

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ





# Oxygen Therapy: Principles & Practice

Dr M. Hashemi  
PULMONOLOGIST



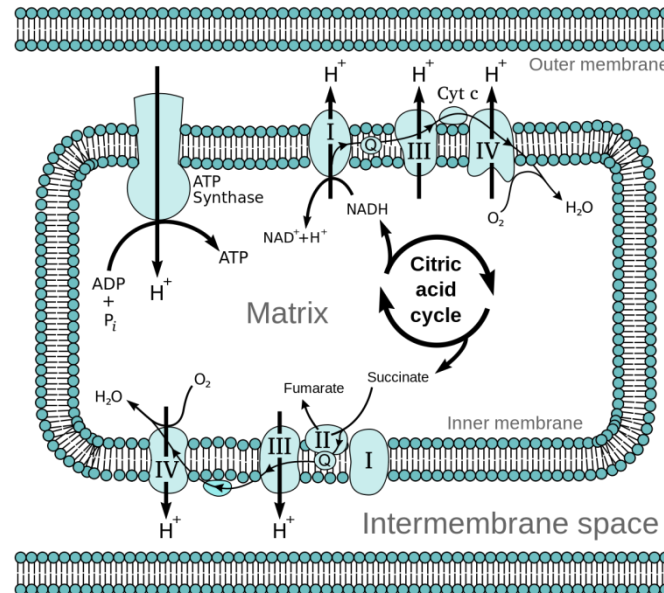


► **Why oxygen is  
required for survival?**



# Oxidative phosphorylation

► Glucose + O<sub>2</sub> → CO<sub>2</sub> + H<sub>2</sub>O + 38 ATP



# Basics

- ▶ **Anoxia.** No oxygen availability in tissues
- ▶ **Hypoxia.** Lack of oxygen availability in tissues
- ▶ **Hypoxemia.** Lack of oxygen in the blood
- ▶ **FiO<sub>2</sub>** (Fraction of O<sub>2</sub> in Inspired gas) 21%
- ▶ PaO<sub>2</sub>?
- ▶ SaO<sub>2</sub>?

## FiO<sub>2</sub>

1 L/min=24%

2 L/min=28%

3 L/min=32%

4 L/min=36%

5 L/min=40%


6 L/min=44%



# What is O<sub>2</sub> Therapy?

- ▶ Oxygen therapy is the administration of oxygen at concentrations **greater than that in room air** to treat or prevent **hypoxia**.



- 
- ▶ Oxygen should be regarded as a drug (BNF 2016).
  - ▶ Oxygen must be prescribed in all situations (except for the immediate management of critical illness in accordance with BTS guidelines) (NPSA Oct 2009).
  - ▶ If abused it can cause complication.

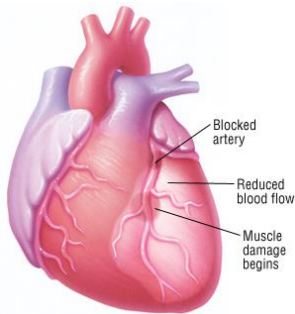


## Few important question:

- ▶ What are the indications for O<sub>2</sub> therapy?
- ▶ How to administer optimally?
- ▶ What are the hazard?



# Clinical goal of O<sub>2</sub> therapy



- ▶ **Treat hypoxia**
- ▶ **Decrease work of breathing**
- ▶ **Decrease myocardial work**



# Types of hypoxia

- ▶ Hypoxic hypoxia
- ▶ Anemic Hypoxia
- ▶ Stagnant hypoxia
- ▶ Histotoxic hypoxia

# Hypoxic hypoxia

## Causes:

- ▶ O<sub>2</sub> poor air, hypoxic gas mixture
- ▶ High altitude
- ▶ Hypoventilation
- ▶ Shunts – septal defects
- ▶ Diffusion defects – pneumonia, lobar collapse

