

OXYGENATION

J. Wolfe, MSN, RN,
CNE

LEARNING OBJECTIVES

- ❖ Discuss hypoxemia/hypoxia and poor perfusion
- ❖ Recognize the impact of gas exchange and identify clinical manifestations of impaired gas exchange
- ❖ Discuss care strategies to assist the patient with impaired gas exchange
- ❖ Review methods to improve oxygenation
- ❖ Demonstrate the use of various oxygen therapy modalities (nasal cannula, non-rebreather mask, venturi mask)
- ❖ Teach about oxygen policies and oxygen safety

WHAT IS POOR OXYGENATION?

A decreased oxygen level in the blood

- Oxygen Saturation can be used to assess oxygen level

- SpO₂ - measure of how saturated hemoglobin are with oxygen (measured with pulse oximetry)

- 95-100%

- Often see order “keep above 92%”



SIGNS/SYMPTOMS OF POOR OXYGENATION

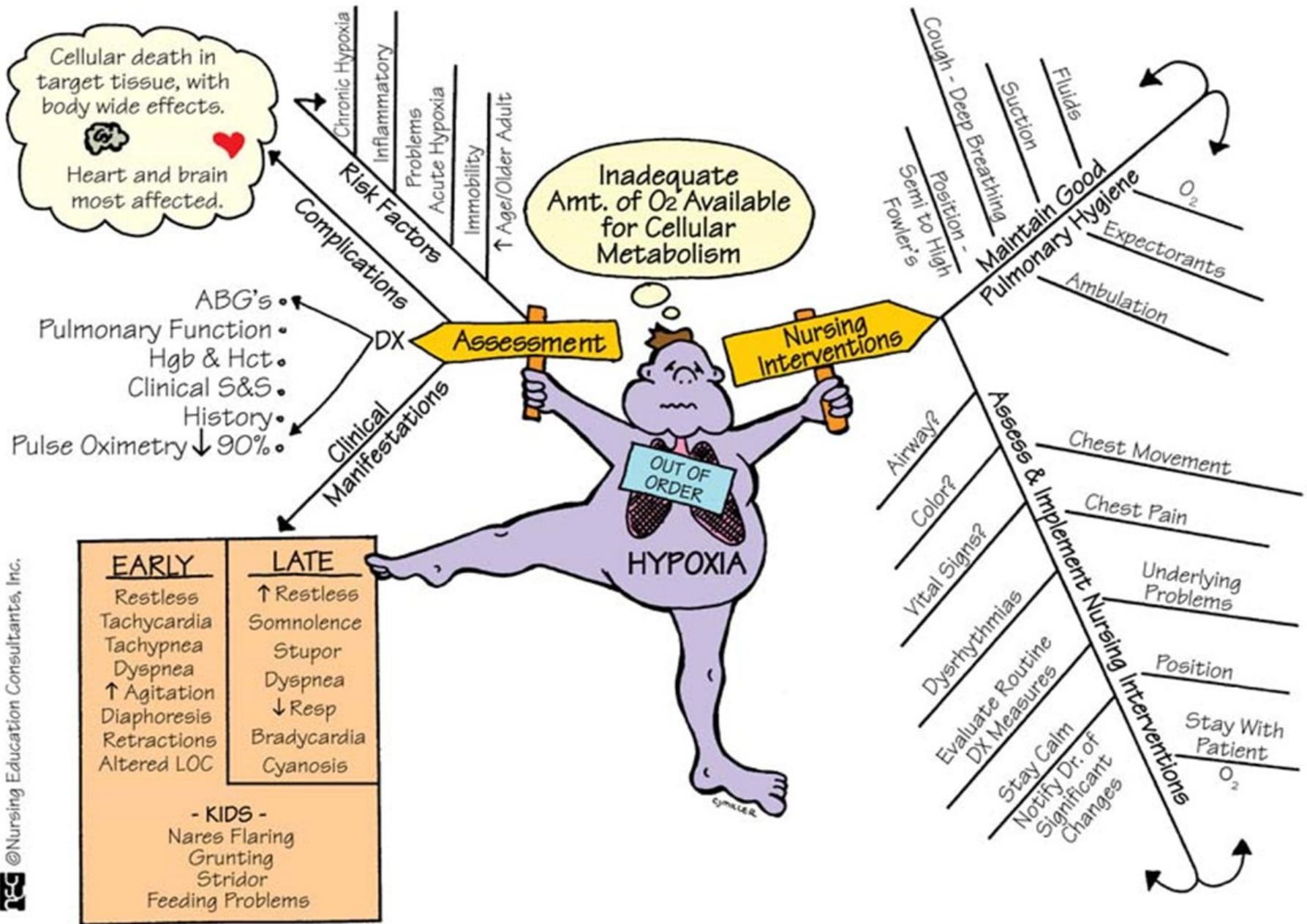
- ❖ Restlessness/confusion
- ❖ Decreased blood pressure
- ❖ Cool extremities
- ❖ Pallor or cyanosis of extremities
- ❖ Slow capillary refill

When oxygen delivery is inadequate to meet metabolic demands of the body = tissue ischemia and cell death

Hypoxia (low oxygen in your tissues) when your **blood** doesn't carry enough oxygen to the tissues to meet the body's needs

Cellular death in target tissue, with body wide effects.
 Heart and brain most affected.

Inadequate Amt. of O₂ Available for Cellular Metabolism



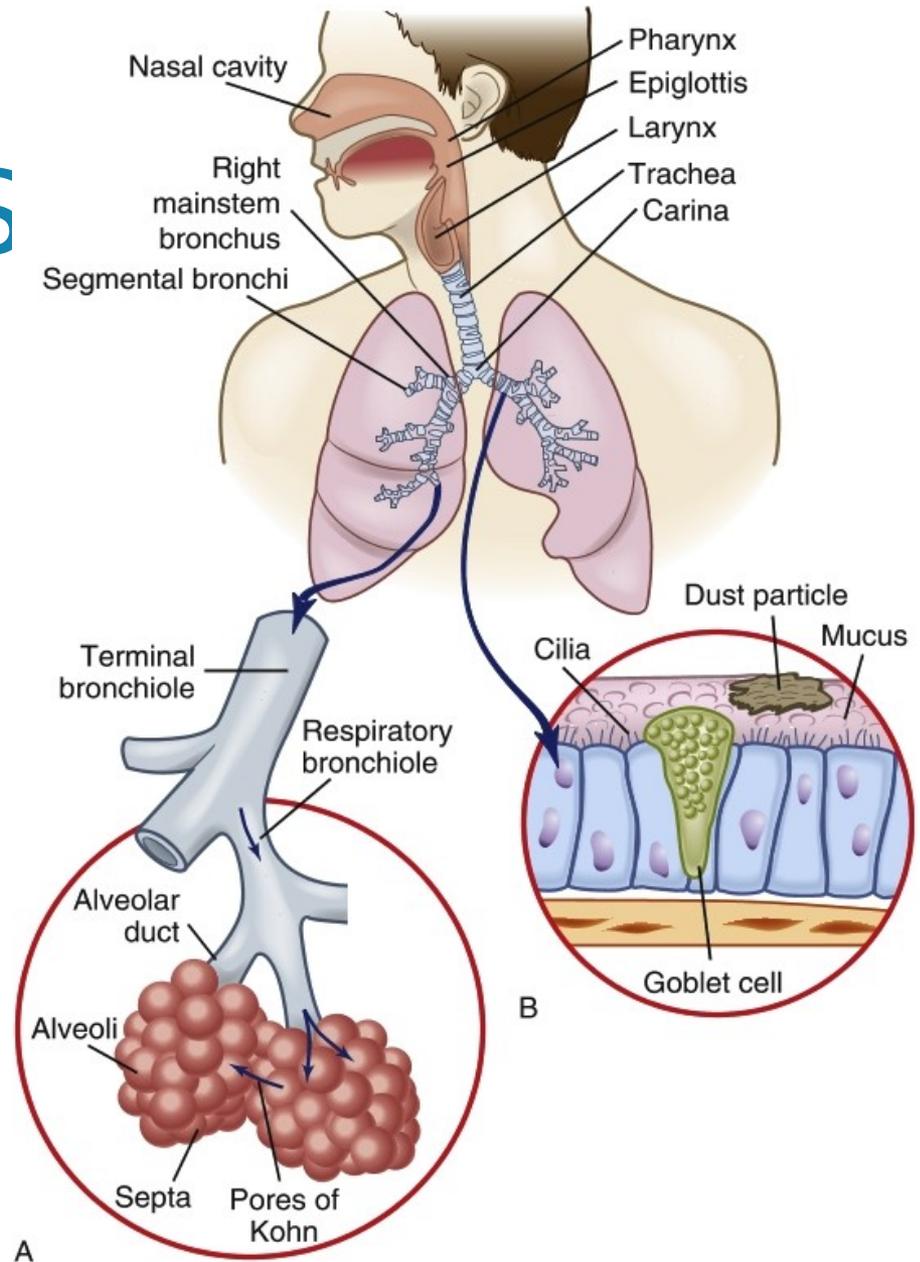
EARLY	LATE
Restless	↑ Restless
Tachycardia	Somnolence
Tachypnea	Stupor
Dyspnea	Dyspnea
↑ Agitation	↓ Resp
Diaphoresis	Bradycardia
Retractions	Cyanosis
Altered LOC	
- KIDS -	
Nares Flaring	
Grunting	
Stridor	
Feeding Problems	

