



C-NOTES

Neonatal Vital Signs & Monitoring Review for Bedside Nursing

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EDUCATIONAL OBJECTIVES

- ✓ Review common neonatal vital signs and normative ranges
- ✓ Understand the equipment available for monitoring vital signs.
- ✓ Recognize and interpret abnormal vital signs.
- ✓ Discuss special considerations in neonatal monitoring.

Introduction



Vital Signs 101

- Unique physiology in neonates
- Immature autonomic regulation
- Transition from fetal to neonatal circulation

Commonly Monitored Vital Signs

- Heart Rate (HR)
- Respiratory rate (RR)
- Temperature
- Blood Pressure (BP)
- Oxygen Saturation (SpO₂)

Normal Neonatal Vital Signs



Normal Vital Sign Ranges (by Gestational Age)

Gestational Age	HR (beats/min)	RR (breaths/min)	Mean Arterial Pressure (MAP)	SpO ₂ (%)
<28 weeks	100-160	40-60	≥30	90-95
28-33 weeks	100-160	40-60	≥35	90-95
34-36 weeks	100-160	40-60	≥40	90-97
Term (>37 weeks)	100-160	30-60	≥45	94-100

Heart Rate Monitoring

- Monitored via ECG or pulse oximeter
- Bradycardia: HR < 100bpm
- Tachycardia: HR > 160bpm

Gestational Age	HR (beats/min)
<28 weeks	100-160
28-33 weeks	100-160
34-36 weeks	100-160
Term (>37 weeks)	100-160

Respiratory Rate Monitoring

Gestational Age	RR (breaths/min)
<28 weeks	40-60
28-33 weeks	40-60
34-36 weeks	40-60
Term (>37 weeks)	30-60

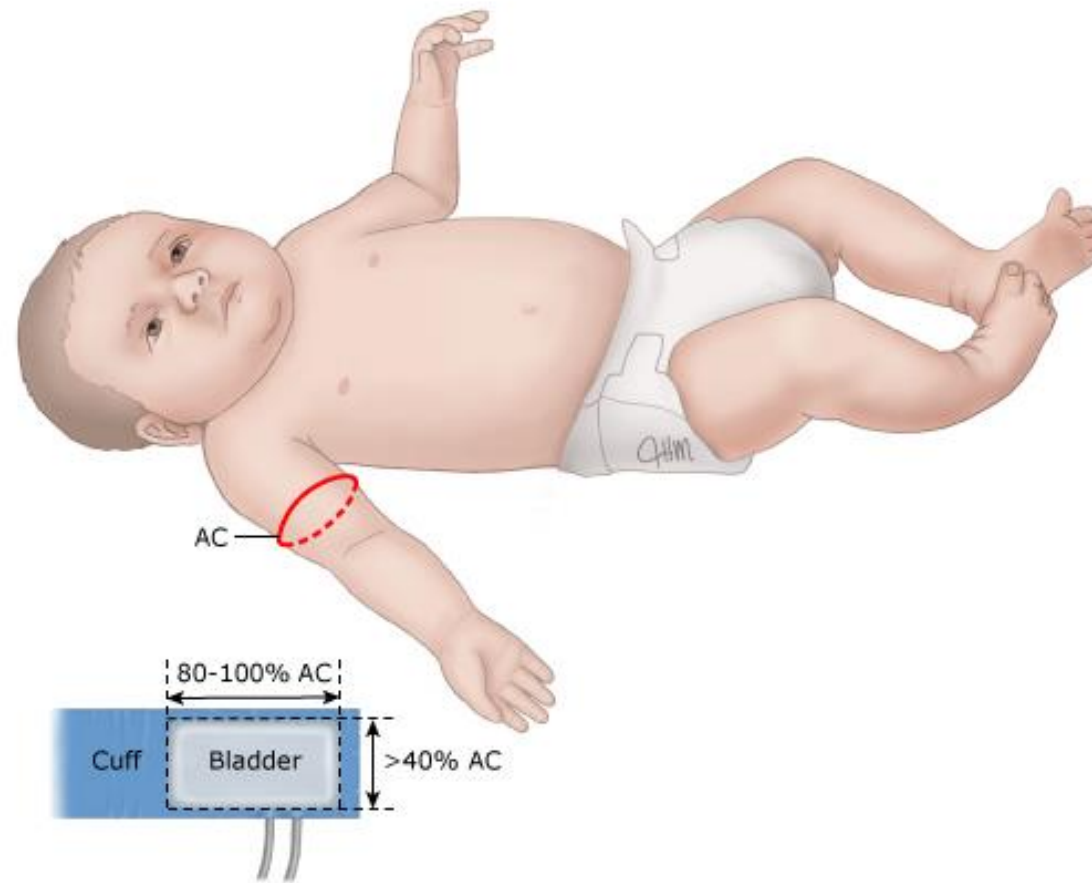
- Monitored via observation or impedance sensor
- Periodic breathing is common
- Tachypnea = >60 breaths/min
- Apnea = episodes of cessation of breathing
 - ≥ 20 seconds of cessation of breathing
 - shorter respiratory pause associated with bradycardia, cyanosis, pallor, and/or marked hypotonia

