

Care of the Well Newborn

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This article was accepted for publication prior to the American Academy of Pediatrics September 2022 release of the revised clinical practice guideline on the management of hyperbilirubinemia in the newborn infant 35 or more weeks of gestation. While the content of this review on care of the newborn is basically unchanged, the reader should refer to the following document in regards to managing hyperbilirubinemia and following the updated nomogram for risk assessment of hyperbilirubinemia in 35 or more weeks gestation newborns based on hour-specific serum bilirubin values:

Kemper AR, Newman TB, Slaughter JL, et al. Clinical Practice Guideline Revision: Management of Hyperbilirubinemia in the Newborn Infant 35 or More Weeks of Gestation. *Pediatrics*. 2022;150(3):e2022058859

PRACTICE GAPS

The routine care of the well newborn is a common practice for many pediatricians. In a busy practice it can be difficult to stay informed of updated practice guidelines.

OBJECTIVES *After completing this article, readers should be able to:*

1. Discuss the importance of antenatal care and the potential effects on the fetus.
2. Describe common risk factors associated with poor fetal outcomes during labor.
3. Explain the important elements of a newborn examination.
4. Delineate normal growth and feedings, including emphasis on skin-to-skin practice and breastfeeding.
5. Review preventive strategies in the newborn and methods to address parental refusal of interventions: vitamin K, hepatitis B vaccine, and eye prophylaxis.
6. Explain the management of common problems seen in the newborn (ie, jaundice, meconium aspiration) as well as more novel conditions such as neonatal abstinence syndrome and coronavirus disease 2019 infections.
7. Review anticipatory guidance for parents during the newborn period.

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ABBREVIATIONS

AAP American Academy of Pediatrics
 ACOG American College of Obstetricians and Gynecologists
 AGA appropriate for gestational age
 CCHD critical congenital heart disease
 CDC Centers for Disease Control and Prevention
 CHD congenital heart disease
 COVID-19 coronavirus disease 2019
 FGR fetal growth restriction
 GBS group B *Streptococcus*
 HBIG hepatitis B immune globulin
 LGA large for gestational age
 SGA small for gestational age
 SIDS sudden infant death syndrome
 SpO₂ pulse oxygen saturation
 VKDB vitamin K deficiency bleeding

ABSTRACT

Care of the newborn infant is a critical skill for general pediatricians and other providers in the practice of pediatric medicine. Optimal care relies on a thorough understanding of risk factors that may be present during the pregnancy and delivery, as well as the ability to recognize and address unanticipated problems in the postnatal period. This article focuses on antenatal care of the newborn, issues that present in the immediate postdelivery period, and care of the newborn after discharge. It also includes updated information on current topics in pediatric practice, such as the importance of vaccination, parental hesitancy in accepting common medical interventions, and updated guidelines related to the coronavirus disease 2019 pandemic. At the conclusion of the article, the reader should have a general understanding of antenatal risk factors that could affect the transition from the intrauterine environment and have the knowledge to address common issues that arise in the care of newborn infants.

INTRODUCTION

Caring for a newborn remains one of the most rewarding and endearing tasks for pediatricians. It is a time to celebrate, support, and educate families in a way that is unique to other areas of practice.

In this article we review care of the well newborn during the neonatal period, or the first 28 days after birth, including updates on contemporary practices and challenges facing the pediatric provider. We discuss the centuries-practiced newborn examination and emphasize the importance of breastfeeding. During the past decade, challenges to newborn medicine have included parental refusal of prevention strategies (ie, vitamin K), neonatal abstinence syndrome, and, most recently, the impact of coronavirus disease 2019 (COVID-19) on mothers and their newborn infants.

ANTENATAL CARE

Early Antenatal Care

Care for the newborn begins many months before birth—and ideally before conception—to evaluate maternal and fetal well-being and mitigate potential complications associated with pregnancy and childbirth. Antenatal care provides a unique opportunity to build rapport and engage parents in healthy lifestyle choices. Early pregnancy care should address the mother's medical and pregnancy history in addition to use of medications, supplements, or other substance use. Both maternal and paternal family history can provide insight into potential risks or complications for a pregnancy, and special attention should be given regarding mental health and social support factors. Guidance should also be provided regarding healthy diet, exercise, smoking/alcohol cessation, and appropriate weight gain during pregnancy. Prenatal visits are an ideal setting for shared decision-making and anticipatory guidance, providing an opportunity for answering questions, inquiring about

feeding and birthing plans, and setting expectations regarding hospital and follow-up care.

Maternity care often involves a variety of providers from diverse disciplines, and effective communication is important to ensure appropriate medical management of complications that may arise. The pediatrician is also often in a position to promote various aspects of prenatal care, especially when the provider responsible for the newborn is established early or is concurrently caring for siblings. This counseling includes vitamin supplementation and vaccinations, in addition to health education and promotion. It is recommended that mothers receive daily supplementation of 400 to 800 µg of folic acid at least 1 month before conception and throughout the first trimester to prevent neural tube defects. (1) The tetanus, diphtheria, acellular pertussis vaccine is recommended during each pregnancy between 27 and 36 weeks' gestation for protection against pertussis and to maximize efficiency of passive antibody transfer to the fetus. (2) In addition, family members and other caregivers who will be in close contact with the infant are recommended to receive tetanus, diphtheria, acellular pertussis and influenza vaccines if immunizations are not previously up to date, ideally at least 2 weeks before contact, to provide a "cocoon of immunity." (3)

COVID-19 vaccination has been at the forefront of recent public attention and is a particularly sensitive subject for expecting mothers. The American College of Obstetricians and Gynecologists (ACOG) recommends the vaccination to all pregnant and lactating women. Studies have shown the safety of the vaccine in pregnancy and lactation and general efficacy in prevention of severe COVID-19 signs and symptoms. (4)(5)(6)(7)

Delivery

In all of medicine, there are few more astonishing transitions than that from intrauterine to extrauterine life. Predicting the

success of this transition is largely affected by both maternal and fetal risk factors. As a clinician, it is imperative to review the maternal history and prenatal ultrasonography results for fetal anatomical or placental abnormalities that may result in neonatal depression. In the setting of a high-risk pregnancy, anticipatory care often involves a multidisciplinary team. Many hospital systems have committees that meet regularly to review upcoming deliveries that may warrant additional resuscitation and care.

