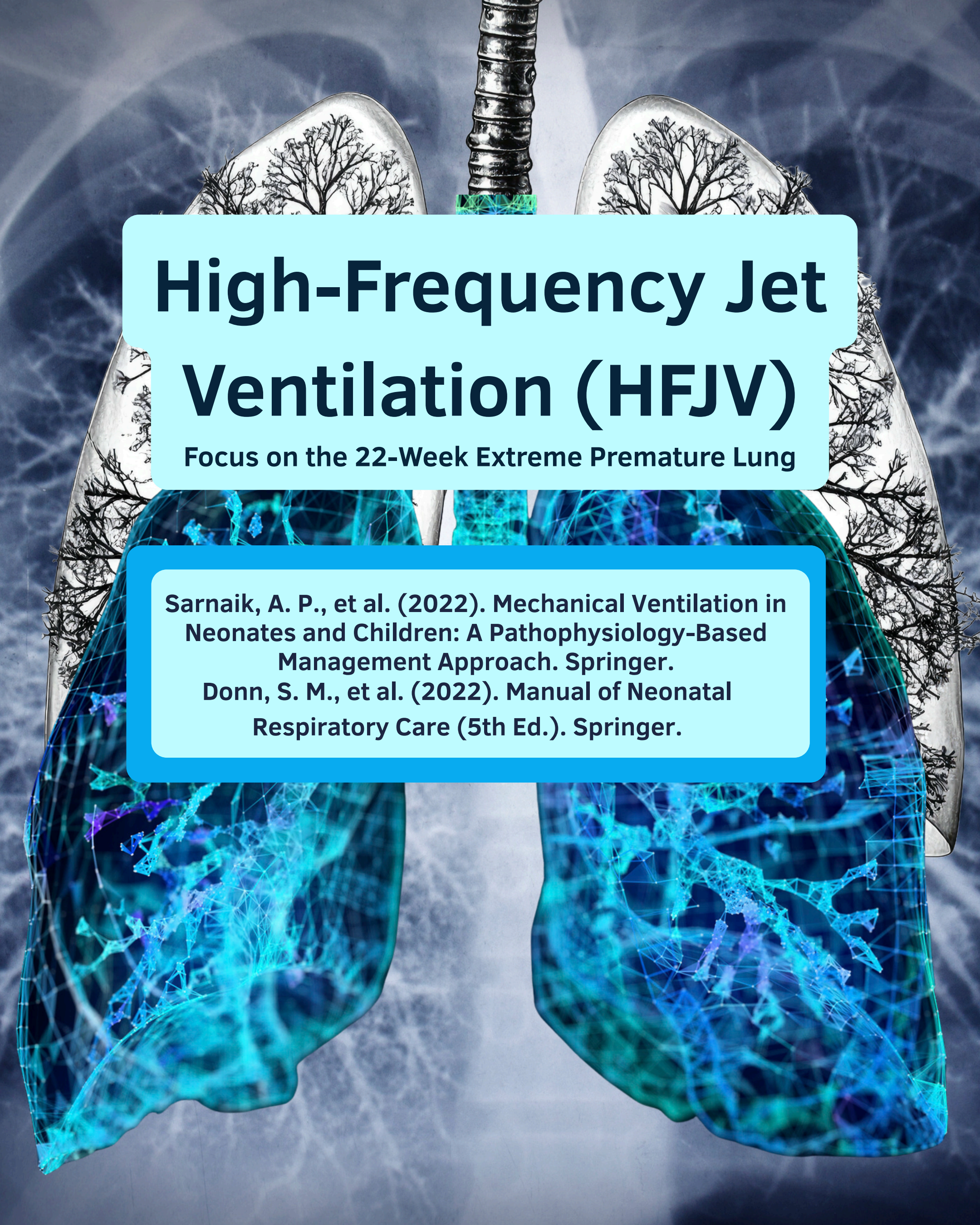




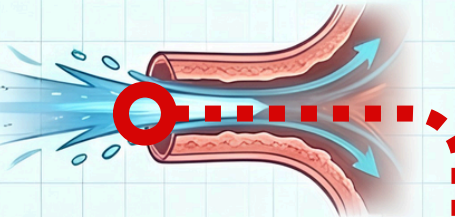
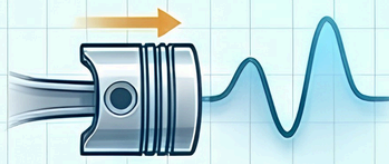
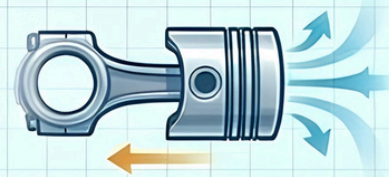
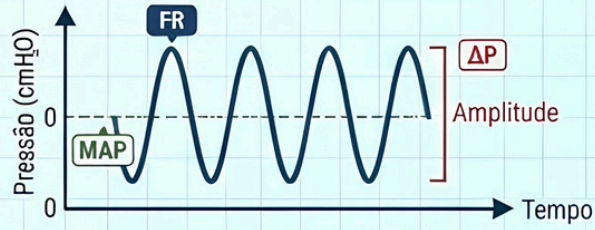
High-Frequency Jet Ventilation (HFJV)

Focus on the 22-Week Extreme Premature Lung

Sarnaik, A. P., et al. (2022). Mechanical Ventilation in Neonates and Children: A Pathophysiology-Based Management Approach. Springer.