Gestational Age	Mean Arterial Pressure (MAP)
<28 weeks	≥30
28-33 weeks	≥35
34-36 weeks	≥40
Term (>37 weeks)	≥45

Blood Pressure Monitoring

- Measured via cuff (oscillometric) vs arterial line (central)
 - Appropriate cuff size is important
- Normative values vary by gestational age and postnatal age
- Mean Arterial Pressure (MAP) \approx Gestational Age (weeks)

Determining appropriate blood pressure cuff size in neonates



The cuff bladder width should be at least 40 percent of the arm circumference (AC) at a point midway between the olecranon and the acromion, and the bladder length should cover 80 to 100 percent of the circumference of the arm at that point.

Neonatal blood pressures and potential treatment parameters

Postmenstrual age	50 th percentile	95 th percentile	99 th percentile
44 weeks			
SBP	88	105	110
DBP	50	68	73
MAP	63	80	85
42 weeks			
SBP	85	98	102
DBP	50	65	70
MAP	62	76	81
40 weeks			
SBP	80	95	100
DBP	50	65	70
MAP	60	75	80
38 weeks			
SBP	77	92	97
DBP	50	65	70
MAP	59	74	79
36 weeks			
SBP	72	87	92
DBP	50	65	70
MAP	57	72	77
34 weeks			
SBP	70	85	90
DBP	40	55	60
MAP	50	65	70
32 weeks			
SBP	68	83	88
DBP	40	55	60
MAP	49	64	69
30 weeks			
SBP	65	80	85
DBP	40	55	60
MAP	48	63	68
28 weeks			
SBP	60	75	80
DBP	38	50	54
MAP	45	58	63
26 weeks			
SBP	55	72	77
DBP	30	50	56
MAP	38	57	63

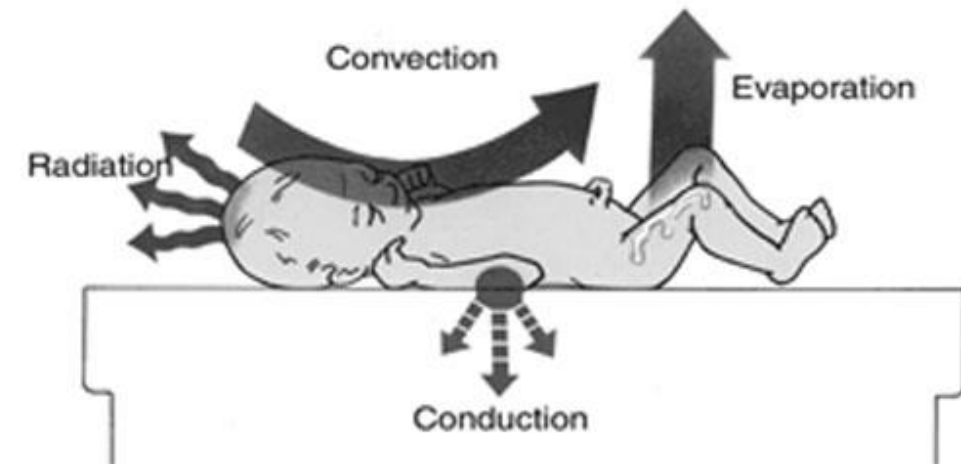
This table provides estimated values for blood pressures after 2 weeks of age in infants from 26 to 44 weeks postmenstrual age. The 95th and 99th percentile values are intended to serve as a reference to identify infants with persistent hypertension that may require treatment.

