# Neonatal **Weaning and Extubation** from Mechanical Ventilation

Evidence-Based Strategies, Readiness, and Post-Extubation Management

**Shalish W, Sant'Anna G, Keszler M. Weaning and Extubation From Mechanical Ventilation. In: Goldsmith's Assisted Ventilation of the Neonate. 7th ed.**



# Invasive Weaning Strategies: Modality Comparison

| Modality | Weaning Mechanism | Clinical Nuance |
|---|---|---|
| SIMV (Synchronized Intermittent Mandatory Ventilation) | Gradually reduce mandatory rate. | Carries a risk of increased work of breathing (WOB) between mandatory breaths. |
| AC (Assist Control) | Wean by reducing PIP; patient controls the rate. | Offers better WOB reduction than SIMV. |
| PSV (Pressure Support Ventilation) | Flow-cycled; supports spontaneous breaths. | Excellent for weaning as it directly targets and offloads WOB. |

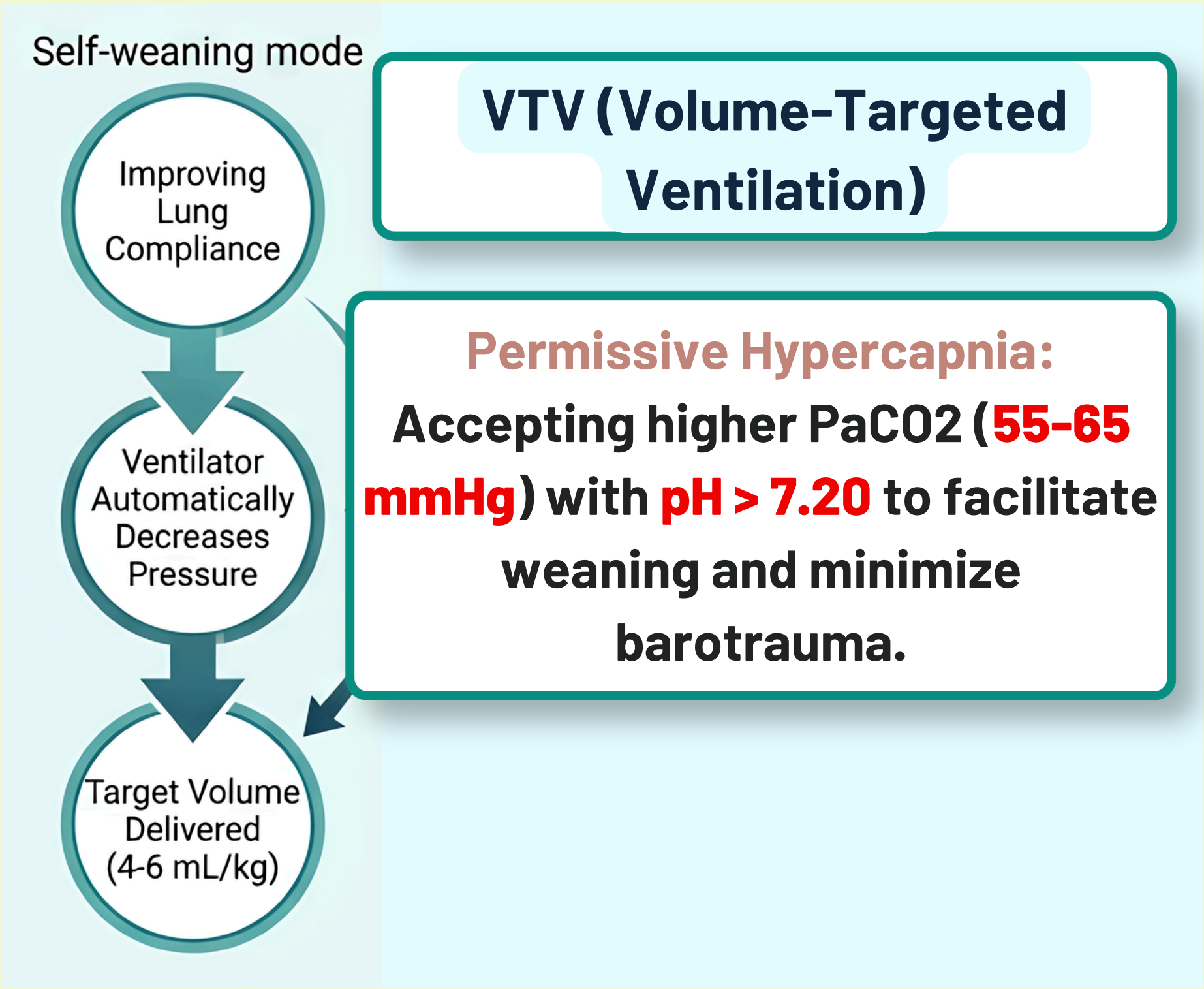
## High Frequency

### HFOV & HFJV Weaning Parameters

| Modality | Weaning Mechanism/Strategy |
|---|---|
| HFOV | Reduce MAP (mean airway pressure) in 1-2 cm H2O steps; concurrently reduce Amplitude (ΔP). |
| HFJV | Reduce PIP to decrease ΔP; lower background MAP. |