In most newborn deliveries, resuscitation is not required. However, up to 10% of newborn deliveries do require some form of resuscitation (most commonly respiratory), and 1% require aggressive resuscitation. (8) Preparation is crucial due to the infrequency of resuscitation in general. Confirming that staff and equipment are available and trained in the Neonatal Resuscitation Program® is essential to ensuring the best possible outcomes. (8) As part of the preparation, clinicians should familiarize themselves with the delivery suite and equipment and consider running through scenarios as a team on a regular basis to maintain these critical skills.

Apgar scores remain the long-standing standard for clinical assessment of the newborn infant in the first minutes after birth. Assessing the newborn's appearance, pulse, grimace, activity, and respiration individually on a scale from 0 to 2, the Apgar score gives a quick clinical evaluation of the newborn's physiological health—particularly hemodynamic stability—and thereby the need for resuscitation. Scores are routinely taken at 1 and 5 minutes. Newborns who score below 7 should be reevaluated every 5 minutes until 20 minutes after birth or the score improves. Table 1 includes an expanded Apgar score as recommended by the ACOG and the American Academy of Pediatrics (AAP). (9) Apgar scores should not be considered predictive for any long-term neurologic outcomes or mortality. Moreover, although Apgar scores can help guide intervention and encourage interprofessional teamwork, it is largely a quick clinical tool rather than a diagnostic tool.

The ACOG currently recommends 30 to 60 seconds of delayed cord clamping because it has been shown to

improve the newborn's hemoglobin level and lower the risk of necrotizing enterocolitis and intraventricular hemorrhage. Once the cord is clamped, blood gasses are collected to provide an objective measure—pH, Po₂, Pco₂—of a newborn's metabolic state.

After Delivery

Healthy term or late preterm newborn infants should be placed directly on their mother (skin-to-skin contact) as soon as possible after birth regardless of mode of delivery unless the mother or infant is medically unstable or the mother continues to experience effects of anesthesia. On delivery, the infant should be dried and stimulated for an initial breath and then placed on the mother with the umbilical cord intact for the first minute. The baby should be placed ventrally on the mother's bare chest with a warm blanket placed over the newborn's back. Skin-to-skin contact should occur for at least 1 hour. (10)

Infants receive numerous health benefits from this skin-to-skin contact, including metabolic, cardiorespiratory, gastrointestinal, and neurologic outcomes. The maximum benefit occurs during the first hour postpartum, when oxytocin levels are high. Oxytocin is a hormone that strengthens the maternal-fetal bond. Moreover, this hour provides an ideal time for the mother to attempt breastfeeding. Studies indicate that babies with an hour of skin-to-skin contact have higher success with breastfeeding and are more likely to be exclusively breastfed on discharge. (11) Assuming that the newborn is healthy, clinical assessments and routine medical care should either be performed during skin-to-skin time or be delayed until skin-to-skin time is finished. For example, Apgar scores can be assessed while the infant is on the mother, and prophylactic erythromycin can be given up to 4 hours after birth (after the initial hour of skin-to-skin contact). Continued research shows numerous benefits to mothers as well, such as decreasing maternal stress, decreasing maternal depression scores, and easing the practice of breastfeeding. (10)

Table 1. Expanded Apgar Score as Recommended by the American College of Obstetricians and Gynecologists and the American Academy of Pediatrics

	APGAR SCORE		
	0	1	2
Color	Blue or pale	Acrocyanotic	Completely pink
Heart rate	Absent	<100 beats/min	>100 beats/min
Reflex irritability	No response	Grimace	Cry or active withdrawal
Muscle tone	Limp	Some flexion	Active motion
Respiration	Absent	Weak cry; hypoventilation	Good, crying

HOSPITAL CARE OF THE NEWBORN

Growth and Gestational Age

A comprehensive newborn assessment is ideally completed within the first 24 hours after birth and begins with review of the baby's gestational age, vital signs, and growth parameters. Determination of correct gestational age is an important step in evaluation and interpretation of newborn examination findings. If obstetrical gestational age is unknown or uncertain, neonatal maturity may be assessed using the New Ballard Score (<https://www.ballardscore.com>). (12) The New Ballard Scoring System is an indirect measure of brain and neuromuscular maturation as assessed by active and passive muscle tone, activity, and reflexes that reflect the progression from extensor to flexural posturing during central nervous system maturation. The Ballard Score also incorporates signs of physical maturity, including the appearance of the skin, extent of lanugo, and presence of plantar creases, as well as indicators of ear, breast, and genital development. This method yields an estimate of newborn gestational age in weeks and can be a valuable addition to traditional measures of gestational age given that fetal stressors can accelerate or delay the balance between physical maturity and fetal growth. Preterm infants are defined as being born at or before 36 weeks 7 days, term infants are defined as gestations between 37 weeks 0 days and 41 weeks 7 days, and postterm infants are gestations of 42 weeks 0 days and longer.

Once gestational age has been established, measures of weight, length, and head circumference can be evaluated on standardized growth curves, such as those established by the World Health Organization. These growth standards (https://cdc.gov/growthcharts/who_charts.htm) are specifically recommended for ages 0 to 2 years as they represent optimal growth in breastfed infants. Infants whose birthweights are less than the 10th percentile are considered small for gestational age (SGA) and birthweights greater than the 90th percentile are considered large for gestational age (LGA), leaving infants who weigh within the 10th to 90th percentiles classified as appropriate for gestational age (AGA). An important distinction to consider is the difference between fetal size and growth. Because extremes of fetal size are often indicative of aberrant growth, size is often used as a proxy for appropriate fetal growth; however, SGA or LGA is not necessarily indicative of underlying pathology, and neither does AGA guarantee developmentally appropriate growth. (13)(14) As such, it is estimated that approximately 40% of SGA infants may be constitutionally small yet healthy, whereas others fail to meet their genetic growth potential, as is indicative of fetal growth restriction (FGR). (15) Symmetrical FGR is typically caused by early first-trimester

insults, such as chromosomal abnormalities or congenital infection, resulting in a global growth delay. Asymmetrical FGR is characteristic of uteroplacental insufficiency or maternal malnutrition often occurring later in the second or third trimester, which results in "head-sparing" growth delays due to fetal blood flow redistribution to vital organs. (16) Post-term neonates are similarly at risk for FGR secondary to uteroplacental insufficiency as well as increased risk of meconium aspiration, intrauterine infection, and dysmaturity. Neonates who are LGA are at increased risk for birth trauma such as brachial plexus injuries, clavicular fractures, or scalp hematomas.