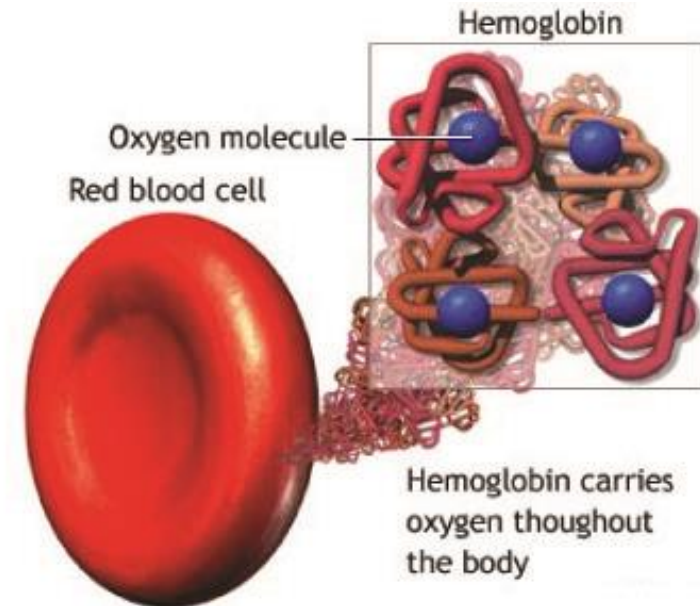




# Anemic hypoxia

**Oxygen carrying capacity of blood is decreased.**

- ▶ Anemia
- ▶ Altered Hemoglobin: CO Poisoning



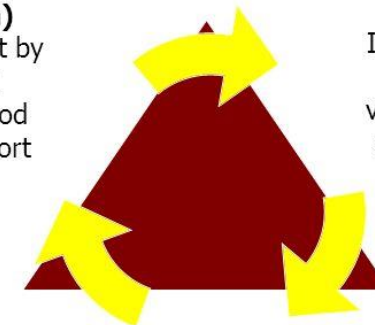
# Stagnant hypoxia

## Inadequate tissue perfusion:

- ▶ Generalized:
  - ▶ Hypovolemia
  - ▶ Mitral Stenosis
  - ▶ Constrictive pericarditis
  - ▶ Myocardial ischemia
- ▶ Localized hypo perfusion:
  - ▶ Arterial obstruction, thrombus,
  - ▶ edema

### 3 | Perfusion Triangle

**Heart  
(Pump Function)**  
Damage to the heart by disease or injury. It cannot move blood adequately to support perfusion.

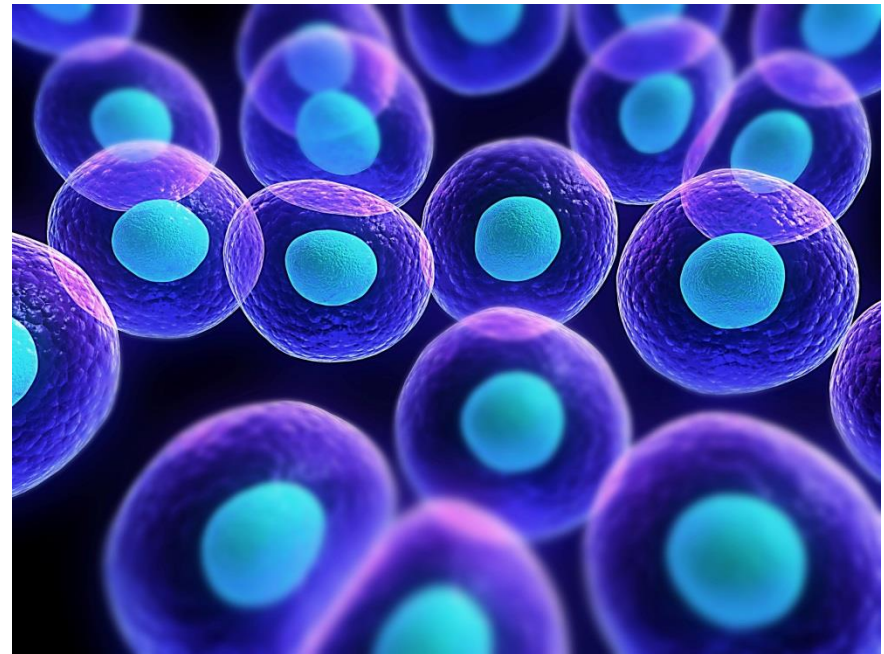


**Blood Vessels  
(Pipe Function)**  
If all the vessels dilate at once, the normal amount of blood volume is not enough to fill the system and provide adequate perfusion to the body.

