiterwaal CSPM, Heesen GJM, et al. Does the empiric use of vancomycin in pediatrics increase the risk for Gram-negative bacteremia? Pediatr Infect Dis J,2001;20:171-7. |
| 010 | British Infection Association | Key area for quality improvement 1<br>Antimicrobial prescribing | There is huge variation in antibiotic use for late-onset neonatal sepsis. That has to be a major issue to look at. | Standardisation of practice based on evidence leads to better quality care | See A M R Fernando, P T Heath, and E N Menson . Antimicrobial policies in the neonatal units of the |

| ID | Stakeholder | Suggested key area for quality improvement | Why is this important? | Why is this a key area for quality improvement? | Supporting information |
|---|---|---|---|---|---|
| | | | | | United Kingdom and republic of Ireland J. Antimicrob. Chemother. (2008)61 (3): 743-745 |
| 011 | MRSA Action UK | Key area for quality improvement 1<br><br>Patient information in the quality standard on antibiotics for neonatal infection | Understanding when it is appropriate to offer antibiotics is important in our view. MRSA Action UK can only comment as a patient group that has a lot of contact with patients who seek information on the treatment of MRSA and other healthcare associated infections. Patient information is very important and the NICE guidelines always provide very good guidance for patients.<br><br>In the guideline reference is made to 'IFP55 for care of women and their babies during labour'. This is a very useful resource for patients and covers the risks of infection very well. One area that was not covered in relation to intrapartum care was cervical examination and any associated risks when the membranes have been ruptured after a given period of time. | We believe it is useful for mums and their carers to be to be aware of infection risks, this can be an additional mitigating intervention, particularly if labour is prolonged and can involve changes in shift, mums-to-be are in a position to highlight risks if they are concerned.<br><br>Being clear on any history of allergic reaction to penicillin is also important and should be documented in the patient guidance, due to risks of anaphylaxis and the affects to mother and baby.<br><br>Being clear on antibiotic resistance and the risks associated with administering antibiotics also needs to be documented in the patient guidance. | Association of intrapartum antibiotic exposure and late-onset serious bacterial infections in infants. Pediatrics. 2005 Sep;116(3):696-702. PMID: 16140710 Authors: Tiffany S Glasgow, Paul C Young, Jordan Wallin, Carolyn Kwok, Greg Stoddard, Sean Firth, Matthew Samore, Carrie L Byington<br><br>Maternal anaphylaxis and fetal brain damage after intrapartum chemoprophylaxis. J Perinat Med. 2004;32(4):375-7. PMID: 15346827 Authors: Alberto Berardi, Katia Rossi, Francesca Cavalleri, Angela Simoni, Lorenzo Aguzzoli, Giuseppe Masellis, Fabrizio Ferrari |

| ID | Stakeholder | Suggested key area for quality improvement | Why is this important? | Why is this a key area for quality improvement? | Supporting information |
|---|---|---|---|---|---|
| 012 | The Royal College of Midwives | Key area for quality improvement 1<br>Improving antibiotic prescribing to avoid overuse. | Development of resistant organisms.<br><br>Potential impact on developing immune system<br><br>Mothers and babies are kept in hospital much longer than otherwise needed. | Current tendency to over prescribing | Rational prescribing in paediatrics in a resource-limited setting.<br>Risk R. Naismith H. Burnett A. Moore SE. Cham M. Unger S.<br>Archives of Disease in Childhood. 98(7):503-9, 2013<br><br>Improving antibiotic prescribing in neonatal units: time to act. [Review]<br>Russell AB. Sharland M. Heath PT.<br>Archives of Disease in Childhood Fetal & Neonatal Edition.<br>97(2):F141-6, 2012 |
| 013 | The Royal College of Midwives | Key area for quality improvement 2<br>Standardising the observations required for at risk infants | Appropriate monitoring should identify most babies with infection | Early symptoms of sepsis will be recognised and treated promptly | Various publications on the use of the NEWS charts |
| 014 | The Royal College of Midwives | Key area for quality improvement 3<br>Prompt processing of laboratory investigations | Confirmation or exclusion of sepsis reduces cost of treatment | Delayed processing of laboratory samples lead to poor patient experience unnecessary delays in treatment and higher cost | Patient feedback surveys.<br>Publications on the use of CRP on investigation of sepsis |