Donn, S. M., et al. (2022). Manual of Neonatal Respiratory Care (5th Ed.). Springer.

HFJV vs. HFOV: Fluid Dynamics & Mechanics Comparison

	 HFJV (Bunnell LifePulse)	 HFOV (e.g., SensorMedics 3100A)
 Inspiration	Active (Jet pulses) 	Active (Piston push) 
 Exhalation	Passive (Relies on lung recoil) 	Active (Piston pull) 
 Waveform		
 Superior For	Air leaks, Pulmonary Interstitial Emphysema (PIE), clearing secretions.	Homogeneous lung diseases (e.g., uncomplicated RDS).

Active Inspiration:

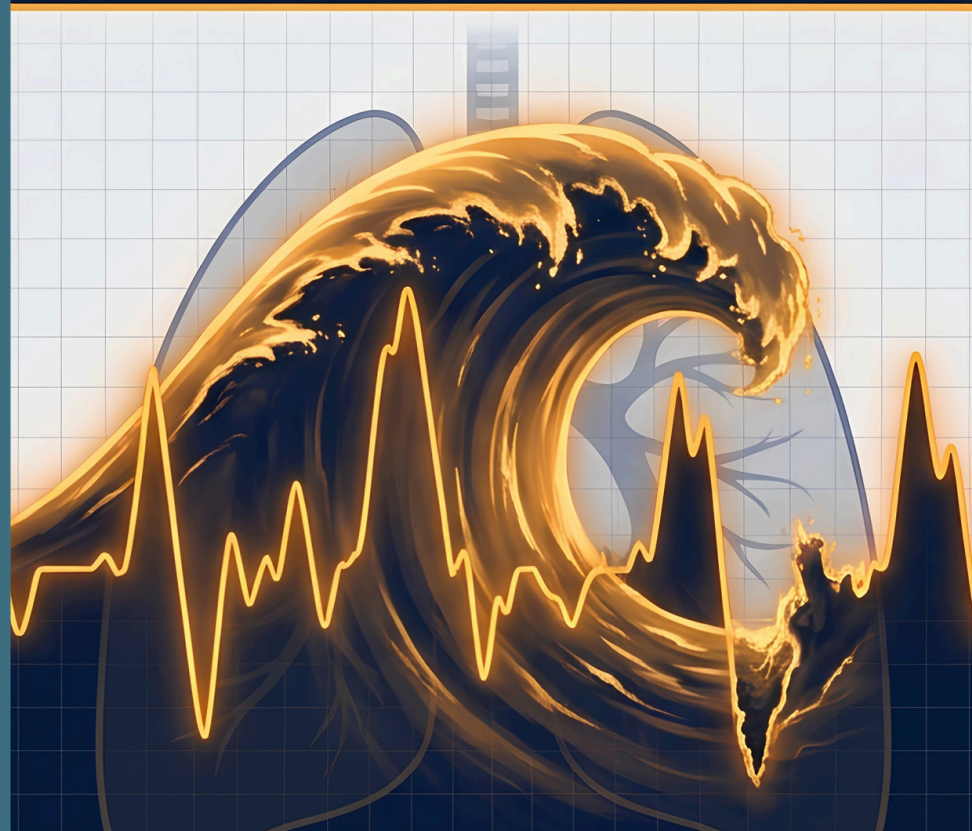
High-velocity gas penetrates the central airway core.

Passive Exhalation:

Elastic lung recoil drives exhaust gas and secretions spiraling up the outer walls.