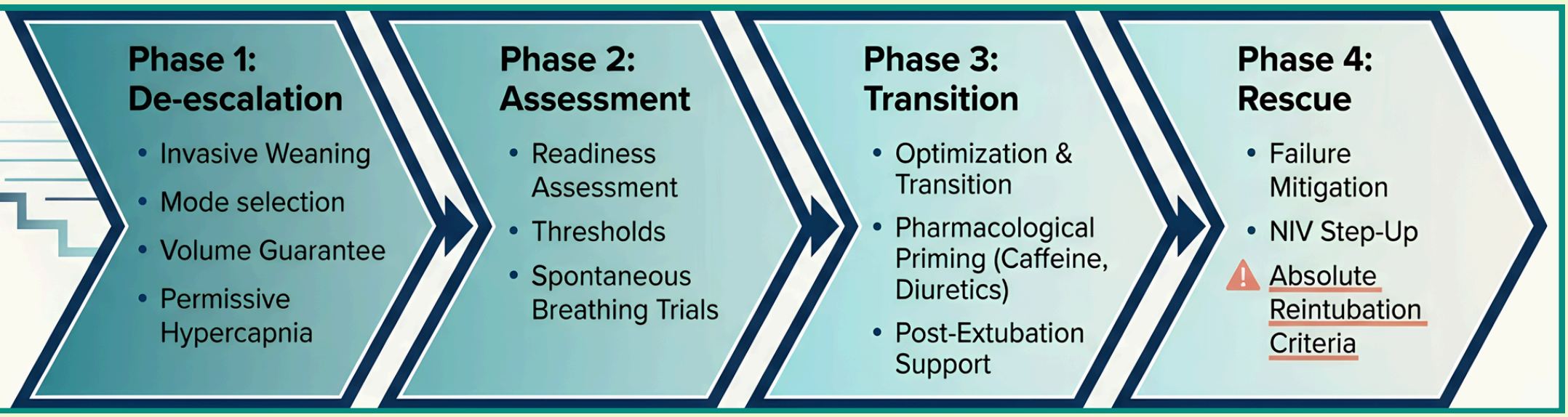
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# Volume Targeting

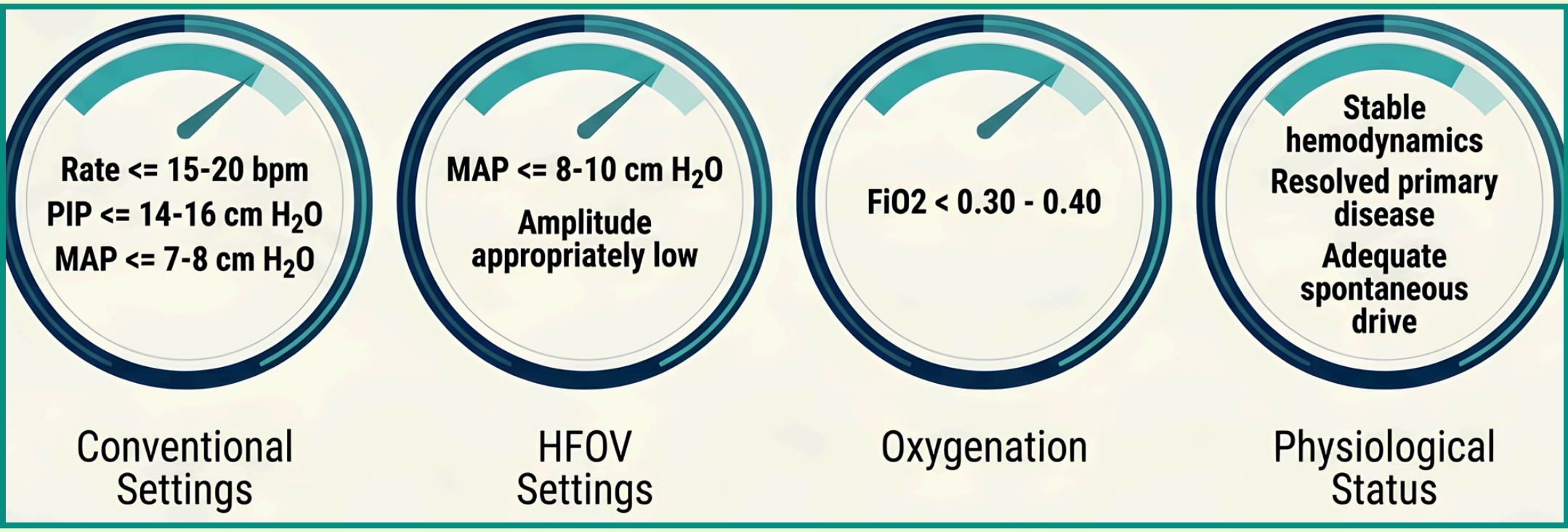



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# The Weaning & Extubation Continuum




# Extubation Readiness Thresholds




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# Extubation Readiness Trials (ERTs) / Spontaneous Breathing Trials (SBTs)

**Setup**

Place patient on CPAP (5-7 cm H2O) via the endotracheal tube to simulate post-extubation WOB.