LUNG DISEASES

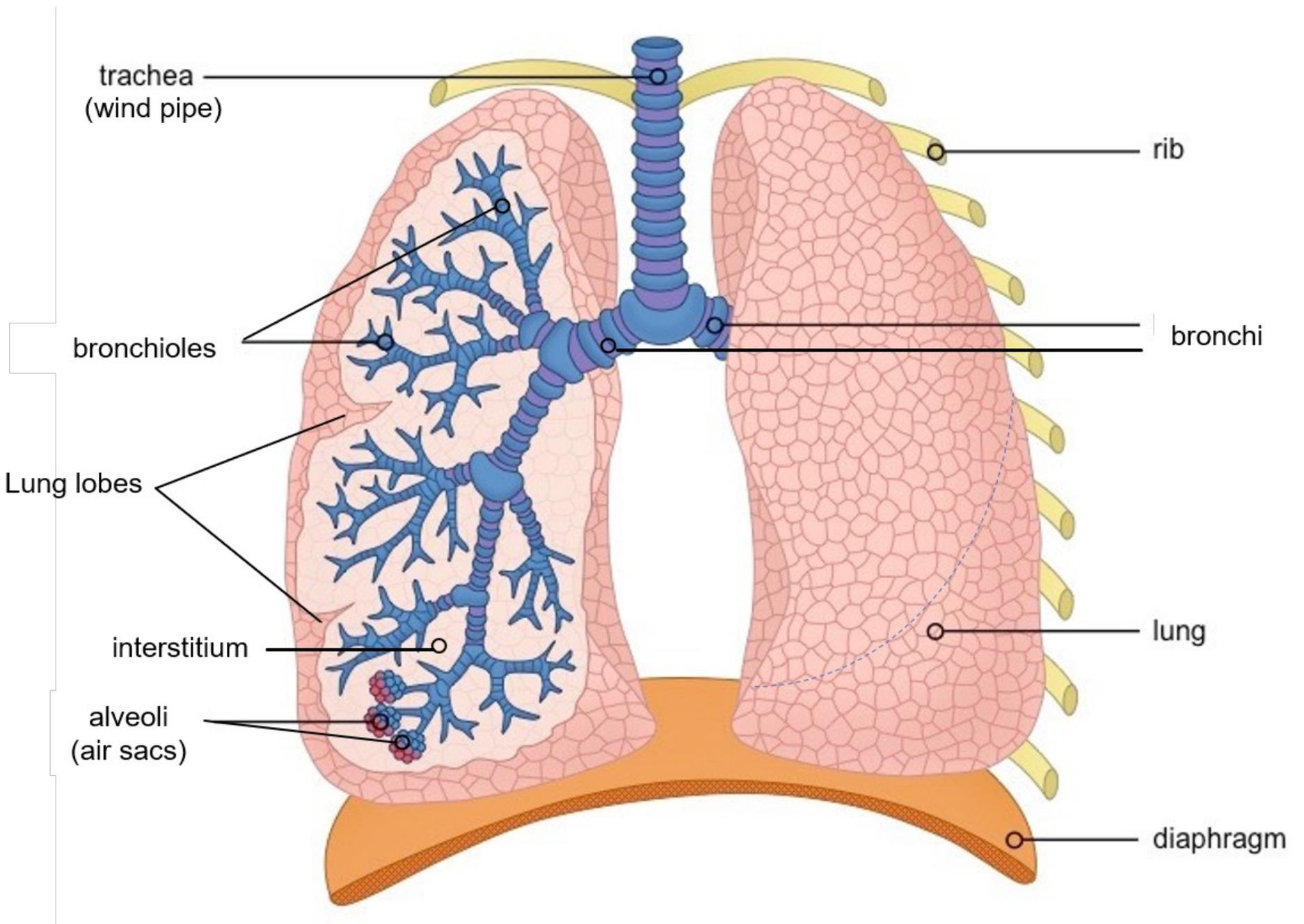
The lungs have a large surface area that is constantly exposed to the external environment.

Lung disease is greatly influenced by what a patient is exposed to

- Environmental
- Occupational
- Personal
- Social habits



(Redrawn from Price SA, Wilson LM: *Pathophysiology: Clinical concepts of disease processes*, ed 6, St Louis, 2003, Mosby.)



trachea
(wind pipe)

rib

bronchioles

bronchi

Lung lobes

interstitium

lung

alveoli
(air sacs)

diaphragm

PULMONARY DISEASES

Pulmonary diseases are often classified as acute or chronic, obstructive or restrictive, infectious or noninfectious and is caused by alterations in the lungs or heart.

- ❖ Acute – bronchitis
- ❖ Chronic – asthma
- ❖ Obstructive – Chronic Obstructive Pulmonary Disease (COPD)
- ❖ Restrictive – pulmonary fibrosis, sarcoidosis
- ❖ Infectious – pneumonia
- ❖ Noninfectious – asthma, COPD, pulmonary fibrosis

CLINICAL MANIFESTATIONS OF RESPIRATORY ALTERATIONS

- ❖ Cough – acute or chronic
- ❖ Dyspnea – shortness of breath, feeling of inability to get a good breath
- ❖ Chest pain
- ❖ Abnormal sputum
- ❖ Hemoptysis – coughing up blood
- ❖ Altered breathing patterns – tachypnea, bradypnea, use of accessory muscles
- ❖ Cyanosis – bluish discoloration of skin and mucus membranes
- ❖ Fever

VIDEO –ACCESSORY MUSCLE USE

<https://www.youtube.com/watch?v=iv7zgdIFrgs>

CYANOSIS



ORTHOPNEA

Orthopnea = dyspnea when laying down

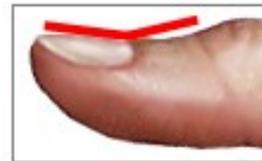
Patients can breath better when propped up slightly.

