

Pulmonary Management



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This pocket reference gives nurses quick and convenient pulmonary management information, including:

- Pulmonary assessment
- Blood gas analysis
- Ventilator settings
- Spontaneous breathing trial

NOTE: This pocket card is for quick reference only. Please review and follow your institutional policies and procedures before clinical use.

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Assessment

	Patient History: Chief Complaint	
Cough	<ol style="list-style-type: none"> 1. Onset/duration 2. Recent change in frequency or severity 3. Character - acute and self-limiting, chronic and persistent, dry, hacking, barking, or brassy pitch 	<ol style="list-style-type: none"> 4. Timing - time of day, daily, seasonal 5. Alleviating factors - medications 6. Aggravating factors - smoking, chemicals, allergens 7. Accompanying signs/symptoms - sputum, chest pain, dyspnea
Dyspnea	<ol style="list-style-type: none"> 1. Onset/duration - abrupt or insidious, acute or chronic, constant or intermittent 2. Alleviating/aggravating factors - body position (orthopnea), activity, medications, time of day 	<ol style="list-style-type: none"> 3. Accompanying signs/symptoms - cough, wheezing, chest pain, diaphoresis
Chest Pain	<ol style="list-style-type: none"> 1. Onset/duration - constant, intermittent 2. Location/radiation 3. Character/severity - crushing, shooting, sharp, increases with deep breath 	<ol style="list-style-type: none"> 4. Alleviating/aggravating factors - medications, activity 5. Associated events - trauma, meals 6. Accompanying signs/symptoms - cough, nausea/vomiting, fever, hemoptysis, dyspnea, diaphoresis
Sputum	<ol style="list-style-type: none"> 1. Onset/duration 2. Volume 3. Time of day 4. Character - color, odor, consistency 	<ol style="list-style-type: none"> 5. Presence/absence of blood 6. Alleviating/aggravating factors - medications 7. Microscopic examination
Hemoptysis	<ol style="list-style-type: none"> 1. Onset/duration 2. Frequency and amount 3. Character - gross blood, blood-tinged 	<ol style="list-style-type: none"> 4. Distinguish hematemesis (vomiting of blood) from hemoptysis (expectoration of bloody sputum) 5. Rule out nasopharynx as potential source

	Patient History: Past Medical History	
Previous History	1. Asthma 2. Pneumonia 3. Tuberculosis (radiographic results, tuberculin skin test results, treatment received) 4. Allergies	5. Sleep apnea 6. Trauma 7. Cancer 8. Previous hospitalizations, illnesses, operations 9. Smoking/chewing habits - past and present
Parental/Sibling History	1. Lung cancer 2. Emphysema 3. Asthma	4. Tuberculosis (also current cohabitants) 5. Allergies
Exposure to Irritants	1. Dust 2. Smoke 3. Asbestos	4. Fumes 5. Allergens

Breath Sounds

Normal	
Vesicular:	Heard over most areas of lung fields, low pitch. Soft, short expiration with pause.
Bronchovesicular:	Heard over main bronchus and right upper posterior lung field, medium pitch. Equal, no pause between expiration and inspiration.
Bronchial/Tracheal:	Heard only over trachea, high pitch. Loud, long expirations that are slightly longer than inspirations with pause.

Adventitious: Abnormal sounds that are superimposed on underlying breath sounds

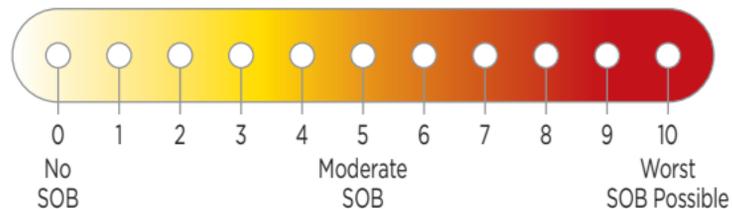
Fine Crackles: Origin:	Noncontinuous, explosive sound. Sounds like rubbing hair strands near ear. Secretions in alveoli or airways. Heard at end of inspiration.
Coarse Crackles: Origin:	Noncontinuous, loud, low-pitched sound. Sounds like bubbling carbonated soft drink. Mucous in alveoli or airways. Usually heard at start of inspiration.
Rhonchi (aka ronchus): Origin:	Loud, low-pitched continuous snoring sound. Sounds like 2 balloons rubbing together. Secretions and mucous in large airways
Wheezes: Origin:	High-pitched continuous sound with a musical quality. Narrowing of airways

