

1. OBJECTIVE STRUCTURED CLINICAL EXAMINATION (OSCE) CHECKLIST

Instrument Overview:

- **Origin:** Adapted from the National Neonatal Resuscitation Protocol Guidelines, refined via a modified Delphi method with eight neonatal nursing experts (CVI = 0.92).
- **Purpose:** To assess critical clinical skills in high-risk neonatal emergencies, including airway management, resuscitation techniques, and medication administration.
- **Reliability:** Inter-rater reliability (ICC = 0.87, 95% CI: 0.83–0.91) and test-retest reliability ($r = 0.85$).
- **Scoring:** Each item is rated on a scale from 0 to 2, based on quality and completeness of performance. The maximum total score is 40.

Instructions: For each performance task, circle the score that best corresponds to the participant's execution:

- **0** = Not performed or incorrect
 - **1** = Performed partially or with significant prompting/errors
 - **2** = Performed correctly, independently, and without error
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Section A: Preparation and Initial Assessment

1. **Hand Hygiene**
0 | 1 | 2
(Use of appropriate technique and timing before patient contact)
 2. **Equipment Check** (e.g., suction, bag-valve mask, oxygen supply)
0 | 1 | 2
(Ensuring all necessary equipment is present and functioning)
 3. **Patient Identification and Verification**
0 | 1 | 2
(Verifying patient identity using institutional protocol)
 4. **Initial Visual Inspection of Neonate** (color, tone, activity)
0 | 1 | 2
(Observing for obvious distress or anomalies)
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Section B: Airway Management and Breathing Interventions

5. **Airway Clearance** (positioning, suction)
0 | 1 | 2
(Appropriate technique for airway patency)
6. **Supplemental Oxygen Use**
0 | 1 | 2
(Correct flow rate, indication, and administration method)
7. **Bag-Valve-Mask Ventilation**
0 | 1 | 2
(Proper seal, rate, and volume delivery)

8. Assessment of Breathing Effectiveness

0 | 1 | 2

(Checking rate, depth, chest rise)

Section C: Circulation and Resuscitation Efforts

9. Heart Rate Monitoring

0 | 1 | 2

(Auscultation or pulse oximeter use at correct intervals)

10. Chest Compressions (if indicated)

0 | 1 | 2

(Correct depth, rate, hand placement, and coordination with ventilation)

11. Medication Preparation (e.g., epinephrine)

0 | 1 | 2

(Correct drug, dose, route; proper labeling)

12. Medication Administration Technique

0 | 1 | 2

(Sterile technique, verification, timing)

Section D: Ongoing Assessment and Support

13. Vital Signs Reassessment

0 | 1 | 2

(Periodic checks of HR, RR, SpO₂, perfusion, temperature)

14. Thermoregulation

0 | 1 | 2

(Use of radiant warmer, appropriate covering to avoid heat loss)

15. Documentation

0 | 1 | 2

(Accurate, timely, and complete charting of interventions)

16. Team Communication

0 | 1 | 2

(Clear instructions, updates, and delegation)

Section E: Overall Performance and Critical Thinking

17. Efficiency and Organization

0 | 1 | 2

(Workflow, avoidance of unnecessary delays)

18. Adherence to Neonatal Resuscitation Algorithm

0 | 1 | 2

(Follows recommended sequence and guidelines)

19. Problem-Solving and Adaptability

0 | 1 | 2

(Adjusts interventions based on neonate's evolving condition)

20. **Patient Safety Focus**

0 | 1 | 2

(Demonstrates safe practices, checks, and precautions)

OSCE Total Score (Maximum = 40):

___ / 40

2. MULTIPLE-CHOICE QUESTIONNAIRE (MCQ)

Instrument Overview:

- **Purpose:** To assess knowledge of neonatal emergency protocols.
- **Development:** Created specifically for this study via expert review, systematic item analysis, and pilot testing with 40 NICU nurses (Cronbach's $\alpha = 0.86$, KMO = 0.82).
- **Scoring:** Each item is worth 1 point for a correct answer (no partial credit). Total possible score = 50.