People with chronic lung disorders may sleep better sitting up in a recliner.

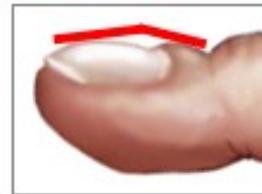


CLUBBING

Clubbing often occurs in heart and lung diseases that reduce the amount of oxygen in the blood.

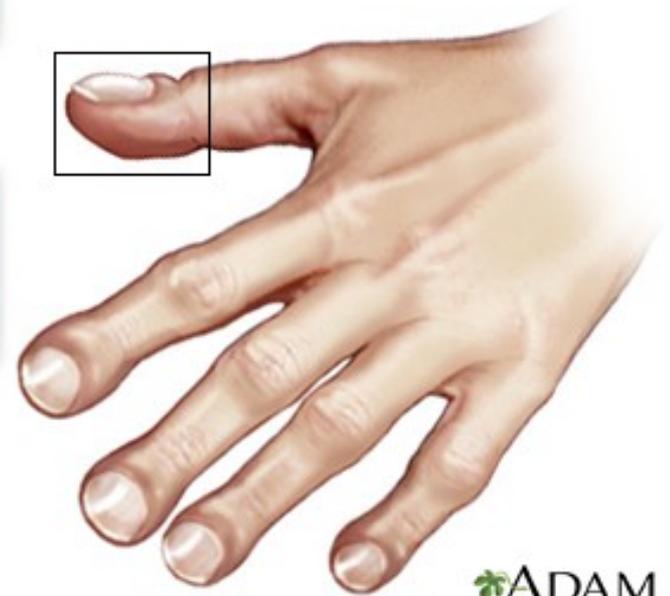


Normal angle of nail bed



Distorted angle of nail bed

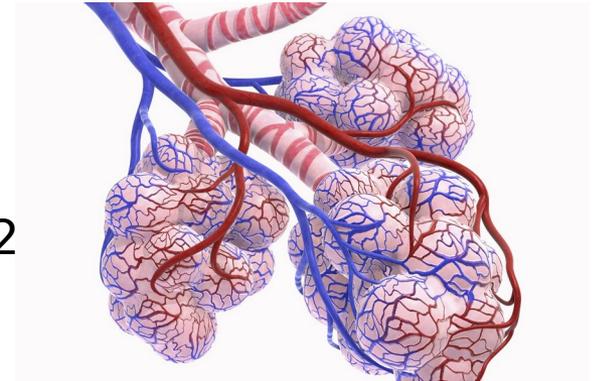
Clubbed fingers



HYPOXIA VS HYPOXEMIA

Hypoxemia = low level of oxygen in the blood

- ▣ What device can we use to measure this?
- ▣ SpO₂ - Oxygen Saturation
- ▣ 95-100%
- ▣ Often see orders to “Keep O₂ Sats above 92”



Hypoxia = low levels of oxygen in the tissues and organs.

- ▣ Can be difficult to measure
- ▣ We can assume that a patient with hypoxemia for an extended amount of time has hypoxia

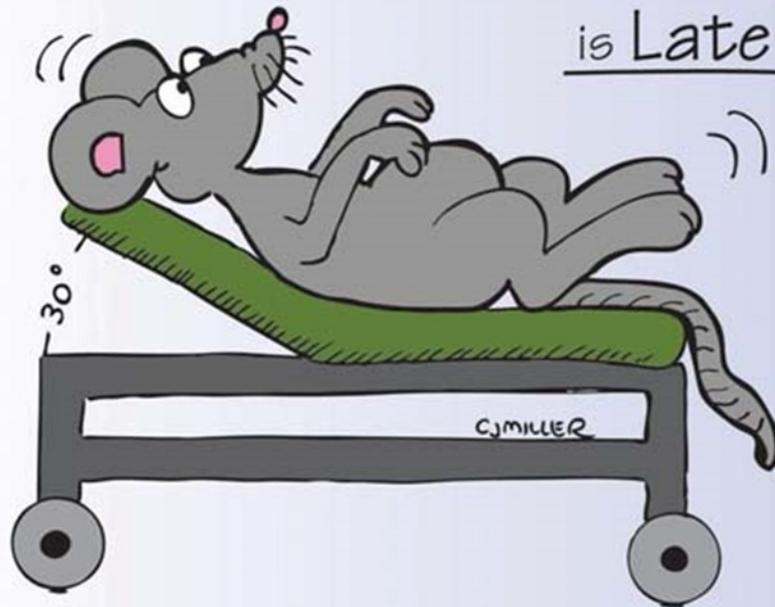
SYMPTOMS OF HYPOXIA

Early

R - Restlessness

A - Anxiety

T - Tachycardia/Tachypnea



is Late to **B** - Bradycardia

E - Extreme Restlessness

D - Dyspnea (Severe)

(In Pediatrics) → **F** - Feeding Difficulty

I - Inspiratory Stridor

N - Nares Flare

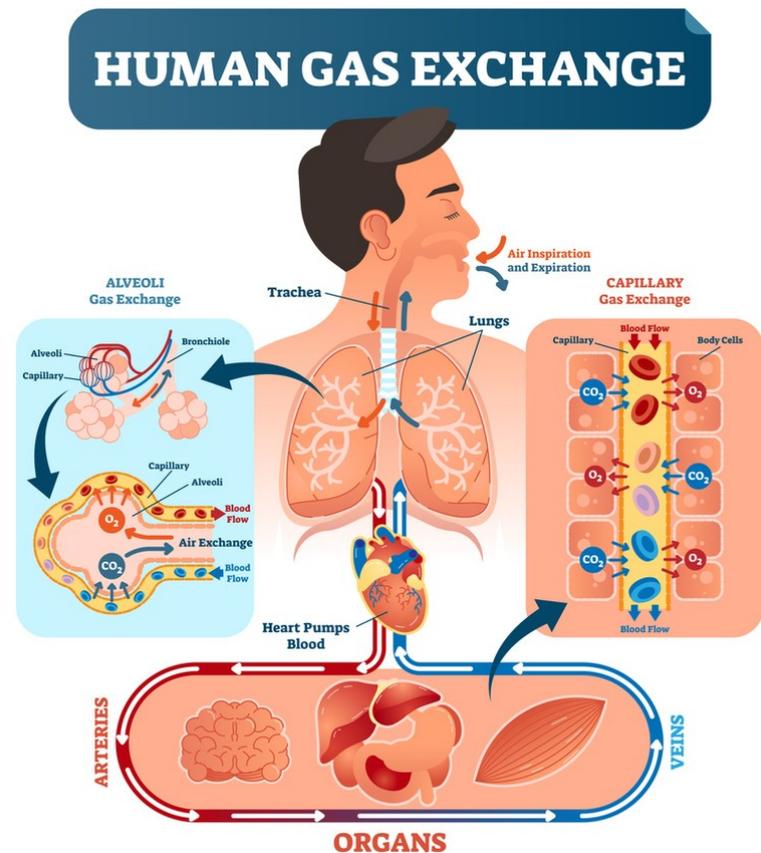
E - Expiratory Grunting

S - Sternal Retractions

VENTILATION

Hypoventilation – breathing too shallow or too slow to meet the body's needs for oxygen

Hyperventilation – breathing that is too rapid or too deep. Breathing exceeds the body's metabolic demands.