**Blood  
(Content Function)**  
If blood or plasma is lost, the volume in the container is not enough to support the perfusion needs of the body.

# Histotoxic hypoxia

- ▶ **Cells can not utilize the oxygen**
- ▶ Electron transfer system of cytochrome oxidase is paralyzed
- ▶ E.g. cyanide poisoning



# Benefit of O<sub>2</sub> Therapy in Hypoxia

Types of hypoxia	Benefit
Hypoxic hypoxia	+++
Anemic hypoxia	+
Stagnant hypoxia	+
Histotoxic hypoxia	-



# Indication for O<sub>2</sub> Therapy

- ▶ **Hypoxia** – when PaO<sub>2</sub> comes down to 60mmHg
- ▶ **Normoxic hypoxia** – like low cardiac output state, anemia, CO Poisoning
- ▶ **Trapped gases** – like obstruction
- ▶ **Special situation** – like anesthesia

# Clinical Presentation

## Effect of hypoxia

### Acute hypoxia:

- ▶ Restlessness
- ▶ Disorientation, confusion
- ▶ In-coordination, impaired judgment
- ▶ Hyperventilation air hunger
- ▶ Circulatory changes (tachycardia → brady)

### Chronic hypoxia:

- ▶ Fatigue, drowsiness,
- ▶ Intensiveness, apathy, delayed reaction time

# Assessment of need

- ▶ Presence of clinical indicators
- ▶ Measurement of inadequate oxygen saturation
  - ▶ Arterial blood gas
  - ▶ Pulse oximetry



# O2 Delivery System

## ▶ Low flow systems

- ▶ contribute partially to inspired gas client breathes
- ▶ Ex: nasal cannula, simple mask , non-re breather mask , rebreather mask

## ▶ High flow systems

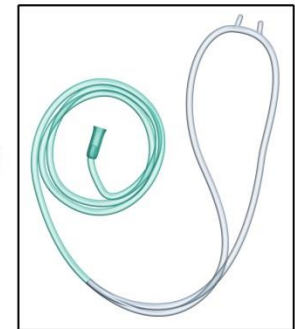
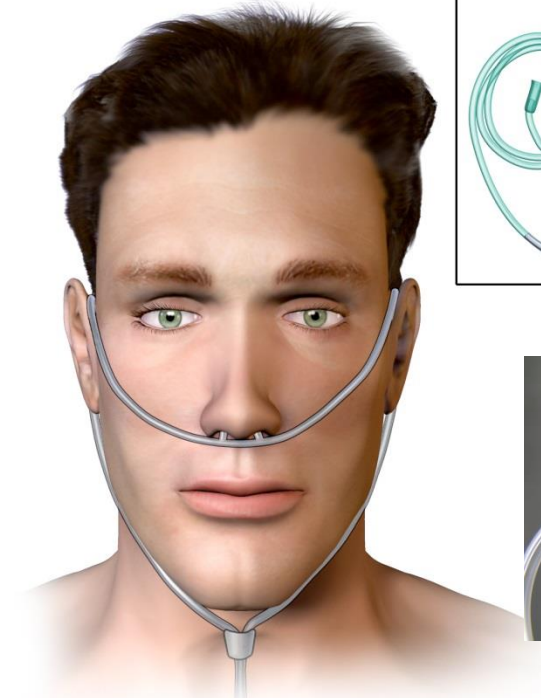
- ▶ deliver specific and constant percent of oxygen independent of client's breathing
- ▶ Ex: Venturi mask,, trach collar, T-piece