Below are all 50 items. Correct answers are not marked, as the questionnaire is used for assessment.

1. Which heart rate indicates a need to begin chest compressions in a neonate already receiving positive-pressure ventilation?
 - A. <100 bpm
 - B. <80 bpm
 - C. <60 bpm
 - D. <120 bpm
2. In a neonate with persistent bradycardia despite adequate ventilation, which is the next recommended step?
 - A. Increase FiO₂ to 100%
 - B. Begin chest compressions
 - C. Intubate immediately
 - D. Continue ventilation without changes
3. What is the correct compression-to-ventilation ratio during neonatal CPR?
 - A. 3:1
 - B. 15:2
 - C. 30:2
 - D. 5:1
4. The Apgar score is generally assessed at which intervals after birth?
 - A. 1 and 5 minutes
 - B. 5 and 10 minutes
 - C. 1, 5, and 10 minutes
 - D. 2 and 7 minutes
5. When providing bag-valve-mask ventilation, the recommended initial respiratory rate for a compromised neonate is approximately:
 - A. 20 breaths per minute
 - B. 40 breaths per minute
 - C. 60 breaths per minute
 - D. 10 breaths per minute
6. Which clinical finding indicates adequate ventilation in a neonate?
 - A. Heart rate consistently below 80 bpm
 - B. Improved color and rising heart rate above 100 bpm
 - C. Decreased respiratory effort
 - D. Lethargy and reduced retractions
7. Meconium-stained amniotic fluid is significant because it:
 - A. Never leads to neonatal aspiration
 - B. Indicates a low-risk delivery

- C. Can predispose neonates to respiratory distress if aspirated
 - D. Requires routine intubation in every case
8. During resuscitation, epinephrine is primarily administered to:
- A. Decrease respiratory drive
 - B. Increase heart rate and cardiac output
 - C. Reduce metabolic rate
 - D. Maintain normothermia
9. Which is the best route for administering emergency medications in a neonate?
- A. Endotracheal only
 - B. Intramuscular in the vastus lateralis
 - C. Intravenous or intraosseous
 - D. Oral, if the neonate is stable
10. Thermoregulation in neonates is essential because:
- A. Hypothermia can increase oxygen consumption and worsen outcomes
 - B. Neonates can shiver effectively to produce heat
 - C. Hyperthermia is rarely a concern
 - D. Temperature does not affect metabolic rate
11. The Silverman-Anderson score is used to assess:
- A. Neonatal neurological status
 - B. Maternal preeclampsia severity
 - C. Respiratory distress in neonates
 - D. Risk of early neonatal sepsis
12. Which of the following signs suggests respiratory distress in a neonate?
- A. Grunting and nasal flaring
 - B. Persistent bradycardia
 - C. Hyperglycemia
 - D. Abdominal distension
13. A neonate with a heart rate below 60 bpm despite adequate ventilation and chest compressions may require:
- A. Normal saline bolus only
 - B. Epinephrine administration
 - C. Immediate antibiotic therapy
 - D. Stopping compressions to re-check vitals
14. When should positive-pressure ventilation be initiated during neonatal resuscitation?
- A. Heart rate >100 bpm but irregular respirations
 - B. Heart rate <100 bpm or inadequate respiratory effort
 - C. Respiratory rate >60 bpm
 - D. Apgar score <7 at 1 minute
15. Which factor best predicts successful neonatal transition post-birth?
- A. Birth weight alone
 - B. Gestational age alone
 - C. Effective initial ventilation
 - D. Maternal age
16. The most common cause of bradycardia in neonates is typically:
- A. Congenital heart defect
 - B. Hypoglycemia
 - C. Inadequate ventilation
 - D. Hyperthermia
17. After intubation, correct endotracheal tube placement in neonates is best confirmed by:
- A. Chest X-ray only
 - B. Bilateral breath sounds and rising SpO₂