**3 to 10 Minute Observation Window**

**Pass (Success)**

Maintenance of SpO2, absence of severe bradycardia, adequate spontaneous tidal volumes.

→ Proceed to Extubation.

**Fail**

Desaturation, bradycardia, poor effort.

→ Resume baseline support.

**Clinical Value: A predictive tool to reduce unnecessary extubation failures. Highly valuable in complex or prolonged ventilation cases.**

# Pharmacological Adjuncts: Caffeine Citrate Optimization

**Mechanism:** Centrally acting respiratory stimulant; increases minute ventilation, improves diaphragm contractility.

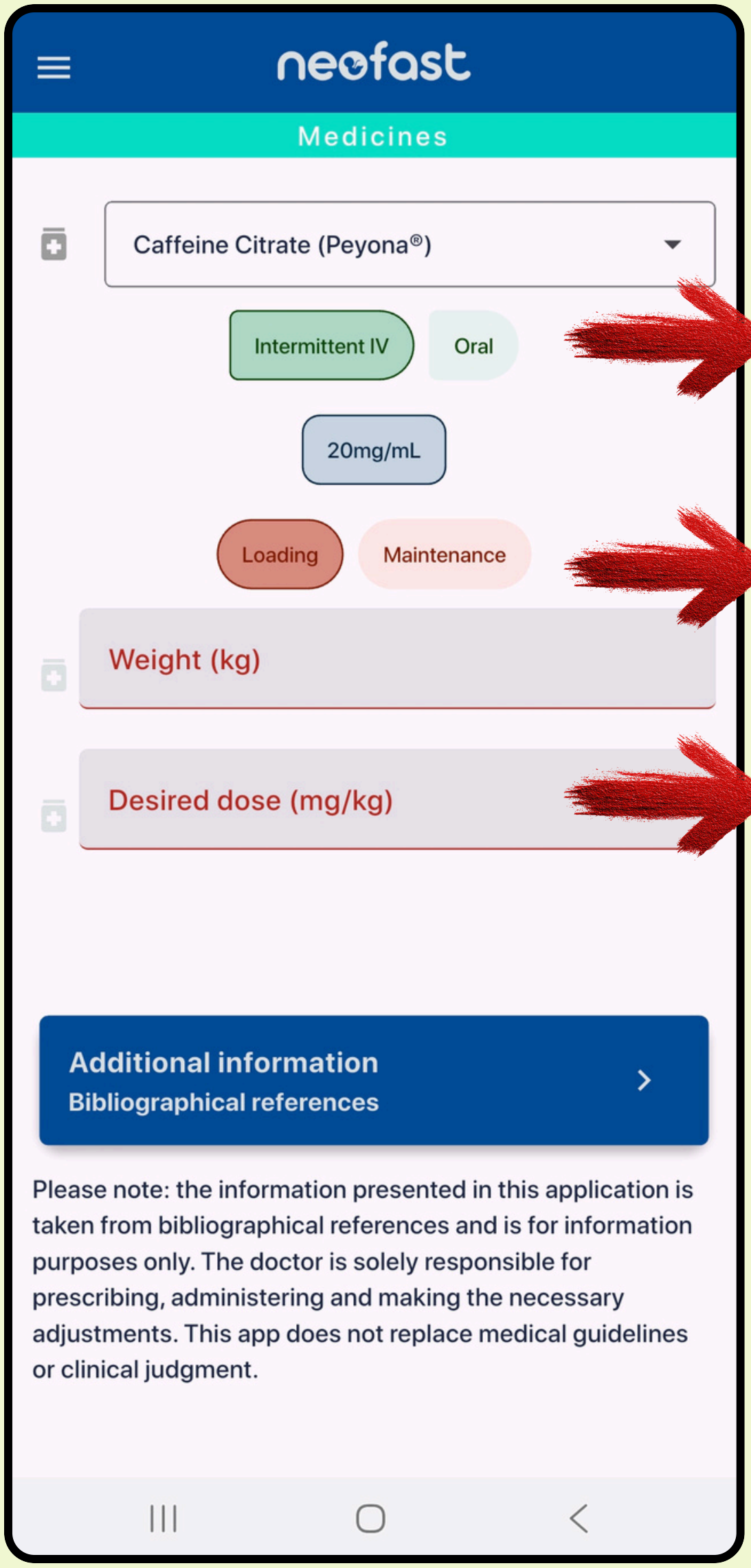
**1 Loading Dose**
20 mg/kg

**2 Standard Maintenance**
5 - 10 mg/kg/day

**3 High Maintenance**
10 - 20 mg/kg/day
(Utilized for frequent apnea or difficult weaning, guided by clinical response)

**Administer loading dose well prior to planned extubation to ensure peak serum concentrations.**

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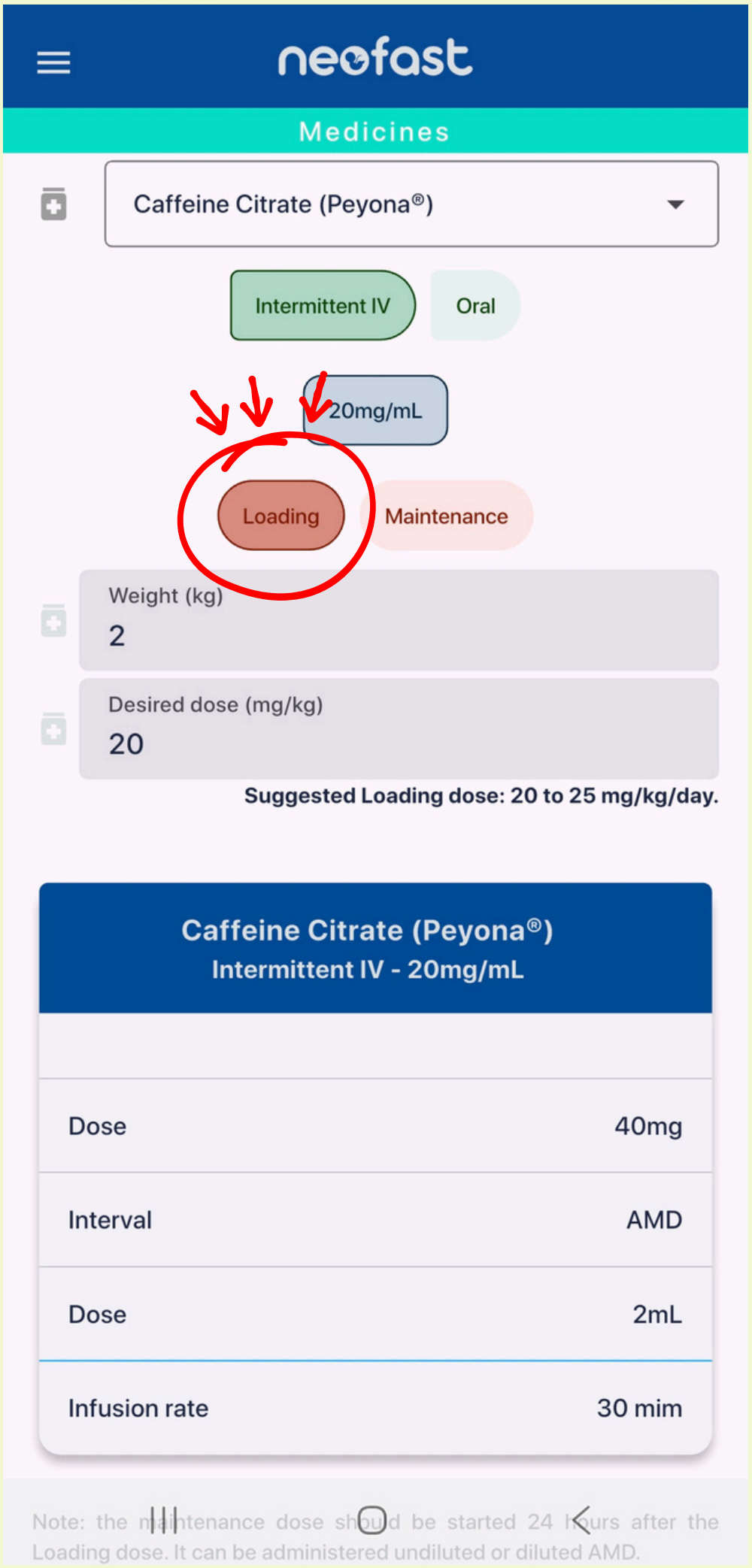

