Neonatal and pediatric critical care is markedly different from adult critical care because of the physiologic and hemodynamic dissimilarities between immature and adult animals. Clinicians are often wary of treating these patients because of their small size and the presumptive limitations in diagnostic and therapeutic interventions. Nevertheless, we have the ability to treat these young animals aggressively. In doing so, however, we must be cognizant of the unique distinctions among pediatric patients with regard to normal physiologic variables that affect physical examination findings and diagnostic test results (see Pediatrics by the Age).

Common Causes of Pediatric Illness
Ill neonates can quickly become critically ill. In fact, more than half of all deaths in puppies occur within the first 3 days of life. Any of several disease states, problems with basic animal husbandry, or lack of maternal care can result in a debilitated puppy or kitten that requires critical care.

Common causes of neonatal illness include poor mothering, failure to nurse, and failure of the mother to produce adequate milk. These conditions often manifest in the first week of life but may be delayed if the mother becomes ill in the days or weeks after whelping. Excellent guides are available for the care of orphaned kittens and puppies (see Resources, next page).

Infection is another important cause of critical illness; the juvenile immune system is not fully functional. Bacterial infection with Escherichia coli, β-hemolytic Streptococcus spp, or Pasteurella spp, which may gain access through the umbilical stump, is particularly likely in neonates.

Although some infections occur shortly after birth, others are more common in older puppies or kittens (see Important Infectious Agents in Puppies and Kittens, next page). Assuming the mother is healthy and the offspring nurse colostrum, many viral infections (especially those whose antigens are contained in routine vaccines) become more likely after maternal antibodies have waned (eg, parvovirus in dogs, panleukopenia in cats).

Other rule-outs for fading puppy or kitten syndrome include poor environmental conditions, congenital defects (eg, congenital heart disease, cleft palate), thyroid dysfunction, thymic disorders, undetected trauma, neonatal isoerythrolysis, and taurine deficiency. Animals with low birth weight are especially susceptible to illness.
In the emergent evaluation of unstable neonates, initial therapy should focus on the primary survey—the ABCDs (ie, airway, breathing, circulation, dysfunction). Immediate life-saving therapy should then be initiated as necessary, including oxygen therapy, IV or IO catheter access, blood glucose monitoring, dextrose supplementation (if hypoglycemic), temperature support, and volume resuscitation. Once the patient has been stabilized, a more thorough and systematic physical examination can be pursued. Patients should be weighed 4–6 times per day to allow for careful assessment of hydration and weight gain. Use of a gram scale is important to ensure accurate weight measurement.

### Resources

The following resources on the care of newborn and orphaned puppies and kittens can provide insight into at-home care and are especially useful to share with clients.

#### Websites

- **ASPCA:**
  - Newborn Puppy Care: aspca.org/pet-care/dog-care/newborn-puppy-care
  - Newborn Kitten Care: aspca.org/pet-care/cat-care/newborn-kitten-care
- **Koret Shelter Medicine Program (University of California–Davis):**
  - Canine: Guide to Raising Orphan Puppies: sheltermedicine.com/node/33
  - Feline: Guide to Raising Orphan Kittens: sheltermedicine.com/node/39
- **Maddie’s Fund:**
  - Orphaned Kitten Care: How-to Videos: maddiesfund.org/maddies_institute/videos/orphaned_kitten_care_how_to.html

#### Literature

Neonates should show evidence of adequate muscling on examination, and weight gain should be evaluated. Kittens should weigh approximately 100 g at birth, while puppy birth weights vary by breed (eg, Pomeranian, 120 g; beagle, 250 g; greyhound, 490 g; Great Dane, 625 g; Table 1).

Kittens should gain 7–10 g/day, whereas puppies should gain 1 g/lb of anticipated adult weight per day. Assessment of hydration status by measuring skin turgor may be inaccurate because of increased water content and decreased fat content in neonatal skin. Likewise, assessing dehydration by looking for hypersthenuria is inaccurate because of decreased glomerular filtration rate in the neonate. Hence, prerenal azotemia and concentrated urine specific gravity may not be present in neonates despite profound dehydration.

Neonates have an immature autonomic nervous system, altering their response to shock. Monitoring parameters such as heart rate and blood pressure are not reliable in assessing hypovolemia in the youngest patients. The traditional evaluation of an adult patient with hypovolemic shock is based on tachycardia, weak pulses, and a low—normal central venous pressure (ie, ≤0 cm H₂O). In neonates, normal resting heart rate is higher (180–200 bpm), while mean arterial pressure is lower (50 mm Hg) than that in adults. The decrease in mean arterial pressure is believed to be a result of the immaturity of the muscular component of the arterial wall at birth.