Normal Blood Gas Values¹

	Arterial	Venous		Arterial	Venous
pH	7.35-7.45	7.31-7.41	HCO₃	21-28 mEq/L	21-28 mEq/L
PCO₂	35-45 mm Hg	40-50 mm Hg	O₂ Saturation	95%-100%	—
PO₂	80-100 mm Hg	35-45 mm Hg	Base Excess	-2 to +2	—

Dyspnea Numeric Rating Scale

Ask patient: "On a 0 to 10 scale, how much shortness of breath are you having right now? (0 = no, 10 = worst)"



Blood Gas Changes & Acid-Base Abnormalities

	Acid-Base Abnormality			Partial Compensation			Fully Compensated		
	pH	PCO ₂	HCO ₃	pH	PCO ₂	HCO ₃	pH	PCO ₂	HCO ₃
Respiratory Acidosis	< 7.35	Increase	WNL	Decrease	Increase	Increase	WNL	Increase	Increase
Metabolic Acidosis	< 7.35	WNL	Decrease	Decrease	Decrease	Decrease	WNL	Decrease	Decrease
Respiratory Alkalosis	> 7.45	Decrease	WNL	Increase	Decrease	Decrease	WNL	Decrease	Decrease
Metabolic Alkalosis	> 7.45	WNL	Increase	Increase	Increase	Increase	WNL	Increase	Increase

Traditional Weaning Criteria (Not Effort Dependent)

Negative Inspiratory Pressure (NIP)	≤ -20 cm H ₂ O	Vital Capacity (VC)	≥ 15 mL/kg
Positive Expiratory Pressure (PEP)	≥ +30 cm H ₂ O	Fraction of Inspired Oxygen (FiO₂)	≤ 0.5
Spontaneous Tidal Volume (STV)	≥ 5 mL/kg	Minute Ventilation (MV)	≤ 10 L/min

Ventilator-Associated Pneumonia²

Preventing Gastric Reflux:

- All patients receiving mechanical ventilation and those at high risk for aspiration (eg, decreased level of consciousness, enteral tube in place) should have the head of bed elevated at an angle of 30° to 45° unless medically contraindicated.
- Routinely verify appropriate placement of the feeding tube.
- Airway management: Use an ET tube with a dorsal lumen above the ET cuff to allow drainage by continuous suctioning of tracheal secretions that accumulate in the subglottic area.
- Unless contraindicated by patient condition, perform orotracheal intubation vs nasotracheal intubation.
- ET cuff management: Before deflating the ET cuff or removing the ET tube, ensure all secretions are cleared above the tube cuff.
- Perform daily sedation interruption and assessment for readiness to wear.

Oral Care:

- Develop/implement a comprehensive oral care program.
- Use an oral chlorhexidine gluconate (0.12%) rinse.

Prevent Cross-Contamination:

- Hand hygiene
- Wear gloves when handling any secretions or objects contaminated with respiratory secretions.
- Wear additional personal protective equipment such as a gown or eye protection if soiling with respiratory secretions is anticipated.

Progressive Mobilization:

- Ambulate as soon as medically indicated.

Equipment Changes:

- Do not routinely change, on the basis of duration of use, the patient's ventilator circuit.

Criteria for Initiating Mechanical Ventilation:

VC	< 10-12 mL/kg (65-75 mL/kg)
V_T	< 5 mL/kg (5-7 mL/kg)
RR	< 10 or > 35/min (10-20/min)
MV	> 10 L/min (5-6 L/min)
NIP	> -20 cm H ₂ O (-75 to -100 cm H₂O)
PaCO₂	> 55 mm Hg* (35-45 mm Hg)
Pao₂	< 60 mm Hg** (80-100 mm Hg)
FEV	< 10 mL/kg (50-60 mL/kg)
Chest radiograph	Diffuse infiltrates (clear)

Other signs and symptoms: Decreased level of consciousness, pulse < 60 or > 120, central cyanosis, ventricular ectopy, blood pressure change > 20 mm Hg systolic, > 10 mm Hg diastolic, PCWP > 20 mm Hg, anxiety

*Except patients with COPD. **Despite supplemental O₂.