**Choose the method of administration and presentation.**

**Loading or maintenance dose?**

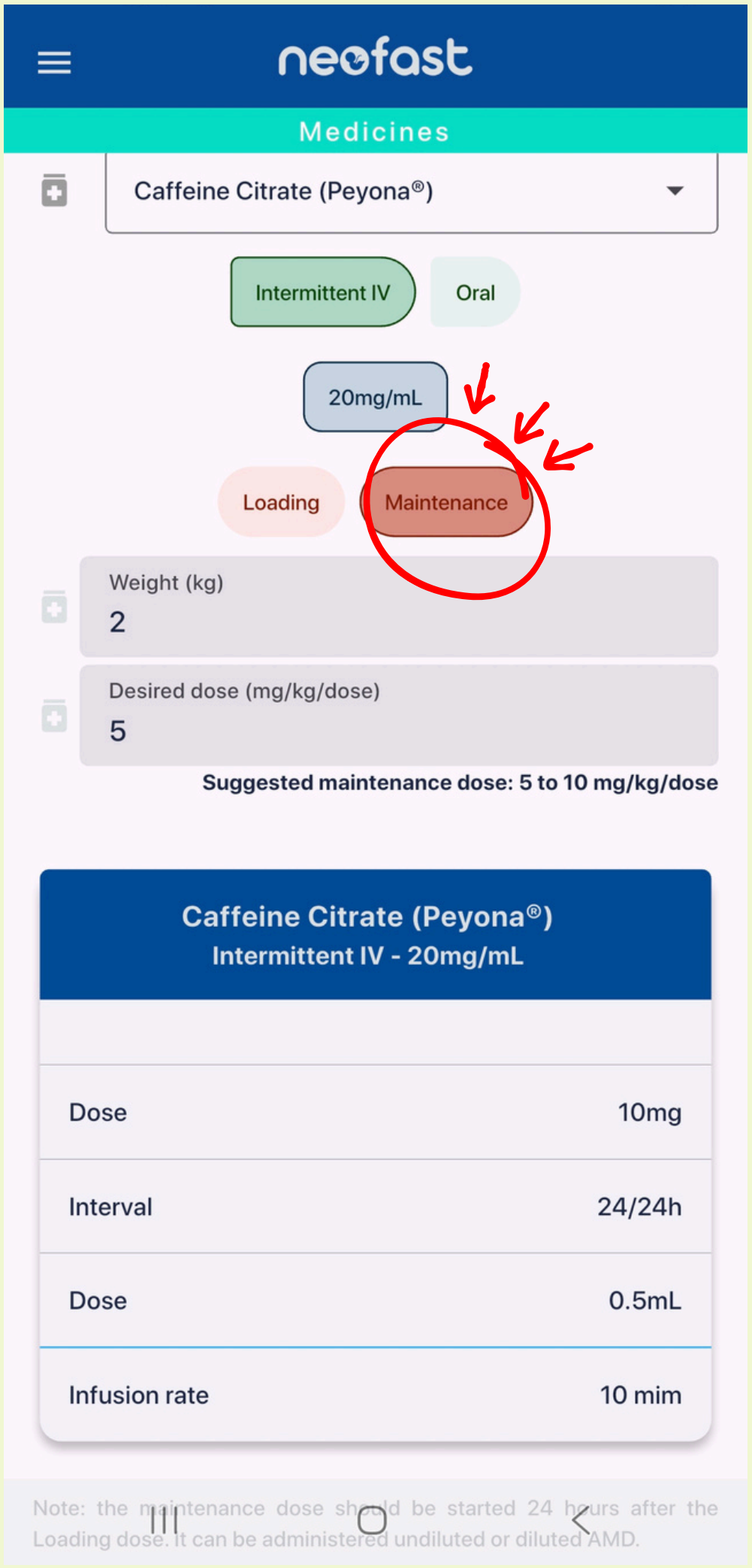
**Enter the weight and desired dose.**

**Once you enter the weight, the SUGGESTED dose will be displayed!**

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**LOADING**




**MAINTENANCE**

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# Pharmacological Adjuncts: Diuretics



**Agent: Loop Diuretics (Furosemide)**

**Mechanism**

Reduces pulmonary interstitial edema, improves lung compliance, decreases airway resistance.

**Indication**

Evolving BPD or fluid-overloaded infants struggling to wean.