- C. Direct visualization of the tube passing the vocal cords only
 - D. Absence of gastric distension
18. Administering IV fluid boluses (e.g., normal saline) in neonatal shock is done at:
- A. 20 mL/kg over 5–10 minutes
 - B. 10 mL/kg over 1–2 hours
 - C. 2 mL/kg over 15 minutes
 - D. 50 mL/kg over 1 hour
19. Which statement is TRUE regarding pulse oximetry in neonatal resuscitation?
- A. Probes should be placed on the upper extremities for pre-ductal saturations
 - B. Pulse oximetry is unnecessary if the neonate appears pink
 - C. Target saturations are the same as adults at birth
 - D. Placement on the lower limb provides pre-ductal values
20. Neonatal hypoglycemia in the first hour of life is commonly defined as blood glucose below:
- A. 70 mg/dL
 - B. 60 mg/dL
 - C. 45 mg/dL
 - D. 30 mg/dL
21. A newborn's heart rate is 90 bpm despite adequate ventilation. The next step would be:
- A. Administer epinephrine
 - B. Start chest compressions
 - C. Intubate if not already done
 - D. Increase oxygen flow rate to 10 L/min
22. Delayed cord clamping in preterm infants is recommended primarily to:
- A. Prevent neonatal jaundice
 - B. Improve circulatory stability and reduce intraventricular hemorrhage
 - C. Increase maternal comfort
 - D. Eliminate the need for resuscitation
23. The primary role of brown fat in neonates is to:
- A. Provide insulation for the neonate's skin
 - B. Produce shivering responses
 - C. Generate heat through non-shivering thermogenesis
 - D. Store glucose for future use
24. When preparing epinephrine for a neonate in the delivery room, the usual concentration is:
- A. 1:1,000 (1 mg/mL)
 - B. 1:10,000 (0.1 mg/mL)
 - C. 1:100,000 (0.01 mg/mL)
 - D. 1:1 (1 g/mL)
25. Infants of diabetic mothers are at risk for:
- A. Hypoglycemia after birth
 - B. Hypernatremia
 - C. Chronic lung disease
 - D. Congenital hypothyroidism
26. When suctioning the airway of a vigorous term neonate born through meconium-stained fluid:
- A. Routine intubation and tracheal suction are mandatory
 - B. Only the mouth and nose require gentle suction if needed
 - C. Suctioning is contraindicated
 - D. Comprehensive mechanical suctioning is needed immediately
27. Prolonged respiratory distress in the first hour could indicate:
- A. Normal adaptation to extrauterine life
 - B. Transient tachypnea of the newborn or underlying pathology
 - C. Adequate lung expansion
 - D. Overheating by the radiant warmer

28. In neonatal resuscitation, rechecking the heart rate post-intervention should occur approximately every:
- A. 30 seconds
 - B. 2 minutes
 - C. 5 minutes
 - D. 10 minutes
29. A neonate's heart rate remains below 60 bpm despite adequate ventilation and chest compressions for 45 seconds. The next step is:
- A. Terminate compressions to reassess
 - B. Administer volume bolus
 - C. Administer epinephrine
 - D. Increase oxygen to 100% without any additional steps
30. Which is the greatest concern in an SGA (small for gestational age) neonate immediately after birth?
- A. Low Apgar at 10 minutes only
 - B. Hypothermia and hypoglycemia
 - C. Polycythemia
 - D. Hyperbilirubinemia
31. A newborn with a respiratory rate of 60 but good tone and a heart rate of 130 bpm at 1 minute likely needs:
- A. No immediate intervention beyond routine care
 - B. Urgent intubation
 - C. Epinephrine injection
 - D. Chest compressions
32. Which neonatal complication can arise from excessive ventilation pressures?
- A. Congenital diaphragmatic hernia
 - B. Pneumothorax
 - C. Ventricular septal defect
 - D. Persistent pulmonary hypertension
33. The target pre-ductal oxygen saturation for a neonate at 5 minutes of life is approximately:
- A. 60–65%
 - B. 70–75%
 - C. 80–85%
 - D. 90–95%
34. A neonate demonstrating seesaw respirations is most likely suffering from:
- A. Healthy respiratory variability
 - B. Hypoglycemia
 - C. Respiratory distress
 - D. Early sepsis
35. If the neonate's heart rate is 40 bpm despite two rounds of epinephrine, the recommended action is to:
- A. Cease resuscitation efforts completely
 - B. Continue compressions and ensure ventilation is optimal
 - C. Switch from IV to endotracheal medication
 - D. Attempt an exchange transfusion
36. A neonate born at 34 weeks with respiratory distress is initially managed with:
- A. Immediate extubation to room air
 - B. Non-invasive support like CPAP if spontaneously breathing
 - C. Routine suction only
 - D. Antibiotic therapy alone
37. When using a pulse oximeter during neonatal resuscitation, the sensor is best placed on the:
- A. Right wrist (pre-ductal)

