

Neonate (0-28 days of life)

Overview

According to the CDC, a **total of 3,988,076 births** were registered in the United States in 2014, up 1% from 2013. The number of births rose among each of the largest race and Hispanic origin groups (non-Hispanic white, non-Hispanic black, and Hispanic women) from 2013 to 2014.

The CDC also reports that in 2013, the infant mortality rate was 5.96 infant deaths per 1,000 live births. The 10 leading causes of infant death were:

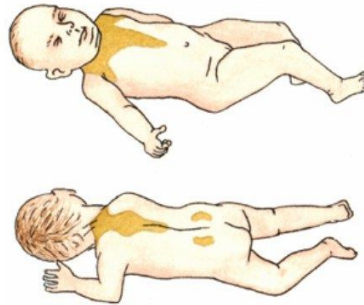
- Congenital malformations, deformations and chromosomal abnormalities (congenital malformations).
- Disorders related to short gestation and low birth weight, not elsewhere classified (low birth weight)
- Newborn affected by maternal complications of pregnancy (maternal complications)
- Sudden infant death syndrome (SIDS)/Sudden unexpected infant death syndrome (SUIDS)
- Accidents (unintentional injuries)
- Newborn affected by complications of placenta, cord and membranes (cord and placental complications)
- Bacterial sepsis of newborn
- Respiratory distress of newborn
- Diseases of the circulatory system
- Neonatal hemorrhage

The neonate may be brought to the hospital by the caregivers for many reasons including common concerns - irritability, crying, feeding issues and severe concerns - fever, apnea, and decreased responsiveness. It is important to be thorough in the evaluation of this patient and have the ability to recognize serious concerns, illnesses, or injuries.

Brief review of systems:

- **Thermoregulation** - Beginning at birth, the infant faces new environmental challenges and new means of coping with a cold environment. With the increased body surface area to weight ratio, the neonate is very susceptible to rapid heat loss. When an infant is exposed to cold or heat, the temperature is sensed through peripheral thermal receptors found over the entire surface of the skin, which then send increased signals to the hypothalamic regulatory center. The hypothalamic regulatory center is in the preoptic and anterior nuclei of the hypothalamus. It is here that signals from both peripheral and central thermoreceptors are integrated together, triggering mechanisms to conserve and produce heat. Efferent signals from the hypothalamic nuclei result in an increase in sympathetic activity. In the adult, this leads to heat production and conservation via shivering, peripheral vasoconstriction, and diminished sweating. Other than

vasoconstriction, however, these factors play a minimal role in newborns. Sympathetic stimulation of skeletal muscle is minimal, and shivering plays little role in the response to cold. Instead, the newborn response depends largely on non-shivering thermogenesis or direct heat production through the metabolism of brown adipose tissue.



- **Respiratory** - Lungs begin to alveolarize at 24-28 weeks with proliferation of capillary network surrounding the terminal airspaces. At full term birth the lungs are still immature. Term newborn lungs contain 50 million alveoli, reaching adult levels of 500 million by about 4 years of age. The neonate's oxygen consumption is doubled vs in the adult and to meet the higher metabolic demand there is an increased respiratory rate (40-60 breaths/minute).
- **Cardiovascular**- Dramatic changes allow transition to extrauterine life. The cardiovascular system changes from two parallel circulations to two circulation in serial. Neonatal myocardium contains immature contractile elements and is less compliant than the adult myocardium. Higher cardiac output and oxygen consumption per kilogram supported with a higher baseline heart rate. Thus, normal vital signs for neonates and children include higher heart rates and lower blood pressures than adults. With neonates, the sympathetic innervation is incomplete, leading to exaggerated vagal responses with minor stimuli (suctioning) and can lead to bradycardia. Neonates may also respond to hypoxia by becoming bradycardic, and therefore decreasing CO further, worsening hypoxia. This can make resuscitation difficult.
- **Renal/Endocrine/Genitourinary**- Neonates have increased total body water, extracellular fluid volume, and water turnover rate. They also have decreased glycogen stores and are prone to hypoglycemia, especially during times of stress. Glucose should be maintained between 40 and 125 mg/dl. Symptoms of hypoglycemia include jitteriness, irritability, lethargy, high-pitched or weak cry, tachypnea, hypothermia apnea, and seizures. Increases losses of sodium, glucose, and other solute make the neonate susceptible to electrolyte abnormalities. Kidney function is immature and urine output normally begins 24 hours after birth, with an average of 2ml/kg/hour.
- **Neurological**– Healthy neonate's response to stimuli should be brisk. Movements are uncoordinated and normal reflexes include: sucking, rooting, grasp, startle (Moro), and the Babinski. Head circumference is 32.6-37.2cm and increases on a weekly basis.

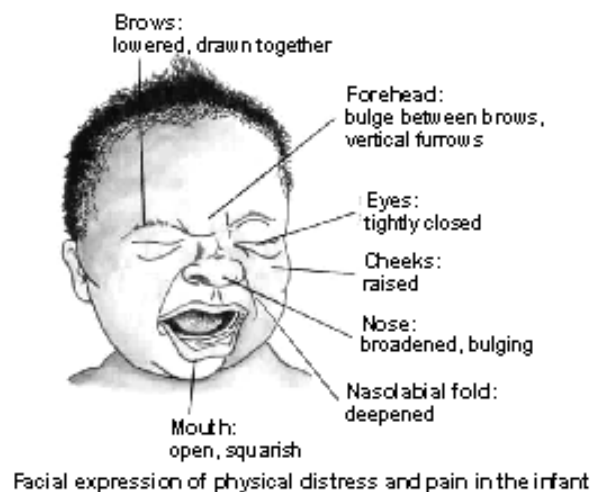
Fontanelles are open and soft. Sunken fontanelles indicate dehydration and bulging/firm fontanelles indicate increased ICP.