# Nasal cannula

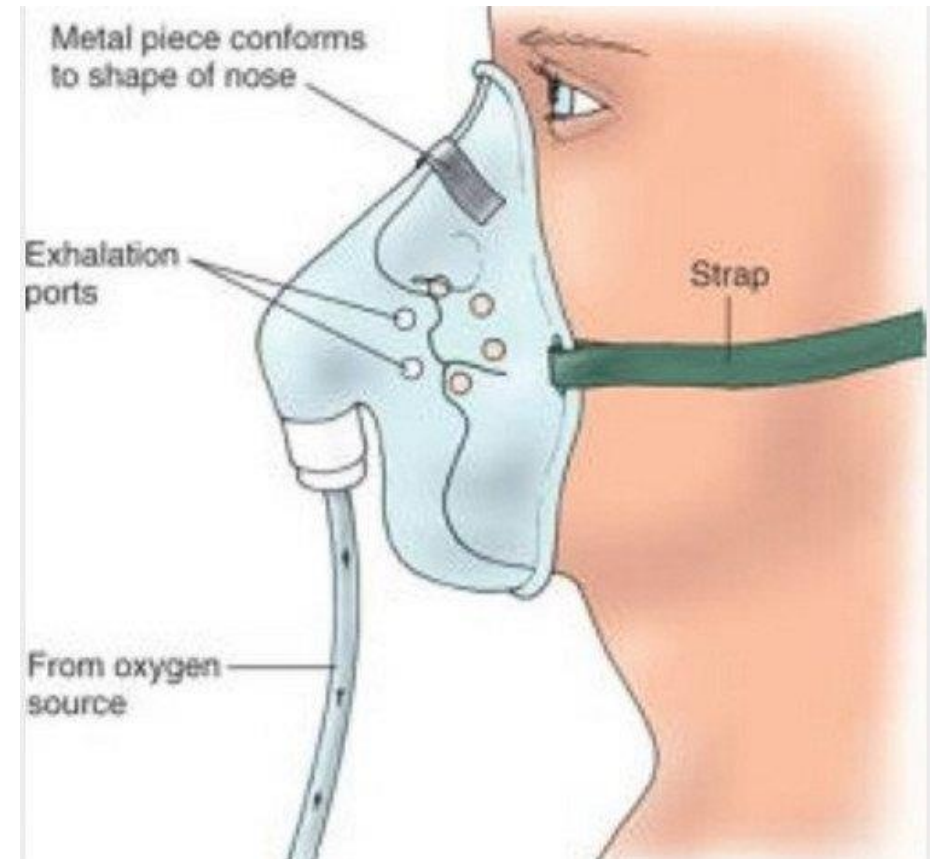
- ▶ The prongs protrude 1 cm into nares
- ▶ Used for low concentrations of **Oxygen 24-44% at 1-6L/min.**
- ▶ Patient are able to talk and eat with oxygen in place
- ▶ May cause irritation to the nasal and pharyngeal mucosa
- ▶ If oxygen flow rates are above 4 L/min variable FiO<sub>2</sub>