**⚠ Caution**

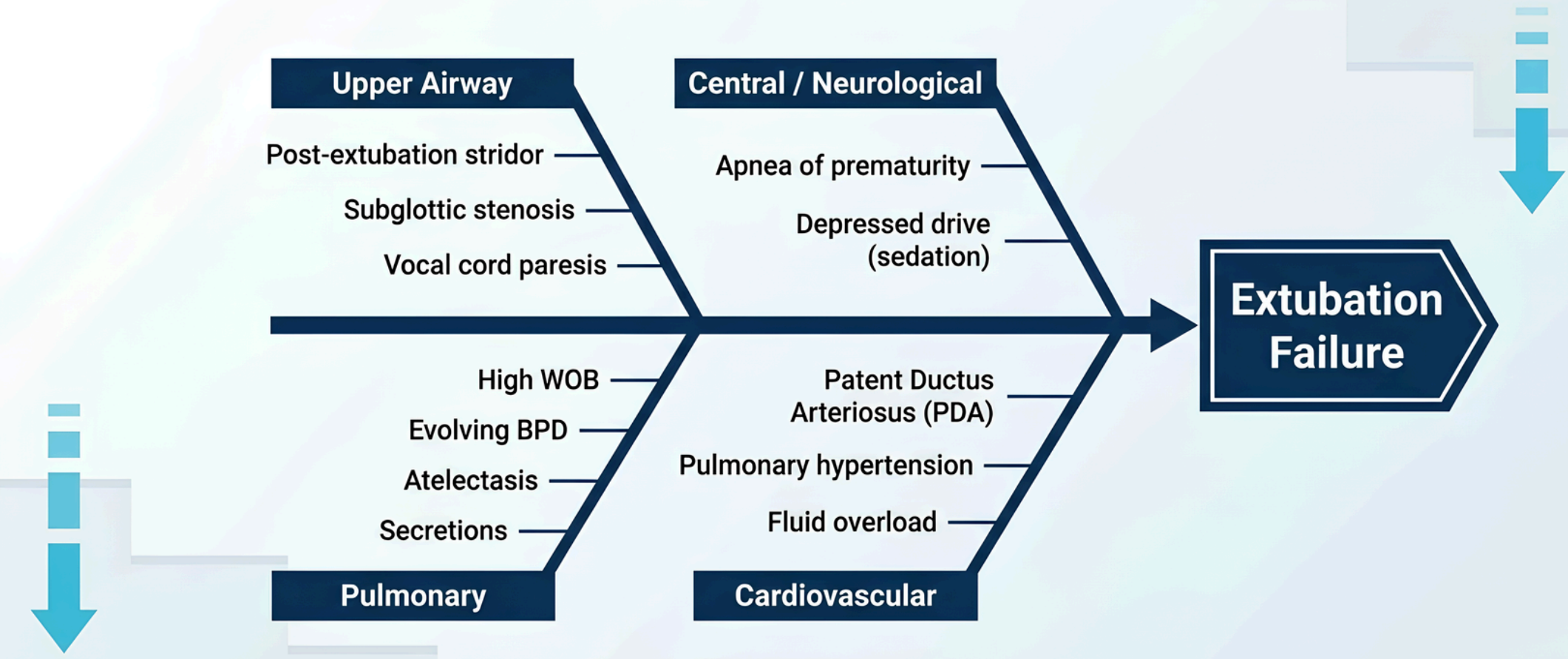
Monitor for electrolyte imbalances (hypokalemia, hyponatremia), ototoxicity, and nephrocalcinosis with prolonged use.

# Post-Extubation Non-Invasive Support Modalities

| | CPAP | NIPPV | HFNC |
|---|---|---|---|
| **Mechanism** | Continuous distending pressure. | Adds peak inspiratory pressure. | Heated/humidified flow (unmeasured distending pressure). |
| **Clinical Efficacy** | Standard of care to prevent alveolar collapse. | Reduces asynchronous breathing/WOB. Superior to CPAP in reducing failure in high-risk preterms. | Less nasal septum injury, but variable pressure. |
| **Preferred Use Case** | Standard extubation. | High-risk, extreme prematurity, or evolving failure. | Stable, lower-risk infants transitioning to room air. |

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# Risk Factors & Causes of Extubation Failure

