

Textbook of

Neonatal Resuscitation®

9th Edition



The Neonatal Resuscitation Blueprint

A Visual Guide to the First 60 Seconds
(Based on NRP 9th Edition Guidelines)



American
Heart
Association.

American Academy
of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN®



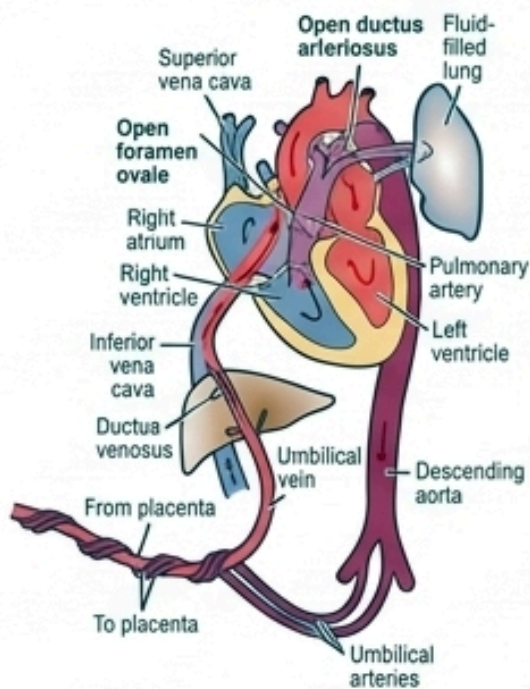
The Physiological Shift Matrix

Fetal Circulation

Gas exchange in Placenta

Lungs filled with fluid

Pulmonary vessels tightly constricted

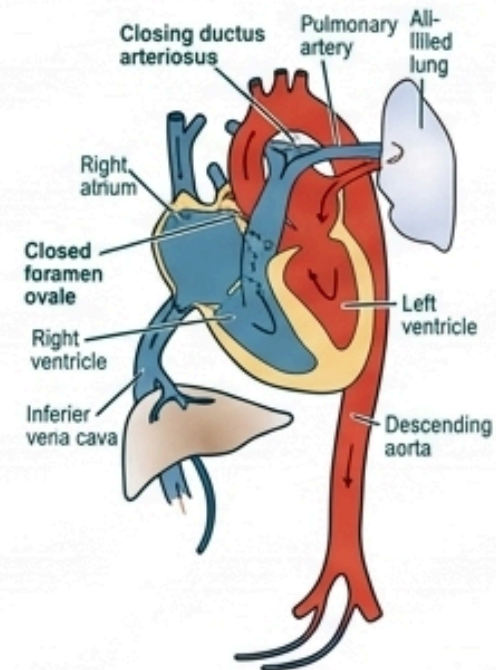


Neonatal Circulation

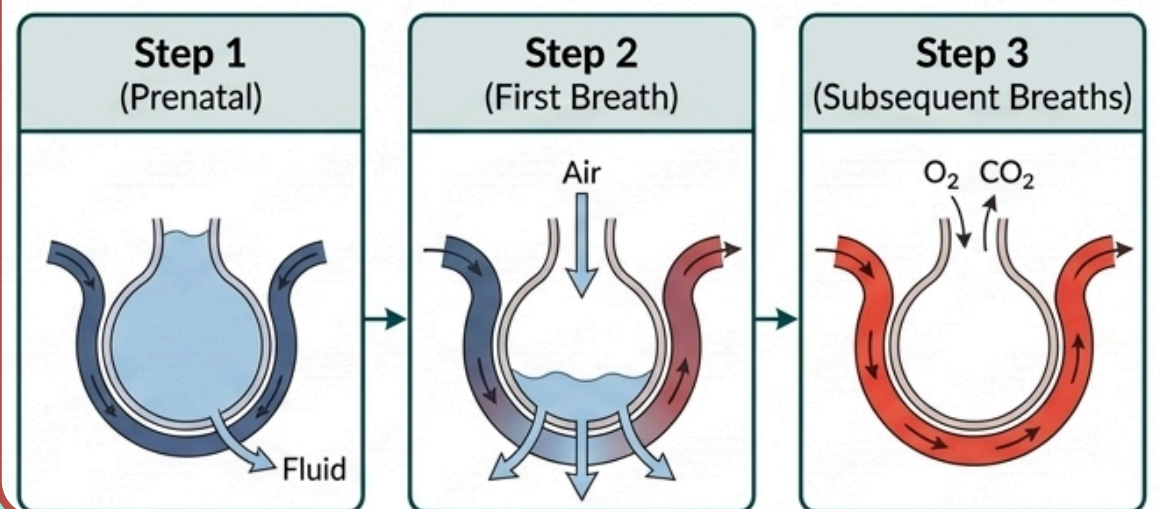
Gas exchange in Lungs

Lungs filled with air

Pulmonary vessels relaxed



The Alveolar Fluid Clearance Model



Because the primary problem is a lack of gas exchange, the single most important step in neonatal resuscitation is effective ventilation of the lungs.

Recognizing Interruption in Normal Transition

Normal Transition

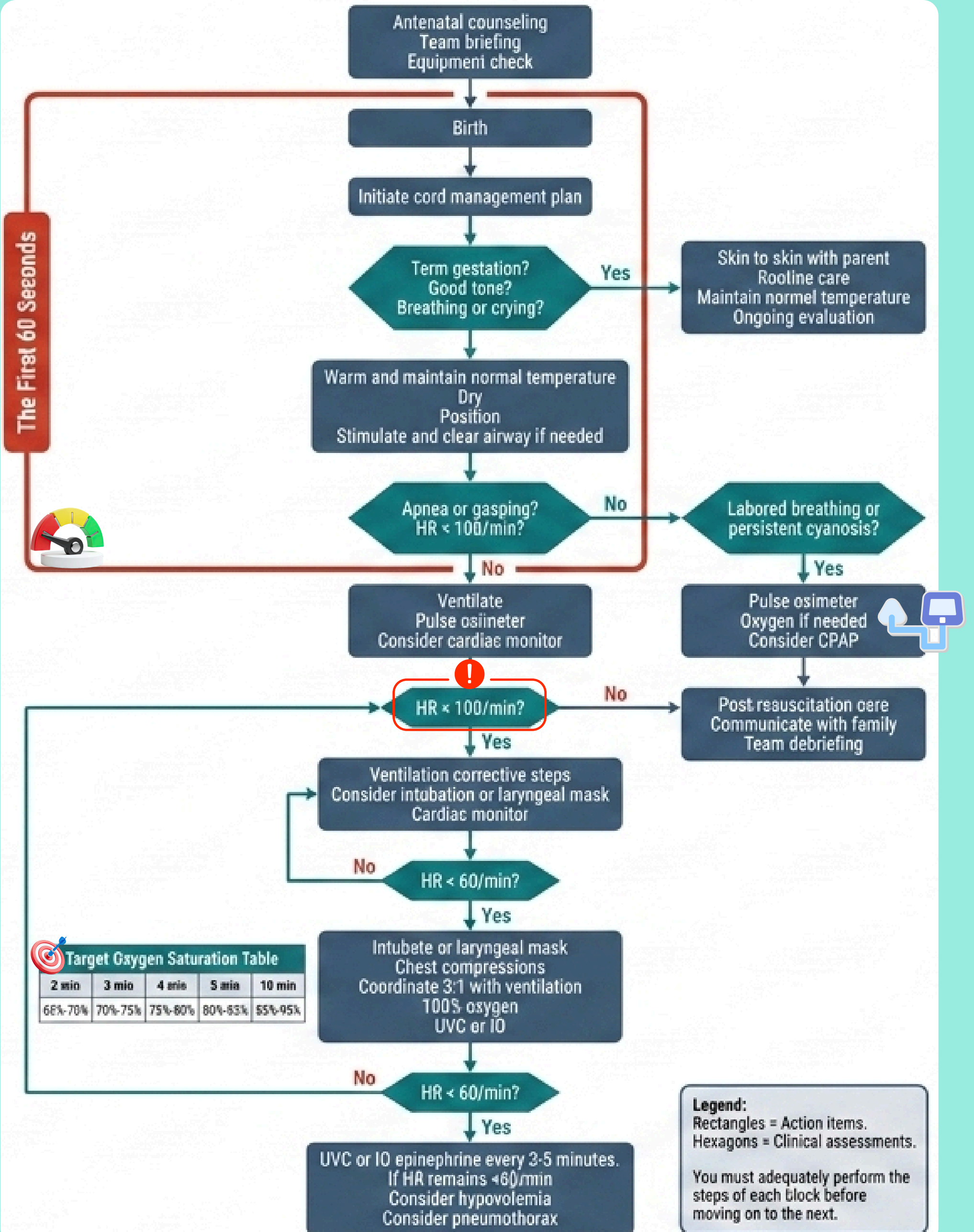
- ✓ Spontaneous breathing/crying
- ✓ Good muscle tone
- ♥ Heart rate > 100 bpm
- ✓ Gradual improvement in oxygen saturation

