Hit or Miss? A Review of Early-Onset Sepsis in the Neonate

Monica Scheel, MSN, RN, Shannon Perkins, MSN, APRN, NNP-BC*

KEYWORDS

• Early-onset sepsis • EOS • Neonatal sepsis • Group B streptococcus • GBS • Neonatal infection

KEY POINTS

- Neonatal sepsis carries a high morbidity and mortality rate due to the neonate's immature immune response to pathogens.
- Early-onset sepsis occurs within the first week of life.
- Identification of at-risk infants is often overlooked because clinical presentation can be subtle and vague.
- Lack of universal implementation of screening protocols leads to inconsistencies in identification and treatment of at-risk neonates.
- The role of the bedside nurse is critical in the recognition and treatment of at-risk neonates and their families.

INTRODUCTION

Infections during the neonatal period have a high incidence of developing into sepsis, which carries a high morbidity and mortality rate for this vulnerable population.[1] A major concern for health care providers is the difficulty of early diagnosis of neonatal sepsis due to inconsistent use of nationally established guidelines. Impediments to accurate diagnosis, recommended treatments, nursing management, and recommendations for addressing this high-risk condition are discussed. The primary focus is addressing early-onset sepsis (EOS) as opposed to late-onset sepsis (LOS).

DEFINITION

Neonatal sepsis can be defined as a potentially life-threatening infection occurring within the first 28 days of life. Infections may be either bacterial or viral in nature.[1]

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Delgado Community College-Charity School of Nursing, 450 South Claiborne Avenue, New Orleans, LA 70112, USA
* Corresponding author.
E-mail address: sperki@dcc.edu

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Neonatal sepsis is separated into 2 categories: EOS and LOS. EOS occurs within the first week of life, most often within the first 3 days after birth.[2] LOS occurs after the first week of life, often from days 7 through 28 but can occur up to 90 days after birth.[1]

The primary route of transmission for EOS is vertical from the mother to the fetus during the intrapartum period, whereas LOS may be acquired through exposure to environmental contaminants from either the hospital or the community.[1] Infections in the neonate predispose the infant to sepsis development due to a weak immune system that is poorly responsive to bacteria.[3] Common infections leading to the development of sepsis include pneumonia, urosepsis, and meningitis. It is important for health care providers to suspect a diagnosis of sepsis in any neonate presenting with a fever. These infants should receive an immediate workup for sepsis and meningitis because of the rapid deterioration of the infant's physical condition.[3]

RISK FACTORS

Maternal diagnoses of intrapartum fever and chorioamnionitis are the most common factors used to identify EOS risk.[4] Chorioamnionitis is caused by vertical transmission of bacterial colonization of the uterus leading to inflammation of fetal membranes. Maternal fever and foul-smelling or cloudy amniotic fluid are the most prevalent symptoms of chorioamnionitis. The Centers for Disease Control and Prevention (CDC) guidelines allow maternal fever to be used as a surrogate for chorioamnionitis and recommend the use of neonatal antibiotics.[4] **Table 1** lists the most common risk factors requiring an EOS evaluation of the neonate.

The infant is protected within the sterile environment of the amniotic sac during pregnancy. However, pathogenic exposure from the birth canal and the environment may occur during labor and the delivery process. Neonatal immunity is received passively through transfer of maternal antibodies across the placenta, with most placental transfer occurring after 30 weeks gestation.[1] The primary form of passive immunity before birth is the transmission of immunoglobulin (Ig)G antibodies. These antibodies help protect the neonate from viruses and bacterial infections. Newborns lack IgA, IgE, and IgM antibodies because they do not readily cross the placenta. This leaves the neonate vulnerable to gram-negative organisms and certain viruses.[3] Active immunity is not developed at birth, leaving neonates susceptible to infection.