The Newborn Physical Examination

A complete head-to-toe newborn assessment allows the physician to evaluate the infant for possible abnormalities while providing an opportunity to engage parents in the health and care for their newborn. Performing the examination at the parents' bedside encourages parental involvement, providing an opportunity to give reassurance and to address questions that may arise. The approach to the physical examination for newborns typically begins with less invasive aspects of the examination, often beginning with inspection of the infant's muscle tone, color, activity, and disposition as well as the quality of the parent-infant interaction. Common newborn skin findings may include erythema toxicum (papules with an erythematous base on the face and trunk), milia (white papules consisting of keratinous cysts often present on the nose), nevus simplex (aka "stork bite," pink-red capillary dilations on the forehead or nape of the neck), hemangiomas, café-au-lait spots (light-brown macules), and congenital dermal melanocytosis (formerly referred to as Mongolian spots, which appear as blue-grey pigmented macules). Signs of acrocyanosis, which is isolated to the hands and feet, should be differentiated from central or generalized cyanosis warranting further cardiopulmonary evaluation. Jaundice is commonly observed in healthy newborns, and care must be undertaken to recognize potential signs of severe hyperbilirubinemia. On physical examination, assessing possible jaundice is best appreciated by gentle blanching of the skin with adequate lighting and is routinely assessed at least every 8 to 12 hours after birth. Jaundice typically progresses in a cephalocaudal fashion, and icterus of the sclera and/or mucous membranes may become evident at a bilirubin level of 3 g/dL (51,312 $\mu\text{mol/L}$). Because visual assessment can be an unreliable predictor of bilirubin concentration, serum and/or transcutaneous bilirubin screening is often performed before hospital discharge. (17)

Inspection of the head often reveals molding or signs of swelling of the face and eyelids from trauma due to the birth process. Fontanelles and suture lines should be palpated and evaluated for craniosynostosis and/or signs of scalp swelling, especially given the increased risk of trauma in forceps or vacuum-assisted deliveries. A cephalohematoma is a subperiosteal hemorrhage that presents as a firm swelling, which does not cross sutures. Cephalohematomas typically resolve over the course of a month and may increase the risk of hyperbilirubinemia as the hematoma resorbs. Rarely, cephalohematomas may persist and become calcified, which may necessitate surgical intervention. (18) Caput succedaneum is edema or hematoma superficial to the periosteum, which often self-resolves within days. The presence of overlying bruising or expansion of soft, fluctuant swelling that crosses suture lines is concerning for subgaleal hemorrhage, which can cause life-threatening bleeding. Symmetry of facial movements should be noted along with eye color, eye and eyelid movement, interpupillary spacing, pupillary size, and appearance of the conjunctiva and sclera. A normal red reflex will appear symmetrical without opacities or white/dark spots. Ophthalmoscopic examination of the red reflex has been shown to be especially sensitive for anterior eye abnormalities, such as cataracts and coloboma, but slightly less sensitive for posterior or retinal abnormalities. (19) The presence of tears, avoidance of light, and/or blepharospasm during examination may suggest congenital glaucoma. The position of the ears should also be evaluated along with inspection for external ear abnormalities such as skin tags, pits, or brachial cleft cysts, which may be indicative of hearing abnormalities. Similarly, the nose should be inspected for patency and the palate inspected visually or palpated by gloved finger. The neck should be supple and exhibit full range of motion. The neck region should be palpated for masses, which may include hematomas, webbing, brachial cleft, or thyroglossal duct cysts that can often be differentiated by location. A clavicular fracture is also a common birth injury, which may manifest as swelling or crepitus on palpation or, if nondisplaced, more subtly as asymmetry of the Moro reflex.

Significant physiologic changes occurring during the transition to extrauterine life make the cardiovascular and pulmonary examination particularly important. Respiratory effort and breathing pattern should be carefully assessed before auscultation. Signs of respiratory distress may include tachypnea, nasal flaring, grunting, retractions, or cyanosis. Due to a highly compliant chest wall, breathing may appear paradoxical with inward chest wall motion and outward abdominal motion during inspiration but is considered a normal finding in newborns. Breath sounds should be equal and symmetrical.

Palpation of the chest wall may detect heaves or thrills, and care should be taken to appreciate the quality of peripheral pulses, which are often most easily appreciated at the femoral, temporal, or brachial arteries. The S₁ heart sound corresponds to tricuspid and mitral valve closure and can be most easily appreciated at the cardiac apex. The S₂ heart sound is normally split during inspiration, reflecting the aortic and delayed pulmonic closure near the cardiac base. Evaluation of benign versus pathologic cardiac murmurs can be particularly challenging but can typically be distinguished by timing, quality, and intensity.

Evaluation of the extremities includes inspection of the digits, palmar creases, and equal spontaneous movement of all extremities. Surveillance of developmental dysplasia of the hips within the first 3 months of life requires careful evaluation using the Barlow and Ortolani maneuvers. The Barlow maneuver promotes posterior dislocation of the hip through adduction of the hip with posteriorly directed pressure over the greater trochanter, allowing palpation of the femoral head dislocating from the socket. Similarly, the Ortolani maneuver is performed by applying anterior pressure during abduction of the hip, during which a “clunk” may be felt as the femoral head reduces back into the acetabulum. An audible “click” during these maneuvers may be due to manipulation of soft tissue and is considered a normal finding. (20) Another common orthopedic abnormality is talipes equinovarus, or clubfoot, which presents with inversion and adduction of the forefoot with limited extension of the ankle and an internally rotated limb. Care should be taken to distinguish clubfoot from positional deformities, which easily correct with manipulation.

The genitourinary tract should be inspected for abnormalities or evidence of ambiguous genitalia. Female neonates may have small amounts of vaginal discharge or bleeding secondary to withdrawal from maternal estrogens. In male newborns, the testes should be evaluated for descent into the scrotal sac and the scrotum for evidence of inguinal hernia or hydrocele. Hypospadias, penile curvature, or a retractile penis are contraindications to circumcision and warrant referral for correction. The anus should also be evaluated for placement and patency. Sacral dimples that are located beyond 2.5 cm of the anal verge, that are greater than 0.5 cm in diameter, or that are associated with cutaneous findings should be further evaluated by ultrasonography before 3 months of age for possible spinal dysraphism.

Neurologic assessment includes the newborn’s muscular tone while held in suspension as well as infantile reflexes, including the suck, rooting, grasping, stepping, and Moro

reflexes, which typically disappear around 6 months of age. The Babinski reflex can be elicited by stimulation of the sole of the foot, resulting in dorsiflexion of the great toe. This reflex typically disappears between 12 and 24 months of age due to progressive central nervous system maturation. (21)

The Late Preterm Infant

In the newborn nursery setting, many clinicians encounter the late preterm (near-term) infant, born between 34 0/7 and 36 6/7 weeks' gestation. (22) The late preterm infant often masquerades as a healthy term infant but is prone to hypoglycemia, jaundice, respiratory distress, temperature instability, feeding challenges, and increased rates of readmissions compared with a term counterpart. (23) For this reason, most hospital systems have protocols that require late preterm infants to be monitored for 48 hours, in addition to interventions such as passing a car seat trial before discharge.