Abnormal Transition (Triggers for Action)

- ! Irregular breathing, apnea, or tachypnea
- ! Bradycardia (< 100 bpm) or tachycardia
- ! Decreased muscle tone / alertness
- ! Persistent central cyanosis or pallor
- ! Low oxygen saturation



Initiate NRP Algorithm



The Gestational Viability Matrix



T-Minus: Prenatal Counseling

ZONE 1	ZONE 2	ZONE 3
< 22 Weeks: Profound Prematurity	22 to 23 Weeks: The Perivable Gray Zone	≥ 24 Weeks: Standard Viability
Physiological lack of lung development precludes survival. Standard Approach: Palliative & Comfort Care. Active resuscitation generally not indicated. Focus: Maternal and family emotional support.	High risk of severe morbidity and mortality. Standard Approach: Highly individualized. Requires extensive prenatal parental counseling. Action: If parents choose resuscitation, prepare for immediate intensive care (intubation, early surfactant).	Standard Approach: Active resuscitation. Stabilization initiated for all infants. Follow standard algorithmic care.

Anticipate & Prepare: Environmental Parameters



T-Minus: Equipment Check

Thermal Management by Zone

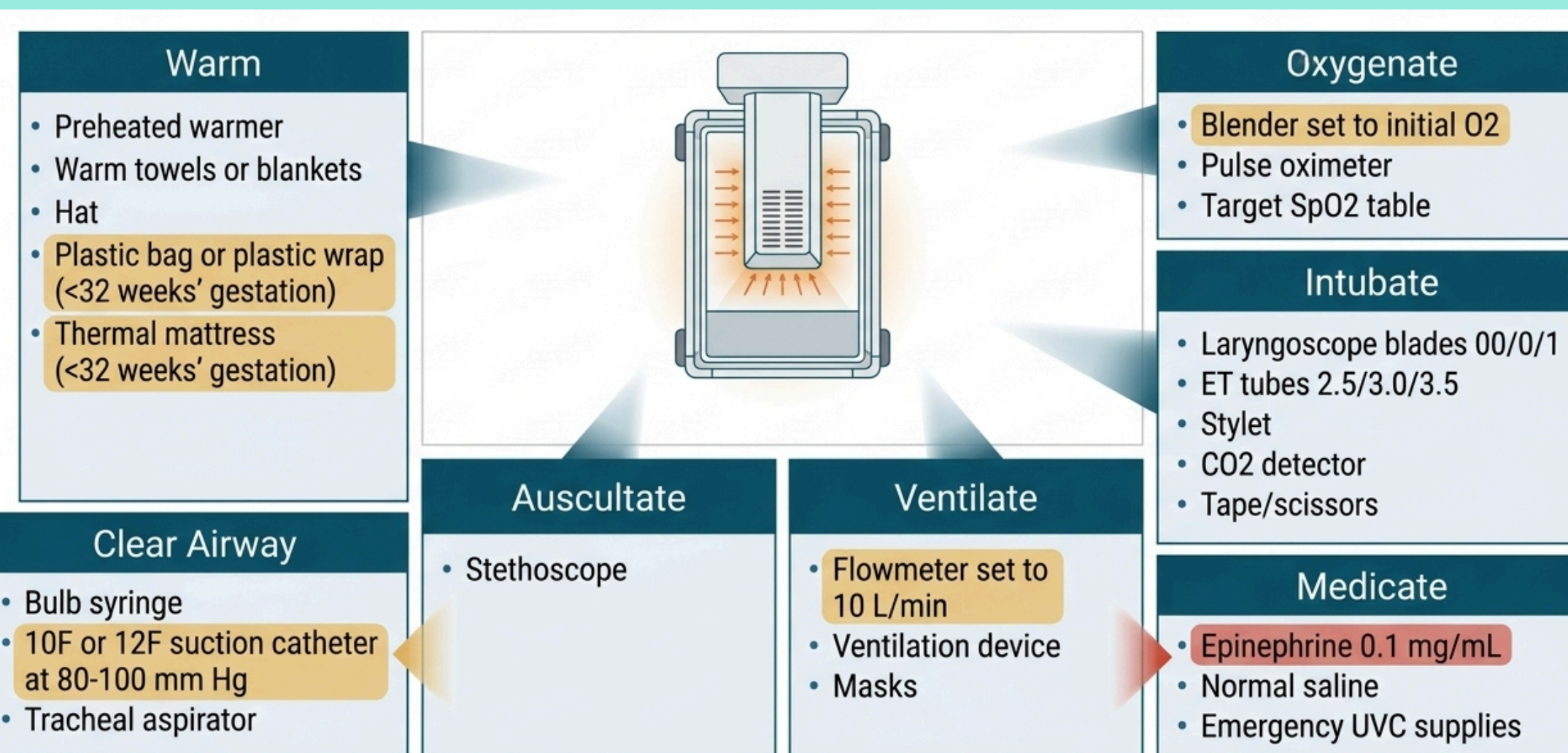
Room Base: Tightly controlled at 23°C to 25°C (74°F to 77°F) for all births.

The 4 Pre-Birth Questions

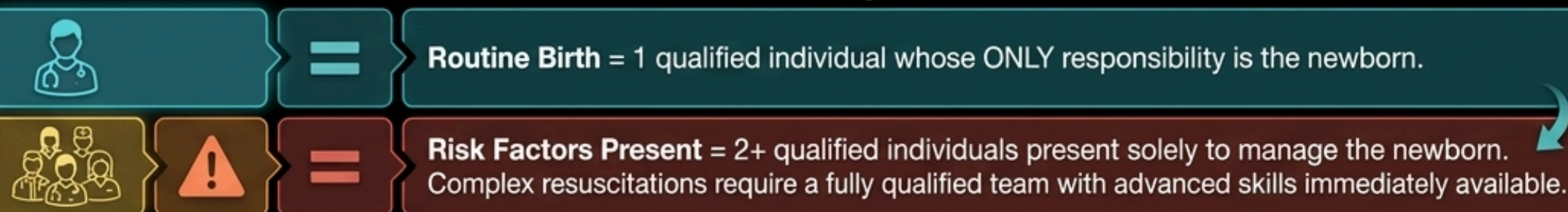
- ☐ Expected gestational age?
- ☐ Amniotic fluid clear?
- ☐ Additional risk factors?
- ☐ Umbilical cord management plan?