ATELECTASIS

Atelectasis = collapsed air sacs (alveoli)

Prevention -

- ❖ Early ambulation
- ❖ Turn, Cough, Deep Breathing
- ❖ Incentive Spirometry



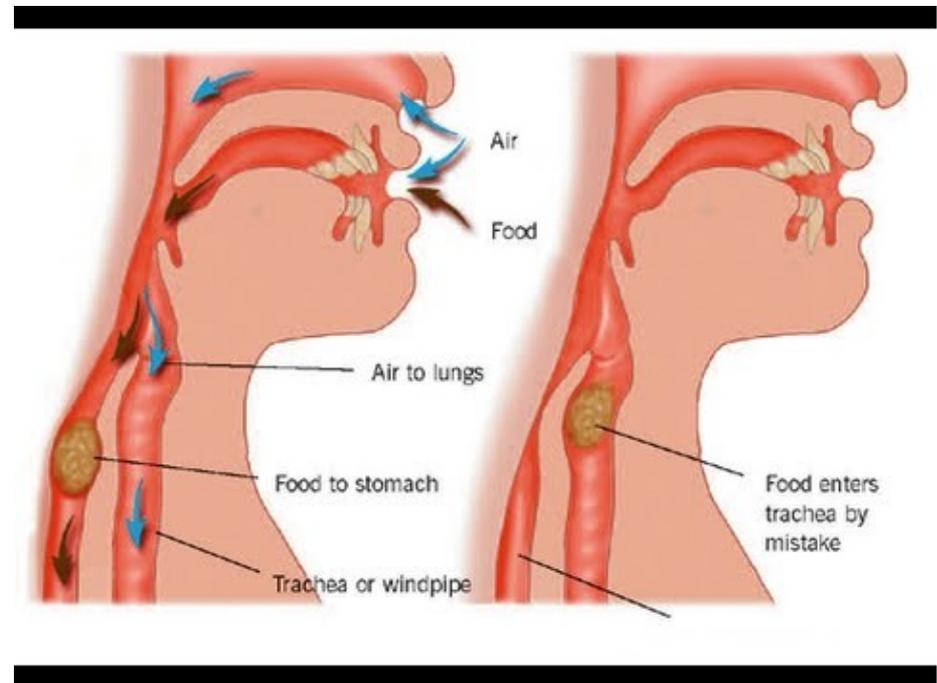
ASPIRATION

Aspiration = passage of gastric contents (fluid or solid) into the lungs

Can cause **aspiration pneumonia**.

Prevention -

- ❖ Assess patient's ability to swallow
- ❖ Keep head of bed elevated with tube feedings
- ❖ Thorough lung assessment



ASSESSMENT OF RESPIRATORY SYSTEM

- ❖ Respiratory Rate
- ❖ Use of Accessory Muscles
- ❖ Cyanosis
- ❖ Oxygen Saturation (SpO₂)
- ❖ Adventitious Breath Sounds (crackles, wheezes, rhonchi, stridor, rubs)
- ❖ Clubbing
- ❖ Dyspnea with activity



HTTPS://
WWW.YOUTUBE.COM/
WATCH?V=TIJDMTNJQUG

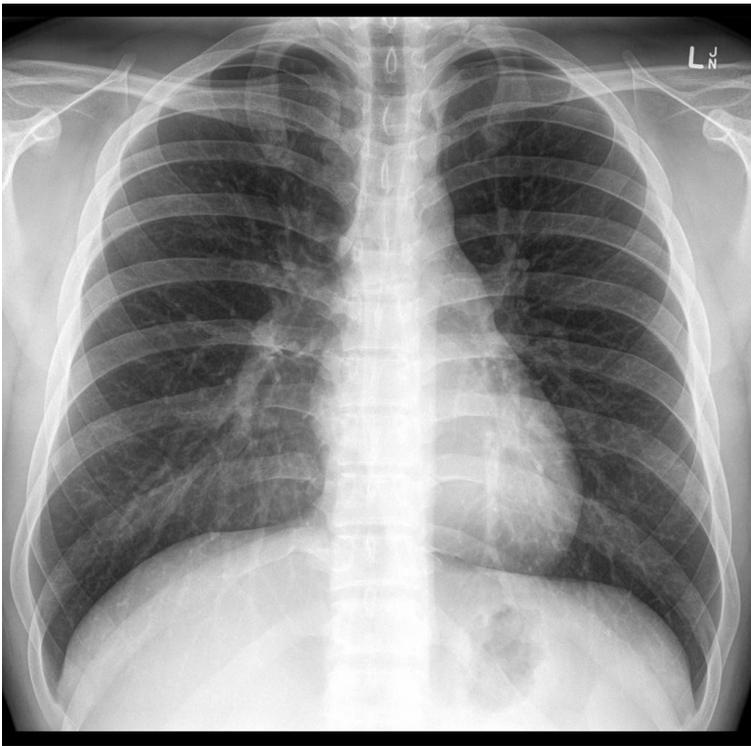
DIAGNOSTIC TESTS

- ❖ Chest X-ray
- ❖ Arterial Blood Gases
- ❖ Sputum Culture and Sensitivity
- ❖ CT Scans
- ❖ Magnetic Resonance Imaging (MRI)
- ❖ Bronchoscopy
- ❖ Thoracentesis



CHEST X-RAY

Normal



Atelectasis



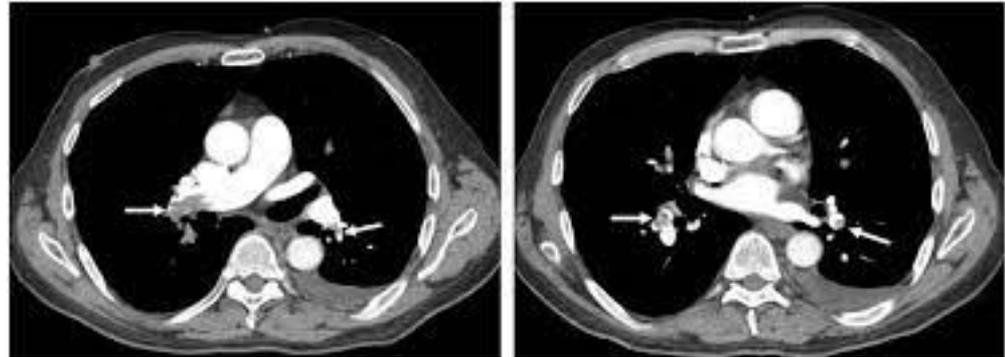
SPUTUM CULTURE AND SENSITIVITY



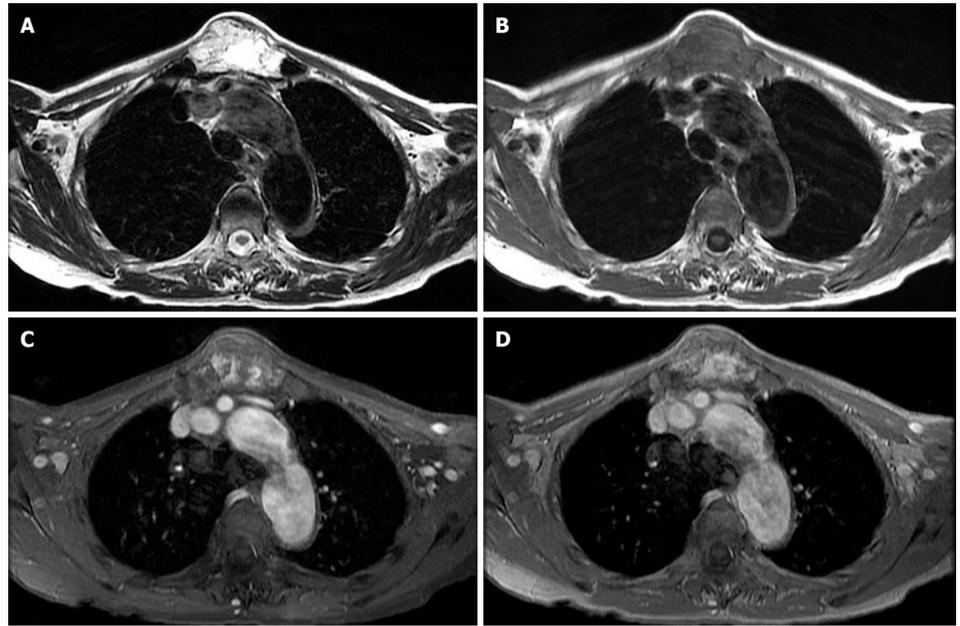
CT SCAN



© MAYO FOUNDATION FOR MEDICAL EDUCATION AND RESEARCH. ALL RIGHTS RESERVED.