- **Musculoskeletal**- the skeleton is composed of more cartilage than ossified bone. Flexion of all four extremities is an expected finding with flexed hands. Assess for symmetry in limbs and skin folds. In critical situations the insertion of an intraosseous (IO) needle in less than 3kg is NOT recommended. Typically, the umbilical vein can be used and is an easily accessible route to cannulate.
- **Gastrointestinal**- The intestine undergoes tremendous growth during fetal life. It elongates 1,000-fold from 5 to 40 weeks' gestation, with the length doubling in the last 15 weeks of gestation to a mean of 275 cm at birth. The neonates' first stool is usually within 24 hours of birth. Due to immature intestines neonates are prone to nonbilious regurgitation and gas. Any bilious vomiting and abdominal distention should be further evaluated.

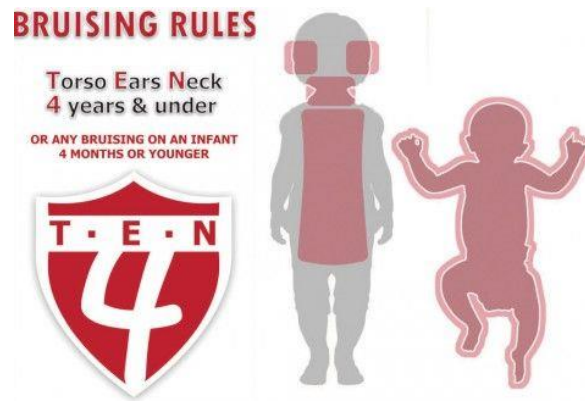
Interventions specifically related to Neonates:

- Pain Assessment – use “cry-face”, CRIES, NIPS, N-PASS, or Premature Infant Pain Profile tools for assessment.

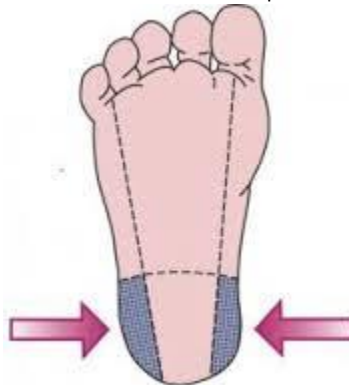


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- Always assess for abuse and neglect. Neonates and infants are at high risk for CAN. Use the **TEN-4 rule**. Bruising to the **T**orso, **E**ars, **N**eck, or anywhere under **4** years old are significant indicators of abuse. “If the baby isn’t cruisin’, they shouldn’t be bruising!”



- During head-to-toe assessment perform the most intrusive aspects last (example rectal temps).
- Keep neonate warm. Prevent heat loss with ambient warmers and cover head.
- Blood draws – consider heel sticks. Procedure: Warm heel (3-5 min), clean site, use lancet to puncture the lateral or medial area of plantar surface, drip sample into tube.



- If suctioning is needed – use bulb syringe and suction the mouth before nose.
- To evaluate right-to-left shunting: place a pulse oximeter on right hand and second on foot. Infants with right-to-left shunting will exhibit lower PaO₂ and oxygen saturations in their lower extremities versus their right arm.
- **2015 AHA CPR tips:**
 - Compressions are delivered on the lower third of the sternum to a depth of approximately one third of the anterior-posterior diameter of the chest
 - The 2 thumb-encircling hands technique is suggested as the preferred method because the 2-thumb technique generates higher blood pressures and coronary perfusion pressure with less rescuer fatigue.
 - The chest should be allowed to re-expand fully during relaxation, but the rescuer’s thumbs should not leave the chest. The Neonatal Resuscitation ILCOR and Guidelines

- Task Forces continue to support use of a 3:1 ratio of compressions to ventilation, with 90 compressions and 30 breaths to achieve approximately 120 events per minute to maximize ventilation at an achievable rate.
- A 3:1 compression-to-ventilation ratio is used for neonatal resuscitation where compromise of gas exchange is nearly always the primary cause of cardiovascular collapse, but rescuers may consider using higher ratios (eg, 15:2) if the arrest is believed to be of cardiac origin.
 - Respirations, heart rate, and oxygenation should be reassessed periodically, and coordinated chest compressions and ventilations should continue until the spontaneous heart rate is ≥ 60 per minute.
 - Frequent interruptions of compressions should be avoided, as they will compromise artificial maintenance of systemic perfusion and maintenance of coronary blood flow.
 - Drugs are rarely indicated in resuscitation of the newly born infant. Bradycardia in the newborn infant is usually the result of inadequate lung inflation or profound hypoxemia, and establishing adequate ventilation is the most important step to correct it. However, if the heart rate remains less than 60/min despite adequate ventilation with 100% oxygen (preferably through an endotracheal tube) and chest compressions, administration of epinephrine or volume, or both, is indicated.
 - Volume expansion should be considered when blood loss is known or suspected (pale skin, poor perfusion, weak pulse) and the infant's heart rate has not responded adequately to other resuscitative measures.
 - An isotonic crystalloid solution or blood may be useful for volume expansion. The recommended dose is 10 mL/kg, which may need to be repeated.