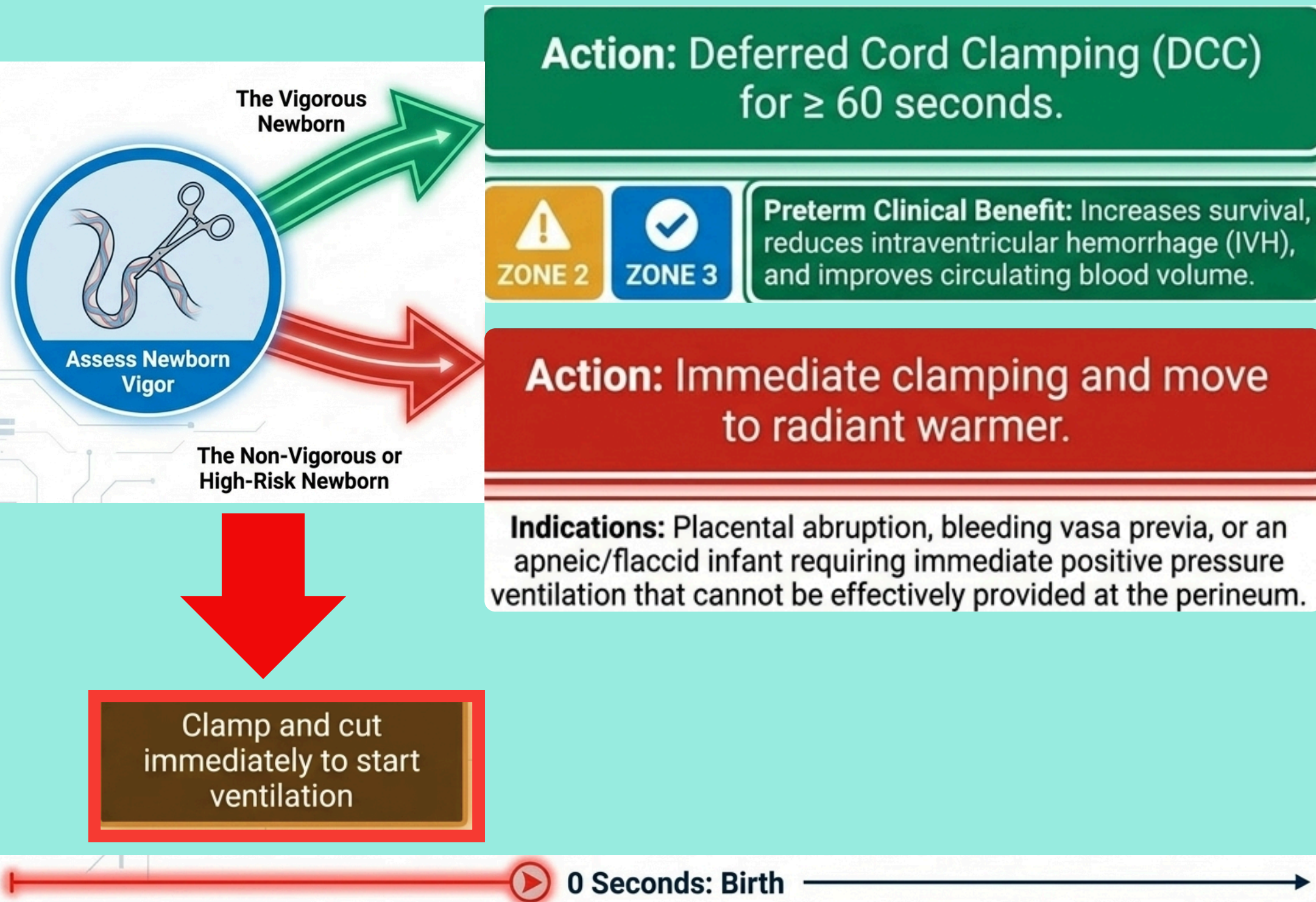
NRP Quick Supplies & Equipment Station



Team Assembly Rule



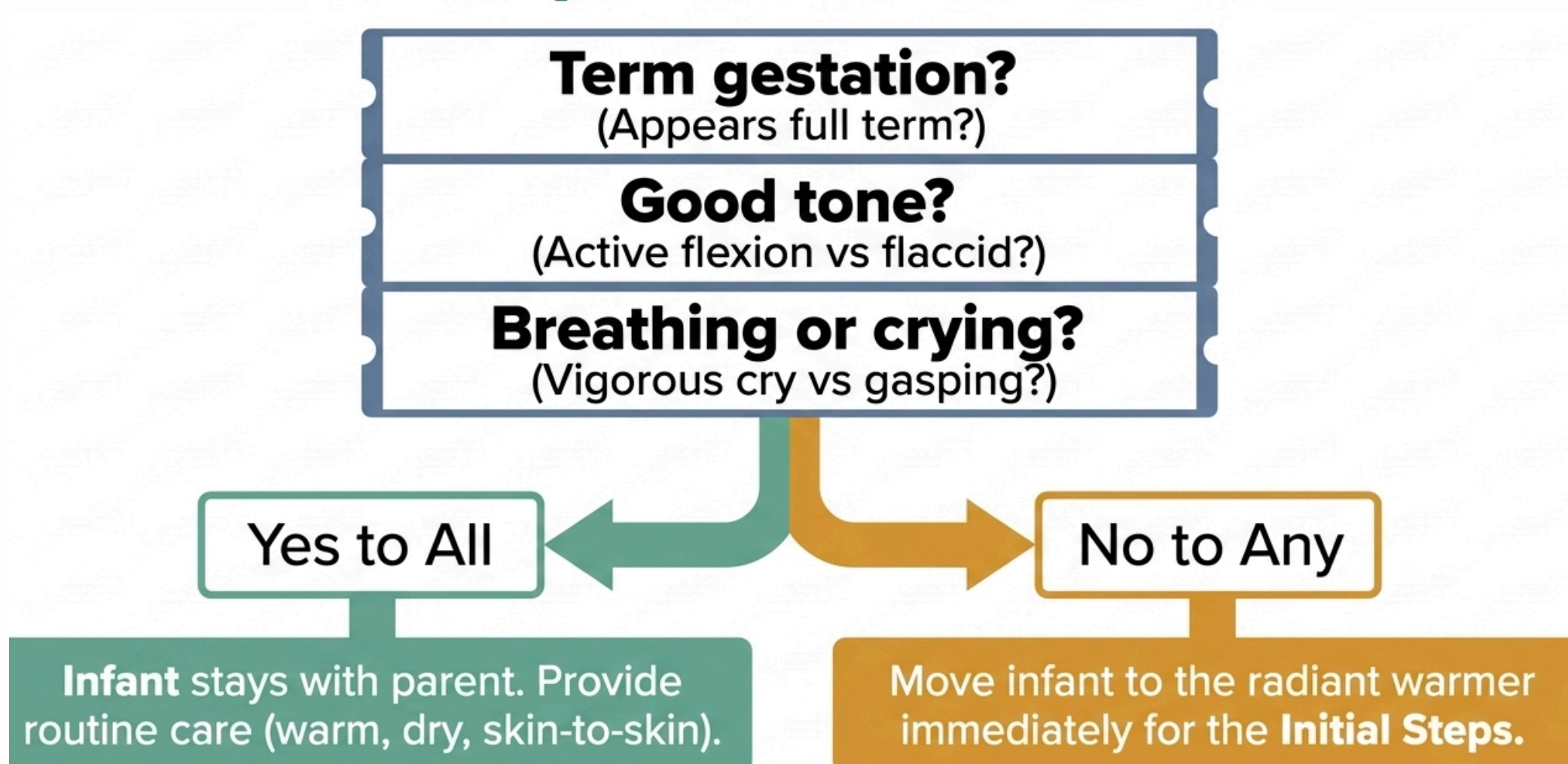
Time 0: Umbilical Cord Management



Alternate: Umbilical Cord Milking

- ✓ Reasonable for term/late preterm (>35 weeks) who remain non-vigorous despite stimulation.
- ⚠ **WARNING:** NOT recommended for preterm infants <28 weeks (increased risk of severe intraventricular hemorrhage).