Premature infants, especially those less than 30 weeks gestation, are at higher risk of developing EOS than term infants owing to an immature immune system and lack of

Table 1
Risk factors necessitating early-onset sepsis evaluations in the neonate

Maternal Factors	Fetal Factors
Intrapartum maternal fever 38.0° – 38.2° C	Fetal tachycardia
Obstetric diagnosis of chorioamnionitis	Gestational age <37 wk
Prolonged ROM ≥24 h	Low birthweight infants
Premature rupture of membranes	Low Apgar score (<6 at 1 or 5 minutes)
GBS-positive or unknown status	Birth asphyxia
Inadequate GBS intrapartum antibiotic prophylaxis (IAP)	Meconium staining
IAP given <4 h before delivery	Congenital anomalies
No IAP given	
Poor prenatal care	

Abbreviation: ROM, rupture of membranes.
Data from Refs.[1,5,6]

passive immunity.[1] Premature infants often have low birthweights and require invasive medical interventions, predisposing them to greater risk of infection exposure. EOS remains a primary cause of illness and death among neonates of all birthweights and gestational ages, with particularly devastating effects on premature infants.[5]

INCIDENCE

Group B streptococcus (GBS) was found to be the leading cause of EOS in the United States as early as the 1960s.[5] *Escherichia coli* is the second leading cause of neonatal EOS.[2] A maternal diagnosis of chorioamnionitis or maternal fever greater than 38°C remains the primary indicator for intrapartum antibiotic administration.[6] The CDC reported 90% of early-onset GBS sepsis manifests within the first 24 hours of life, with pneumonia, meningitis, and septicemia being the most common infections present.[7]

The incidence of GBS-related EOS is less than 1 case per 1000 live births in term infants.[3] There is a higher incidence of EOS in preterm infants of approximately 3.7 cases per 1000 live births (if <37 weeks gestation).[3] The rate for low birthweight infants (<1500 g) is approximately 11 cases per 1000 live births.[3] Despite these relatively low numbers of cases, EOS infections remain a major cause of mortality and morbidity for the neonatal population and may have long-term impacts on those who survive. **Table 2** notes highest incidence rates of EOS.

SYMPTOMS

EOS in the neonate often presents with vague, nonspecific symptoms that are easily missed.[1] Currently, there is no single set of criteria for diagnosing neonatal EOS. It is imperative that health care providers recognize risk factors and early signs of neonatal sepsis, and provide essential treatment to prevent rapid deterioration. Symptoms of EOS differ between the term infant and the premature infant.[3] Obtaining a thorough maternal history will help indicate increased risk factors requiring close assessment of the neonate for infection and sepsis development. The initial physical examination of the infant should include baseline vital signs, level of activity and alertness, muscle tone, and cardiopulmonary stability. Use of a pediatric or neonatal early warning scale scoring tool may assist with identification of high-risk infants.[1] Common signs and symptoms of neonatal EOS are listed in **Box 1**.

If meningitis is suspected, the neonate may show signs of increased irritability, jitteriness, seizures, hypertonia, and abnormal eye movements. Nuchal rigidity is often not present in the neonate and they are unable to demonstrate photophobia, although the

Table 2
Highest incidence rates for early-onset sepsis

Maternal	Fetal
Maternal chorioamnionitis or intrapartum fever >38.0°C	Premature infants <34 wk gestation
Positive GBS antenatal screening at 35–37 wk gestation	Very low birthweight infants <2500 g
Prolonged rupture of membranes before delivery (>18 h)	African American race
Advanced maternal age	Highest morality rate = preterm, very low birthweight
Caesarian delivery	

Data from Schrag S, Farley MM, Petit S, et al. Epidemiology of invasive early-onset neonatal sepsis, 2005 to 2014. Pediatrics 2016;138(6):[pii:e20162013]; and Stoll BJ. Early-onset neonatal sepsis: a continuing problem in need of novel prevention strategies. Pediatrics 2016;138(6):[pii:e20163038].

Box 1
Common signs and symptoms of neonatal early-onset sepsis

Incessant crying, unable to console

Poor feeding

Dyspnea, tachypnea, or apnea

Bradycardia or tachycardia

Hypotonia

Hypothermia less than 36°C (preterm infants)

Hyperthermia greater than 38°C (term infants)

Mottled skin color

Glucose instability

Hypoxia

Decreased responsiveness

Bulging fontanelle (suspect meningitis)

Data from Barnden J, Diamond V, Heaton PA. Recognition and management of sepsis in early infancy. Nurs Child Young People 2016;28(10):36–44.

infant may turn their head away from lights.[3] If the infant experiences a prolonged septic period, bleeding and clotting times will be abnormal, which may predispose the neonate to further complications. The absence of fever is not a reliable indicator of sepsis because premature neonates may not have the capability to generate a febrile response to infectious processes.[1] These nonspecific symptoms of EOS are often missed opportunities in accurately diagnosing and treating neonatal sepsis.

