

**Abstract:**

The first week of life can be a critical period in which previously subclinical disorders may manifest, causing significant illness. Newborn infants also have different baseline vitals and laboratory parameters, which complicate the initial evaluation of infants. Rapid identification of sick neonates, stabilization, and directed evaluation are keys to minimizing long-term morbidity and mortality. This review targets 5 conditions that present in the first week of life: neonatal sepsis, critical congenital heart disease, inborn errors of metabolism, congenital adrenal hyperplasia, and hemorrhagic disease of the newborn. The primary focus is on key findings, initial evaluation, and immediate treatment in the emergency department where these infants often present after discharge from the newborn nursery.

**Keywords:**

neonate; shock; early-onset sepsis; late-onset sepsis; congenital heart disease; cyanosis; inborn errors of metabolism; congenital adrenal hyperplasia; hemorrhagic disease of the newborn; vitamin K-deficient bleeding

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# The Decompensated Neonate in the First Week of Life

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**M**any critical and potentially fatal illnesses can arise in the first week of life, making rapid and efficient evaluation and stabilization paramount in this population. Neonates often present with nonspecific findings and may decompensate quickly. It is vital that caregivers are able to recognize at-risk neonates, maintain a broad differential (Table 1), and approach evaluation and management simultaneously and methodically. Diagnostic priority should be placed on ruling out immediately life-threatening etiologies such as sepsis, critical congenital heart disease (CHD), inborn errors of metabolism, endocrine crises, and hematologic emergencies.

## RECOGNIZING THE CRITICALLY ILL NEONATE

The evaluation and identification of at-risk neonates often occur in triage before a physician sees the patient. The ability to identify abnormal initial history, appearance, and vital signs is key to appropriate triage and timely care. A change of behavior, noted by the family, is often the initial clue to impending decompensation.

A typical neonate sleeps approximately 15 to 18 hours per day,<sup>1</sup> awakening spontaneously every 2 to 4 hours for feeding. Parents should report 8 to 12 feedings of either formula or breast milk, with the infant taking at least 2 oz or nursing for 10 to 15 minutes at the breast.<sup>2-4</sup> The infant should also have a minimum of 6 to 8 wet diapers in a 24-hour period.<sup>4</sup> Normal stooling patterns are variable; however, soft, seedy, yellow-to-green stools should be accepted as normal, and any stools with blood or mucus or that are clay colored must be considered abnormal. Frequent spitting up is a common complaint in this age group, as two thirds of normal, healthy infants have gastroesophageal reflux. Gastroesophageal reflux can be associated with vomiting of gastric contents, typically

**TABLE 1. Differential diagnosis for decompensation in the first week of life**

Infection	Bacterial/Viral Sepsis, Neonatal Pneumonia, Meningitis Neonatal Herpes: Skin, Eye, Mouth (SEM) Disease, CNS Disease, Disseminated Disease
Cardiac	Ductal-dependent Systemic Blood Flow (shock): Coarctation of the Aorta, Interrupted Aortic Arch, Valvular Aortic Stenosis, Hypoplastic Left Heart Syndrome Ductal-dependent Pulmonary Blood Flow (cyanosis): Tetralogy of Fallot, Pulmonary Valve Stenosis, Pulmonary Atresia, Tricuspid Atresia
Metabolic	Amino Acidopathies, Urea Cycle Enzyme Defects, Organic Acidurias, Fatty Acid Oxidation Defects, Disorders of Carbohydrate Metabolism, Disorders of Bilirubin Metabolism, etc.
Endocrine	Congenital Adrenal Hyperplasia: 21-hydroxylase Deficiency, 3B-hydroxylase Deficiency, 11B-hydroxylase Deficiency Neonatal Thyrotoxicosis
Hematologic	Hemorrhagic Disease of the Newborn
Miscellaneous	Seizures, Gastrointestinal Emergencies, Non-accidental Trauma, Toxins, Formula Mixing Errors

described as partially digested breast milk or formula; however, reports of green-colored (bilious) or forceful (projectile) emesis require further evaluation.<sup>5</sup>

Visual inspection of the infant can be quick and telling regarding the status of the neonate. A healthy neonate should appear comfortable, with a normal respiratory effort. Infants with significant respiratory distress will sometimes develop head bobbing. The infant should have flexed extremities with spontaneous movements. The infant's color should be pink to indicate adequate perfusion, although some infants may become mottled when unwrapped in cold environments. Mucous membranes, as well as palms and soles, can be evaluated for color in darkly pigmented infants. The infant may not be vigorous if sleeping but when presented with stressful stimuli, such as blood pressure measurement, should show signs of arousal.

Abnormal vital signs may be the key to identifying a baby in shock. Over the first days and weeks of life, infants' vital signs change dramatically and need to be understood based on referenced norms (Table 2). A rectal temperature is the preferred method of recording and should be between 36.5°C and 38°C, or 97.7°F and 100.4°F.<sup>6</sup> The normal respiratory rate of an infant is between 30 and 60 breaths per minute. Heart rate can vary depending on the neonate's sleep-wake status and activity level. Typically, a heart rate of 85 to 205 beats per minute when awake and 80 to 160 beats per minute when sleeping is considered appropriate.<sup>7</sup> Blood pressure measurement may not be standard in initial emergency department triage of neonates but is important in this population to determine hemodynamic stability. A systolic blood pressure of 65 to 85 mm Hg and a diastolic blood pressure of 45 to 55 mm Hg are considered adequate for age.<sup>8</sup> A mean

blood pressure that approximates the corrected gestational age of the infant can be used as a quick assessment of adequacy. After the initial transition period at birth, the normal oxygen saturation regardless of probe placement should be greater than 94%. Values outside the parameters listed in Table 2 should alert the caregiver that the infant requires immediate attention.

Initial laboratory tests and imaging can be obtained to support the evaluation of the sick neonate. Preliminary laboratory tests can include a complete blood count (CBC), blood culture, blood gas, lactate, and complete metabolic panel. Chest and abdominal plain radiographs can be obtained for infants exhibiting signs concerning for respiratory or gastrointestinal disorders. Seizing infants or those with suspected intracranial processes should undergo neuroimaging including head computed tomography or magnetic resonance imaging.

## NEONATAL SEPSIS

Infection can be a devastating and unfortunately common disorder in the first week of life, occurring in 1 to 5 neonates per 1000 live births.<sup>9</sup> Neonatal

**TABLE 2. Normal newborn vital signs.**

Temperature	36.5-38°C
Respiratory rate	30-60 breaths per minute
Heart rate	85-205 beats per minute (awake) 80-160 beats per minute (asleep)
Blood pressure	Systolic 65-85 mm Hg Diastolic 45-55 mm Hg
Oxygen saturation	>94%

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