DBP: diastolic blood pressure; MAP: mean arterial pressure; SBP: systolic blood pressure.

Reproduced from: Dionne JM, Abitbol CL, Flynn JT. Hypertension in infancy: diagnosis, management, and outcome. *Pediatr Nephrol* 2011 with kind permission from Springer Science + Business Media B.V. Copyright © 2011. This table includes the changes published in the correction: *Pediatr Nephrol* 2012; 27:159.

Temperature Monitoring

- Most commonly obtained via axillary thermometer
- Normothermia: 36.5°-37.5°C
- Infants (especially premature) are at higher risk for developing temperature instability
- Servo-controlled warmers/incubators



Gestational Age	SpO ₂ (%)
<28 weeks	90-95
28-33 weeks	90-95
34-36 weeks	90-97
Term (>37 weeks)	94-100

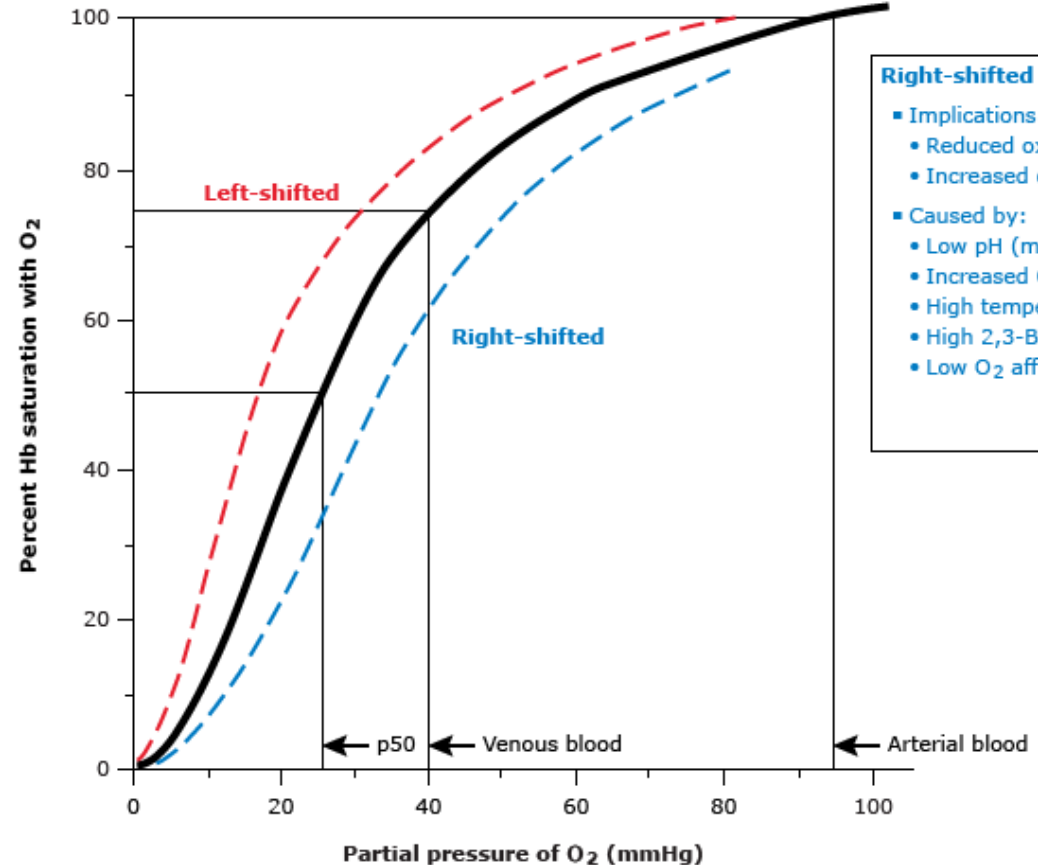
Oxygen Saturation (SpO₂) Monitoring

- Measured via pulse oximeter
- “Fifth vital sign”
- Location of monitoring (Pre-ductal vs. Post-ductal)
- Target ranges vary based on gestational age and disease state
 - <28 weeks: 90-95%
 - 28 - <34 weeks: 90-95%
 - 34 - <37 weeks: 90-97%
 - >37 weeks: 94-100%