- B. Left wrist (post-ductal)
 - C. Right lower limb (post-ductal)
 - D. Umbilical stump
38. The primary advantage of room air over 100% oxygen in initial neonatal resuscitation is:
- A. No advantage—100% oxygen is always recommended
 - B. Decreased oxidative stress and better outcomes in many cases
 - C. Higher success in achieving normal saturations
 - D. Reduced risk of hypothermia
39. The normal range for neonatal systolic blood pressure in the first 24 hours is approximately:
- A. 30–40 mmHg
 - B. 40–50 mmHg
 - C. 60–80 mmHg
 - D. 90–100 mmHg
40. For a neonate experiencing persistent apnea after birth, the priority intervention is:
- A. Wait and observe for spontaneous recovery
 - B. Start chest compressions immediately
 - C. Provide tactile stimulation and support breathing
 - D. Administer IV fluids
41. A neonate at 2 hours of life is jittery, diaphoretic, and has a blood glucose of 35 mg/dL. The immediate action should be:
- A. Continue observing for 30 minutes
 - B. Initiate IV bolus of dextrose
 - C. Begin chest compressions
 - D. Administer epinephrine
42. The recommended maximum break between ventilation attempts during neonatal resuscitation is:
- A. 5 seconds
 - B. 10 seconds
 - C. 30 seconds
 - D. 1 minute
43. Surfactant administration is typically considered in:
- A. All neonates >37 weeks
 - B. Neonates with meconium aspiration only
 - C. Premature neonates with RDS (Respiratory Distress Syndrome)
 - D. Neonates demonstrating normal ABG values
44. During resuscitation, the recommended site for IO (intraosseous) access is usually:
- A. Anterior tibia
 - B. Femur
 - C. Radius
 - D. Iliac crest
45. Excessive suction pressure in the neonate can lead to:
- A. Hypoxia and bradycardia
 - B. Elevated alveolar recruitment
 - C. Immediate improvement in respiratory status
 - D. No complications
46. The “Golden Minute” in neonatal resuscitation refers to the first 60 seconds in which:
- A. The neonate must achieve an SpO₂ of 95%
 - B. The neonate requires minimal handling
 - C. Ventilation and oxygenation should be effectively established
 - D. Epinephrine must be administered
47. When intubating a neonate, the appropriate size of the endotracheal tube for a term baby (≥ 3 kg) is generally around:

- A. 2.0–2.5 mm internal diameter (ID)
 - B. 3.5–4.0 mm ID
 - C. 4.5–5.0 mm ID
 - D. >5.0 mm ID
48. Which is a complication of prolonged use of a high fraction of inspired oxygen (FiO_2) in neonates?
- A. Bronchopulmonary dysplasia (BPD)
 - B. Polycythemia
 - C. Reduced alveolar damage
 - D. Renal failure
49. Apnea of prematurity is primarily due to:
- A. Neurological immaturity in respiratory control
 - B. Hypovolemia
 - C. Hyperbilirubinemia
 - D. Overuse of 100% oxygen
50. A neonate with an initial heart rate of 150 bpm but rapidly dropping saturations (below 80% at 2 minutes) likely needs:
- A. Immediate chest compressions
 - B. Intubation for severe bradycardia
 - C. Respiratory support and possible CPAP/PPV
 - D. Epinephrine as the first step
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3. VIRTUAL REALITY-BASED ASSESSMENT OF CLINICAL EMERGENCY RESPONSE (VACER)

Instrument Overview:

- **Purpose:** Developed for this study to measure decision-making competency within the VR simulation environment.
- **Validation:** Demonstrated strong concurrent validity ($r = 0.82$, $p < 0.001$) compared with traditional simulation metrics.

Scoring Components:

1. **Timing Metric**
 - Automatically tracks time (in seconds) from scenario start to initiation of correct interventions (e.g., starting positive-pressure ventilation if indicated).
2. **Action Log**
 - Records key clinical actions (e.g., suction, ventilation, chest compressions) and whether they were performed correctly (Yes/No/Partial).
3. **Decision Appropriateness Score (0–10)**
 - Assessed by comparing sequence of user actions against the standard neonatal emergency algorithm:
 - 0–3 = Major deviations, frequent errors
 - 4–6 = Partial adherence, multiple errors or delays
 - 7–8 = Mostly correct with a few minor errors
 - 9–10 = Highly accurate, timely interventions
4. **Outcome Rating (0–5)**
 - Based on neonate's final status in the simulation:
 - 0–1 = Neonate remains unstable, critical errors
 - 2–3 = Partial stabilization but significant delays or errors
 - 4 = Stabilization achieved with minimal errors
 - 5 = Rapid, error-free stabilization
5. **Feedback Module**
 - Displays immediate alerts for critical steps missed or incorrectly performed (e.g., incorrect dosage, missed chest compression timing).

VACER Total Score = Decision Appropriateness (0–10) + Outcome Rating (0–5)
(Additional time-based metrics are used for objective comparisons but do not factor into the total score.)

4. CONFIDENCE IN PERFORMING CLINICAL SKILLS (CPCS) SCALE

Instrument Overview:

- **Purpose:** A 20-item Likert-type scale developed to measure self-reported confidence in performing essential neonatal emergency care tasks.
- **Reliability:** Excellent internal consistency (Cronbach's $\alpha = 0.92$).
- **Validity:** Confirmed via structural equation modeling (CFI = 0.95, RMSEA = 0.06).
- **Scoring:** Each item is rated from 1 (Not Confident at All) to 5 (Highly Confident). Total scores range from 20 to 100.

Instructions:

Read each statement and circle the number that best represents your level of confidence, from 1 (Not Confident at All) to 5 (Highly Confident).

1. **Performing a rapid initial assessment** (heart rate, color, tone)
1 | 2 | 3 | 4 | 5
2. **Conducting basic airway clearance** (positioning, suction)
1 | 2 | 3 | 4 | 5
3. **Initiating bag-valve-mask ventilation**
1 | 2 | 3 | 4 | 5
4. **Administering emergency medications** (e.g., epinephrine)
1 | 2 | 3 | 4 | 5
5. **Gaining IV or IO access** under pressure
1 | 2 | 3 | 4 | 5
6. **Executing proper chest compression technique**
1 | 2 | 3 | 4 | 5
7. **Employing thermoregulation strategies** (e.g., radiant warmer)
1 | 2 | 3 | 4 | 5
8. **Reading/interpreting neonatal vital signs** (HR, RR, SpO₂)
1 | 2 | 3 | 4 | 5
9. **Documenting interventions and outcomes** in real time
1 | 2 | 3 | 4 | 5
10. **Communicating effectively** with the NICU team
1 | 2 | 3 | 4 | 5
11. **Evaluating a neonate's changing clinical status**
1 | 2 | 3 | 4 | 5
12. **Recognizing complications or adverse events** (e.g., pneumothorax)
1 | 2 | 3 | 4 | 5
13. **Adhering to standardized neonatal resuscitation protocols**
1 | 2 | 3 | 4 | 5
14. **Adjusting interventions** based on neonate's condition
1 | 2 | 3 | 4 | 5
15. **Providing emotional support to families** during emergencies
1 | 2 | 3 | 4 | 5
16. **Troubleshooting common equipment issues** (oxygen flow, monitor alarms)
1 | 2 | 3 | 4 | 5
17. **Prioritizing interventions** when multiple problems arise
1 | 2 | 3 | 4 | 5