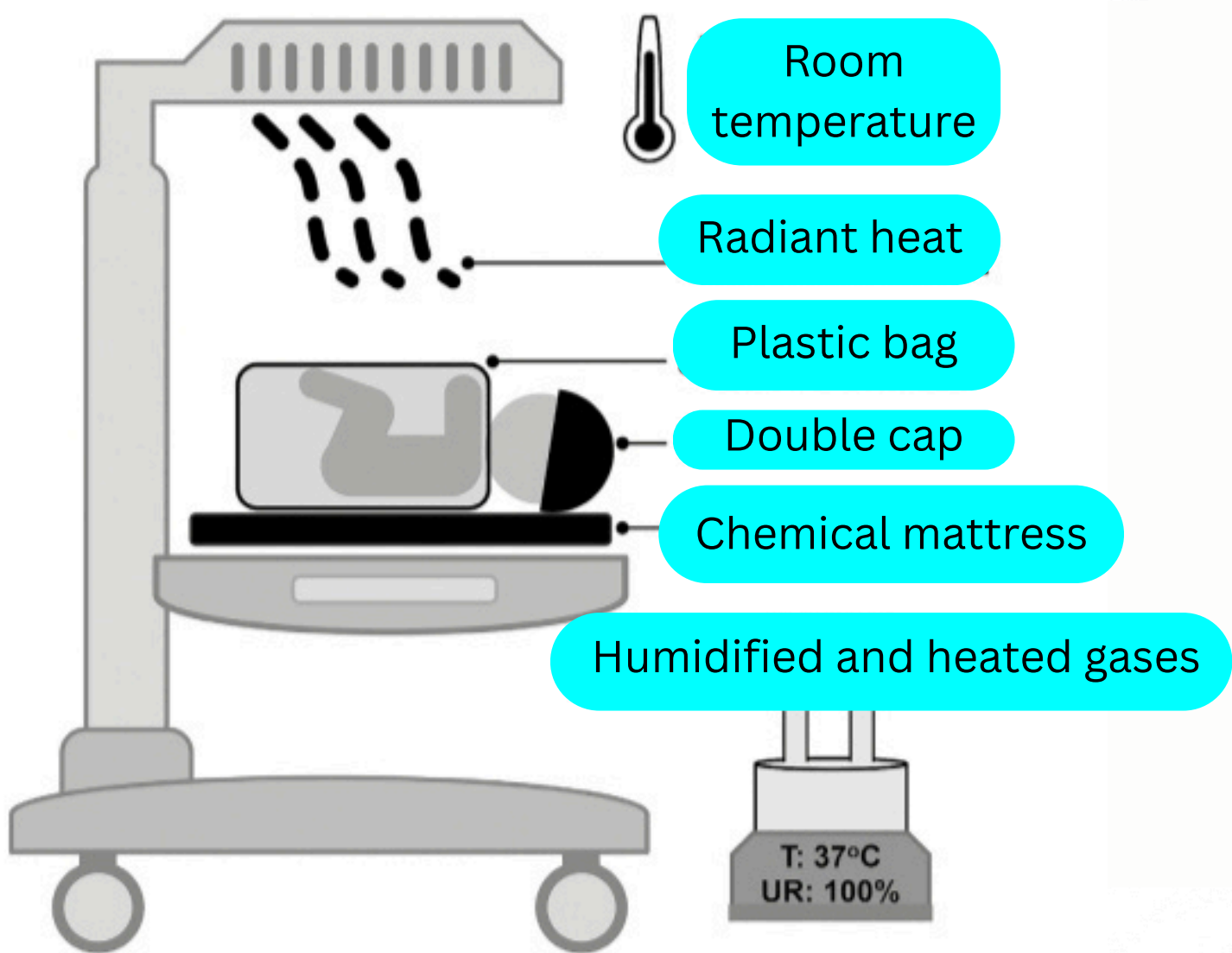
The Rapid Initial Evaluation



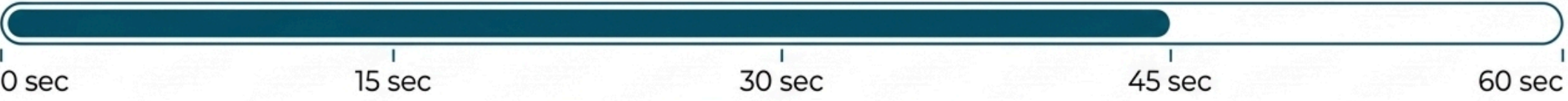
Executing the Initial Steps (The Golden Minute)

1. Warm

Place under radiant warmer.



Ticking Clock: 60 Seconds





2. Dry

Vigorously dry with towel/blanket, remove wet linen immediately (promotes rapid cooling if left).

⚠ Note: Do not dry <32 weeks; wrap in plastic.



3. Stimulate

Gently rub back, trunk, or extremities if still apneic.

⚠ Warning: Never shake.

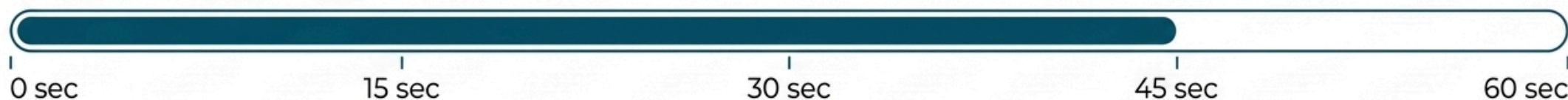


4. Clear Airway

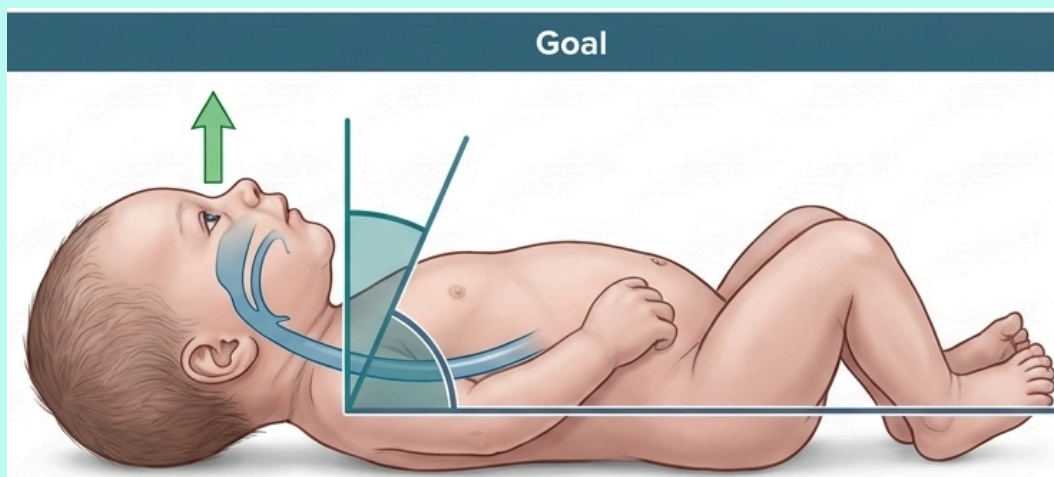
Only if needed (obstructed, meconium, or PPV anticipated).

Bulb syringe: **Mouth before Nose** ("M before N").

Ticking Clock: 60 Seconds



Optimizing the Airway: The "Sniffing" Position



Error 1: Hyperextension



Error 2: Flexion



Error/Fix

Managing Meconium-Stained Fluid

Vigorous Infant

Good respiratory effort and muscle tone.

Action: Infant stays with parent. Clear secretions from mouth/nose with bulb syringe gently.

Non-Vigorous Infant

Depressed respirations or poor muscle tone.

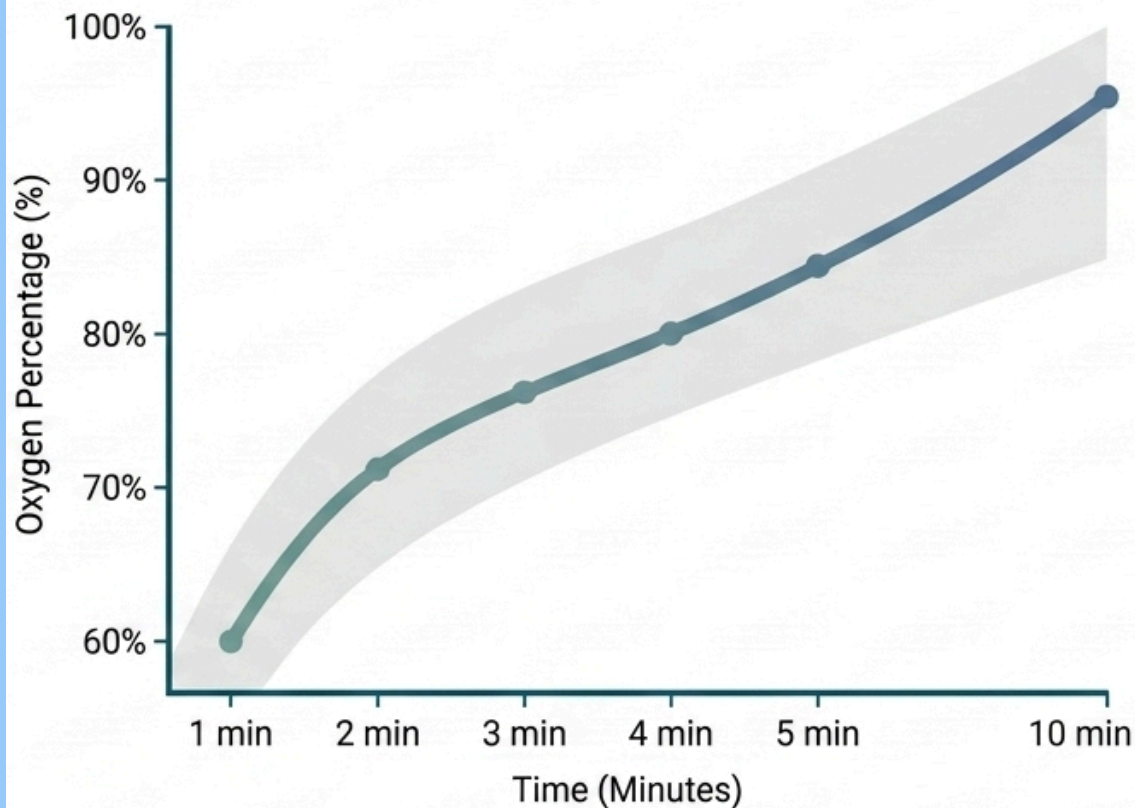
Action: Bring to radiant warmer. Perform initial steps. Perform initial steps. Use bulb syringe to clear airway.