Oxygen Saturation (SpO₂) vs. Partial Pressure of Oxygen (PaO₂)

- SpO₂ 85-95% ≈ PaO₂ 45-65 mmHg

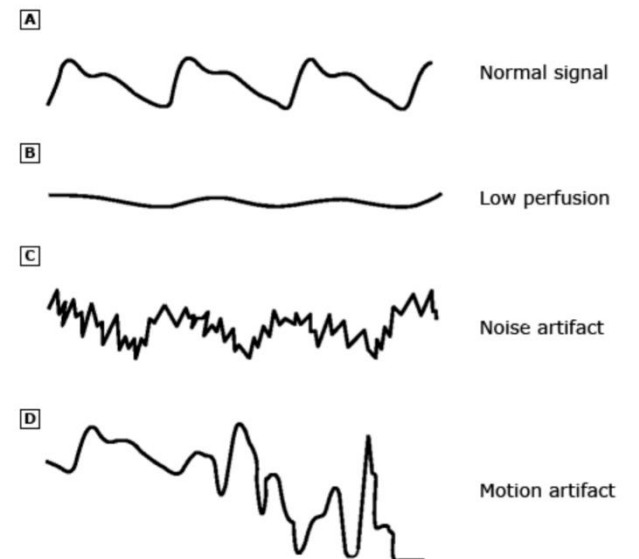
- Left-shifted curve**
- Implications:
 - Increased oxygen affinity (R state)
 - Reduced oxygen delivery to tissues
 - Caused by:
 - High pH (more basic)
 - Low temperature
 - Low 2,3-BPG
 - Fetal Hb (Hb F)
 - Methemoglobinemia*
 - Carboxyhemoglobinemia
 - High O₂ affinity Hb variants



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Oxygen Saturation (SpO₂) Monitoring – Sources of Error

- Choice of oximeter
- Technical issues
 - Motion artifact
 - Improper probe placement
 - Exposure to ambient light
- Clinical factors
 - Hypoperfusion
 - Severe anemia
 - Skin pigmentation