Nasal Cannula



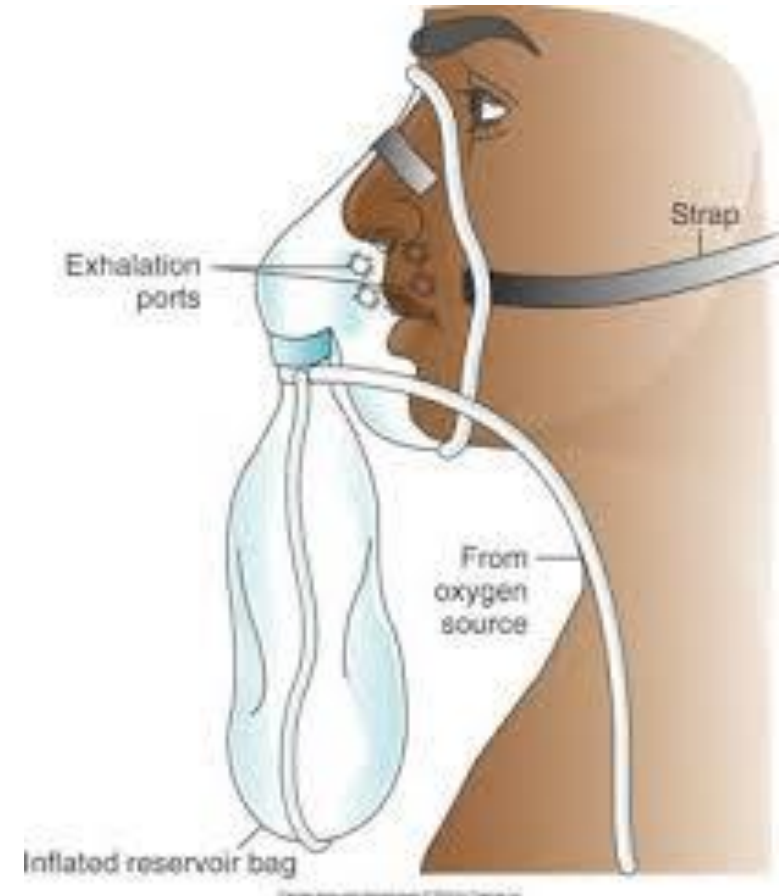
# Simple face mask

- Air entrained through ports if O<sub>2</sub> flow through does not meet peak inspiratory flow
- It delivers 35% to 60% oxygen at 6-10 L/min.
- Flow must be at least 5 L/min to avoid CO<sub>2</sub> build up and resistance to breathing
- Potential for skin breakdown due to pressure and moisture
- Uncomfortable while eating or talking. Obstruct coughing.



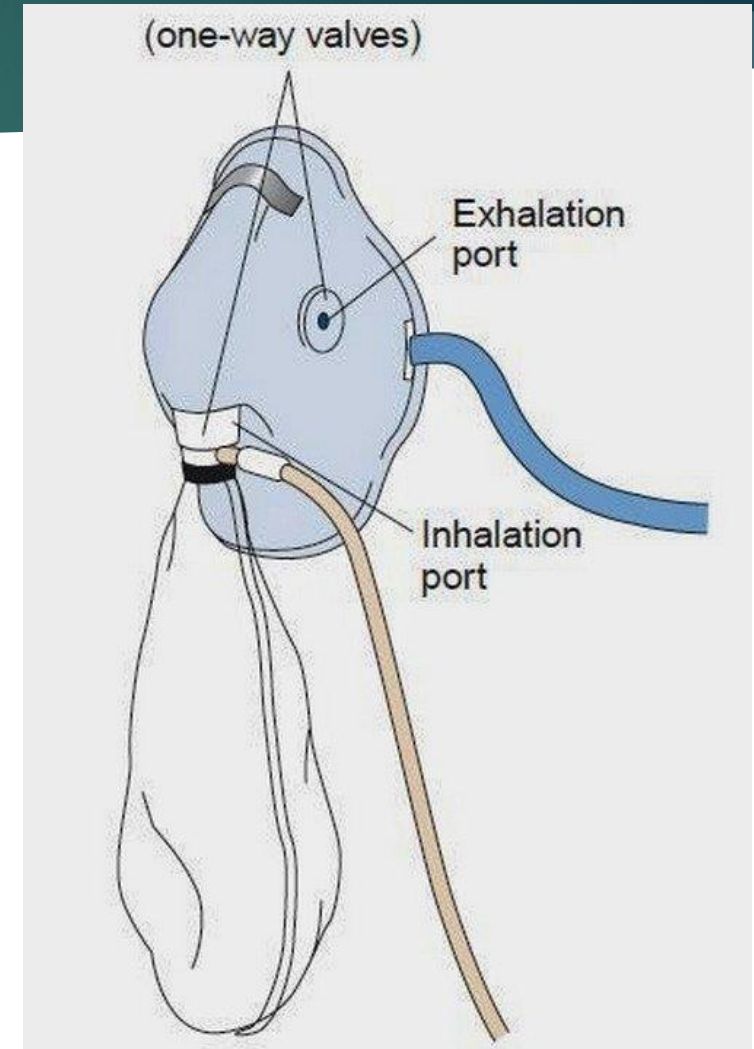
# Rebreather Mask

- It is used to deliver oxygen concentrations up to 80% at 8-12L/m.
- O<sub>2</sub> directed into reservoir
- Insp: draw gas from bag & room air
- Exp: first 1/3 of exhaled gas goes into bag (dead space)
- Dead space gas mixes with 'new' O<sub>2</sub> going into bag
- Bag should remain at least 1/3 full during inspiration



# Nonrebreather Mask

- ▶ Have 2 one-way valves at exhalation ports and bag
- ▶ This mask provides the highest **concentration of oxygen (95-100%) at 10-15L/min.**
- ▶ Client can only inhale from reservoir bag
- ▶ Valve prevents exhaled gas flow into reservoir bag. Valve over exhalation ports prevents air entrainment.
- ▶ **Bag must remain inflated at all times**
- ▶ For Critical illness / Trauma patients, Post-cardiac or respiratory arrest
- ▶ **Effective for short term treatment**