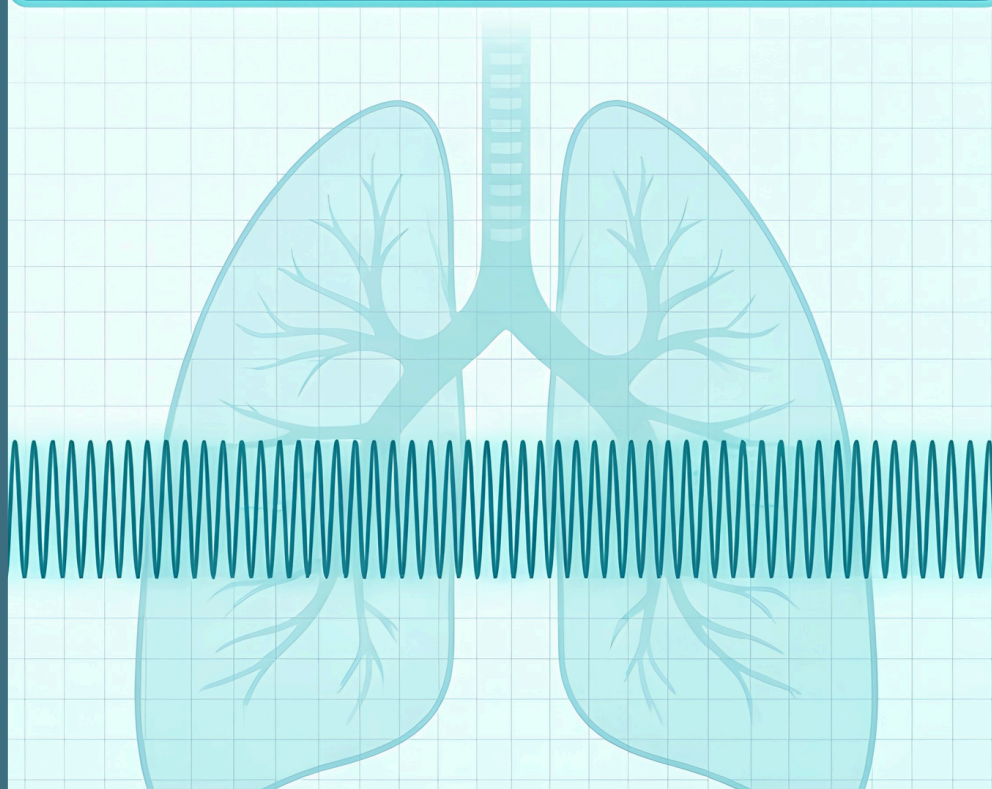


Conventional Ventilation (CMV)



High V_t = Risk of Volutrauma, Alveolar Overdistension, and PIE.

High-Frequency Ventilation (HFV)



Gas exchange utilizing tidal volumes (V_t) smaller than anatomical dead space. Lung-protective.

HFJV Clinical Management: Oxygen & Ventilation

Oxygenation Controls



Primary Driver:
Mean Airway Pressure (MAP)

Control Knob: PEEP

Ventilation / CO₂ Controls



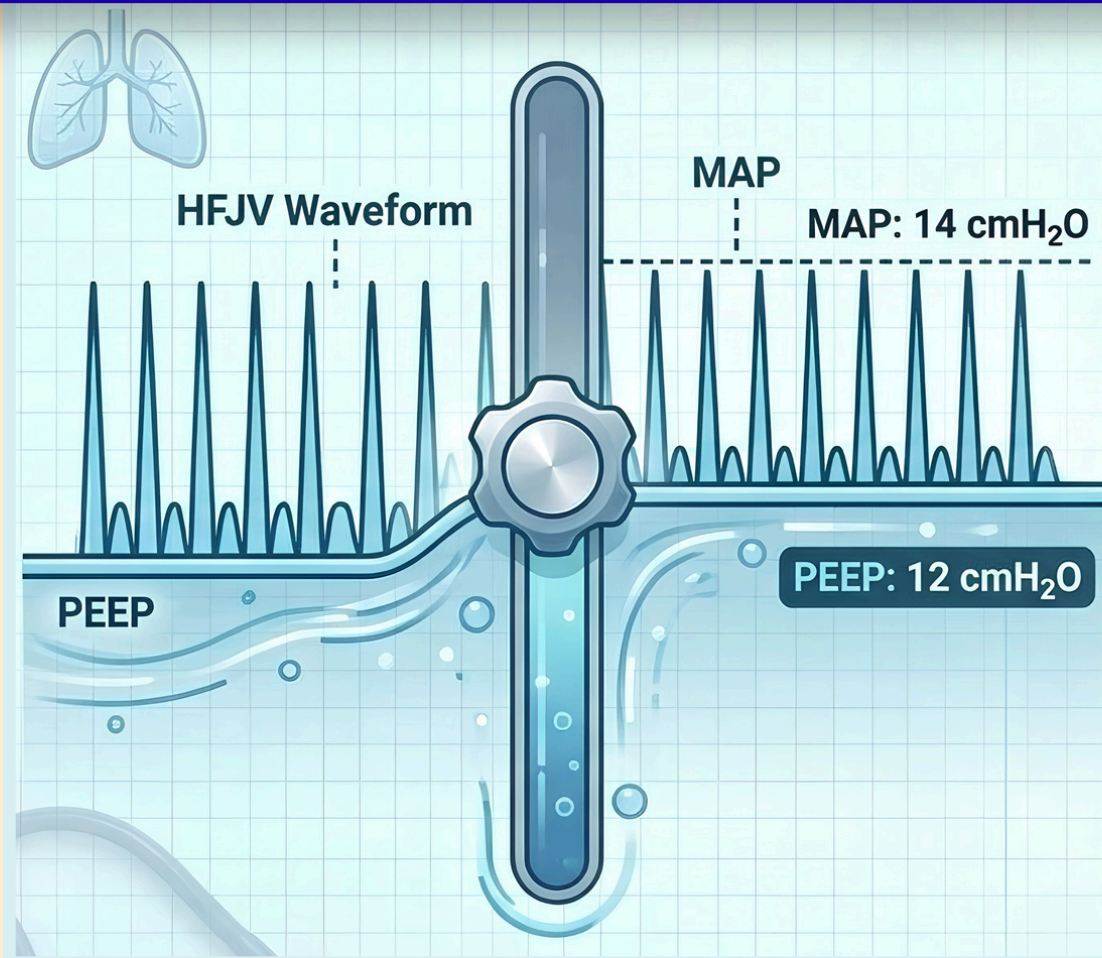
Primary Driver:
Amplitude (ΔP)