Routine Newborn Screening

Newborn screening allows for early identification of serious medical conditions for which effective treatment and/or prevention is available. Screening programs vary from state to state but typically include screening for inborn errors of metabolism, congenital hypothyroidism, cystic fibrosis, hemoglobinopathies, and immunodeficiencies, in addition to screening for critical congenital heart defects and hearing loss as outlined by the US Department of Health and Human Services and American College of Medical Genetics and Genomics–recommended uniform screening panel. (24)

Metabolic testing consists of a dried blood spot sample collected on a filter paper and sent to a central laboratory for analysis, typically by tandem mass spectrometry. Metabolic testing for healthy newborns is ideally obtained close to discharge because this timing allows for maximal accumulation of substances to maximize sensitivity. Positive or equivocal screening should prompt confirmatory testing and should be followed until a specific diagnosis is established or excluded. False-negative results are more likely in premature infants, newborns screened within 24 hours of birth, or those who received blood transfusion or dialysis. Resources for health-care providers and caregiver education include the website Baby's First Test (<https://www.babysfirsttest.org>) and ACTION sheets provided by the National Coordinating Center for the Regional Genetics Networks (<https://nccrcg.org>). (25)

Newborn screening also includes evaluation for hearing loss through point-of-care testing in the newborn nursery. Bilateral hearing loss is the most common congenital

disorder, with a prevalence of 1.7 per 1,000 babies screened in 2019. (26) Genetic causes are estimated to account for at least 50% of cases of hearing loss in children, and another 30% of cases are attributed to intrauterine infection, such as congenital cytomegalovirus, or other environmental causes. (23) Screening is typically accomplished with either otoacoustic emissions, which detects movement of the outer hair cells of the cochlea, or the automated auditory brainstem response, which measures the cochlear nerve action potentials to screen for sensorineural hearing loss and auditory neuropathy. (27) Early detection of hearing impairment has been associated with improved developmental outcomes in children with permanent hearing impairment. (28)

Universal newborn screening for critical congenital heart disease (CCHD) consists of preductal (right hand) and postductal (either foot) pulse oximetry ideally performed after 24 hours of age. (29) The prevalence of congenital heart disease (CHD) is approximately 1%, and approximately 25% of these infants will have CCHD, considered a critical defect requiring surgical or catheter-based intervention within the first year after birth. (30) It is estimated that up to one-third of infants with CHD are asymptomatic during the first few days after birth as the timing of presentation can vary with dependence on ductus arteriosus patency. Because early detection has been shown to improve infant morbidity and mortality, universal screening for CCHD was adopted in 2011. (31) According to the updated AAP algorithm, (32)(33) a positive screen is considered a pulse oxygen saturation (SpO₂) measurement less than 95% in either extremity or a greater than 3% difference between upper and lower extremities. To facilitate prompt intervention, an SpO₂ measurement of less than 89% in either extremity or a single 1-hour repeated SpO₂ of less than 95% or a difference of greater than 3% between extremities should prompt referral for further evaluation with an echocardiogram (Table 2). (32)(33) Importantly, the prevalence of CCHD remains low, and most infants who screen positive will not have CCHD. (34) Caregivers should be appropriately counseled regarding interpretation of a positive screening result.

Standard Newborn Medical Interventions

In 2019, the US Preventive Services Task Force reaffirmed its 2011 recommendation for the use of prophylactic erythromycin in newborns for the prevention of gonococcal ophthalmia neonatorum. The antibiotic should be administered topically within the first 4 hours after birth.

Intramuscular vitamin K continues to be recommended treatment for newborn infants. Because newborns have

Table 2. Summary of Pulse Oximetry Recommendations for Newborn Congenital Heart Disease Screening

TIMING	INTERPRETATION	PULSE OXIMETRY READING	NEXT STEPS
Measurement 1 >24 h after birth or shortly before discharge if <24 h after birth	Pass (Negative screen)	Spo ₂ ≥95% in preductal and postductal readings AND ≤3% absolute difference between Spo ₂ readings	Provide routine newborn care; repeated screening not recommended
	Indeterminate	Spo ₂ of 90%–94% in EITHER preductal or postductal readings OR >3% absolute difference between Spo ₂ readings	Repeat pulse oximetry measurements in 1 h
	Fail (Positive screen)	<89% in EITHER preductal or postductal readings	Do not repeat screening; refer for immediate assessment
Measurement 2 1 h after first screening	Pass	Spo ₂ ≥95% in preductal and postductal readings AND ≤3% absolute difference between Spo ₂ readings	Provide routine newborn care; do not repeat screening
	Fail	Spo ₂ <95% in EITHER preductal or postductal readings OR >3% absolute difference between Spo ₂ readings	Do not repeat screening; refer for immediate assessment

Spo₂=pulse oxygen saturation.

Adapted from Martin GR, Ewer AK, Gaviglio A, et al. Updated strategies for pulse oximetry screening for critical congenital heart disease. *Pediatrics*. 2020;146(1):e20191650.

relatively low vitamin K reserves, as it does not readily cross the placenta, newborns are at risk for vitamin K deficiency bleeding (VKDB). Intramuscular vitamin K prophylaxis has shown effectiveness in reducing the incidence of VKDB in infants and has become a globally adopted practice. Clinicians should be aware that some families may have resistance to vitamin K administration, and clinicians should respond to families' particular concerns by emphasizing the safety of administration along with the increased risk of VKDB when not administered. An association between administration of vitamin K and pediatric cancers has not been proven. Oral vitamin K may be a viable alternative but has not been well studied.

COMMON POSTNATAL COMPLICATIONS

In caring for the newborn, it is important to review the mode of delivery and understand the associated risk factors. Birth trauma commonly associated with vaginal deliveries include head injuries such as caput succedaneum and cephalohematomas. In addition, in deliveries in which forceps or vacuums are used, a clinician should be aware of the risk of a subgaleal hemorrhage. (35) For infants delivered while immersed in water, commonly referred to as waterbirths, a clinician should be aware of possible complications, including infection, difficulties with thermoregulation, and possible aspiration. (36) Obstetricians may elect for cesarean deliveries for a variety of reasons, including an attempt to reduce injuries such as a clavicle fracture or Erb

palsy associated with abnormal positioning at the time of a vaginal delivery.