MRI



BRONCHOSCOPY

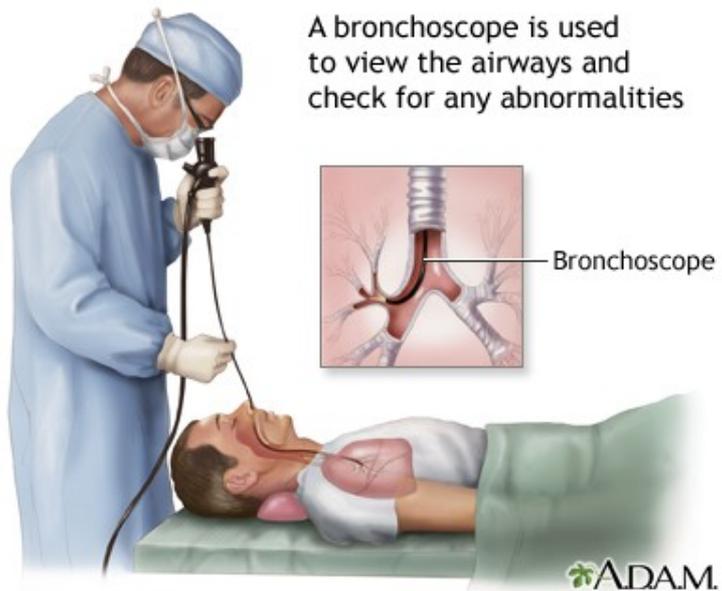
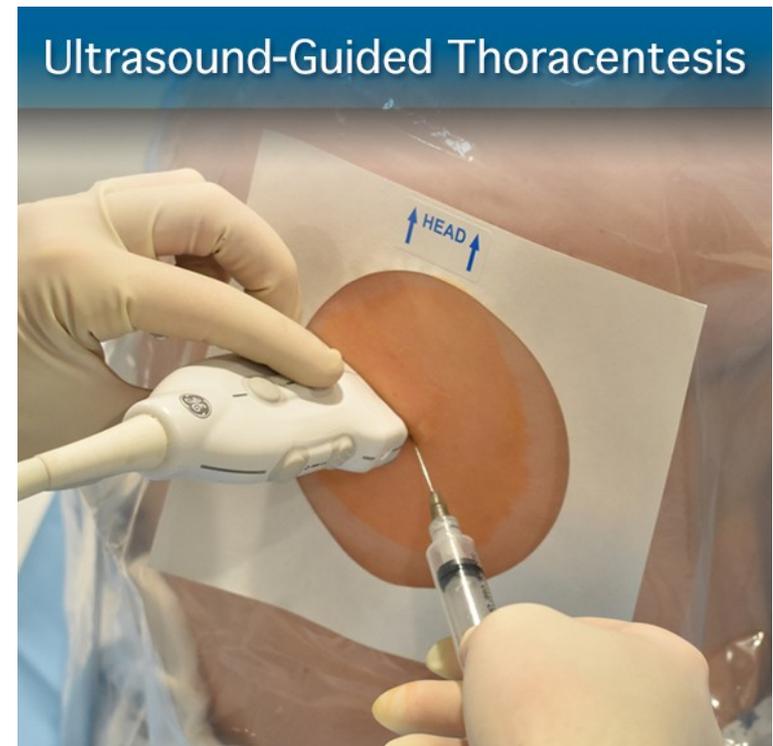
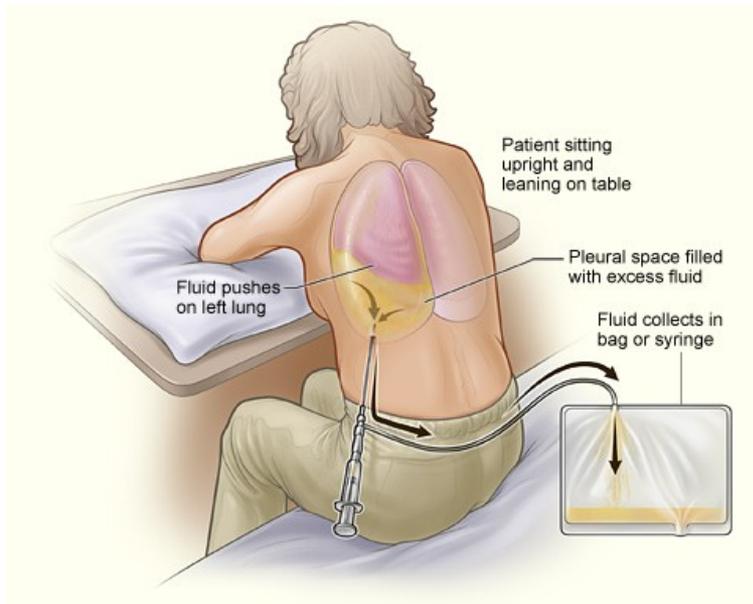


Figure 2 Bronchoscopic view of normal airway

THORACENTESIS



INTERVENTIONS PRIOR TO OXYGEN USE

Promotion of lung expansion

- ▣ Position changes frequently – every 2 hours
- ▣ Keep upright
- ▣ Increase daily activities; ensure adequate hydration
- ▣ Coughing exercises
- ▣ Deep breathing (IS)

Post Operative

- ▣ IS
- ▣ TCDB
- ▣ Splinting incision

ALBUTEROL (PROAIR) MDI



Bronchodilator

- ▢ Rescue inhaler for acute difficulty breathing (asthma, COPD)
- ▢ Beta 2 agonist (SABAs) Short-Acting Beta Agonist
 - ▢ Stimulates beta-2 adrenergic receptors, relaxing airway smooth muscle
 - ▢ Two puffs inhaled every 4 to 6 hours prn bronchospasm/difficulty breathing
 - ▢ May take 2 puffs 5-30 minutes before exercise
 - ▢ Common reactions
 - ▢ Nervousness, tachycardia, headache, throat irritation

SYMBICORT (BUDESONIDE/FORMETER INHALED)



Corticosteroid/Bronchodilator

- ▢ Beta 2 agonist (LABA) Long-Acting Beta Agonist
- ▢ MDI: 80mcg/4.5mcg; 160/4.5 mcg
 - ▢ Two puffs bid (2 times/day)
 - ▢ Treatment for prevention of asthma attacks and exercise-induced bronchospasm and COPD
 - ▢ Common Reactions
 - ▢ Tachycardia, nervousness, palpitations, oral candidiasis
 - ▢ **Rinse mouth and spit it out after inhalation