DIAGNOSIS

A focused history and astute clinical evaluation are the basis for diagnosing neonatal EOS. Ascertaining risk factors from the maternal history and clinical symptoms of the infant enable the health care provider to perform a thorough EOS assessment and workup. Components of a focused history are included in **Box 2**.

Box 2
Components of a focused history

Maternal health history

GBS screening results

Intrapartum antibiotic prophylaxis given to mother during labor

Duration of membrane rupture

Infections in prior pregnancies

Birth history

Feeding tolerance of newborn

Onset of respiratory distress in the newborn after than 4 hours of life

Data from Barnden J, Diamond V, Heaton PA. Recognition and management of sepsis in early infancy. Nurs Child Young People 2016;28(10):36–44.

It must be reemphasized that infection in a neonate can be present without obvious clinical symptoms; therefore, infants in high-risk categories should receive a detailed sepsis workup. **Table 3** lists common diagnostic tests included in a neonatal EOS evaluation.

One of the main difficulties in identifying newborns at risk for EOS is the occurrence of bacteremia among infants born to mothers who screen GBS negative.[8] Rescreening GBS negative mothers with real-time nucleic-acid amplification testing at the time of presentation for delivery could remediate this problem; however, this is not deemed to be a cost-efficient practice.[8] The development and implementation of a GBS vaccine may provide the safest and most efficient approach to the neonatal GBS EOS problem.[8] Substantial variation remains in newborn EOS risk assessment, which affects the definition of risk, the level of medical intervention required, and the impact on mother–infant separation.[4] Identifying and implementing an optimal approach to EOS risk assessment could positively affect the care of a large proportion of newborns.

The CDC established national guidelines for prevention of neonatal GBS disease in 1996 and revised these guidelines in 2002 and 2010. The guidelines contain recommendations for evaluation, treatment, and management of GBS in the mother and the infant. In 2010, collaborative efforts between the CDC, the American Academy of Pediatrics (AAP), the Committee on Fetus and Newborn, the American College of Nurse-Midwives, the American College of Obstetricians and Gynecologists, and the Committee on Infectious Diseases set forth to revise and endorse a single set of national guidelines for detecting and managing early-onset GBS disease in neonates.[9] The approved algorithm is available for review at https://www.cdc.gov/groupbstrep/guidelines/downloads/secondary-prevention.pdf.

Despite these national guidelines, wide variation still exists in clinical practice regarding approaches to sepsis screening and management in the neonate.[8]

Table 3
Diagnostic testing for early-onset sepsis

Blood Cultures	Minimum of 1 mL Sample Required[3]
Complete blood count	Including white blood cell differential and platelet count at birth and/or a 6–12 h of life[6]
Chest radiograph	Indicated with respiratory abnormalities or when source of infection remains unidentified[6]
Lumbar puncture	May be deferred in critically ill infants until their physical condition stabilizes[6] Focus specifically on the white blood cell count and differential[3]
Urinalysis and urine culture	Urine culture important even when urinalysis is normal because newborns do not store urine in the bladder long enough to produce nitrates in response to bacteria[3]
C-reactive protein	Indicates inflammation, often used as an indicator of when to discontinue antibiotics, instead of when to start them[3]
Skin and vesicle swabs	If herpes or varicella suspected, puncture vesicle and take swab by scraping bottom of the lesion[3]

Data from Rubarth LB, Christensen CM, Riley C. Bacterial sepsis in the neonate. Nurse Pract 2017;42(9):25–32; and Center for Disease Control and Preventition (CDC). Questions and answers about implementing the 2010 guidelines for neonatal providers: algorithm for secondary prevention of early-onset group-B streptococcal (GBS) disease among newborns. CDC.Gov 2016. Available at: https://www.cdc.gov/groupbstrep/clinicians/qas-neonatal.html. Accessed January 4, 2018.

Confusion regarding initial interpretation of recommendations among the CDC and the AAP guidelines was noted as a primary source of variation in guideline usage.[4] This variation in evaluation, diagnosis, and management of GBS EOS in the neonate underscores the importance of stricter adherence to a single set of national guidelines to improve rates of accurate diagnosis and early treatment of EOS.