Control Knob:
PIP (Peak Inspiratory Pressure)

**Golden Rule of HFJV: Oxygenation
and Ventilation are managed
independently.**



Dial 1: Oxygenation (PEEP & MAP)



I-Time is ultra-short (0.02s).
Therefore, MAP rests only
slightly above PEEP.

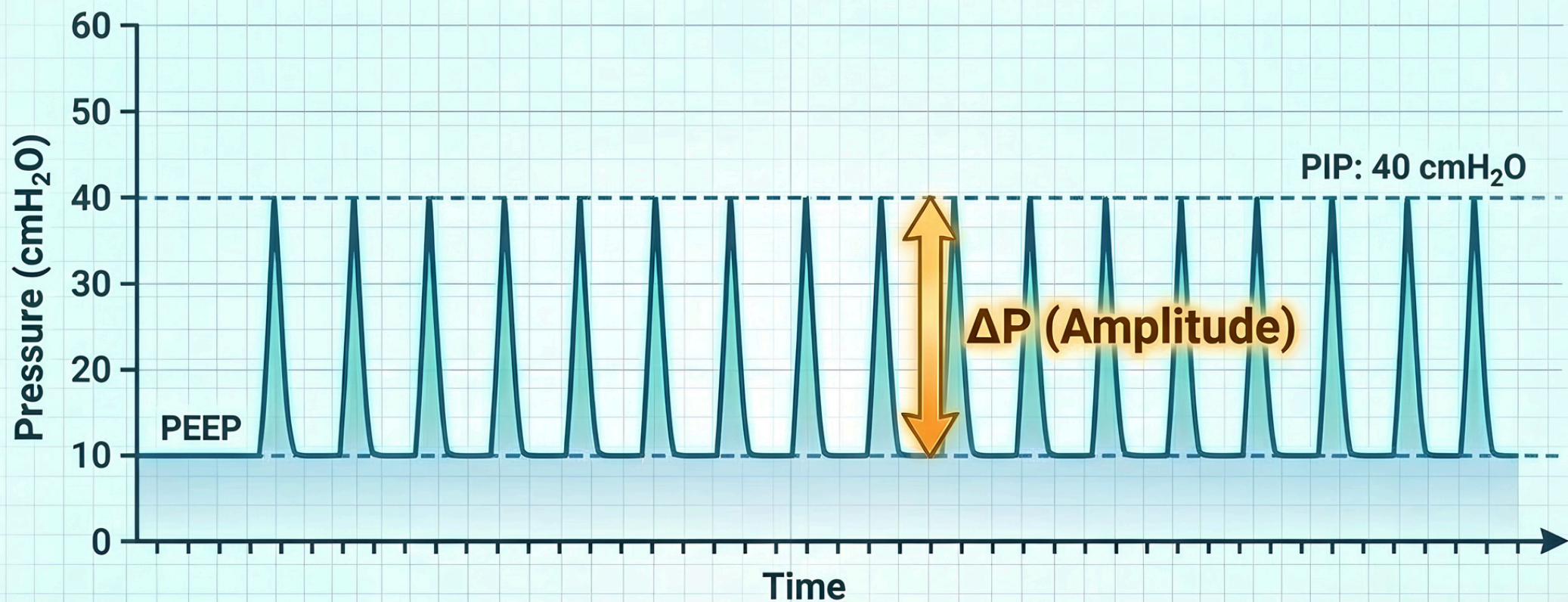


To recruit alveoli and
maintain MAP, HFJV requires
higher PEEP settings than
CMV (often 8-12 cmH₂O).



If FiO₂ requirement is high
→ Increase PEEP to raise MAP
and recruit lung volume.