Developmental Dysplasia of the Hip

Infants born in a breech presentation or with a history of breech presentation in the third trimester are at increased risk for developmental dysplasia of the hip. If signs of hip subluxation or dislocation are appreciated with the Barlow or Ortolani maneuver, ultrasonography should be performed to identify hip dysplasia by 3 to 4 weeks of age. (20) For infants with increased risk of developmental dysplasia of the hip who display normal examination findings, screening hip ultrasonography is typically performed approximately 6 weeks after delivery. (20) There is a certain degree of ligamentous laxity present at birth naturally to assist in the birthing process, and waiting 6 weeks allows for resolution of this laxity and reduces the rate of false-positive screening.

Hypoglycemia

Hypoglycemia is an important condition to assess during the postdelivery period. Risk factors for hypoglycemia include infants who are born to diabetic mothers, are LGA or SGA, are premature, or have a history of intrauterine growth restriction. There is a large range of normal glucose levels for healthy, term, AGA newborns, from 25 to 110 mg/dL (1.33–6.11 mmol/L); however, timing and context are paramount for interpreting normal plasma glucose concentrations. (37) For example, 1 to 2 hours after delivery,

in an asymptomatic neonate, a glucose level of 30 mg/dL (1.67 mmol/L) would be considered an appropriate finding in the transition to extrauterine life. (38) However, by 12 hours of age stable glucose concentrations are expected to be greater than 45 mg/dL (>2.50 mmol/L). Similar to bilirubin, there is not a plasma glucose concentration or duration of hypoglycemia that can determine neurologic injury in high-risk infants. (38) Clinical symptoms include jitteriness, floppiness, apneic episodes, tachypnea, lethargy, or poor feedings.

Hypoglycemia in the infant may be asymptomatic, making it difficult to identify without routine screening protocols in place. Typically, the infant's blood sugar level stabilizes around 12 to 24 hours after birth. The timing and duration of neonatal hypoglycemia is influenced by many factors. Infants born to mothers with diabetes can present with hypoglycemia as early as 1 hour after delivery that can last until 12 hours of age, in contrast to LGA and SGA infants, who may present with hypoglycemia at 3 hours of age that persists until 10 days of age. (38) Persistence of hypoglycemia after 48 to 72 hours of age should prompt referral to endocrinology for further evaluation.

Treatment options for neonatal hypoglycemia include breastfeeding, formula feeding, oral dextrose gel application, and intravenous administration of glucose-containing fluids. Due to the asymptomatic nature of infant hypoglycemia, controversy exists regarding treatment. On the one

hand, there is concern for overtreatment, including supplementation with formula and interruption of breastfeeding, separation of the infant from the mother, and increased family anxiety regarding the testing and treatment protocols. Concern for not treating asymptomatic hypoglycemia is that it will progress to symptomatic hypoglycemia presenting as postnatal depression or seizure activity. There are also concerns about the long-term developmental impact that hypoglycemia may cause, although it may not be apparent until the child reaches school age.

Jaundice

Physiologic jaundice is an unconjugated hyperbilirubinemia that arises after 24 hours of age, typically peaking at approximately day 3 or 4 of age, and may persist for up to 1 week. Importantly, any signs of jaundice within the first 24 hours after birth should prompt investigation for pathologic etiology. Common risk factors for severe hyperbilirubinemia include exclusive breastfeeding, gestational age of 35 to 38 weeks, cephalohematoma or bruising, and history of siblings with significant jaundice. Interpretation of bilirubin concentrations should consider the infant's gestational age, age in hours since birth, and timing of the blood sampling during risk stratification. (39) The web-based BiliTool™ (<https://bilitool.org>), based on the hour-specific bilirubin nomogram (Fig), provides guidance on

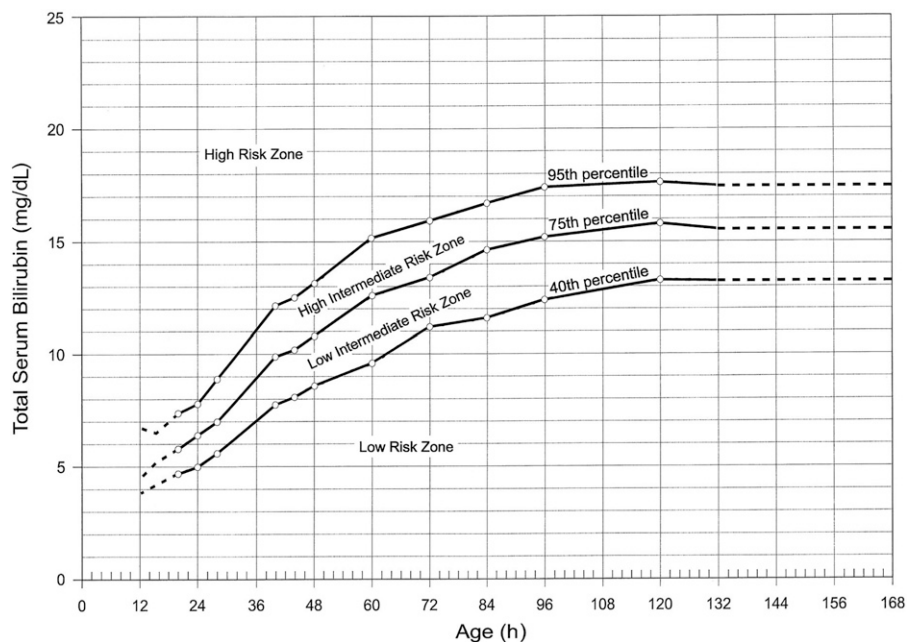


Figure. Nomogram for risk assessment of hyperbilirubinemia in term and near-term newborns based on hour-specific serum bilirubin values. Intended for infants greater than 35 weeks' gestation without evidence of hemolytic disease. Reprinted with permission from Bhutani VK, Johnson L, Sivieri EM. Predictive ability of a predischarge hour-specific serum bilirubin for subsequent significant hyperbilirubinemia in healthy term and near-term newborns. *Pediatrics*. 1999;103(1):6–14.

management and discharge recommendations for newborns greater than 35 weeks' gestational age. (40)