GUIDELINE UPDATE: Routine laryngoscopy with or without intubation for tracheal suction is **NO LONGER RECOMMENDED** for non-vigorous infants with meconium. If heart rate < 100 bpm or infant is apneic, proceed immediately to assisted ventilation (PPV).

Oxygenation Takes Time (SpO₂ Targets)

The SpO₂ Target Curve



**Minutes
after birth**

2
3
4
5
10

**Target pre-
ductal SpO₂**

65-70%
70-75%
75-80%
80-85%
85-95%



Diagnostic warning

Visual assessment of
cyanosis is unreliable.
Use pulse oximetry.

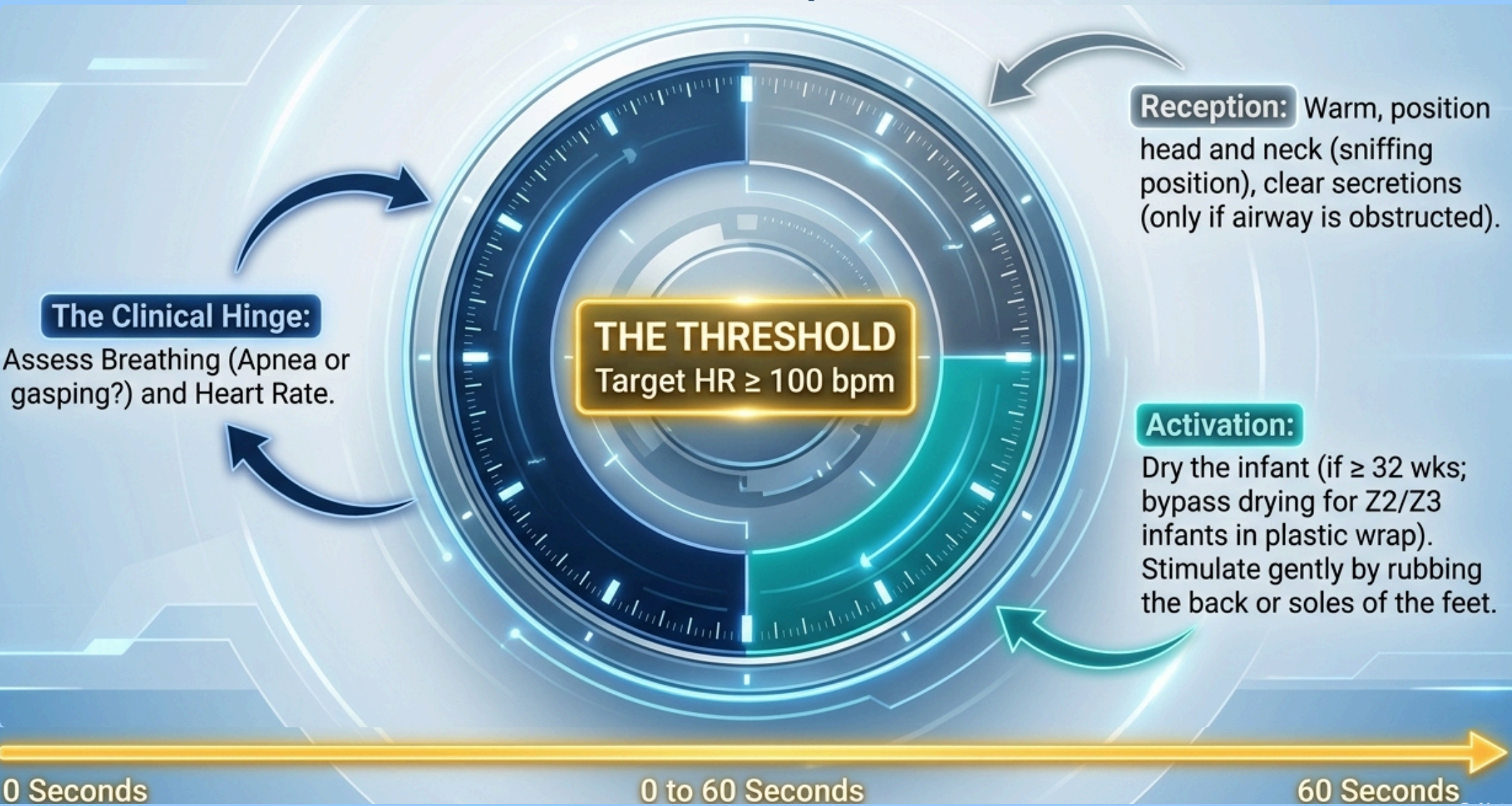
ECG is the gold standard for initial HR. More accurate than auscultation. Target ≥ 100 bpm



Pulse oximeter: sensor mandatory on the right upper limb (pre-ductal)

Connect sensor to infant first, then plug into the monitor for faster reading

The Golden Minute: Initial Steps & Crucial Assessment



Integrated Clinical Assessment: The Respiratory Fork



What happens at exactly 60 seconds if transition is abnormal?



THE CPAP PATHWAY

Diagnostic Hinge

Infant is breathing spontaneously **AND** Heart Rate is ≥ 100 bpm, **BUT** breathing is labored or SpO₂ is persistently below target.



Action

Initiate CPAP to support work of breathing.

THE VPP PATHWAY

Diagnostic Hinge

Infant is apneic **OR** gasping **OR** Heart Rate is < 100 bpm.



Action

Initiate **Positive Pressure Ventilation (VPP)** immediately. Delaying ventilation worsens outcomes.

Exactly 60 Seconds

Supporting Labored Breathing (HR > 100 bpm)

Supplemental Free-Flow Oxygen

- For persistent cyanosis but breathing well.
- **Setup:** Adjust flowmeter to 10 L/min. Start blender at 30% oxygen. Hold tubing close to face.