Neonatal providers expressed the following concerns as a basis for nonadherence to established guidelines: (1) low risk (0.4 cases per 1000 births) of GBS infection to infants of GBS-positive mothers in the absence of additional risk factors, including fever or prolonged rupture of membranes[8]; (2) development of resistance to first-line beta-lactam therapies used as prophylactic treatment of GBS[2]; and (3) neonatal exposure to intrapartum antibiotics may increase risk of sepsis from non-GBS pathogens, especially *E coli*.[2] However, adherence to the 2010 CDC guidelines on prevention may eliminate the need for up to 25% of current EOS screening, improve methods for distinguishing high-risk infants, decrease mortality and morbidity rates, decrease incidence of early-onset GBS sepsis, and improve outcomes for neonates.[5] Inclusion of the GBS EOS protocol established by the CDC and AAP, as a core measure to be monitored by the Joint Commission, may provide the impetus for health care agencies to adhere to a standardized approach for neonatal EOS identification, treatment, and management. The main identification of infants with possible EOS is based on obstetric and neonatal risk factors and the condition of the infant at birth. Evaluating the infant's condition remains challenging and depends on clinical expertise.[5]

TREATMENT

As stated previously, there remains substantial variation in risk identification, evaluation, and treatment of neonatal EOS.[4] Reported management does either more or less than national standards recommend. Although it is important to tailor practice to account for local resources and structures of care, variations in decisions to start and stop antibiotics among newborns under the same clinical circumstances represent unnecessary deviations in management that could have a negative impact on the newborn.[4]

The primary goal of antibiotic therapy is to adequately cover the most likely pathogens while preventing antibiotic overuse and resistance.[3] The site of microbial entry is not always easy to identify in neonatal sepsis; therefore, initiating antibiotic therapy with broad-spectrum coverage is desired until therapy can be narrowed because of culture and sensitivity testing, usually after 36 to 48 hours of treatment.[6] Duration of antimicrobial therapy ranges between 7 and 21 days. Dosages and intervals vary by gestational age, postnatal age, weight, and depend on the suspected site-specific location of the infection.[3]

Antibiotics have various mechanisms of action and are frequently used in combination for better efficacy, or for the treatment and prevention of microbial resistance.[3] This is often referred to as double-coverage. The primary purpose is to attack the pathogen by killing it before the organism's ability to develop resistance. Certain antibiotics should be avoided in the neonatal population owing to the increased risk of adverse reactions, including (1) trimethoprim-sulfamethoxazole (Bactrim), (2) ceftriaxone, and (3) tetracycline.[3]

Most infants exposed to intrapartum antibiotics were given beta-lactams (eg. ampicillin or penicillin) or cephalosporins.[6,10] Many antimicrobials are not approved by the US Food and Drug Administration for use in infants, yet primary research and literature supports the safety and efficacy for use of these medications. Health care providers are encouraged to review dosing recommendations frequently because research is always ongoing with newer antibiotics.[3]

Concern about risks of prolonged early neonatal antibiotic exposure has been recognized as among the reasons for variation in sepsis management by health care providers.[2] Risks of early neonatal antibiotic exposure can lead to increases in (1) LOS, (2) necrotizing enterocolitis, (3) fungal infections, (4) recurrent wheezing disorders, (5) permanent and severe hearing loss associated with aminoglycosides (eg, gentamicin), (6) impact on the development of the intestinal microbiome (normal distribution and function of cellular structures within the body) with resulting risk of gastrointestinal disease, and (7) death.[2]

Selection of the appropriate antimicrobial therapy requires careful consideration of various factors.[10] If sepsis is strongly suspected, the National Institute for Health and Care Excellence has developed guidelines for treatment initiation, which includes[1]

- Starting treatment with intravenous (IV) antibiotics before receiving the results of diagnostic tests
- Administering antibiotics within 1 hour of therapy initiation
- Reviewing the antibiotic course length at 36 hours (health care providers may consider discontinuing IV antibiotics if the infant remains well and blood culture remains negative).

Treatment modalities in EOS may include but are not restricted to the following[1,4]:

- Antibiotics, antivirals, and immunoglobulins
- Isolation (especially when MRSA and other specific infections are present)
- Antipyretics (the drug of choice is acetaminophen, prescribed based on body weight)
- Fluids and supportive management (focused on maintaining stable blood glucose and electrolyte levels through fluid resuscitation, IV parenteral nutrition, or nasogastric tube feedings)
- Cardiopulmonary support (focused on stabilizing blood pressure with inotropes to maintain urine output, as well as administer oxygen and ventilatory assistance as needed)
- Maintaining neutral body temperature (may require placement in an incubator or overhead warmer to avoid shivering or overheating)
- Close monitoring (may require transfer to neonatal intensive care unit).