| ID | Stakeholder | Suggested key area for quality improvement | Why is this important? | Why is this a key area for quality improvement? | Supporting information |
|---|---|---|---|---|---|
| | | | | | |
| 015 | The Royal College of Midwives | Key area for quality improvement 4<br>Information giving to mothers | Improved information giving to mothers will enable families to be part of the assessment team | Current practice of early postnatal discharge from hospital. | Readmission rates from community. |
| 016 | The Royal College of Midwives | Key area for quality improvement 5<br>Communication with primary care | Primary care staff need to be aware that babies are at risk of sepsis even post discharge form hospital | Lack of information from secondary care services leads to dangerous assumptions and poor care with risk of bad outcome for babies with sepsis | Patient complaints, Readmission rates from community and feedback form local GPs and midwives |
| 017 | SCM1 | Key area for quality improvement 1<br><br>Ruling out infection in newborns who commence antibiotics for suspected sepsis | The NICE guideline recommends that consideration should be given to discontinuing antibiotics at 36 h when clinical assessment deems that it is safe to do so, and where two laboratory parameters (blood cultures, CRP) are normal. | Many neonatology services have failed to fully implement this aspect of the guideline. In particular, it has proved difficult to obtain blood culture results within the required timescale, and some clinicians have indicated that the advice that antibiotics can be stopped where CRP is <10 mg/L may have had an unintended effect of increasing antibiotic use for babies who have a CRP value of just over 10 mg/L | Results of survey of neonatal networks in England undertaken in August 2013:<br>MacVe J, Gedling C, Cole J, Downe S, Gray J. Early-onset neonatal sepsis: Assessing the impact of NICE guideline 149, Antibiotics for the prevention and treatment of early-onset neonatal infection. Poster presentation at FIS 2013: Action on Infection, Birmingham 11-13 November 2013. |
| 018 | SCM1 | Key area for quality | The NICE guideline recommends benzyl penicillin + an | Around 20% of neonatology services may be continuing to use cephalosporin-based | Attached to email is a copy of an abstract that was |

| ID | Stakeholder | Suggested key area for quality improvement | Why is this important? | Why is this a key area for quality improvement? | Supporting information |
|---|---|---|---|---|---|
| | | improvement 2<br><br>Avoidance of unnecessarily broad-spectrum antibiotics as empiric therapy for EONS | aminoglycoside as the most appropriate empiric therapy for most cases of suspected EONS | regimens as empiric therapy. Such regimens may cause harm to the individual baby; may have an impact on the microbial flora (MRSA, enterococci, drug-resistant Gram-negative bacteria) of the local neonatal unit; and can cause confusion, and a risk of missed antibiotic doses) where babies are transferred within neonatal networks. | presented at the Federation of Infection Societies meeting I do not have permissions to attach to this document please see JH |
| 019 | SCM1 | Key area for quality improvement 3<br><br>Use of clinical parameters and risk factors to inform decisions on whether to withhold or commence antibiotic therapy | A very large number of newborn babies are commenced on intravenous antibiotics, the vast majority of whom are never diagnosed as having had an infection. Some Consultants have described a lack of confidence in this aspect of the NICE guideline. It is likely that junior doctors will feel even less confident about withholding antibiotic treatment in babies without red flags indicating that immediate antibiotic therapy is indicated | Overuse of antibiotics is wasteful of resource, presents a risk of secondary infection (e.g. infections introduced via the cannula), increases length of stay, interferes with family life for the parents, their new baby and any other children at home, as well as the risks around antibiotic resistance | |
| 020 | SCM2 | 1. Ensuring that appropriate intrapartum antibiotic prophylaxis (IAP) is offered to women with the risk factors described in the guideline in timely manner | Timely IAP will reduce the incidence of EOGBS neonatal infection | At GBSS, we regularly hear from families describing significant variation in practices in the UK. | A recent news story highlighted the importance of ensuring IAP is offered when a risk factor is present http://www.standard.co.uk/news/london/brain- |

| ID | Stakeholder | Suggested key area for quality improvement | Why is this important? | Why is this a key area for quality improvement? | Supporting information |
|---|---|---|---|---|---|
| | | | | | damaged-boys-mother-calls-for-tests-for-deadly-bug-during-pregnancies-9173043.html<br>GBSS also has collated the views of many parents who support this position |
| 021 | SCM2 | 2. Ensuring parents of babies where EONI has been suspected are informed on discharge in writing & orally of signs & symptoms to watch for in their newborn baby & should any arise what action to take | Written as well as verbal Information to parents. | This will support parents in the early identification of symptoms. Parents receiving clear and accurate information will also know what action to take if they have concerns about their baby which will facilitate early treatment of infection in the baby | Parents feedback as above |
| 022 | SCM2 | 3. For women with prelabour rupture of membranes and/or those in threatened preterm labour, consider establishing the mother's GBS carriage status | GBS carriage is a recognised risk factor for EOGBS infection, as are preterm labour and prolonged rupture of membranes.<br>Not knowing a woman's GBS status does not mean carriage is absent, just that we don't know. If a woman has been tested with an appropriate test and found to be negative, this removes GBS as a risk factor.<br>A woman whose GBS status is unknown in preterm labour could | Knowledge of pregnant women's GBS status is useful to plan her intrapartum care and her baby's postpartum care. This gives health professionals the opportunity to respond more appropriately with knowledge regarding the presence or absence of GBS carriage. | Group B streptococcal disease in UK and Irish infants younger than 90 days. Heath PT, Balfour G, Weisner AM, Efstratiou A, Lamagni TL, Tighe H, O'Connell LA, Cafferkey M, Verlander NQ, Nicoll A, McCartney AC; PHLS Group B Streptococcus Working Group.Lancet, January 2004. |