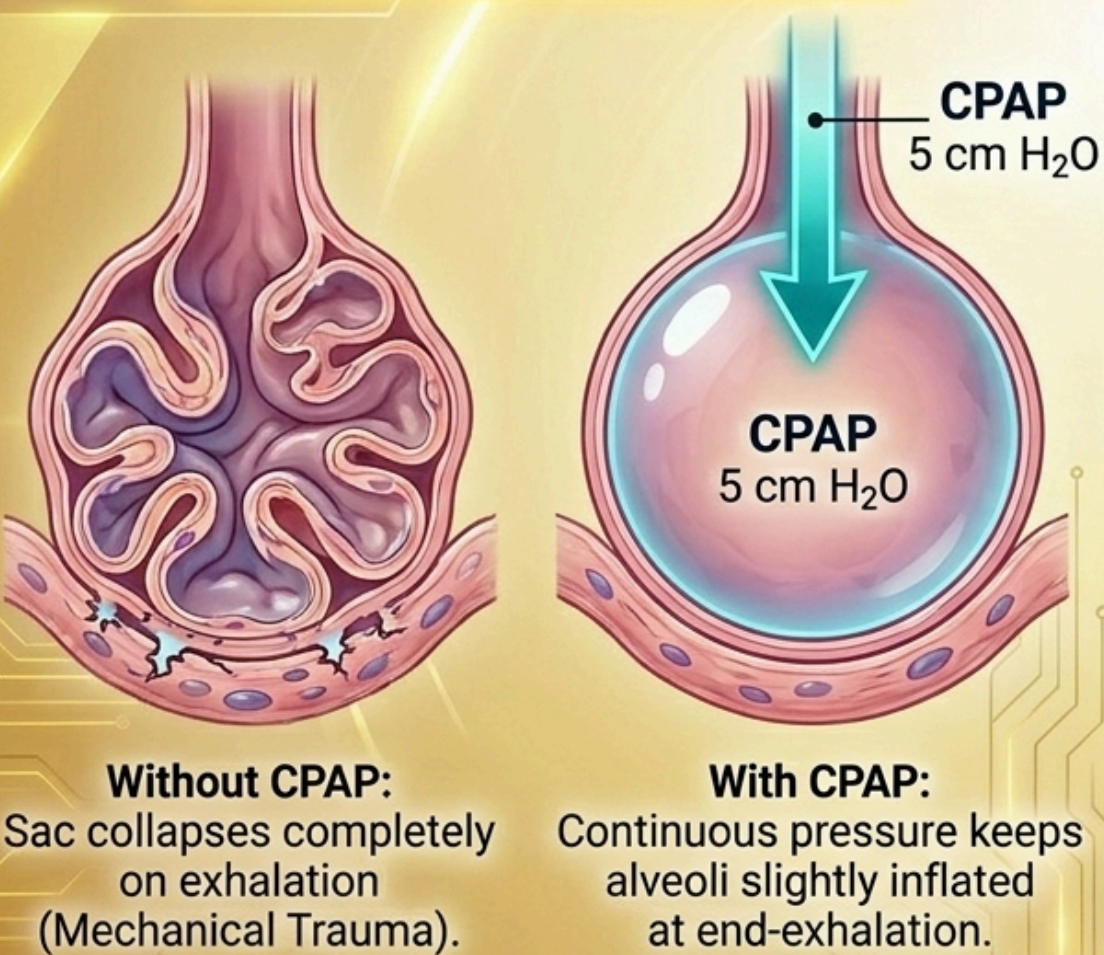
 **Warning:** Do NOT attempt to administer free-flow oxygen through the mask of a self-inflating bag.

CPAP (Continuous Positive Airway Pressure)

- For spontaneous but labored breathing or low SpO₂ despite O₂.
- **Mechanism:** Keeps airway open by maintaining continuous pressure.
- **Setup:** Must use flow-inflating bag or T-piece resuscitator attached to a mask held tightly against the face.

Non-Invasive Support: CPAP Protocol & Mechanics

Alveolar Mechanics Diagram



CPAP Protocol Details

Equipment: Must use a T-piece resuscitator or flow-inflating bag. (**WARNING:** Cannot be delivered via a self-inflating bag).

Starting Setting: 5 to 6 cm H₂O PEEP.

ZONE
2

ZONE
3

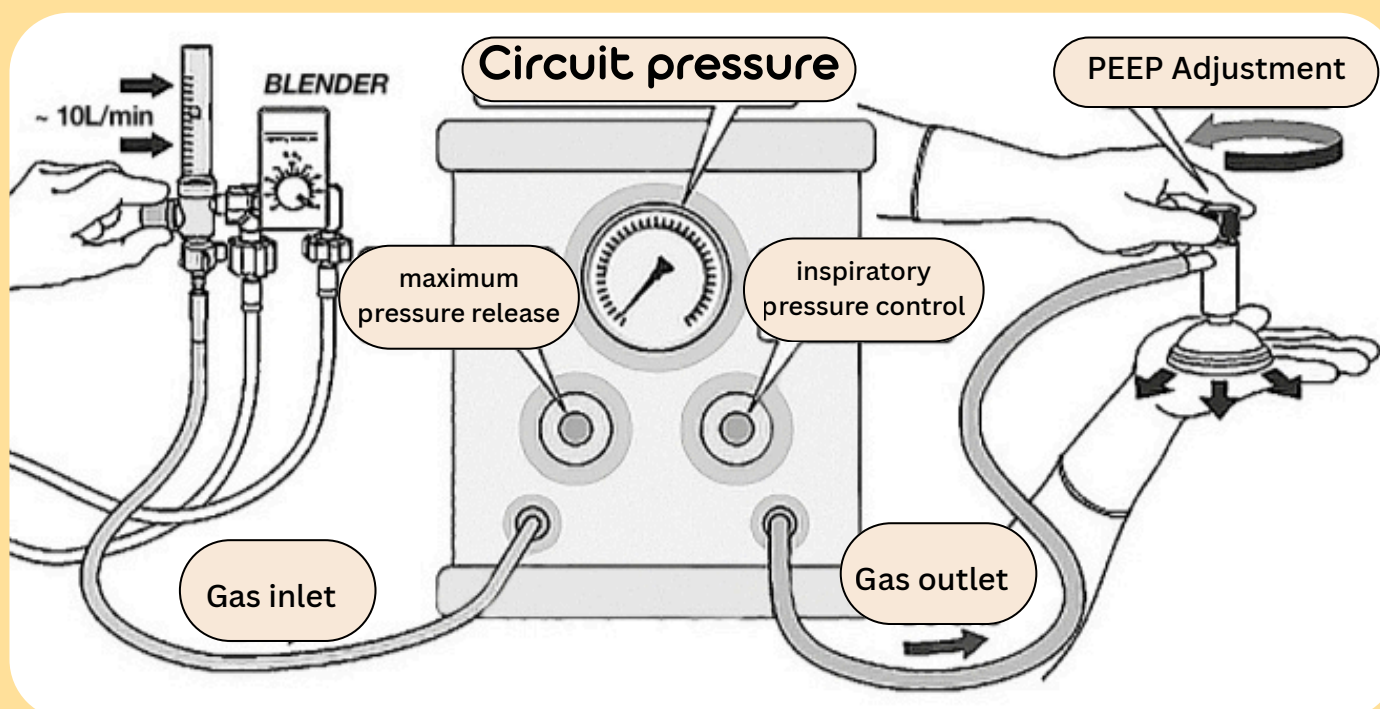
Gestational Context:
Early CPAP is highly preferred over routine intubation for preterm infants to avoid the mechanical trauma of ventilation.

1 to 2 Minutes

Ventilating with a T-piece resuscitator with a face mask



Manual mechanical ventilator with T-piece and blender



Positive Pressure Ventilation: Cadence & Parameters

The Cadence



Rate: 40 to 60 breaths per minute.

Rhythm: Breathe, Two, Three, Breathe, Two, Three.

Initial Pressures



PIP: 20-25 cm H₂O (Zones 2 & Early 3).

PIP: Up to 30 cm H₂O for term infants.

PEEP: 5 cm H₂O.

Initial Oxygen (FiO₂)



≥ 35 weeks: 21% (Room Air).