Dial 2: Ventilation (PIP & Amplitude)



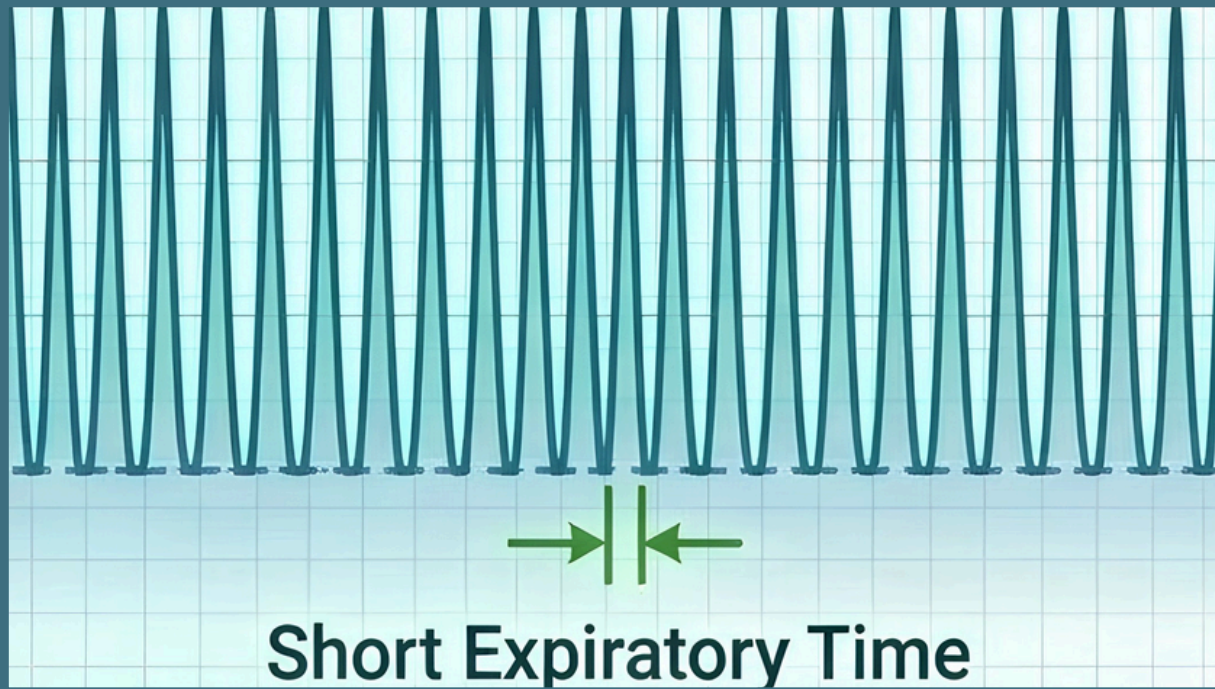
$$\Delta P = PIP - PEEP.$$

Higher PIP increases Tidal Volume (V) and clears more CO₂.

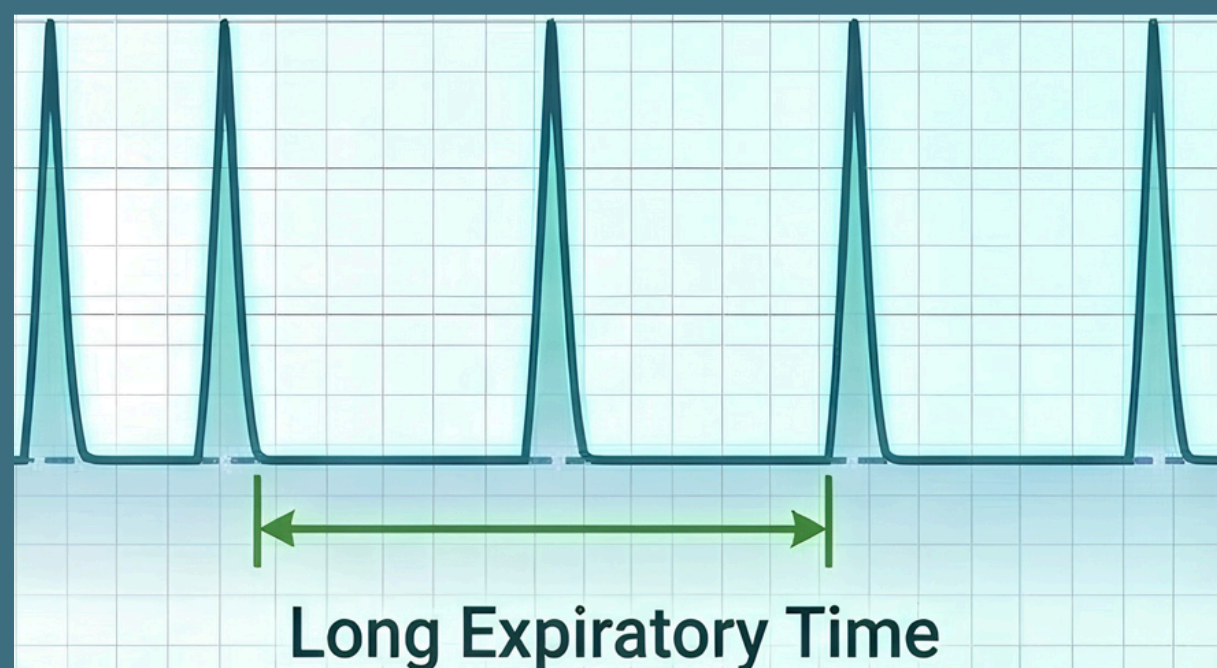
Pressure rapidly attenuates before reaching fragile alveoli.