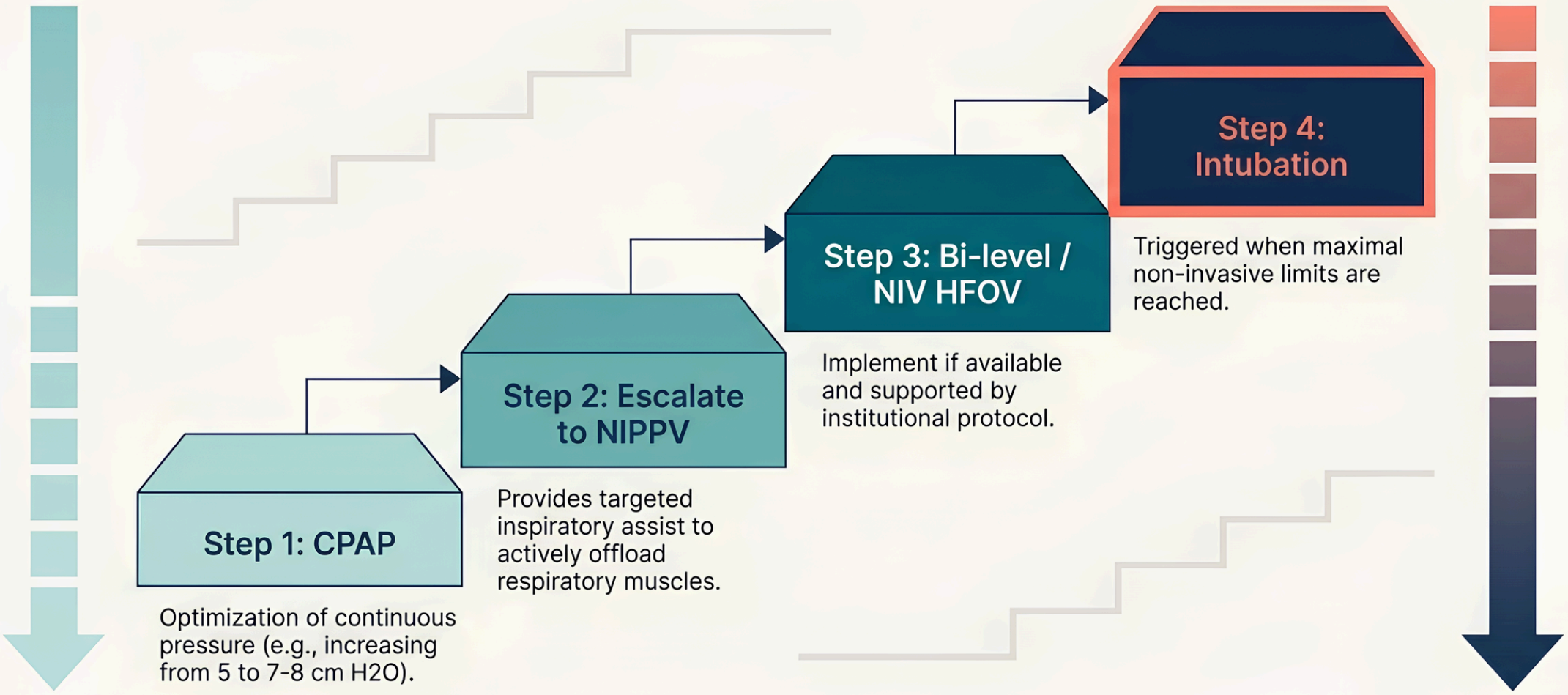



# Management Strategies to Prevent & Treat Failure

| Clinical Problem | Actionable Strategy |
|---|---|
| Post-extubation edema/stridor | Consider prophylactic or therapeutic systemic corticosteroids (e.g., Dexamethasone) |
| Secretion retention & Atelectasis | Implement chest physiotherapy, ensure adequate humidification, institute suctioning protocols |
| High Apnea burden / Depressed drive | Escalate to high-maintenance Caffeine (10-20 mg/kg/day) |

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# Post-Extubation Failure: Step-Wise Escalation

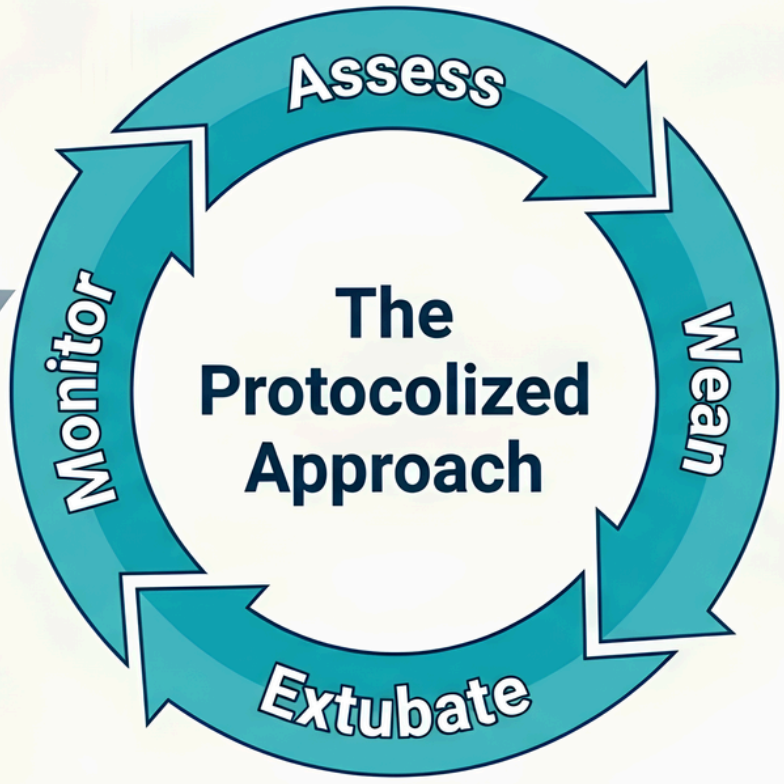



## Absolute Criteria for Reintubation

- **Severe, recurrent apnea requiring positive pressure ventilation (PPV).**
- **Refractory respiratory acidosis (e.g., pH < 7.20 with $PaCO_2$ > 65-70 mmHg, relative to baseline).**
- **Persistent hypoxemia ($FiO_2$ > 0.60-0.70 required to maintain target saturations).**
- **Hemodynamic instability or clinical shock.**
- **Severe, unremitting work of breathing leading to clinical exhaustion.**

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# The Protocolized Approach to Weaning




## Why Protocols Matter

- Reduces variation in unit practice.
- Decreases total days on mechanical ventilation.
- Prevents premature, unsafe extubations.
- Empowers bedside nursing and respiratory therapy staff.