- 18. **Maintaining composure** under high-stress scenarios
1 | 2 | 3 | 4 | 5
- 19. **Leading or assisting a neonatal code** effectively
1 | 2 | 3 | 4 | 5
- 20. **Reflecting on and learning from mistakes** in emergency care
1 | 2 | 3 | 4 | 5

CPCS Total Score = sum of all item scores (range: 20–100)

5. NEONATAL OUTCOME METRICS

Instrument Overview:

- **Purpose:** These objective metrics gauge the clinical outcomes of the simulated neonates within the VR scenarios.
- **Validation:** Automated VR recordings showed strong concordance ($r = 0.89$) with expert observational ratings.

1. Stabilization Time

- Duration (in minutes) from the start of the scenario until the neonate reaches stable vital signs (heart rate ≥ 100 bpm, SpO₂ within acceptable range).

2. Successful Intervention Rate

- Percentage of critical interventions (e.g., IV access, correct medication dosing) performed successfully on the first attempt.

3. Patient Safety Events

- Number of near-misses or adverse events (e.g., medication errors, significant delays) occurring during the scenario, logged automatically by the VR system.
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6. SEMI-STRUCTURED INTERVIEW GUIDE

Instrument Overview:

- **Purpose:** To explore participants' lived experiences, perceptions, and suggestions related to the VR neonatal emergency training.
 - **Design:** Developed specifically for this study and aligned with Kolb's Experiential Learning Theory; expert review established a CVR of 0.86.
 - **Administration:** Conducted post-training, lasting approximately 45–60 minutes. Interviews are audio-recorded, transcribed verbatim, and analyzed via thematic analysis.
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Interview Sections and Sample Questions:

1. Concrete Experience

- "Can you describe, in detail, your experience with the VR neonatal emergency scenarios?"
- "Did the VR simulation feel realistic compared to actual neonatal emergencies?"

2. Reflective Observation

- "What emotions or thoughts did you have during the simulations, especially when faced with acute neonate distress?"
- "Were there moments where you felt unsure or overly challenged?"

3. Abstract Conceptualization

- "How did the VR sessions help you connect theoretical knowledge (e.g., neonatal resuscitation algorithms) to hands-on practice?"
- "Did any of your assumptions about emergency care change after the simulation?"

4. Active Experimentation

- "How might you apply the strategies or skills you practiced in VR to real-life clinical settings?"
- "Are there any specific interventions or protocols you feel more confident about now?"

5. Confidence and Anxiety

- "Did the VR training help reduce any anxiety you typically experience in high-stakes scenarios?"
- "Can you share examples of how your confidence evolved from the first simulation to the last?"

6. Implementation and Recommendations

- “What aspects of VR-based training would you most like to see adopted in routine NICU training programs?”
- “Are there improvements either technical or educational that you would recommend for future VR simulations?”

7. Final Reflections

- “Is there anything else you would like to add about your overall experience, challenges, or insights gained?”

Interviewers may use probing questions such as “Could you expand on that?” or “What led you to that conclusion?” to elicit richer responses. Data are then analyzed following Braun and Clarke’s thematic analysis approach, ensuring methodological rigor.