Normal values in ()

Volume Ventilator Settings³

Tidal Volume	5-7 mL/kg = V_T in mL
Inspiratory-Expiratory Ratio (I:E ratio)	1:1 to 1:3
RR	10-16/min
Pressure Limit	10 cm H ₂ O + V_T pressure or 10 mm Hg > V_T pressure
Oxygen F_{iO_2}	Titrate → P_{aO_2} 60-70 mm Hg

Humidifier	Midrange temperature is best
PEEP	3-5 cm H ₂ O physiological PEEP tailored to patient need, based on cardiopulmonary assessment and CO and P_{aO_2}
Pressure-Supported Ventilation	5-10 cm H ₂ O when used with SIMV or titrate → V_T 10-15 mL/kg when patient is breathing spontaneously

Examples of Pressure Modes and Parameters⁴

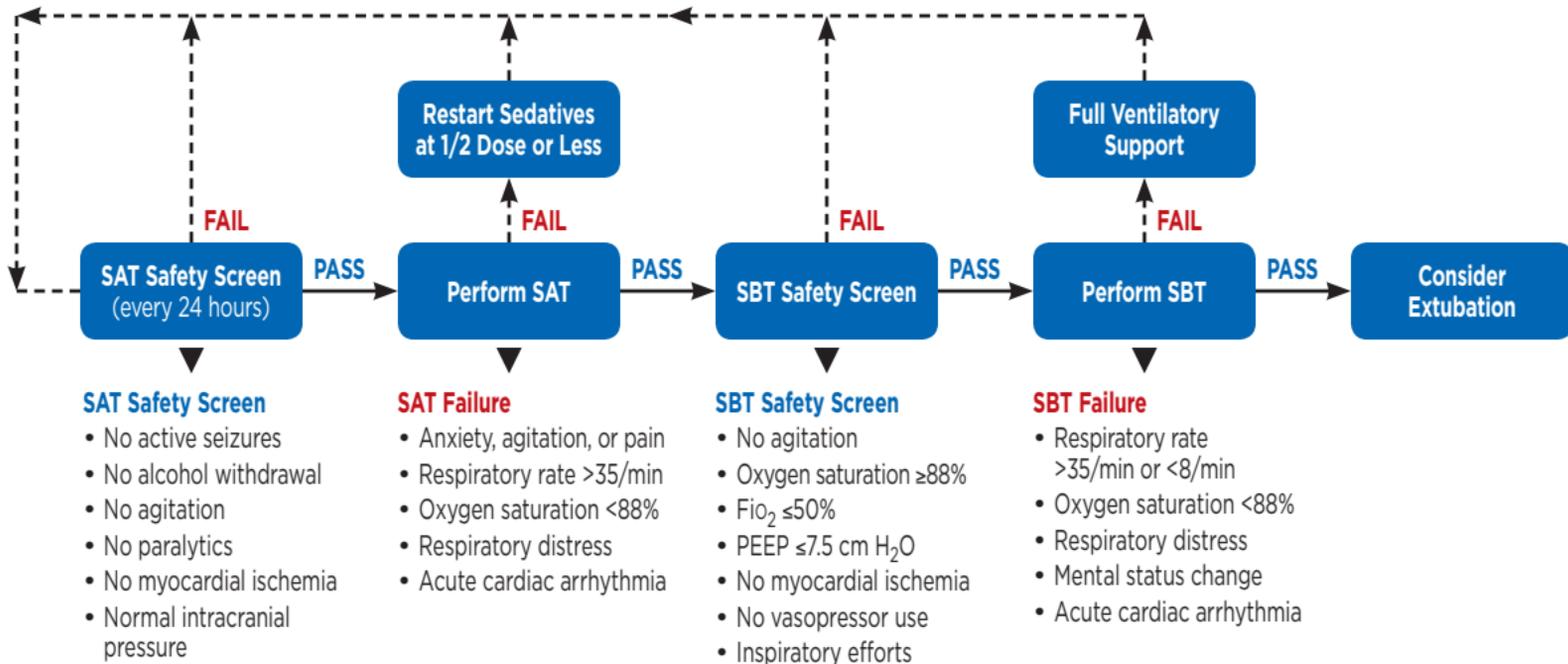
Mode	Main Parameters
Pressure Support	Pressure support level, sensitivity, F_{iO_2} , and PEEP
Pressure Control	Inspiratory pressure level, f_x , T_i , sensitivity, F_{iO_2} , and PEEP
Pressure-Controlled Inverse Ratio Ventilation	Same as for pressure control ventilation, but an inverse I:E ratio is attained by lengthening the T_i . Inverse ratios include 1:1, 2:1, 3:1, and 4:1.
Airway Pressure Release Ventilation	Pressure high: high CPAP level; pressure low: generally 0-5 cm H ₂ O; time high; time low, and F_{iO_2}