Syphilis

Despite being a preventable illness, cases of primary and secondary syphilis in adults have continued to rise since the 2000s, with increasing prevalence in women of child-bearing age. Correspondingly, rates of congenital syphilis have risen from 2016 (16.2 cases per 100,000 live births) to 2020 (57.3 cases per 100,000 live births), representing a 253% relative increase. Vertical transmission may occur at any gestational age, and risk corresponds to the stage of maternal infection, with secondary and early latent stages incurring the highest risk. (41) In addition to increased rates of spontaneous abortion or stillbirth, common fetal or neonatal abnormalities include hepatomegaly, rhinitis (snuffles), anemia/hydrops, and intrauterine growth restriction with associated placental and umbilical cord abnormalities. (42) Nevertheless, most infants born to mothers with untreated syphilis do not display clinical evidence of infection until later in infancy or childhood. (43) Because serologic diagnosis is complicated by transplacental antibody transfer, treatment decisions depend on probability of infection based on maternal diagnosis and subsequent treatment, laboratory and/or clinical findings in the neonate, comparative titers between neonate and mother, or positive darkfield microscopy or *Treponema pallidum* DNA polymerase chain reaction. Ideally, high-risk pregnancies are screened at the initial prenatal and 28-week visits in addition to the time of delivery. Infants born to mothers who have completed treatment more than 30 days before delivery—provided subsequent serologic titers remain low—do not require further intervention. Confirmed or probable congenital syphilis is treated with a 10-day course of intravenous or intramuscular penicillin G. For additional discussion of management and treatment of equivocal or possible congenital syphilis, please refer to the Centers for Disease Control and Prevention (CDC) guidelines (<https://www.cdc.gov/std/treatment-guidelines/congenital-syphilis.htm>).

Group B *Streptococcus*

In the 1970s, group B *Streptococcus* (GBS) was the leading cause of neonatal morbidity and mortality of otherwise healthy newborn infants, but by 2015, due to increased screening and treatment, the incidence has decreased to 0.23 per 1,000 births. (44)(45) Screening is performed universally between 35 and 37 weeks' gestation, and intrapartum antibiotic prophylaxis is recommended if bacterium is present. Most cases occur within the first 24 to 48 hours; however, GBS infection may occur up to 1 week

after delivery. (46) If adequate intrapartum prophylaxis is administered, then the infant may be observed for a minimum of 24 hours before discharge. In the setting of inadequate antibiotic prophylaxis or unknown maternal GBS status, the recommendation is to observe the infant for a minimum of 48 hours. (47) Recommendations have changed over the years, and currently laboratory studies such as a complete blood cell and blood culture are not universally needed, unless the infant develops any concerning signs. The early-onset sepsis risk calculator tool, developed by Kaiser Permanente, has aided many pediatricians in the evaluation and treatment of sepsis (<https://neonatalesepsiscalculator.kaiserpermanente.org>). This tool, in addition to clinical judgment, has reduced antibiotic use without increasing adverse outcomes. (48)

Maternal Hepatitis B

The AAP Committee on Infectious Disease and the CDC recommend routine screening for and immunization against the hepatitis B virus to reduce the risk of maternal to infant transmission of hepatitis B. Screening of all expecting mothers for hepatitis B infection is routinely performed during the pregnancy. Routine administration of the hepatitis B vaccine in all infants, and administration of hepatitis B vaccine in conjunction with hepatitis B immune globulin (HBIG) in cases of known maternal hepatitis B infection, are both important ways to reduce maternal transmission of hepatitis B to the infant. For infants born to hepatitis B–positive mothers, the infant should still receive the recommended hepatitis B vaccine series and be screened for the presence of hepatitis B at approximately 9 months of age. When a mother's hepatitis B status is unknown, the hepatitis B vaccine should be administered within 12 hours of delivery, and the mother's status should be reconciled as soon as possible. Infants weighing more than 2,000 g should receive HBIG before discharge or within 7 days if the mother's status remains unknown or returns positive. For infants weighing less than 2,000 g, HBIG should be administered within 12 hours unless the mother's status is confirmed negative.

Maternal Human Immunodeficiency Virus Infection

Infants born to mothers who are known to be human immunodeficiency virus positive should be formula fed because human immunodeficiency virus can be transmitted to the infant through human milk; in the developing world this is not always a reality. Zidovudine should be started within the first 12 hours after birth. Consultation from a pediatric infectious disease specialist should be

sought to guide further therapy and for follow-up testing recommendations.

Neonatal Abstinence Syndrome

Infants born with maternal substance exposure, such as opiates, may experience neonatal abstinence syndrome, the incidence of which increased fourfold from 2004 to 2014. (49) An abstinence scoring system should be used, and recently the Eat, Sleep, Console method (<https://caring4nas.com>) has been shown to be more effective than the Finnegan Neonatal Abstinence Scoring System in identifying infants in need of intervention due to neonatal abstinence syndrome. (49) In addition to soothing techniques and frequent feedings, a multidisciplinary approach involving social work, lactation, and maternal mental health support is paramount. Depending on the substance of use, breastfeeding may be withdrawn in some circumstances due to the immediate and long-term effects on the infant. (50)

COVID-19

A treatment challenge that has emerged in the past few years is severe acute respiratory syndrome coronavirus 2 (COVID-19) maternal and neonate infections. A recent consideration for clinicians is the presence of maternal COVID-19 and the effect on the newborn. The highest risk of infection to newborns occurs when the mother has onset of symptoms near the time of delivery. (51) Current recommendations include 1) allowing the mother and newborn to room-in together, 2) encouraging the mother to maintain a reasonable distance from the newborn when possible and to wear a face mask and practice good hand hygiene when hands-on care is performed, 3) allow breastfeeding with appropriate masking techniques, and 4) consider testing the newborn at 24 hours of age and, if negative, repeating testing at 48 hours of age. (52)

Anticipatory Guidance and Discharge

Alongside examining the newborn and mother, physicians should provide anticipatory guidance to families as they prepare to be discharged. Oftentimes this includes a potentially enormous amount of information, so the plan should be tailored to the individual patient and their respective needs.

Feedings

In the newborn period, one of the most common challenges for infants and parents' centers around feedings. As discussed previously, the practice of early skin-to-skin contact and breastfeeding results in the highest

breastfeeding success rates. However, even in the best of circumstances feedings can still be challenging. Many birthing centers recognize the importance of a team approach and have lactation specialists on staff to aid with nursing techniques and latching. Breastmilk remains the most beneficial nutrition for newborns, passing immunity from mother to child and strengthening the bond between mother and child. In recent years, lip- and tongue-tie (ie, ankyloglossia) have become a frequent concern for nursing mothers experiencing difficulties with breastfeeding. The routine practice of lingual or labial frenotomy remains controversial due to the lack of definitive evidence supporting its efficacy.