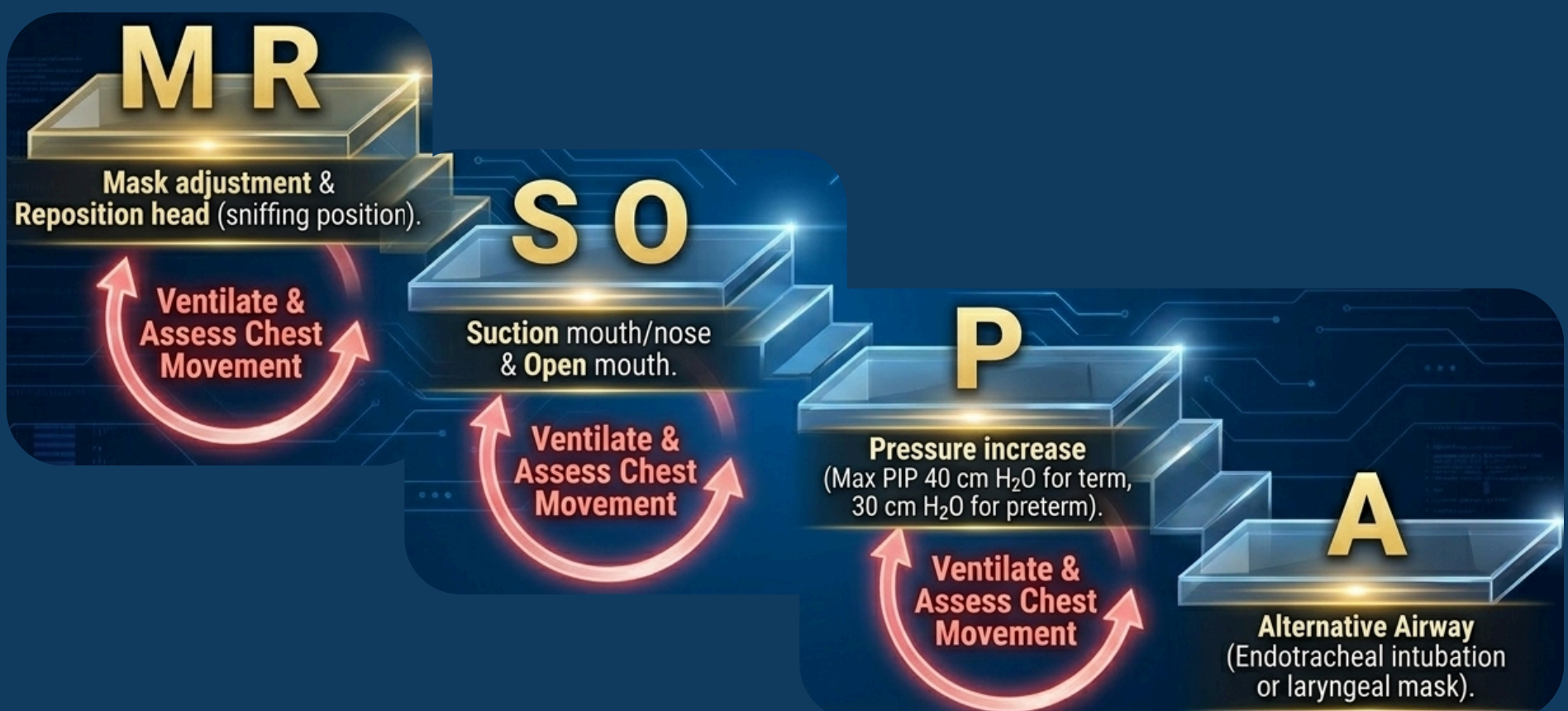
32 to 34 weeks: 21% to 30%.

< 32 weeks (Zones 2 & 3): 30%.

60 Seconds (Immediate Response)

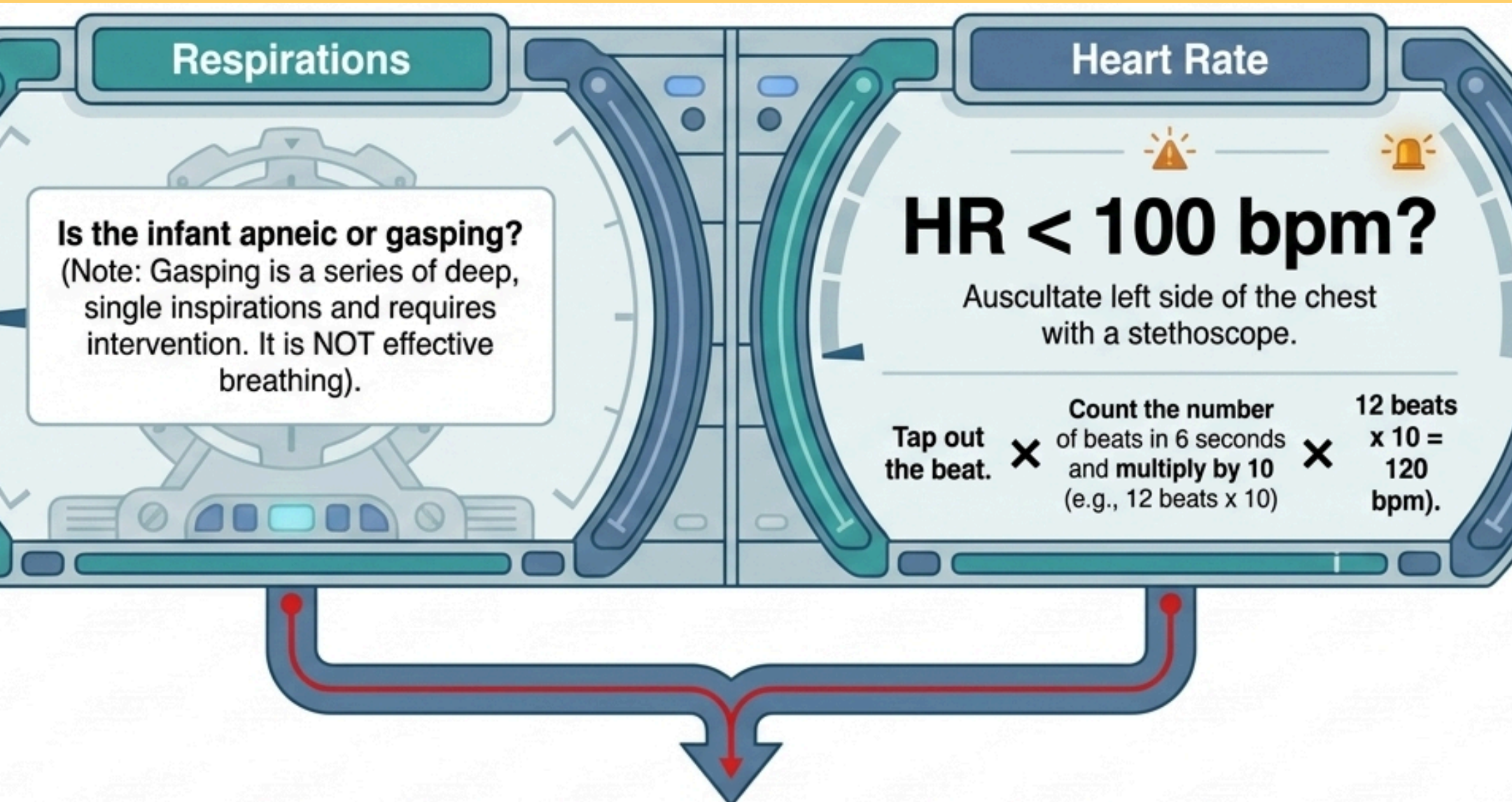
KEY INSIGHT: The absolute primary indicator of successful VPP is a rapidly rising heart rate.

Evaluating VPP: The MR SOPA Corrective Sequence



Post 15-30 Seconds of VPP

The 60-Second Assessment Gate



If Apneic, Gasping, OR HR < 100 bpm -> Initiate Positive-Pressure Ventilation (PPV) immediately.

Alternative Airway: Endotracheal Intubation

Equipment Sizing Matrix

	Gestational Age	Laryngoscope Blade	ET Tube Size (ID mm)
$Z_2/Z_3^{\uparrow}$	< 28 weeks	Size 0 blade	2.5 mm ET tube
Z_3	28 to 34 weeks	Size 0 blade	3.0 mm ET tube
Z_3	≥ 34 weeks	Size 1 blade	3.5 mm ET tube

Indications Matrix

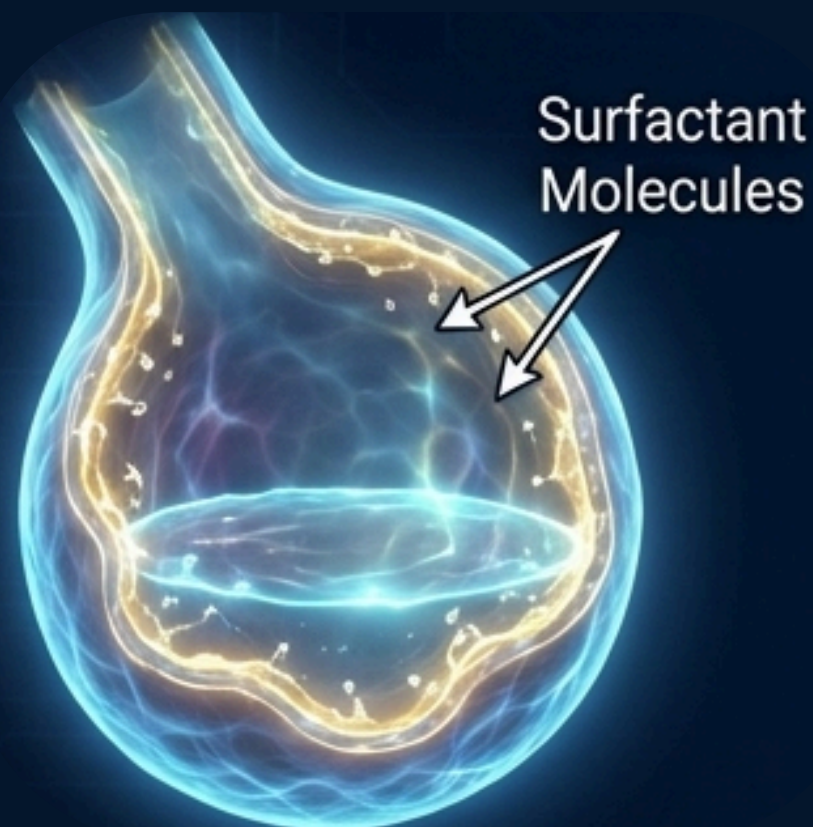
Ineffective VPP (MR SOPA failed), prolonged VPP anticipated, or entering chest compression phase (HR < 60).