ASSESSING PATIENTS ON OXYGEN THERAPY

- ❖ Equipment
- ❖ Correct oxygen delivery device
- ❖ Flow rate is correct
- ❖ Respiratory assessment
 - ▣ *vital signs*
 - ▣ *oxygen saturation*
 - ▣ *Level of consciousness, any s/s of hypoxia*
 - ▣ *skin*

**Flow
Meter**



FRACTION OF INSPIRED OXYGEN (FIO₂)

- ❖ FIO₂ is percent of oxygen a person is inhaling
- ❖ Room air FIO₂ is 21%
- ❖ With supplemental oxygen, FIO₂ can reach 100%

METHODS OF OXYGEN DELIVERY

NASAL CANNULA

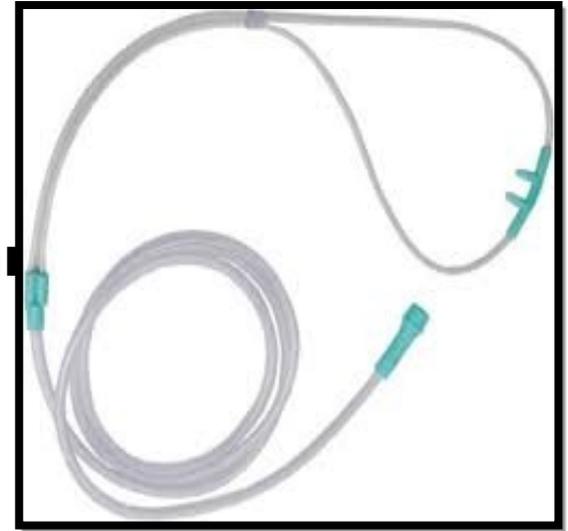
- ▶ Oxygen delivery
 - up to 6L/min. (**usually no more than**)
 - FIO₂ 24%-44%

- ▶ Advantages

- safe & simple, easily tolerated
- increased mobility

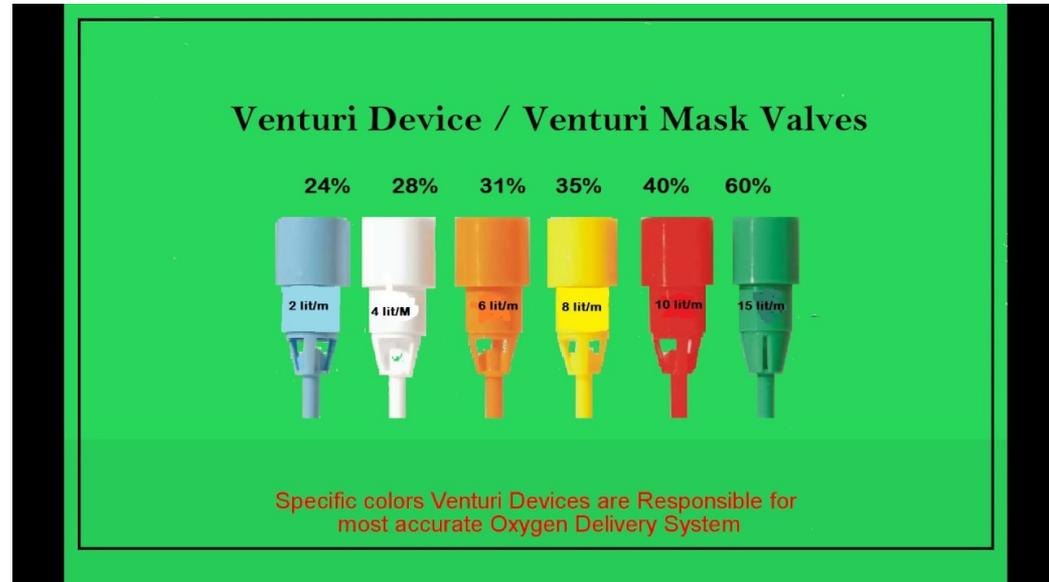
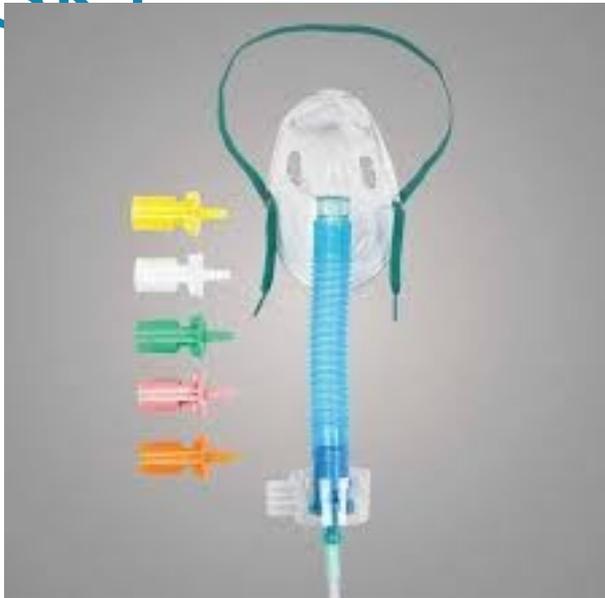
Disadvantages

- dries membranes; skin breakdown



VENTURI MASK (VENTI

MASK)



Advantages

- controls exact concentration of oxygen
- delivers FI_{O_2} of 24-60%
- flow rates from 4-12 L/min

Disadvantages

- Hot & confining
- Interferes with eating & talking
- Commonly used in COPD patients

NON-REBREATHER MASK



- ❖ **Delivers higher concentrations of oxygen**
- ❖ **Treat hypoxia**
- ❖ **↓ workload of breathing**

- ❖ **Face mask with reservoir Bag**
- ❖ **Has one way valves that open during expiration and close during inhalation to prevent decrease in FIO_2 or build up of CO_2**

FIO_2 of 60-100%
Set flow meter
@ 10-15 L for 100%

Face Tent



Advantages

delivers 28-100% with flow rate of 8-12L/min

Alternative for claustrophobia

Disadvantages

- Difficult to control concentration of oxygen

DOCUMENTATION

- ❖ Date & time oxygen initiated
- ❖ Method of delivery
- ❖ Flow rate in liters per minute
- ❖ Patient response to oxygen
- ❖ Condition of patient's skin where device rests
- ❖ Respiratory assessment
- ❖ Patient/family teaching



Humidification



Nebulizer



Tracheostomy



Trach mask



Bag-Valve Mask



T Piece



High Flow Nasal Cannula

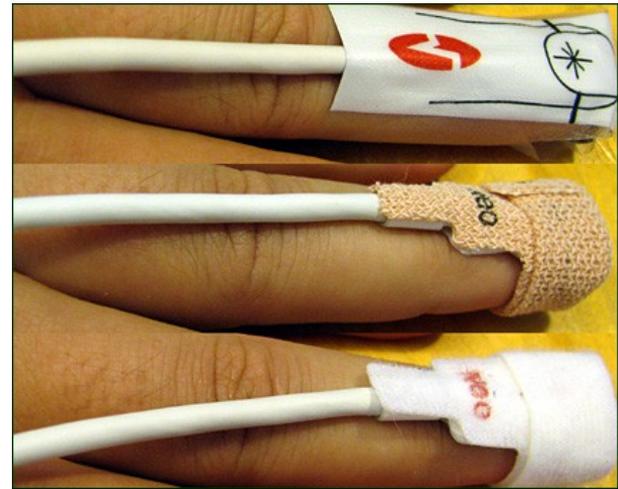
FACTORS THAT ALTER ACCURACY OF PULSE OX

Physical

- ▣ motion/incorrect placement
- ▣ BP monitoring device
- ▣ bright lights, polish, acrylics

