



OXYGENATION

This is the process by which oxygen is supplied to the body tissues and carbon dioxide is removed.

Adequate oxygenation requires:

1. Ventilation

Movement of air into and out of the lungs.

Inspiration: air moves into the lungs.

Expiration: air moves out of the lungs.

1. Diffusion

Movement of oxygen and carbon dioxide across the alveolar-capillary membrane.

1. Perfusion

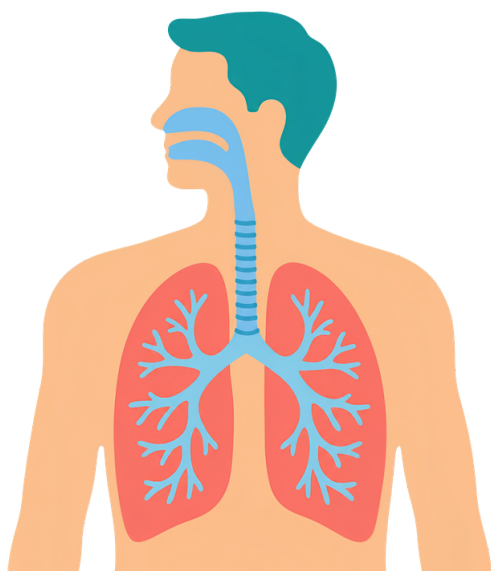
Blood flow through the pulmonary capillaries.

1. Cellular respiration

Oxygen is delivered to tissues and used to produce energy.

Remember: A client may have adequate ventilation but poor oxygenation if there is a problem with diffusion or perfusion.

Anatomy of the Respiratory System



Upper Respiratory Tract: Nose, Nasal Cavity, Sinuses, Pharynx, Larynx

Lower Respiratory Tract: Trachea, Bronchi, Bronchioles, Alveoli, Lungs

Remember: The alveoli are the primary sites of gas exchange

Respiratory Assessment

A. Inspection

Normal Findings

Respiratory rate: 12–20 breaths/min

Rhythm: Regular

Depth: Moderate/equal

Effort: Quiet, effortless

Chest symmetry: Symmetrical chest expansion

Chest shape: Normal/symmetrical

Skin color: Appropriate for the client's natural baseline

Position: Comfortable

LOC: Alert and oriented

Respiratory Patterns

Apnea: Absence of breathing

Bradypnea: <12 breaths/min

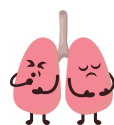
Tachypnea: >20 breaths/min

Dyspnea: Difficulty or discomfort breathing

Orthopnea: Difficulty breathing when lying flat; commonly associated with heart failure

Kussmaul: Deep, rapid breathing; associated with metabolic acidosis

Cheyne-Stokes: Alternating deep and shallow breathing with periods of apnea



Signs of Respiratory Distress

Nasal flaring: Widening of nostrils; increased respiratory effort

Retractions: Inward chest-wall movement during inspiration

Accessory muscle use: Extra muscles used for breathing; increased work of breathing

Difficulty speaking: Unable to speak normally due to dyspnea

Cyanosis: Bluish discoloration of skin, lips, or nail beds; late sign of hypoxemia

Abnormal breath sounds: Wheezes, crackles, rhonchi, or stridor

↓ **SpO₂:** Below expected or individualized target

**Remember:**

- For clients with dark skin, assess less pigmented areas (**palms, conjunctivae, lips, oral mucosa**); cyanosis may appear gray or ashen rather than blue.
- Restlessness, agitation, and anxiety can be early signs of **hypoxia (decreased oxygen in the tissues)**.
- Cyanosis is a delayed and unreliable indicator of **hypoxemia (decreased oxygen in the blood)**. Do not wait for cyanosis before acting.

Positioning

Clients experiencing respiratory distress often assume **Tripod Position**. This can improve use of accessory respiratory muscles.

For a patient experiencing **acute dyspnea**, position upright/high-Fowler's unless contraindicated.

B. Palpation**Assess:**

Chest expansion: Place hands symmetrically on the posterior chest. Normally, both sides expand equally.

Tactile Fremitus: Vibrations transmitted through lung tissue during speech.

Increased fremitus may occur with **Consolidation** while decreased fremitus may occur with **Pleural effusion, Pneumothorax, Air trapping**

C. Percussion

This technique helps identify the density of underlying tissue

Resonance: Normal lung tissue

Hyperresonance: May be caused by excess air, e.g., **emphysema, pneumothorax**

Dullness: May occur with increased density like: **pneumonia/lung consolidation, atelectasis, pleural effusion.**

D. Auscultation

Use the diaphragm of the stethoscope.

Listen systematically. Compare Right vs. left - Upper vs. lower

NORMAL BREATH SOUNDS

Breath sound	Characteristics	Location	Remember
Bronchial	Loud, high-pitched ; expiration longer than inspiration	Trachea/manubrium	Bronchial sounds over peripheral lung fields could indicate possible consolidation
Bronchovesicular	Moderate intensity and pitch ; inspiration=expiration	Major bronchi; anterior 1st-2nd interspaces and posterior between scapulae	Normal over central airways
Vesicular	Soft, low-pitched ; inspiration longer than expiration	Most of the peripheral lung fields	Most common normal breath sound