The volume of feedings will vary with age as the infant grows. For many newborns, the anticipated volumes of feedings will vary from 5 mL every 2 to 3 hours on day 1 of life, increasing quickly to an average of 30 mL by 5 days of life. For breastfeeding infants, volume depends on maternal supply. The initial colostrum is small in volume but rich in caloric content. On average, a mother's milk production will increase between days 3 and 5 after delivery. To ensure adequate intake, breastfed infants are encouraged to have 8 feedings within a 24-hour period.

Signs of appropriate intake will include weight gain, approximately 20 to 30 g daily for the first 3 postnatal months. This does not take into consideration the weight loss that occurs in the first few days after birth (7%–10%). In addition to weight gain, voiding and stooling patterns are followed closely. It is anticipated that the newborn will void by 24 hours of age and that voids will increase as lactation is established. Parents are encouraged to monitor the urinary stream, and if dribbling occurs, providers should consider outlet obstructions such as posterior urethral valves. The first bowel movement should occur by 48 hours of age. If delayed, a clinician should consider conditions such as Hirschsprung disease or cystic fibrosis. By 5 to 7 days of age, output increases to, on average, 3 to 6 stools daily and 4 to 6 voids per day. (53)

Safe Sleep

Newborns sleep 16 to 18 hours per day on average. In the first week, many newborns have longer awake periods at night than during the day. Transitioning the infant to sleeping at night in a bassinet is often a challenge for families, and clinicians need to be aware of the challenges that fatigue will have both physically and mentally for parents. One should encourage safe sleep practice at all times and consider screening for depression and anxiety in both parents.

As will be modeled during their hospital stay, parents should receive guidance on safe sleep for infants to reduce the risk of sudden infant death syndrome (SIDS). Newborns should be placed in a supine position on a firm mattress in a crib or bassinette, which should be free of any other objects, including blankets, pillows, stuffed animals, or bumpers. The infant's crib should be in the same room as the parent(s) for at least 6 months and ideally for the first year. The infant should not share the bed with an adult (commonly referred to as co-sleeping). Physicians should be aware of different cultural beliefs and socioeconomic factors surrounding infant sleep, particularly bed-sharing and using soft bedding, and engage the individual family on best sleep practices for their infant. Physicians should encourage families to provide the infant a smoke-free environment because smoke exposure is a risk factor associated with increased risk of SIDS. (54) Swaddling is not considered protective against SIDS and should be discontinued at the first sign the infant can roll from supine to prone. (55) In fact, swaddling with hips extended and adducted actually increases the risk of hip dysplasia. When swaddled, the infant's hips instead should be freely allowed to be flexed and abducted with the knees free to be flexed. The Safe to Sleep campaign (formerly known as Back to Sleep) showed a significant decrease in cases of SIDS from the early 1990s to the present.

Skin and Cord Care

Families often have questions regarding skin care and care of the umbilical stump after discharge. When bathed, infants should receive only a sponge bath with lukewarm water until the umbilical cord has detached. Once the umbilical stump has fallen off, the infant can have a traditional bath. The newborn should never be left alone in the water and should have most of the body above the water. The combination of keeping the umbilicus dry, folding the diaper down away from the stump, and practicing good hand hygiene when caring for the infant is considered best practice. The stump should otherwise be left alone until it falls off, typically around day 10 to 14 after birth.

Circumcision

Male circumcision is supported by both the CDC and the AAP as a public health measure to decrease the risks of penile infection, genital cancers, and sexually transmitted infections. It is a procedure that also carries a small amount of risk, namely, bleeding, infection, and disfigurement. Ultimately, the decision should be discussed with the family and education should be provided about these

risks and benefits, with the family supported regardless of their decision. (56)(57) The uncircumcised penis can be cleansed normally and does not need any special care and should not be retracted due to risk of bleeding and pain; later in childhood, those who are not circumcised can be counseled on appropriate hygiene strategies. The circumcised penis can be covered in petroleum to protect it from sticking to the diaper or clothing.

Period of PURPLE Crying®

The Period of PURPLE Crying has been a successful campaign to counsel parents on infant crying, help parents anticipate these behaviors, and, ultimately, reduce the incidence of abusive head trauma. Parents should be encouraged to touch their baby (holding, rocking, skin-to-skin practice, caressing) and to interact with their baby (talking, singing, reading) to help find different ways to soothe their infant. Parents should be encouraged to seek support from friends and family in the care of their newborn. When parents become frustrated or upset by their child's crying, they should put their child in a crib or other safe space and ask for help from another parent or caretaker. Crying tends to peak at approximately 6 weeks of age. (58)

Supplementation

The AAP recommends 400 I/U of vitamin D daily for newborns who are exclusively or partially breastfed. (59) Mothers who take a vitamin D supplement as part of their diet may not need to provide vitamin D to the infant but would need to be taking a daily dose of approximately 6,400 I/U. Exclusively breastfed infants should also begin receiving iron supplementation at 4 to 6 months of age. They should receive 1 mg/kg body weight per day until they establish a diet containing iron-rich foods. Formula-fed infants do not need separate iron or vitamin D supplementation. Premature infants are at greatest risk for iron deficiency because iron stores accumulate in the third trimester. Generally, these infants should receive 2 mg/kg per day through either supplementation or fortified formula until 12 months of age. Some infants may need higher doses, up to an oral equivalent of 4 mg/kg per day, but those infants tend to be sicker and more premature. (60)

Car Seat Safety

Car seat safety instruction should be provided for patients. Infants are now recommended to be in a rear-facing car seat and to remain rear-facing as long as possible (ie, weight of 40 lb [18 kg]). Consideration can then be made regarding changing to a forward-facing car seat until the infant outgrows the height or weight restrictions on that car seat model. Winter coats and other bulky clothing should be avoided during

car seat use because they decrease the effectiveness of the restraints; however, if needed for warmth, clothing can be applied once the infant is strapped in place. (61)

Outpatient Visits

The first outpatient visit is intended to correspond with the climax of hyperbilirubinemia levels peaking at 3 to 5 days of age and depends on the baby's age at the time of discharge. Recommended follow-up for newborns discharged between 48 and 72 hours of age is by age 5 days. Follow-up is recommended at 4 days of age for discharges between 24 and 48 hours of age or on day 3 after birth for discharges occurring before the first 24 hours of age. If appropriate follow-up cannot be ensured, delaying discharge until age 3 or 4 days may be appropriate. (62) Although the AAP does not endorse planned home births, pediatricians also have an obligation to provide appropriate care for these newborns, which includes obtaining screening measures (ie, newborn screen). (63) The first outpatient visit is imperative to assess for hyperbilirubinemia, weight gain, hydration, and parental mental well-being. Feeding and output are common discussion points, and feedings should occur every 2 to 3 hours, voiding 6 to 8 times per day, and stools transitioning from meconium to yellow. If infants have weight loss, further counseling and investigation into feedings may be warranted to explore etiologies such as low milk supply or latching difficulties.