Physiological

- ▣ poor arterial flow or edema
- ▣ cold hands; poor capillary filling
- ▣ anemia



INCENTIVE SPIROMETRY (IS)

Purpose

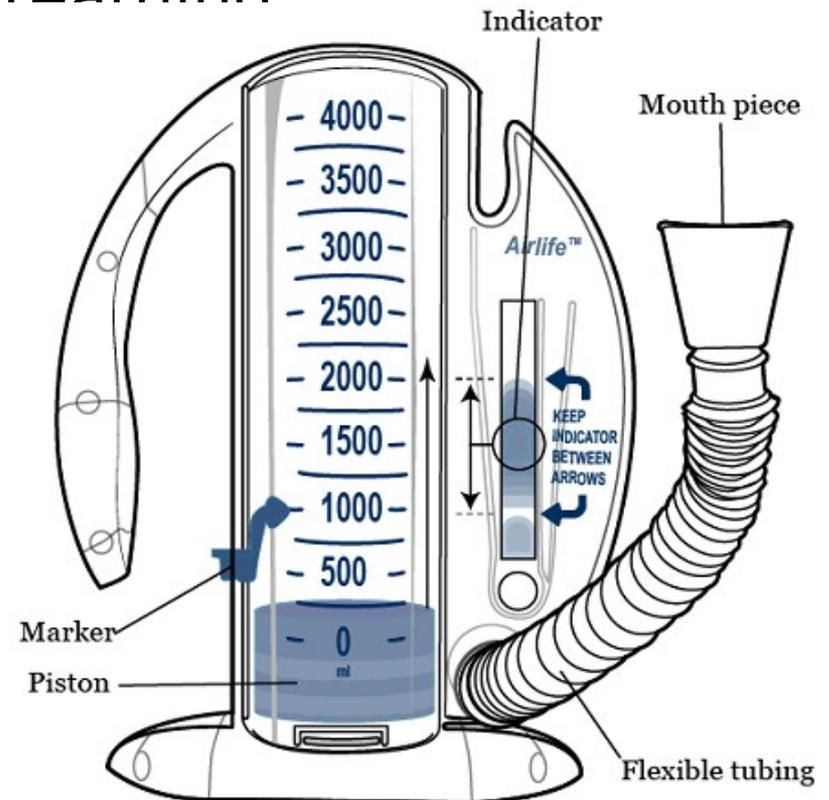
- ▢ helps prevent post-op pulmonary complications (atelectasis)
- ▢ provides voluntary deep breathing
- ▢ gives visual feedback

Technique

- ▢ explain procedure
- ▢ positioning

Frequency

Nursing considerations



OXYGEN SAFETY

- ❖ Do not smoke
- ❖ Do not use aerosol sprays
- ❖ Do not use any petroleum products
- ❖ Should be administered to patient by physician order or in judgment of RN in emergency situations

OXYGEN TOXICITY

Oxygen toxicity can develop when a person breathes 100% oxygen for > 12 hours

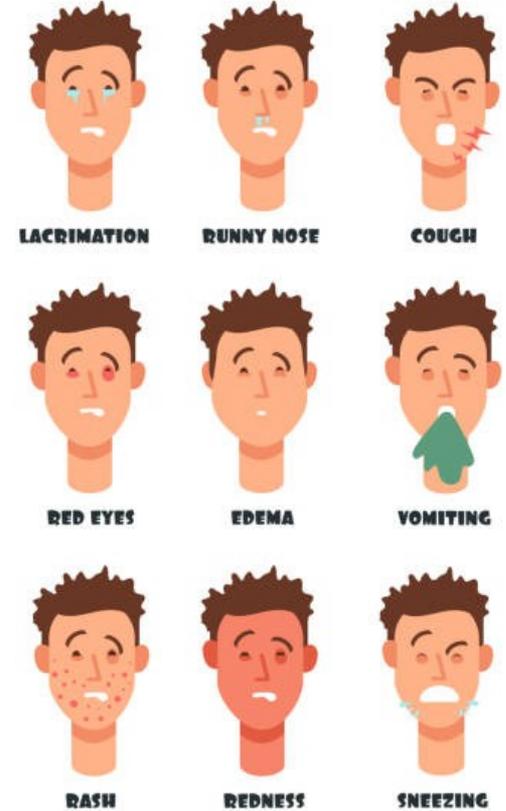
Results from effects on CNS and Pulmonary Systems

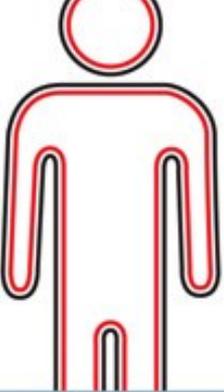
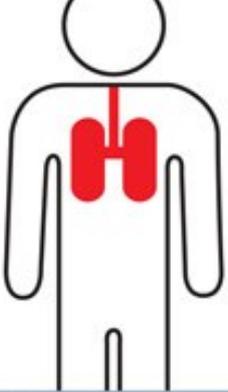
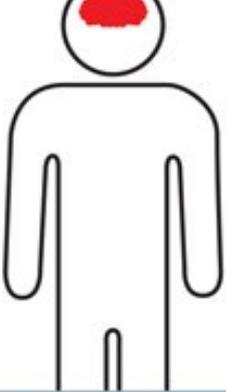
Signs/Symptoms

- ▣ Pallor, sweating, nausea & vomiting
- ▣ Seizures, vertigo, muscle twitching
- ▣ Hallucinations, visual changes, anxiety
- ▣ Chest pain, dyspnea