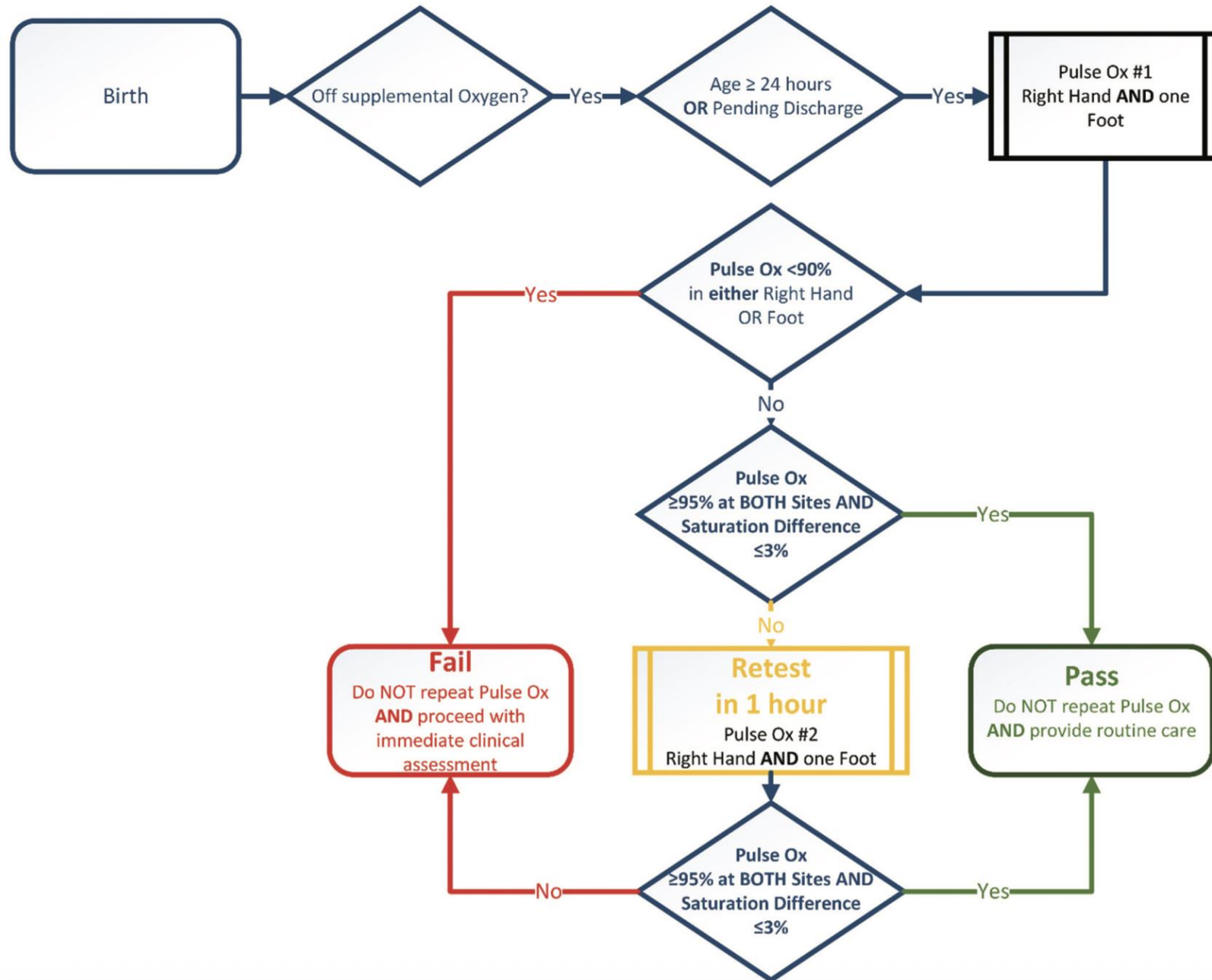
Oxygen Saturation (SpO₂) – Special Considerations

- Delivery room resuscitation
- Cyanotic congenital heart disease
- Persistent pulmonary hypertension of the newborn (PPHN)
- Bronchopulmonary dysplasia (BPD)

Targeted Preductal SpO ₂ After Birth	
1 min	60% - 65%
2 min	65% - 70%
3 min	70% - 75%
4 min	75% - 80%
5 min	80% - 85%
10 min	85% - 95%

Critical Congenital Heart Disease (CCHD) Screening

- Initial AAP recommendation in 2011 → adopted by all states in 2018
 - Goal: detect heart conditions that typically present with hypoxemia and require intervention in the 1st year of life
- Guidelines recently updated January 2025
 - Simplified screening algorithm



Equipment Review



- Equipment
 - Monitors
 - ECG leads
 - BP cuffs
 - SpO2 sensors
 - Thermometer
- Things to consider: location, calibration
- Troubleshoot: artifact, false alarms



Abnormal Neonatal Vital Signs



Common vital sign abnormalities

- Bradycardia + Apnea → evaluate airway, sepsis
- Hypotension → assess perfusion status, urine output
- Oxygen desaturation → assess airway, lung disease, cardiac, equipment

Special Considerations



Patient history matters!

- Congenital Heart Disease: altered SpO2 targets
- PPHN: ductal gradient monitoring
- Post-op: increased BP monitoring frequency

Honorable Mention



Near-Infrared Spectroscopy (NIRS)

- Non-invasive technique allowing for continuous monitoring of tissue oxygen saturation at the regional level
- Most common sites: brain (cerebral NIRS) and kidneys (renal NIRS)
- Used as a trend, rather than an absolute number
- Decreased NIRS: anemia, hypocarbia, hypotension, hsPDA, apnea, IVH, hydrocephalus
- Increased NIRS: Hypercarbia, hyperoxia, hypoglycemia

Case Review



Case Review #1

An 8 day old female infant born at 27 weeks 5 days (CGA 28w6d) with a history of respiratory distress syndrome requiring surfactant administration. The baby has previously been stable on bubble CPAP +5 and tolerating advancing enteral feeds. Overnight the infant was noted to have frequent desaturations and bradycardia events requiring intervention.