<p>Volume-Assured Pressure Modes (1-5 below)</p> <ol style="list-style-type: none"> 1. Pressure Augmentation (Bear 1000; Viasys Healthcare) 2. VS (Siemens) 3. Pressure-Regulated Control (Siemens) 4. VS (Puritan Bennett 840; Covidien) 5. Volume Control Plus (Puritan Bennett 840) 	<p>These modes provide pressure breaths with a volume guarantee.</p> <p>Spontaneous mode: V_T, sensitivity, F_{iO_2}, and PEEP. Control mode: per spontaneous mode, plus f_x and T_i</p> <p>V_T, sensitivity, F_{iO_2}, and PEEP</p> <p>f_x and T_i set in addition to those set for VS</p> <p>V_T, sensitivity, F_{iO_2}, and PEEP</p> <p>f_x and T_i set in addition to those set for VS</p>
<p>Bilevel Positive Airway Pressure (Puritan Bennett 840) (other forms by different manufacturers)</p>	<p>$PEEP_H$, $PEEP_L$, f_x, and T_i</p>
<p>Adaptive Support Ventilation (Galileo and Raphael; Hamilton Medical)</p>	<p>Body weight, % minute volume, and high-pressure limit</p>
<p>Automatic Tube Compensation</p>	<p>ET tube, internal diameter, and % compensation</p>
<p>Proportional Assist Ventilation</p>	<p>Proportional pressure support (Dräger Medical): PEEP, F_{iO_2}, % volume assist, and flow assist</p> <p>Proportional assist ventilation plus (Puritan Bennett), PEEP, F_{iO_2}, and % support</p>

Spontaneous Awakening Trials (SATs) and Spontaneous Breathing Trials (SBTs)

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Decrease ventilator days, length of ICU and hospital stays, and mortality rates by pairing SATs, daily sedation interruption, with SBTs in patients who are on mechanical ventilation.



Awake Indicators (including but not limited to any of the following)

- Eyes open in response to voice
- On request: ◦ Eyes follow ◦ Squeezes hand ◦ Sticks out tongue

Legend: **CO**, cardiac output; **COPD**, chronic obstructive pulmonary disease; **CPAP**, continuous positive airway pressure; **ET**, endotracheal tube; **FEV**, forced expiratory volume; **f_x** , respiratory frequency; **HR**, heart rate; **PCWP**, pulmonary capillary wedge pressure; **PEEP**, positive end-expiratory pressure; **PEEP_H**, positive end-expiratory pressure high; **PEEP_L**, positive end-expiratory pressure low; **RR**, respiratory rate; **SIMV**, synchronized intermittent mandatory ventilation; **SOB**, shortness of breath; **T_i** , inspiratory time; **VS**, volume support; **V_T** , tidal volume; **WNL**, within normal limits

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- 1 Pagana KD, Pagana TJ, Pagana TN. *Mosby's Manual of Diagnostic and Laboratory Tests*. 13th ed. St Louis, MO: Elsevier; 2017.
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- 4 Burns SM. Pressure modes of mechanical ventilation: the good, the bad, and the ugly. *AACN Adv Crit Care*. 2008;19(4):399-411.