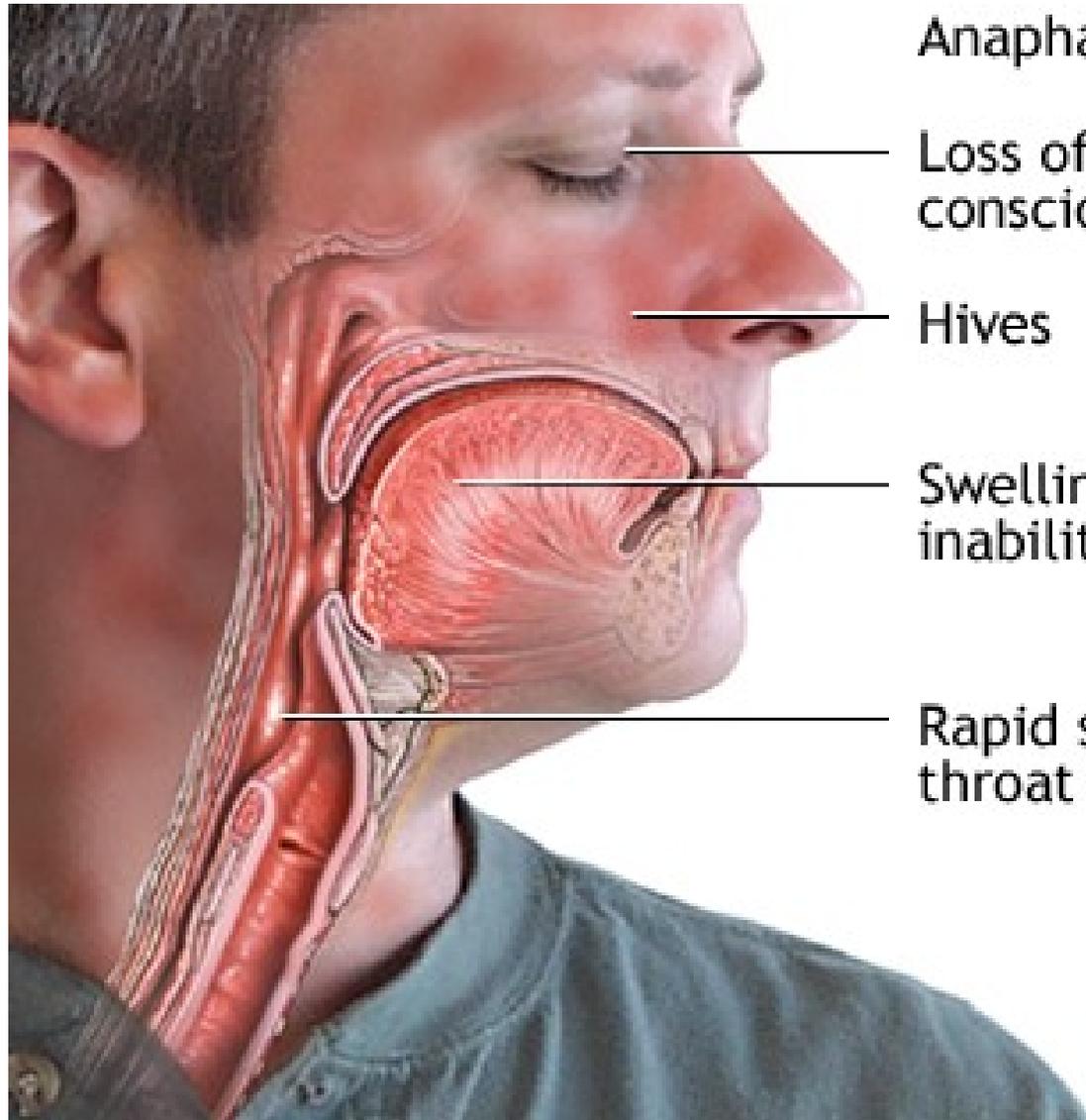
RESPIRATORY IMPLICATIONS OF ALLERGIC REACTIONS

ALLERGY SYMPTOMS



				
SKIN	RESPIRATORY	GASTROINTESTINAL	CARDIOVASCULAR	NEUROLOGICAL
hives, swelling, itching, warmth, redness	coughing, wheezing, shortness of breath, chest pain or tightness, throat tightness, trouble swallowing, hoarse voice, nasal congestion or hay fever-like symptoms, (sneezing or runny or itchy nose; red,	nausea, stomach pain or cramps, vomiting, diarrhea	dizziness/ lightheadedness, pale/blue colour, weak pulse, fainting, shock, loss of consciousness	anxiety, feeling of “impending doom” (feeling that something really bad is about to happen), headache
				OTHER
				uterine cramps

RESPIRATORY IMPLICATIONS OF ANAPHYLAXIS



Anaphalaxis

Loss of
consciousness

Hives

Swelling of tongue,
inability to swallow

Rapid swelling of
throat tissues



Origination:	04/2017
Effective:	05/2020
Last Approved:	05/2020
Last Revised:	04/2017
Next Review:	05/2023
Owner:	<i>Gillian Robinson: Exec Dir, Respiratory Care</i>
Area:	<i>Respiratory Care Services</i>
References:	
Applicability:	<i>TX - CMC CCH CSH</i>

Protocol: Oxygen Administration/Adults

Purpose:

To provide protocol driven respiratory therapy for the administration of oxygen at concentrations greater than ambient air with the intent of treating or preventing the symptoms and manifestations of hypoxia.

Policy:

The Oxygen Administration Protocol will be initiated on all patients.

EXCEPTIONS: The Oxygen Protocol **will not** be initiated on obstetrical patients or for patients in the Labor and Delivery, OR, PACU, pediatrics and those requiring mechanical ventilation.

The RN or Respiratory Care Practitioner (RCP) will initiate, monitor and titrate the oxygen flow rate and mode of oxygen therapy according to protocol guidelines.

Physician will **write a specific order** if patient is **not** to be placed on the oxygen protocol.

Procedure:

The RN/RCP will assess the patient and place on Oxygen Administration Protocol if any of the following clinical indicators are met:

- a. Patient experiencing mild to moderate respiratory distress, (ie: tachypnea (respiratory rate > 26 breath per minute), dyspnea, cyanosis)
- b. Suspected or documented tissue hypoxia, (ie: pulmonary edema, drug overdose, carbon monoxide poisoning)
- c. Neurological changes, (ie: behavior, level of consciousness)
- d. Cardiac function, (ie: chest pain, decreased blood pressure, abnormal heart rate, cool extremity temperature, capillary refill < 2 seconds)
- e. Indications of shock
- f. Trauma patient
- g. Seizure patient
- h. MD writes oxygen order
- i. Patient on home oxygen
- j. Initial O₂ saturation < 90%

The RN/RCP will titrate oxygen (**see Oxygen Therapy Titration algorithm**) appropriately for the patient to maintain a target SpO₂ ≥ 92%, **unless the physician specifies a different target SpO₂.**

- a. Oxygen may be titrated from 0-5 lpm via nasal cannula, or venturi mask up to 40%
- b. All nasal cannula's above 4Lpm **will be humidified.**
- c. Adjust patient positioning (ie: raise HOB, pull patient up in bed etc)
- d. **If necessary to titrate oxygen to >40%, Notify Charge Nurse of changes. CHARGE NURSE TO NOTIFY PHYSICIAN.**

For **COPD patients with known or documented CO₂ retention**, oxygen will be titrated from 0-3 lpm via nasal cannula or 21% to 36% via aerosol or venturi mask to maintain SpO₂ > 88-90%, **unless the physician specifies a different target SpO₂.**

Patient assessments will be documented in the Respiratory Therapy section of the patient medical record.

- a. Any changes in oxygen therapy will be communicated and coordinated to the patient's nurse.
- b. **Physician will be notified immediately by CHARGE NURSE for patients who cannot maintain adequate SpO₂ based on this protocol.**

Patient will be re-evaluated every 24 hours, and then 24 hours after being placed on stand-by (**Oxygen is off at flowmeter but available in needed**).

Oxygen therapy will be titrated and weaned for patients that are able to maintain a SpO₂ of 90% or physicians specified target SpO₂.

- a. If at any time the patient requires > 40% FiO₂, **arterial blood gas is to be drawn and physician will be notified immediately upon receipt of blood gas results by CHARGE NURSE. NOTE: ABG must be obtained within 30 minutes of status change**
- b. If during the weaning period, the patient exhibits persistent difficulty maintaining SaO₂ ≥ 90%, the respiratory therapist will immediately place the patient back on their last setting.
- c. Patients on home oxygen **will not be titrated** below home settings without a physician's order.

Oxygen will be placed on **standby** when the patient meets the conditions defined below.

- a. Stable vital signs including respiratory rate pattern (8-22 breaths per minute and normal work of breathing)
- b. Does not desaturate with exertion
- c. Adequate neurological status (level of consciousness).
- d. Cardiac Status (BP, HR, distal pulses and extremity temperatures)

When discontinuing oxygen therapy the following is required.

- a. Able to maintain a SpO₂ ≥ 90% (on exertion) or physicians target SpO₂ on room air for 24 hours.
- b. **Document room air SpO₂ at rest and on exertion (if able) in Respiratory Care chart record.**
- c. Notify patient's nurse and write order to discontinue oxygen therapy.

Affected departments:

All adult care areas

Responsible parties:

Respiratory Care Staff