ADVENTITIOUS BREATH SOUNDS

Breath sound	Characteristics	Common causes
Wheeze	High-pitched, musical sound; often louder on expiration	Asthma, COPD, bronchospasm THINK: NARROWED AIRWAYS
Stridor	Loud, harsh, high-pitched sound, usually during inspiration	Upper-airway obstruction AIRWAY EMERGENCY!
Pleural Friction Rub	Grating/scratchy sound caused by inflamed pleural surfaces rubbing	Pleurisy, pneumonia, pulmonary embolism USUALLY DOES NOT CLEAR WITH COUGHING
Crackles	Fine/coarse popping or bubbling sounds	Pulmonary edema, pneumonia, atelectasis, pulmonary fibrosis THINK: FLUID IN AIRWAYS
Rhonchi	Low-pitched, coarse, snoring/gurgling sound	Secretions in larger airways MAY IMPROVE AFTER COUGHING OR SUCTION

RESPIRATORY DIAGNOSTICS

Procedure	Nursing Considerations
Pulse oximetry (SpO ₂) Measures oxygen saturation	Generally 95–100% in healthy adults. Assess the client along with the reading. Check for poor perfusion, motion, or incorrect sensor placement



ABG Evaluates oxygenation, ventilation, and acid-base balance	Do not suction or hyperventilate the client immediately before collection (wait 15–20 minutes after suctioning or ventilator changes).
Chest X-ray Lungs and airways visualization	Make sure that female clients of childbearing age undergo urine or blood hCG test to check for possible pregnancy. This prevents fetal radiation exposure.
Pulmonary Function Test Measures airflow, lung volumes, and pulmonary function.	Used for asthma and COPD. Avoid bronchodilators and smoking before testing.
Peak Expiratory Flow Rate: Measures maximum expiratory flow, mainly for asthma monitoring.	Perform at the same time each day when monitoring at home. A decreasing value may indicate worsening asthma.
Bronchoscopy Directly visualizes airways and allows biopsy or specimen collection.	NPO before and after until gag reflex returns.
V/Q Scan (Ventilation-Perfusion Scan) Evaluates ventilation and pulmonary perfusion.	No iodinated contrast is used — often chosen when the client has a contrast allergy or renal impairment Verify pregnancy status in female clients of childbearing age (see Chest X-ray).



Age-Specific Considerations

Infants

- Higher RR (30-60 breaths/min) and O₂ demand than adults.
- Smaller airways= easily obstructed by edema/secretions.
- Less respiratory reserve = rapid desaturation.
- **Poor feeding** may be an early sign of respiratory distress.

Children

- Higher RR than adults; gradually decreases with age.
- Smaller airways= minor edema can significantly increase airway resistance.
- Distress: tachypnea, retractions, nasal flaring, grunting, cyanosis, altered LOC.
- Can deteriorate rapidly due to limited respiratory reserve

Older Adult

- Lower respiratory reserve and decreased lung elasticity.
- ↓ chest-wall compliance, respiratory muscle strength, cough reflex, and pulmonary reserve.
- Increased risk for aspiration, atelectasis, and pneumonia.
- Respiratory infections may present atypically: confusion, weakness, or functional decline rather than fever/cough.

OXYGEN DELIVERY SYSTEMS

The goal of oxygen therapy is to correct or prevent hypoxemia while using the lowest effective oxygen concentration.

Type and Purpose	Nursing Considerations
Nasal Cannula Delivers 1–6 L/min FiO ₂ 24–44%.	Comfortable, allows eating/talking. Monitor for nasal dryness and skin irritation. FiO ₂ is variable.

Simple Face Mask Delivers moderate oxygen; 5–10 L/min, FiO ₂ ~40–60%.	Never <5 L/min → risk of CO₂ rebreathing. Ensure proper fit. Remove for eating if needed.
Venturi Mask Delivers a precise FiO ₂ (4–12 L/min, FiO ₂ 24–50%, color-coded adapters)	Useful when controlled oxygen concentration is needed, especially in COPD. Do not obstruct the air-entrainment ports.
Non-Rebreather Mask (NRB): Provides high-concentration oxygen (FiO ₂ ~60–95%); 10–15 L/min.	Keep the reservoir bag inflated; it should not collapse more than one-third to one-half on inspiration. Ensure adequate O ₂ flow before applying. Monitor SpO ₂ and respiratory status.
Partial Rebreather Mask Delivers moderate–high oxygen concentration, usually 6–11 L/min; FiO ₂ ~40–70%. Allows some exhaled gas to return to the reservoir bag.	Keep reservoir bag partially inflated. Ensure adequate oxygen flow before applying. Monitor SpO ₂ , respiratory status, and bag inflation.



High-Flow Nasal Cannula (HFNC): Delivers heated, humidified, high-flow oxygen (up to ~60 L/min, FiO₂ 21–100%).	Provides high FiO₂ and improves comfort/humidification. Monitor SpO₂, respiratory effort, and device position.
CPAP- Continuous Positive Airway Pressure via mask keeps airways/alveoli open. Used for sleep apnea and some respiratory conditions.	Client must be awake and able to protect the airway. Monitor SpO₂, respiratory status, and mask fit.
BiPAP: Provides two pressure levels: higher during inspiration (IPAP) and lower during expiration (EPAP). Used for ventilatory problems, especially COPD exacerbation.	Avoid in unconscious/uncooperative clients or those unable to protect the airway due to aspiration risk. Monitor ABGs, SpO₂, and respiratory effort.
Mechanical Ventilation (Endotracheal Intubation): Provides positive-pressure ventilation through an endotracheal tube when the client cannot maintain adequate ventilation/oxygenation.	Maintain airway and tube security. Monitor SpO₂, ABGs, breath sounds, ventilator alarms, and complications such as barotrauma, VAP, and decreased cardiac output. <i>(SEE SEPARATE CHEAT SHEET FOR MECHANICAL VENTILATION AND TRACHEOSTOMY)</i>