Antivirals and immunoglobulins may be indicated for severe viral sepsis with herpes simplex virus (HSV) or varicella.[1] Infants with HSV infection should be treated with IV acyclovir (60 mg/kg/d). If varicella is present, the infant will require IV varicella zoster immunoglobulin to prevent the serious complication of varicella pneumonia.[1]

NURSING MANAGEMENT

It is important to consider the possibility of EOS in the differential diagnosis of ill or at-risk newborns because symptoms of EOS are often vague and nonspecific. Early identification leads to appropriate treatment, enabling better outcomes for the neonate. Nurses play a vital role in managing infants with EOS through early detection, initiating treatment, ongoing monitoring, and supporting families.

Nursing management for EOS involves regular observations, use of a neonatal early warning scale, monitoring fluid balance, supporting maternal-infant bonding, and breastfeeding. Some degree of mother–infant separation is required for EOS evaluation, and separation for the entire duration of antibiotic therapy is required at times.[8]

The nurse assumes a leading role in ensuring that bonding between mother and infant is firmly established, as well as expertly addressing the psychological needs of the parents. Psychological support for the parents should address 3 main aspects:

- Explanation: Parents need an understanding of why infections arise because they often feel guilty about having done something wrong, resulting in the neonate's illness.[1]
- Communication: Establishing regular contact with the family allows nurses to keep parents informed and involved in their newborn's care. When parents are directly involved in the practical aspects of care (eg, diaper changes, feedings) they are likely better to cope with the emotional trauma of having a sick child.[9]
- Trust: Consistent communication assists in the building of trust between nurses and parents, which is an essential part of providing family-centered care.[1]

Parents often experience depression, anxiety, stress, and loss of control.[1] They vacillate between feelings of inclusion and exclusion related to the provision of health care for their infant. Nursing interventions that promote positive psychosocial outcomes are needed to decrease these parental feelings. Interventions should be focused on delivering family-centered, developmentally supportive care. The role of the nurse in meeting the emotional needs of the parents is of paramount importance.[1] **Box 3** highlights implications for nursing practice.

PROGNOSIS

When an infection is detected early and treated effectively, the long-term prognosis for infants is improved.[1] Infants who develop severe cases of EOS may require long-term outpatient follow-up to assess for developmental delays, achievement of proper developmental milestones, and persistent neurologic problems. If meningitis or encephalitis develops with EOS, particularly when associated with HSV, GBS, or *E coli*, there may be long-term neurologic complications from the infection.[1] Although

Box 3
Implications for nursing practice for neonatal sepsis

- Remain aware of the various signs and symptoms of sepsis in early infancy.
- Ensure regular monitoring and a prompt medical review of a newborn whose clinical condition deteriorates.
- When sepsis is suspected, antibiotic therapy should be administered in 1 hour.
- Ensure blood and cerebrospinal fluid cultures are checked in a timely manner and that antibiotics are discontinued when indicated.
- Arrange for timely transfer to a specialized unit (neonatal intensive care unit) when necessary.
- Ensure parents are involved in the care of their infant as much as possible.
- Encourage parents to immunize their infants, even if they have suffered a serious infection in the newborn period.
- Educate parents about fever and promote safe use of a single antipyretic agent.
- Collaborate with medical professional colleagues regarding any concerns about suspected developmental delay, even when this is an incidental finding.

Data from Barnden J, Diamond V, Heaton PA. Recognition and management of sepsis in early infancy. Nurs Child Young People 2016;28(10):36–44.

mortality is highest among very low birthweight infants infected with *E coli*, birthweight, pathogens, and mortality are interconnected. Approximately 6% of EOS survivors are reported to have long-term sequelae at time of hospital discharge.[5] If a developmental delay is suspected, the child should be referred to the appropriate pediatric specialist service. As previously mentioned, an increasing number of studies associate exposure to antibiotics early in life with a negative impact on subsequent child health. One of the most significant findings is the condition known as dysbiosis, which is an unhealthy change in the normal bacterial ecology of the body mediated by antibiotic exposures.[2] The potential long-term consequences of this can markedly affect an infant's future health status. However, notably, EOS remains among the leading causes of infant death in the United States.[2]