Vaccine Hesitancy

Addressing vaccine hesitancy and refusal of routine medical interventions remains of central importance to pediatricians' best practice. The ability to address parents' concerns about vaccines has been increasingly important for pediatricians in the past few decades as an increasing number of vaccines have become available, and, of course, the issue has become acutely important since the COVID-19 pandemic. Personal, one-on-one conversations have been shown to be the most effective means for helping reduce parental hesitancy. Motivational interviews, encouraging parents to articulate their questions and concerns, and anecdotes about children who have been sick with vaccine-preventable diseases have been effective in alleviating vaccine hesitancy. Pediatricians should be eager to harbor families' trust and anticipate giving time for these encounters as the conversation provides opportunity to correct misconceptions or misunderstandings. (64)

Postpartum Depression

Maternal mental health is central for best health outcomes for both mothers and newborns. With perinatal depression and postpartum depression rates at 9% and 10%, respectively, the ACOG recommends that women be screened at least once during pregnancy, (65) and the AAP recommends screening at least once within the first 6 months postpartum. A variety of screening tests can be used, including the Edinburgh Postnatal Depression Screen or the Patient Health Questionnaire-9 (<https://www.apa.org/depression-guideline/patient-health-questionnaire.pdf>). A positive screen is not diagnostic, but patients should be referred for follow-up with a mental health professional for further evaluation. Interprofessional communication between pediatricians and obstetricians should be communicated when managing patients at risk for or diagnosed as having postpartum depression. Risks include certain socioeconomic factors, a history of psychiatric illness, and a traumatic delivery. Moreover, pediatricians should familiarize themselves with local resources available to support mothers' mental health and to relieve socioeconomic burdens that contribute to a higher risk of postpartum depression. Similarly, although the subject requires more thorough research, paternal postpartum depression also should be screened for among new fathers. Pediatricians have a unique opportunity to screen because most fathers are present at least during 1 health supervision visit. Fatherhood depression is associated with pediatric psychopathology and reduced parent engagement. Again, the Patient Health Questionnaire-9 is an appropriate tool because a particular screen for paternal depression has yet to be created, and fathers who screen positive should be referred for further psychiatric evaluation. (66)

CONCLUSION

Caring for the newborn remains 1 of the most rewarding practices for many pediatricians. The general practice of newborn medicine has remained consistent for decades; however, guidelines have changed with advances in medicine and the influence of emerging conditions such as the COVID-19 pandemic.

Summary

- Based on evidence level D, educating and counseling families through the newborn period is a unique and rewarding aspect of pediatric practice.
- Based on evidence level B, preventive interventions after delivery (ie, hepatitis B vaccine,

erythromycin, vitamin K) continue to prove their safety and efficacy despite parental refusal.

- Based on evidence level B, breastfeeding remains the optimal nutrition for newborns and should be accompanied by supplementation with 400 IU of vitamin D.
- Based on evidence level D, appropriate measures, such as masking and good hand hygiene, should be used to protect infants from coronavirus disease 2019 (COVID-19) and other infectious etiologies.
- Based on evidence level B, influenza; tetanus, diphtheria, acellular pertussis; and COVID-19 vaccination of mothers and other caregivers aids in the protection of infants from severe infections until they are able to receive vaccinations.

- Based on evidence level B, rear-facing in a car seat remains the safest position for infants and toddlers. They should remain rear-facing until car seat height and weight maximum specifications have been met.

Acknowledgment

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Suggested Reading

Campbell DE. Neonatology: For Primary Care. Itasca, IL: American Academy of Pediatrics; 2020.

*References for this article can be found at
DOI: 10.1542/pir.2022-005511.*



1. A medical student is assisting the OB-GYN attending and resident with a routine vaginal delivery. The attending explains to the medical student the benefits of a delay in clamping the cord after delivery of the baby. According to the American College of Obstetricians and Gynecologists, which of the following is the ideal delay time for cord clamping?
 - A. <30 seconds.
 - B. 30–60 seconds.
 - C. 60–90 seconds.
 - D. 90–120 seconds.
 - E. >120 seconds.

2. During the evaluation of a term newborn in the general newborn nursery, you note a firm swelling on the scalp that does not cross suture lines. The infant is otherwise well-appearing. As you discuss the finding with the family, it is important to discuss the risk of which of the following as a result of this diagnosis?
 - A. Anemia.
 - B. Developmental delays.
 - C. Jaundice.
 - D. Plagiocephaly.
 - E. Seizures.

3. During evaluation and anticipatory guidance for a 24-hour-old infant born at 36 weeks and 3 days, the parents ask if there are any special requirements before discharge given their baby's gestational age. Given the baby's gestational age, you advise the parents that, in addition to monitoring for 48 hours, discharge is appropriate after the baby achieves which of the following?
 - A. Feeding formula only.
 - B. Normal echocardiography.
 - C. Normal head ultrasonography.
 - D. Passing car seat trial.
 - E. Passing vision screen.

4. You are attending a delivery due to concerns for fetal decelerations. Once the infant is born, it is vigorous, crying, and has normal tone. You ask the delivering physician to place the infant with the mother for skin-to-skin contact. The nurses would like to apply the infant's routine erythromycin ointment, and a student nurse asks if it is appropriate to wait to do it after the skin-to-skin period. Which of the following is the recommended upper limit time window before which the routine erythromycin should be applied?
 - A. 1 hour.
 - B. 2 hours.
 - C. 3 hours.
 - D. 4 hours.
 - E. 5 hours.

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5. While examining a patient in the newborn nursery you review car seat safety with the parents. They have a rear-facing car seat to bring the baby home in. They would like to know when it is typically recommended the baby can turn to a forward-facing car seat. Which of the following is the most appropriate recommendation regarding the timing when the infant can be placed in a forward-facing car seat?
- A. 12 months of age.
 - B. 24 months of age.
 - C. Weight of 20 lb (9 kg) or above.
 - D. Weight of 40 lb (18 kg) or above.
 - E. Weight of 50 lb (22.7 kg) or above.