# Synthesis & Key Takeaways



### 1. Precision in Weaning

Match the mode (AC, PSV, VTV) to the patient's physiology; utilize volume targeting to enable safe self-weaning.



### 2. Pharmacological Priming

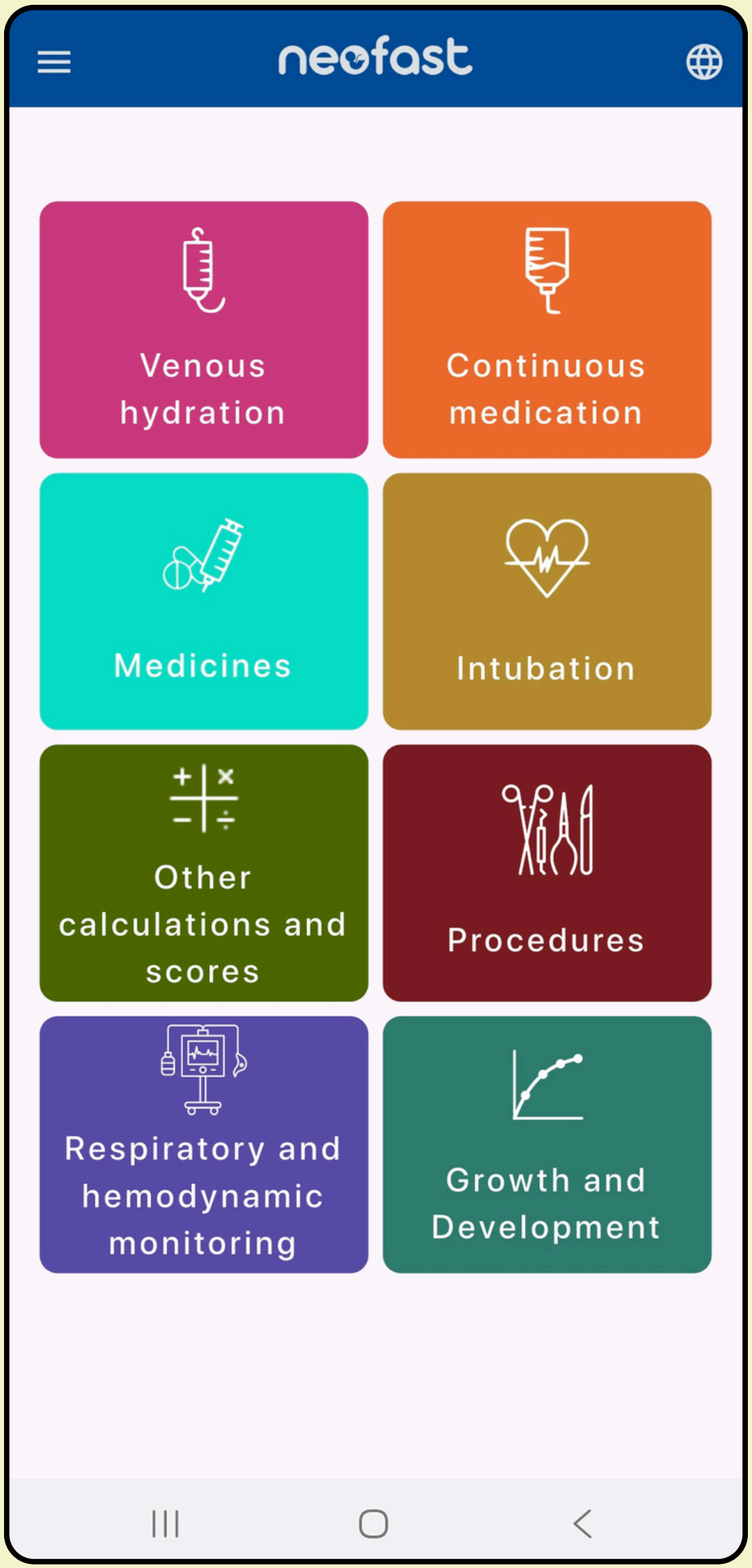
Maximize Caffeine (up to 20 mg/kg/d) and judiciously utilize diuretics to dry fluid-overloaded lungs prior to extubation



### 3. Anticipate & Escalate

Transition smoothly to NIPPV/CPAP, but maintain strict step-wise escalation plans and clear reintubation thresholds to prevent physiological collapse.

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