RECOMMENDATIONS

Further study of pathogens causing EOS is warranted due to the potential negative impact of complications on the infant's neurodevelopment and issues affecting normal microbial activity. The development of an effective maternal immunization against invasive pathogens could prevent disease in the mother, fetus, and the newborn. A specific vaccine for GBS may prevent both EOS and LSO and mitigate other adverse outcomes of pregnancy, including stillbirth, prematurity, and culture-negative sepsis.[5]

Utilization of the CDC guidelines for the use of intrapartum antibiotic prophylaxis to prevent perinatal GBS infection has led to a significant decrease in the incidence of both overall and GBS-specific neonatal EOS.[8] Nationwide adherence to the CDC guidelines as the best standards of care for management of EOS should be implemented.

Establishing neonatal EOS as a quality indicator for the Joint Commission can serve a twofold purpose. First and foremost, it will serve as a driving force for health care providers and agencies to incorporate the guidelines as set forth by the CDC and AAP. This will serve to decrease the wide variation among practitioners in the evaluation, diagnosis, and medical management required for septic newborns. Adherence to a set algorithm will enable consistency in the approach of caring for this vulnerable population. Second, attaching a financial incentive for adherence to the guidelines, by way of a national quality scoring on meeting the quality indicators (similar to those currently in place for conditions such as heart failure and pneumonia) will ensure a sustained impetus toward consistency in caring for EOS patients. Quality scores must be published on specific hospital Web sites to allow public viewing of how well the organization is meeting this indicator for quality patient care. This will drive hospitals to assume a pay-for-performance role in providing the highest quality of care for this patient population.

SUMMARY

Great strides have been made in the identification and treatment of neonatal EOS; however, the fight is far from over. Universal adherence to CDC guidelines for GBS EOS sepsis by health care professionals is paramount to the rapid identification and management of this vulnerable population.[8] Bedside nurses are an integral part of the health care team because they are often the first to encounter subtle clinical changes in the neonate. Early identification and treatment is essential, especially for premature and very low birthweight infants, because they have the highest morbidity and mortality rates from EOS.[5] Through continued education, vigilance, and family-centered focus, health care providers can prevent missed opportunities in addressing neonatal EOS.

REFERENCES

1. Barnden J, Diamond V, Heaton PA. Recognition and management of sepsis in early infancy. Nurs Child Young People 2016;28(10):36–44.
2. Schrag S, Farley M, Petit S, et al. Epidemiology of invasive early-onset neonatal sepsis, 2005 to 2014. Pediatrics 2016;138(6) [pii:e20162013].
3. Rubarth LB, Christensen CM, Riley C. Bacterial sepsis in the neonate. Nurse Pract 2017;42(9):25–32.
4. Mukhopadhyay S, Taylor JA, Von Kohorn I, et al. Variation in sepsis evaluation across a national network of nurseries. Pediatrics 2017;139(3) [pii:e20162845].
5. Stoll BJ. Early-onset neonatal sepsis: a continuing problem in need of novel prevention strategies. Pediatrics 2016;138(6) [pii:e20163038].
6. Questions and answers about implementing the 2010 guidelines for neonatal providers: algorithm for secondary prevention of early-onset group-B streptococcal (GBS) disease among newborns. 2016. Available at: cdc.gov/groupbstrep/clinicians/qas-neonatal.html.
7. Algorithm for secondary prevention of early-onset group B streptococcal (GBS) disease among newborns. 2010. Available at: https://www.cdc.gov/groupbstrep/guidelines/downloads/secondary-prevention.pdf.
8. Mukhopadhyay S, Eichenwald EC, Puopolo KM. Neonatal early-onset sepsis evaluations among well-appearing infants: projected impact of changes in CDC GBS guidelines. J Perinatol 2013;33:198–205.
9. Brady MT, Polin RA. Prevention and management of infants with suspected or proven neonatal sepsis. Pediatrics 2013;132(1):166–8. Available at: http://pediatrics.aappublications.org/content/132/1/166.
10. Committee on Infectious Diseases, Committee on Fetus and Newborn, Baker CJ, Byington CL, Polin RA. Policy statement—Recommendations for the prevention of perinatal Group B Streptococcal (GBS) disease. Pediatrics 2011;128(3):611–6.