- Concerns?
- Plan?

Case Review #1

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- Concerns: apnea, anemia, infection
- Plan: caffeine, CXR, increased CPAP, bloodwork (CBC, blood culture)

Case Review #2

A term neonate born at 38 weeks with uneventful birth course was readmitted to the NICU for hyperbilirubinemia requiring phototherapy. Bilirubin levels have since downtrended and phototherapy was discontinued. On assessment this morning, vital signs were notable for HR of 180bpm, RR of 35, and temp of 38.5°C.

- Concerns?
- Plan?

Case Review #2

A term neonate born at 38 weeks with uneventful birth course was readmitted to the NICU for hyperbilirubinemia requiring phototherapy. Bilirubin levels have since downtrended and phototherapy was discontinued. On assessment this morning, vital signs were notable for HR of 180bpm, RR of 35, and temp of 38.5°C.

- Concerns: sepsis, dehydration
- Plan: cultures, antibiotics, fluids

Summary



Key Takeaways

- Know vital sign norms by gestational age
- Use trends, not isolated values
- Combine clinical judgment with monitor data

Questions?



References

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Practice Questions



You receive handoff report on a premature infant with medical course notable for hemodynamic instability, primarily hypotension previously requiring normal saline boluses and a continuous infusion of epinephrine. Which of the following is a normal mean arterial pressure (MAP) for a 30-week gestation infant on day 3 of life?

- A) 20 mmHg
- B) 25 mmHg
- C) 35 mmHg
- D) 60 mmHg

- **Explanation:** MAP generally approximates gestational age; by day 3, a 30-weeker should have MAP ~35-40 mmHg.

You are called to attend a precipitous delivery of an infant without prenatal care and meconium-stained amniotic fluid noted prior to delivery. The infant emerges without tone and poor color. What is the most appropriate intervention for a term infant with HR 90 bpm and apnea?

- A) Intubation
- B) Positive pressure ventilation
- C) Chest compressions
- D) Suctioning only

- **Explanation:** HR <100 bpm and apnea requires PPV per NRP guidelines.

You are precepting a student nurse when you notice an infant with intermittent self-resolving desaturations for the past hour. You begin to review common causes of oxygen desaturations in preterm infants. Which condition is most associated with recurrent desaturations in a 28-week preemie?

- A) Tetralogy of Fallot
- B) Periodic breathing
- C) Congenital diaphragmatic hernia
- D) Hyperthermia

- **Explanation:** Periodic breathing is common in preemies and often benign but may cause transient desaturations.

You are caring for a 1 day old term infant of a diabetic mother with hypoglycemia. The infant is currently feeding 15-20ml per feed and remains on D10W IV fluids. Blood pressures have been taken with a size 2 cuff with readings of systolic 90-100s and diastolic of 60-70s. Which of the following statements is TRUE about neonatal blood pressure monitoring?

- A) Use the same cuff size regardless of weight
- B) Manual BP readings are preferred in NICU
- C) Cuff width should cover 40% of the limb circumference
- D) BP monitoring is not useful in preterm infants

- **Explanation:** Proper cuff size is critical for accuracy.

You are assigned a 28-week gestational age infant with respiratory distress syndrome (RDS) requiring CPAP support. Oxygen requirements (FiO₂) over the past 24 hours have been 0.21-0.40. Upon initial assessment, you notice the infant is currently on CPAP +5/0.4 with oxygen saturations of 98-100%. What SpO₂ target range is recommended to reduce the risk of ROP in preterm infants?

- A) 70-80%
- B) 80-89%
- C) 90-95%
- D) 95-100%

- **Explanation:** Targeting 90-95% balances oxygenation and ROP risk.