Dial 3: Frequency (Hz) and I-Time

High Frequency (e.g., 420 bpm / 7 Hz)

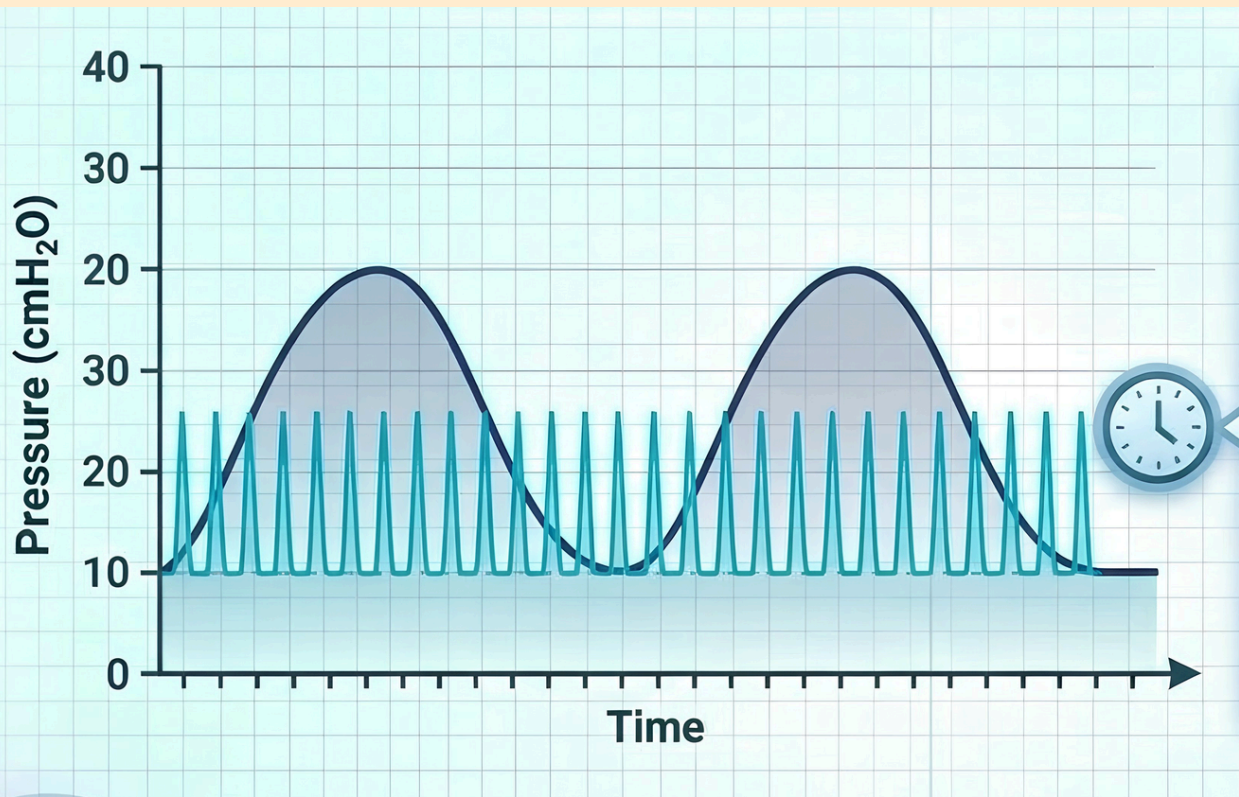


Lower Frequency (e.g., 240 bpm / 4 Hz)



Because I-Time is fixed at **0.02s**, lowering the rate lengthens the expiratory window.
More time for passive exhalation = Larger V_1 = Greater CO₂ clearance.

The Background Sigh (IMV Integration)



Settings Panel

Tandem Requirement:

HFJV requires a conventional ventilator to provide PEEP and background sigh breaths.

- **Sigh Rate:** 1 to 5 breaths/min
- **Sigh I-Time:** 0.3 to 0.5 sec
- **Sigh PIP:** Set 1 to 2 cmH₂O
*below the Jet PIP (To recruit collapsed alveoli without overdistending).

Blueprint: Initial HFJV Settings for a 22-Weeker

Frequency (Rate):

420 bpm (7 Hz)

Note: Ideal for the very short time constants of a 22-week lung.

I-Time (Ti):

0.02 sec

PEEP:

6 to 8 cmH₂O

(Match or slightly exceed previous CMV MAP to stabilize alveoli).

PIP: Set to achieve visible chest wiggle

(Start near previous CMV PIP).

IMV Sigh: 3 to 5 bpm

(PIP slightly below Jet PIP).