# Estimating $\text{FiO}_2$

O <sub>2</sub> Flow rate	FiO <sub>2</sub>	O <sub>2</sub> Flow rate	FiO <sub>2</sub>	O <sub>2</sub> Flow rate	FiO <sub>2</sub>
<u>Nasal cannula</u>		<u>Oxygen mask</u>		<u>Mask with reservoir</u>	
1	0.24	5-6	0.4	6	0.6
2	0.28	6-7	0.5	7	0.7
3	0.32	7-8	0.6	8	0.8
4	0.36			9	0.80+
5	0.4			10	0.80+
6	0.44				

# Venturi or fixed performance masks



- It is high flow concentration of oxygen.
- Oxygen from 24 - 60% At liters flow of 4 to 15 L/min.
- Aims to deliver **constant and most precise oxygen concentration** within and between breaths.
- With TACHYPNOEA (RR >30/min) the oxygen flow should be increased by 50% - see next slide
- **Increasing flow does not increase oxygen concentration**, it is a fixed dose device
- **Good device for patients with raised CO<sub>2</sub> (patients with a target of 88-92%)**



24% Venturi - 2 L/min - Use 3 l/min if RR >30

28% Venturi - 4 L/min - Use 6 l/min if RR >30

35% Venturi - 8 L/min - Use 12 l/min if RR >30

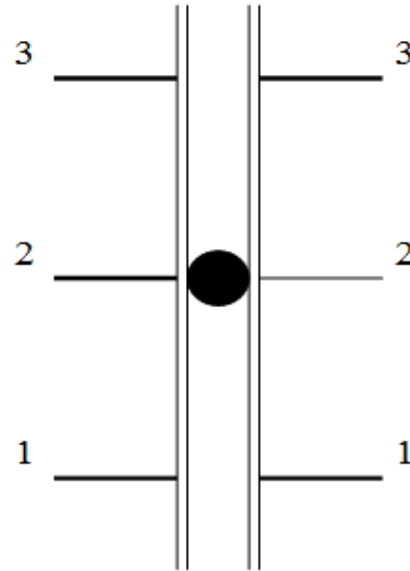
40% Venturi - 10 L/min - Use 15 l/min if RR >30

60% Venturi - 15 L/min - Change to RM if 60%  
Venturi is not sufficient



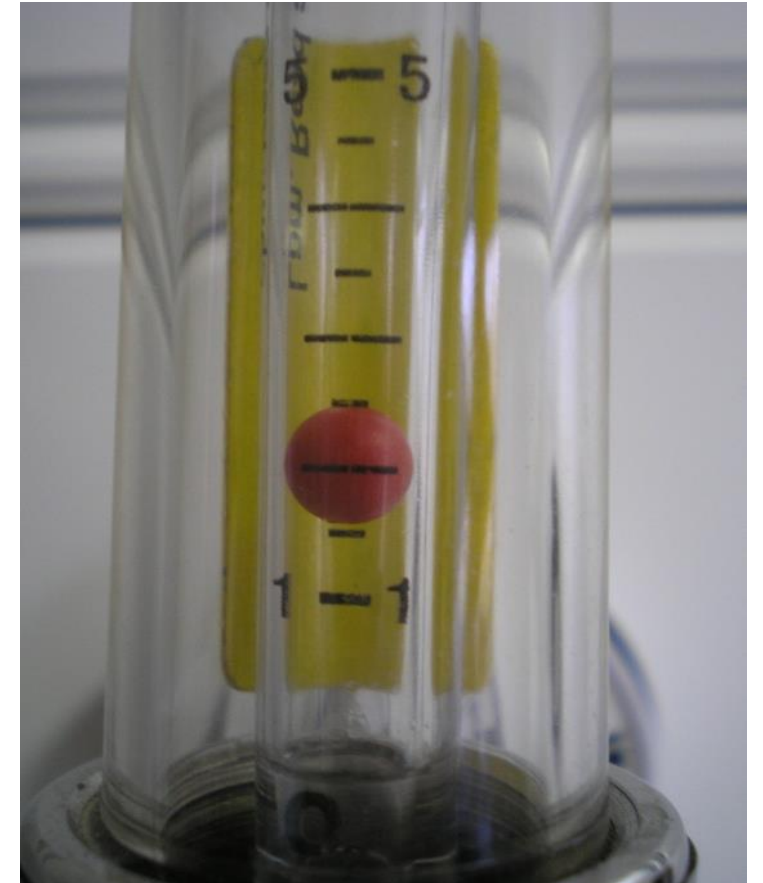
# Oxygen flow meter

The centre of the ball indicates the correct flow rate.