In addition, central venous pressure is 75% higher in neonates (~8 cm H₂O) than in adults, possibly the result of low venous compliance and increased plasma volume. Therefore, neonatal and pediatric critical care monitoring must be based on serial physical examinations, weight

### Table 1. Normal Physiologic Parameters for Neonates

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth weight</td>
<td>Dogs: Varies with breed; most range from 100–650 g Cats: 90–110 g</td>
</tr>
<tr>
<td>Rectal temperature</td>
<td>Newborn: 36°C–37°C (96.8°F–98.6°F) 1 month: 38°C (100°F)</td>
</tr>
<tr>
<td>Heart rate</td>
<td>180–200 bpm</td>
</tr>
<tr>
<td>Respiratory rate</td>
<td>Neonate: 10–18 bpm 1 week: 15–35 bpm</td>
</tr>
<tr>
<td>Urine specific gravity</td>
<td>&lt;1.020</td>
</tr>
<tr>
<td>Water requirement</td>
<td>Output: 2.5 mL/100 g BW/day</td>
</tr>
<tr>
<td>Caloric requirement</td>
<td>Dogs: 20–26 kcal/100 g BW/day Cats: 15–25 kcal/100 g BW/day</td>
</tr>
<tr>
<td>Stomach capacity</td>
<td>4–5 mL/100 g BW</td>
</tr>
</tbody>
</table>

BW = body weight
gain, improved heart and lung sounds, improved mentation, nursing ability, chest radiographs, blood glucose, extremity temperature, serial packed cell volume (PCV)/total solids (TS), urine output, and, potentially, increased trends in central venous pressure (provided a jugular catheter is in place).

**Laboratory Data**
Performing venipuncture on neonates can be physically challenging. The jugular vein should be the primary area for venipuncture, provided there is no evidence of coagulopathy (eg, ecchymoses, petechiae), no history of anticoagulant rodenticide toxicity, and no known hereditary disorder of coagulation or platelets.

Only a limited blood volume can be drawn safely because of the neonate’s small size; no more than 1% of the neonate’s body weight should be taken in a 24-hour period. It is thus imperative that each blood sample be used efficiently and effectively. A minimum database (ie, PCV, TS, blood glucose, blood urea nitrogen as measured by Azostix) and blood smear should be obtained first, with remaining blood used for other tests (eg, chemistry panel). Recheck venipuncture (eg, spot blood glucose checks) should be performed as necessary, but the minimum amount of blood necessary for the test should be drawn. If small volumes of blood are placed in tubes designed for larger volumes, liquid anticoagulant can lead to both sample dilution and false results. Use of tubes designed for very small volumes is ideal. Collection tubes containing ethylenediaminetetraacetic acid (EDTA) or heparin anticoagulant are available in 0.3-, 0.5-, and 1-mL sizes.

Neonatal diagnostic test results (eg, CBC, chemistry panel, coagulation testing, urinalysis) vary from adult parameters as well.\(^1,9,14\) In neonatal puppies, PCV

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**Table 2. Normal Neonatal Physiologic Milestones**\(^*1,2,7,21-23\)

<table>
<thead>
<tr>
<th><strong>Milestone</strong></th>
<th><strong>Age of Occurrence</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain reflex</td>
<td>At birth</td>
</tr>
<tr>
<td>Flexor tone</td>
<td>1–4 days</td>
</tr>
<tr>
<td>Umbilical cord loss</td>
<td>2–3 days</td>
</tr>
<tr>
<td>Extensor tone</td>
<td>5–8 days</td>
</tr>
<tr>
<td>Eyes open</td>
<td>5–14 days</td>
</tr>
<tr>
<td>External ear canals open</td>
<td>6–14 days</td>
</tr>
<tr>
<td>Capable of crawling</td>
<td>7–14 days</td>
</tr>
<tr>
<td>Withdrawal reflex</td>
<td>7–19 days</td>
</tr>
<tr>
<td>Capable of walking, urinating, and defecating spontaneously</td>
<td>14–21 days</td>
</tr>
<tr>
<td>Ambulation</td>
<td>16 days</td>
</tr>
<tr>
<td>Normal vision</td>
<td>21–30 days</td>
</tr>
<tr>
<td>Menace reflex</td>
<td>21–30 days</td>
</tr>
<tr>
<td>Voluntary voiding</td>
<td>3 weeks</td>
</tr>
<tr>
<td>Deciduous incisor/canine teeth erupt</td>
<td>Dogs: 3–6 weeks</td>
</tr>
<tr>
<td></td>
<td>Cats: 3–4 weeks</td>
</tr>
<tr>
<td>Normal hearing</td>
<td>4–6 weeks</td>
</tr>
<tr>
<td>Testes descended</td>
<td>4–6 weeks</td>
</tr>
<tr>
<td>Deciduous premolars erupt</td>
<td>Dogs: 5–6 weeks</td>
</tr>
<tr>
<td></td>
<td>Cats: 4–6 weeks</td>
</tr>
<tr>
<td>Permanent canines</td>
<td>Dogs: 12–16 weeks</td>
</tr>
<tr>
<td></td>
<td>Cats: 12–20 weeks</td>
</tr>
<tr>
<td>Permanent molars</td>
<td>Dogs: 16–24 weeks</td>
</tr>
<tr>
<td></td>
<td>Cats: 20–24 weeks</td>
</tr>
<tr>
<td>Renal function approximates that of adult</td>
<td>8 weeks</td>
</tr>
<tr>
<td>Hepatic function approximates that of adult</td>
<td>4–5 months</td>
</tr>
</tbody>
</table>

* Some differences exist between dogs and cats or between breeds (eg, Abyssinian kittens may open their eyes much sooner than other breeds).
Important disease entities to look for on radiographs include structural defects (eg, diaphragmatic hernia, peritoneopericardial diaphragmatic hernia, pectus excavatum), cardiomegaly (eg, congenital heart defect), megaesophagus (eg, congenital or persistent right aortic arch), or lung pathology (eg, bacterial or viral pneumonia, aspiration pneumonia, noncardiogenic pulmonary edema).

Conclusion
With appropriate knowledge of normal physiologic parameters, we can improve our ability to diagnose critical illness in neonatal and pediatric patients. Size should not prevent us from caring for these tiny patients.

References