Clinical Focus: The 22-Week Extreme Micropreemie



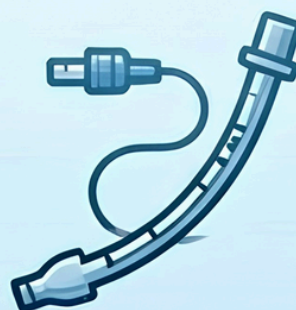
Surfactant Deficiency: Ultra-low lung compliance.



Chest Wall: Highly compliant, leading to severe mechanical disadvantage.



Critical Risk: Extreme susceptibility to Pulmonary Interstitial Emphysema (PIE) and Bronchopulmonary Dysplasia (BPD).



Anatomy: Tiny Endotracheal Tube (ETT) creates massive airway resistance.

The ETT Constraint at 22 Weeks

Standard ETT
(Unrestricted flow)



Standard ETT
(Unrestricted flow)

$$R \propto \frac{1}{r^4}$$

Poiseuille's Law: Halving the radius increases resistance 16-fold.

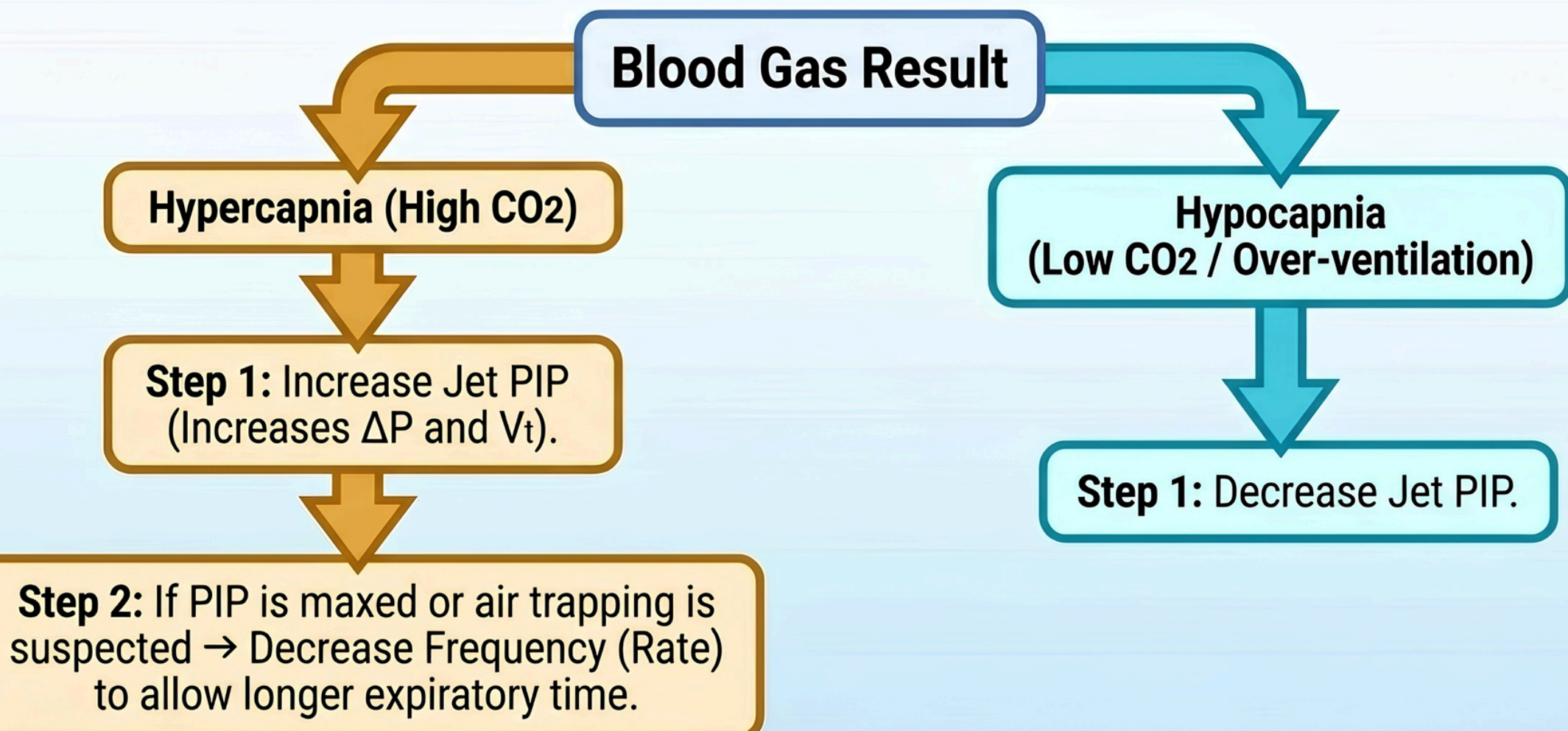
2.0 mm / 2.5 mm ETT
(Extreme restriction)



2.0 mm / 2.5 mm ETT
(Extreme restriction)

Danger: Inadvertent Gas Trapping (Auto-PEEP). The massive resistance of a 22-weeker's tiny ETT limits expiratory flow. Monitor closely for chest hyper-expansion despite short time constants.