The ball must be **centred** on the line.

This diagram illustrates the correct setting of the flow meter to deliver a flow of 2 litres per minute.





# Hazard of O<sub>2</sub> Therapy

- ▶ Drying of mucous membrane
- ▶ Depression of ventilation in COPD
- ▶ Reversal of compensatory hypoxic vasoconstriction
- ▶ Atelectasis due to absorption collapse
- ▶ O<sub>2</sub> toxicity



# Optimization

## ► My SpO<sub>2</sub> is < 90%, what next?

- ☐ Is the pulse oximeter working/accurate
- ☐ Do I have a good signal?
- ☐ Heart rate plus/minus ?
- ☐ Is there adequate perfusion at the probe site?
- ☐ Can the probe be repositioned?
- ☐ Do other vital signs or clinical manifestations give evidence of hypoxemia?

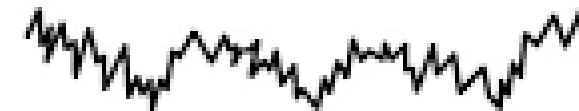
### Pulse Oximeter Waveform



Normal Signal



Low Perfusion



Noise Artifact



Motion Artifact

# Optimization

- **Check my source!**
  - Ensure the O2 delivery device is attached to oxygen not medical air.
  - Follow tubing back to source and ensure patency
  - Are all connections tight?

- ***Is the flow set high enough?***
  - All nebs especially high flow large volume nebs need to be run at the highest rate.
  - Turn flow meter to maximum for large volume nebs.

# Optimization

- **Reposition patient.**

- Avoid laying patient flat on back.
- Raise head of bed.
- Encourage deep breathing/coughing

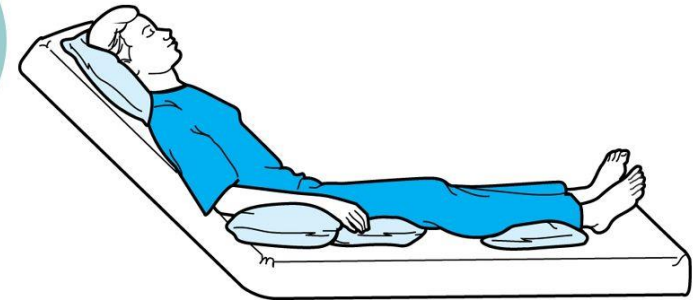
- **Listen to chest.**

- Wheezing?
  - Do they need a bronchodilator?
- Crackles?
  - Encourage deep breathing/cough.
  - Are they fluid overloaded?

# Optimization

- *Can I improve the mechanics of breathing?*
  - Patient position
  - Pursed lip breathing
  - Abdominal breathing.
  - Anxiety relief?

