Mechanical Ventilator Settings and Basic Modes

Mechanical ventilation is a life-saving intervention that supports or replaces spontaneous breathing. A firm understanding of ventilator settings and modes is critical for patient safety and optimized outcomes.

Initial Ventilator Settings

1. Mode

Assist-Control (AC) Mode: Common initial mode.

- Delivers preset tidal volume or pressure at a preset rate.
- If the patient initiates a breath, the ventilator completes it.
- Ensures minimum minute ventilation.

AC mode is ideal in early respiratory failure when full support is needed.

2. Tidal Volume (VT)

- **Healthy lungs**: 6–8 mL/kg of Ideal Body Weight (IBW).
- **COPD**: 6–8 mL/kg (lower end preferred).
- **ARDS**: 4–6 mL/kg IBW (lung-protective strategy to reduce barotrauma).

Avoid high VT to reduce the risk of volutrauma.

3. Respiratory Rate (RR)

- Initial: **12–16 breaths/min**
- Adjust based on:
  - pH/PaCO?
  - Patient's spontaneous effort

4. FiO? (Fraction of Inspired Oxygen)

- Initially set at **100%** post-intubation to avoid hypoxemia.
- Rapidly titrate down to the **lowest level** needed to maintain PaO? ? 60 mmHg or SpO? ? 90%.

Prolonged high FiO? can lead to oxygen toxicity and absorptive atelectasis.

5. PEEP (Positive End-Expiratory Pressure)

- Initial setting: **5 cm H?O**
- In ARDS or refractory hypoxemia: titrate up (e.g., 8–15 cm H?O)

  Mechanism: Prevents alveolar collapse, increases functional residual capacity (FRC), and improves oxygenation.

6. Sigh Breaths

- Not routinely used.
- If needed: Sigh = 1.5–2x VT, delivered 6–8 times/hour, especially in low VT strategies.

Calculations and Rules

Ideal Body Weight (IBW)

- **Men**: IBW = 50 + 2.3 × (height in inches ? 60)
- **Women**: IBW = 45.5 + 2.3 × (height in inches ? 60)

  Used instead of actual body weight to avoid overestimating lung volume.

Minute Ventilation (VE)

- Formula: **IBW (kg) × 100 mL/min**
- Example: 60 kg patient ? 60 × 100 = **6 L/min**

Common Ventilator Settings Across Modes

Setting	Description
FiO?	Fraction of inspired oxygen (21–100%)
PEEP	Maintains alveolar patency; initial 5 cm H?O
Trigger Sensitivity	Determines how easily the ventilator detects a patient's effort (flow or pressure)
I:E Ratio	Ratio of inspiratory to expiratory time (Normal: 1:2)

Asthma/COPD: Prolong expiratory time (e.g., I:E = 1:3–1:4) to avoid air trapping.

Common Modes of Mechanical Ventilation

1. Volume Assist-Control (AC-VC)

- Delivers a set **tidal volume** at a fixed or triggered rate.
- Patient can trigger additional breaths.

- If patient fails to initiate, the ventilator delivers mandatory breaths.

  High-Yield: Risk of **barotrauma** if lung compliance worsens.

2. Pressure Assist-Control (AC-PC)

- Delivers a preset **pressure**, not volume.
- Volume delivered varies with lung compliance and resistance.

  Use in: ARDS (helps avoid volutrauma by limiting airway pressures).

3. Pressure Support Ventilation (PSV)

- Patient initiates every breath.
- Ventilator supports each breath with preset pressure.
- Tidal volume depends on patient effort and lung mechanics.

  Best for weaning and patients with intact respiratory drive.

Inspiratory Flow

- **Normal flow**: 50–60 L/min

- Faster flow allows shorter inspiratory time, increases expiratory time.

  Adjust in obstructive disease (e.g., asthma) to prevent auto-PEEP.

I:E Ratio (Inspiratory:Expiratory Time)

Condition	Suggested I:E Ratio	Rationale
Normal	1:2	Mimics physiologic breathing
COPD/Asthma	1:3 – 1:4	Prevents air trapping, allows full exhalation
ARDS	1:1 – 2:1 (inverse)	Improves oxygenation by increasing mean airway pressure

Lung-Protective Ventilation (ARDSNet Protocol)

Parameter	Target Range
VT	4–6 mL/kg IBW

Parameter	Target Range
Plateau Pressure	< 30 cm H?O
PEEP/FiO?	Guided by ARDSNet table
Permissive Hypercapnia	Acceptable if pH > 7.2

Minimize barotrauma and volutrauma while optimizing gas exchange.

High-Yield Clinical Pearls

- **PEEP** improves oxygenation, but excessive levels may ? CO and cause barotrauma.
- **Auto-PEEP** is common in obstructive lung diseases; allow adequate expiratory time.
- **High FiO?** > 60% for prolonged periods can cause oxygen toxicity.
- **ARDS** requires low VT, high PEEP, and often inverse I:E ratio.
- **Sighs** are rarely needed in lung-protective strategies unless using very low VT.
- **Patient-ventilator synchrony** is key: assess for dyssynchrony, agitation, tachypnea.