| ID | Stakeholder | Suggested key area for quality improvement | Why is this important? | Why is this a key area for quality improvement? | Supporting information |
|---|---|---|---|---|---|
| | | | have 2 risk factors present (one known, the other unknown). | | Missed opportunities for preventing GBS infections May 2009. Arch Dis Child Fetal Neonatal Ed. Vergnano S, Embleton ND, Collinson A, Menson E, Bedford Russell AR, Heath PT. |
| 023 | SCM2 | 4. Diagnostic tests for neonatal infection require improvement | Culture for GBS from, for example, ear swabs, is routinely in non-enriched medium and may fail to detect the presence of GBS.<br><br>Culture negative sepsis remains a problem in neonatal practice | Having more reliable tests would enable antibiotics to be stopped sooner or not started as opposed to administering antibiotics “just in case”.<br><br>Antibiotic use drives antibiotic resistance and is also associated with immune dysregulation in later childhood.<br><br>Prolonged antibiotic use in ELBW neonates is associated with a greater risk of death or NEC. | Luck S, Torny M, d'Agapeyeff K,et al. Estimated early-onset group B streptococcal neonatal disease. Lancet. 2003, 7;361(9373):1953-4<br><br>Cotten CM, Taylor, S, Stoll B, et al. Prolonged Duration of Initial Empirical Antibiotic Treatment Is Associated With Increased Rates of Necrotizing Enterocolitis and Death for Extremely Low Birth Weight Infants. Pediatrics, 2009;123:58-66.<br><br>Bedford Russell AR, Murch SH. Could peripartum antibiotics have delayed health |

| ID | Stakeholder | Suggested key area for quality improvement | Why is this important? | Why is this a key area for quality improvement? | Supporting information |
|---|---|---|---|---|---|
| | | | | | consequences for the infant? BJOG 2006;113:758-765 |
| 024 | SCM3 | 1.Information given to parents and carers regarding when they should seek medical advice after discharge | | | |
| 025 | SCM3 | 2.Use of intrapartum antibiotic prophylaxis to prevent early onset infection for women with indications | | | |
| 026 | SCM3 | 3.Appropriate investigations before starting antibiotics treatment and the decision to start antibiotics in the baby | | | |
| 027 | SCM3 | 4.The choice and duration of antibiotics treatment | | | |
| 028 | SCM3 | 5.Therapeutic drug monitoring of Gentamicin | | | |
| 029 | SCM4 | Antibiotic duration in late onset infections (ie infection occurring after 72 hours of age) | Duration needs to be sufficient to treat an infection but not too long as it may promote resistance and may also have other adverse | Significant variation in practice exists.<br>NEEDS A NEW NICE GUIDELINE | Audits of antibiotic duration. |

| ID | Stakeholder | Suggested key area for quality improvement | Why is this important? | Why is this a key area for quality improvement? | Supporting information |
|---|---|---|---|---|---|
| | | | effects eg increased mortality | | |
| 030 | SCM4 | Antibiotic choice in late onset infections | Rational use of antibiotics is important, ensuring narrow spectrum antibiotics where possible. This minimises development of resistance and consistent guidance on antibiotic choice improves compliance. | Point prevalence surveys demonstrate significant variation in antibiotics used.<br>National bacteremia data (esp. antibiotic resistance data) can provide evidence base for antibiotic choice and for minimising spectrum of antibiotics used.<br>NEEDS A NEW NICE GUIDELINE | ARPEC and other national antibiotic point prevalence survey data.<br>National PHE labbase data on bacteria causing neonatal infections |
| 031 | SCM4 | Intrapartum antibiotic use to prevent EO GBS infections | GBS is the major cause of EO infection. Intrapartum antibiotics can reduce infections. | Significant variation in practice. No change in incidence of EO GBS has occurred since RCOG guidelines introduced. | Audits of IAP use<br>National PHE data on incidence of GBS |
| 032 | SCM4 | Diagnostic tests for neonatal meningitis | Neonatal meningitis has high mortality and morbidity. Early recognition allows early use of appropriate antibiotics and may result in better outcomes | Significant variation in use of diagnostic tests, especially of use of lumbar punctures in neonates.<br>Clinical features may be poorly understood (eg presence of fever is not uniform) and so current guidelines may require updating | Audits of LP use<br>Audits of use of meningitis guidelines<br>National surveillance study on neonatal meningitis (unpublished) |