Tracheal Confirmation



As Indicated by VPP Failure or HR Decline

Surfactant Therapy: Mechanics & Administration



The Alveolar Upgrade

Preterm lungs lack surfactant. Exogenous surfactant coats the interior, lowering surface tension to prevent Respiratory Distress Syndrome (RDS).

The Clinical Pathway

Current Standard:
Early CPAP is preferred.
Avoid routine prophylactic intubation.

Does infant
require intubation
for RDS or fail a
strict CPAP
trial?

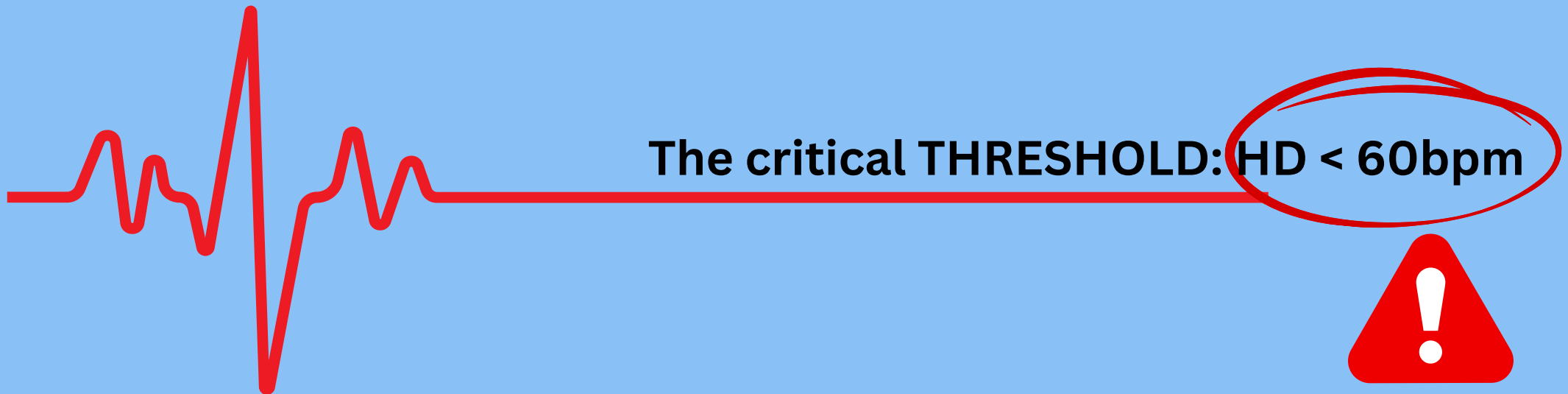
YES

**Administer
Surfactant**

LISA / MIST:
Less Invasive Surfactant
Administration
(via thin catheter while
maintaining CPAP).

INSURE:
INTubate → SURfactant
→ Extubate immediately
back to CPAP.

Entering the Danger Zone: Advanced Resuscitation



HD remains < 60bpm despite 30 seconds of ventilation that visibly moves the chest

Immediate Actions Checklist



1. AIRWAY:

Secure endotracheal tube (if not already done) to ensure absolute patency.



2. OXYGEN:

Immediately dial FiO₂ up to 100%.



3. CIRCULATION:

Initiate Chest Compressions strictly coordinated with VPP.



4. MONITORING:

Secure ECG leads for accurate heart rate tracking.

After ≥ 30 Seconds of Effective VPP

Chest Compressions: The Two-Thumb Technique

Universal Parameters

- **Placement:** Lower third of the sternum (just below the nipple line). Fingers encircle the torso to provide firm back support.
- **Depth:** Depress one-third of the anterior-posterior diameter of the chest.

Gestational Adaptation for Preterm

ZONE
1

ZONE
2

Superimposed Thumbs

For extremely small preterm infants, the sternum is too narrow. Place one thumb directly on top of the other.

Gestational Adaptation for Term

ZONE
3

Juxtaposed Thumbs

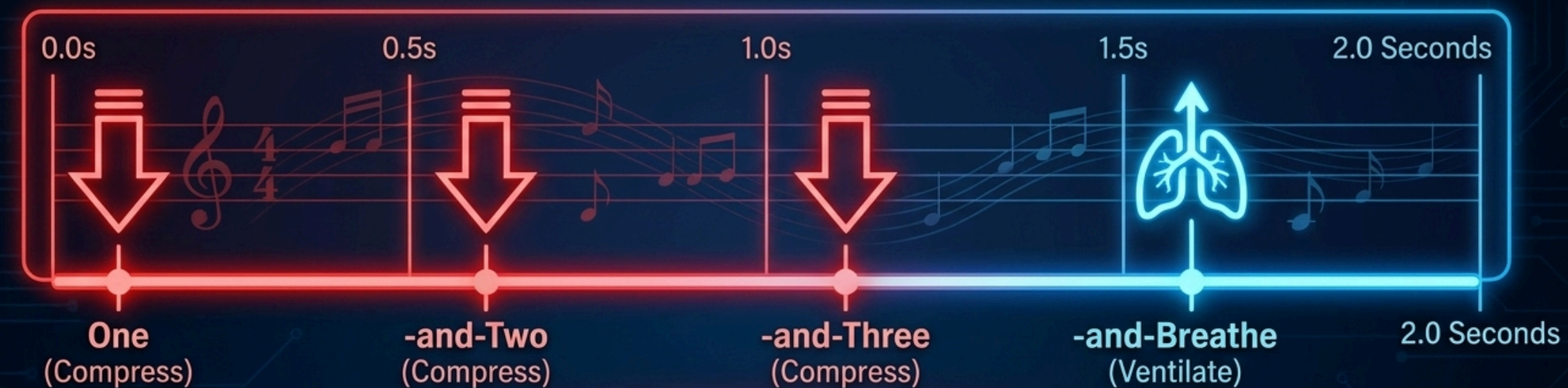
For larger term infants, place thumbs side-by-side.

Continuous Active Resuscitation

Advanced Resuscitation: Rhythm & Cadence

The Ratio: 3 compressions to 1 breath.

The Math: 90 compressions + 30 breaths = 120 total events per minute. (Each event takes 0.5 seconds).



Alert Red

Evaluation Stop

Pause compressions briefly after exactly 60 seconds to assess the ECG heart rate.
If $HR \geq 60$ bpm, stop compressions and resume VPP at 40-60 breaths/min.

120 Events Per Minute

Post-Stabilization & Team Debriefing

Oxygenation (SpO2)



Target climbs from 60-65% at 1 minute up to 85-95% by 10 minutes.

Blood Glucose



Strict monitoring required. Preterm infants possess critically low glycogen stores and are vulnerable to rapid hypoglycemia.

Positioning & Thermoregulation

Maintain normothermia. Strictly avoid the Trendelenburg position (legs elevated) to prevent cerebral venous pressure spikes and IVH.

Team Dynamics & Quality Improvement

Every resuscitation concludes with a multidisciplinary debriefing. Evaluate preparation, communication efficiency, and equipment readiness to continuously improve the Clinical Flight Path for the next patient.

T+ 10 Minutes & Beyond



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Neonatal Resuscitation & Stabilization: The 9th Edition Protocol

Integrated Clinical Pathways, Gestational Age Considerations,
and Advanced Resuscitation Techniques

T-Minus: Prenatal & Anticipation



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Precision Resuscitation: Preterm Neonatal Protocol (NRP 9th Ed.)