Troubleshooting CO2 Abnormalities

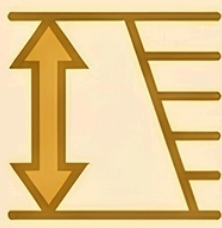


The Golden Rules of HFJV



1. Oxygenation is MAP.

Driven almost entirely by PEEP.



2. Ventilation is ΔP .

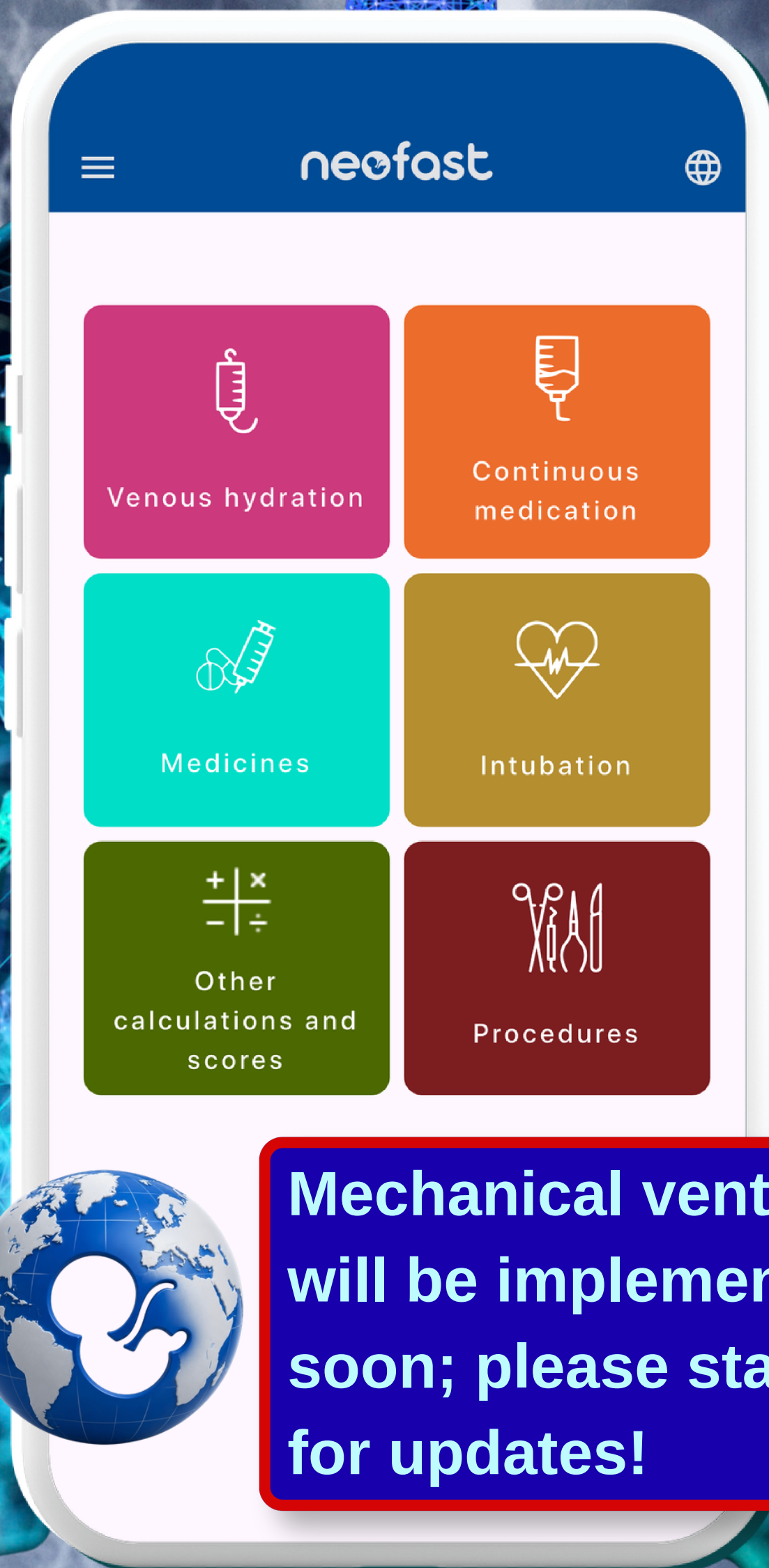
Driven by Peak Inspiratory Pressure (PIP).



3. Passive Exhalation Protects

The 22-week lung is saved by HFJV's passive expiratory spiral, preventing PIE and allowing gas exchange at tidal volumes smaller than dead space.

HFJV is precision fluid dynamics designed for the most fragile anatomy.



Download on the
App Store



GET IT ON
Google Play



**Mechanical ventilation
will be implemented
soon; please stay tuned
for updates!**