Semi-Fowler's Position

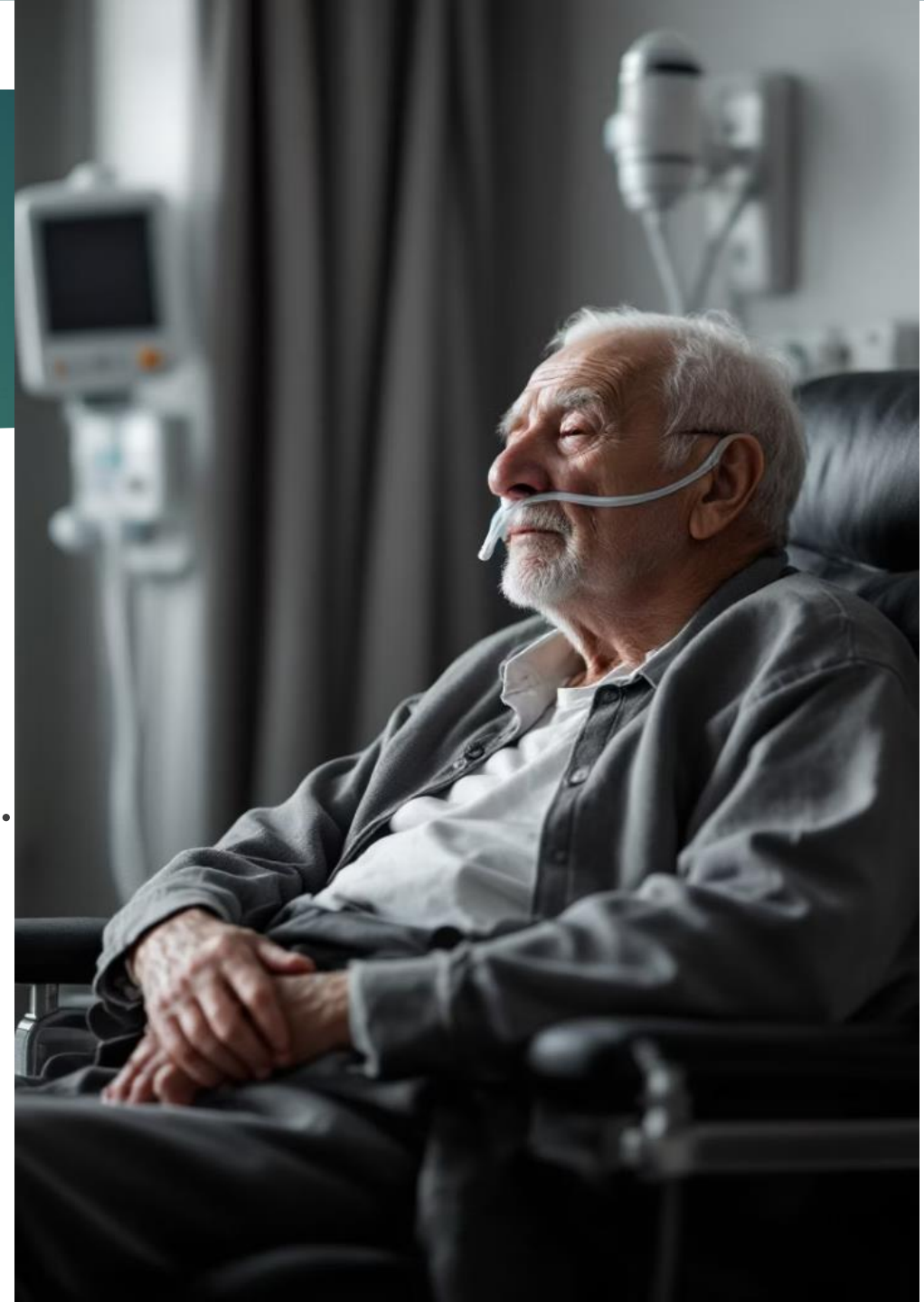


Positioning patients.




# Evaluation

- Breathing pattern regular and at normal rate.
- pink color in nail beds, lips, conjunctiva of eyes.
- No confusion, disorientation, difficulty with cognition.
- Arterial **oxygen** concentration or hemoglobin
- **Oxygen** saturation within normal limits.





A woman with long blonde hair, seen from behind, is walking away through a sun-dappled forest. She is wearing a white, long-sleeved dress. The scene is filled with soft, golden light filtering through the trees, creating a dreamy atmosphere. The ground is covered in green grass and small white flowers. The trees have light green leaves, and the overall tone is warm and ethereal.

قایقی خواهم ساخت،  
خواهم انداخت به آب.  
دور خواهم شد از این خاک غریب  
که در آن هیچ کسی نیست که در بیشه عشق  
قهرمانان را بیدار کند.

هم چنان خواهم راند.  
هم چنان خواهم خواند:  
“دور باید شد ازین خاک غریب”

پشت دریاها شهری است  
که در آن پنجره‌ها رو به تجلی باز است.  
بام‌ها جای کبوترهایی است که به فواره هوش  
بشری می‌نگرند...





► Thank you



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