

Basics of Oxygen Therapy

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Goals of Oxygen Therapy

- Treat hypoxia
- Decrease work of breathing/Alleviate Respiratory Distress

Manifestations of Hypoxia

- Restlessness
- Confusion/Disorientation
- Impaired judgment
- Hyperventilation/Tachypnea

Basic Relevant Terms

- SpO₂ : Oxygen percent saturation in Human body, measured as Percent
- FiO₂: Fraction percent of oxygen in air, Normal Room air has 21% oxygen which can be increased with the help of oxygen supplementation devices
- PaO₂: Partial Pressure of Oxygen in Blood, measured in mm Hg

Baseline values

- SpO₂ > 95% : No Oxygen supplementation **usually** needed
- SpO₂ 90-95%: Nasal Prongs/Face Masks are **usually** effective
- SpO₂ < 90%: Rebreather Masks/Venturi Masks/HFNC/NIV

LOW FLOW DEVICES

- Nasal Canula
- Simple Face Masks
- **fiO₂ delivered is dependent on patient's ventilatory demand**

HIGH FLOW DEVICES

- Venturi Masks(Air entrainment masks)
 - Partial Rebreather Face Mask System
 - Non Rebreather Face Mask System
 - High Flow Nasal Canulae
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- **fiO₂ delivered is NOT dependent on patient's ventilatory demand**

Nasal Canulae

- Also called as Nasal Prongs
- Relatively stable patients with minimal requirement of oxygen
- Well tolerated
- Do not interfere with eating and speaking
- Delivery of constant airflow to nasopharynx and oropharynx
- Acts as a reservoir of 50 ml capacity
- Gas flow produces a Bernoulli's effect in posterior pharynx



Nasal Canulae

- FiO₂ Room Air: 21%
- Roughly $FiO_2 = 20 + 4 \times O_2 \text{ in LPM}$
- Max up to 0.4 FiO₂
- Up to 6 LPM
- Therefore, 6 LPM increases the FiO₂ up to 40% max
- Flow rate beyond that is neither helpful nor comfortable
- Higher flow rate with nasal canulae dries the nasal mucosa and increases chances of infection.



Nasal Canulae

- Also, FiO_2 in Nasal Canulae depends on ventilatory demand
- For a respiratory rate of 30-35 per minute, FiO_2 is decreased by 20-30%
- Therefore, Nasal canulae effective only in patients with less oxygen requirement, relatively stable patients with RR not more than 20-22 per minute



SIMPLE FACE MASKS

- A light weight plastic mask
- Oxygen inlet at the base and holes at the sides for exhalation
- Adds 100-200 ml to the capacity of reservoir
- Delivers oxygen at flow rates of 6-10 LPM
- 6LPM is the minimum flow rate needed to clear the exhaled gas from the mask
- FiO_2 decreases with increasing ventilatory demand
- Have to be removed during eating and drinking etc



PARTIAL REBREATHER FACE MASKS

- Reservoir capacity increased with a bag
- No valve between the mask and the reservoir
- First 1/3 of expiratory gas(which has not participated in gas exchange) is exhaled back into the reservoir
- Next 2/3 is exhaled out via the side ports



PARTIAL REBREATHER FACE MASKS

- The next breath therefore has a higher FiO_2 of oxygen in it
- Can deliver FiO_2 of 0.6-0.8 at flow rates of 6-10 LPM
- Actual FiO_2 depends on ventilatory demand

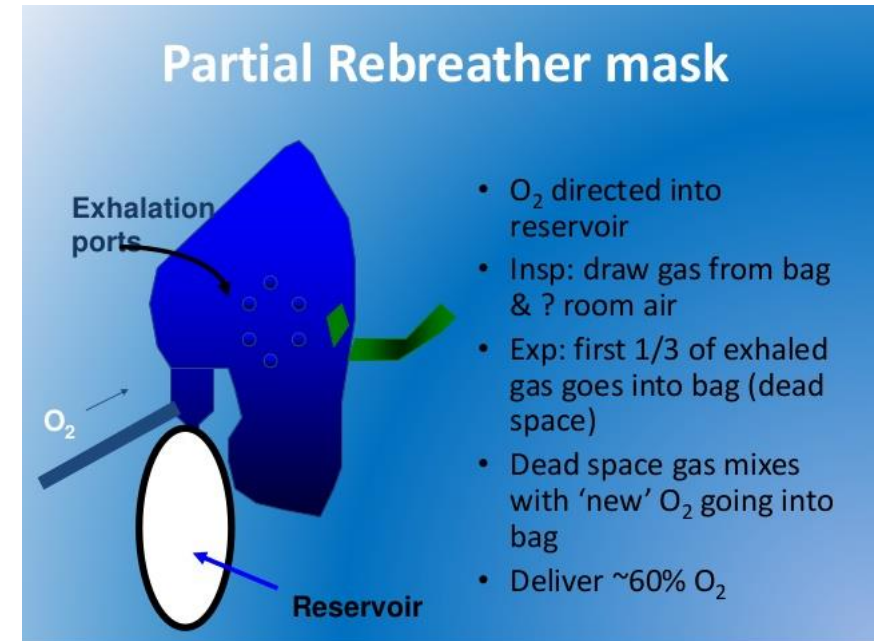
Partial Rebreather Mask

- Consists of mask with exhalation ports and reservoir bag
- Reservoir bag must remain inflated
- O_2 flow rate - 6 to 10L
 $\text{FiO}_2=60\%-80\%$
- Client can inhale gas from mask, bag, exhalation ports
- Poorly fitting; must remove to eat



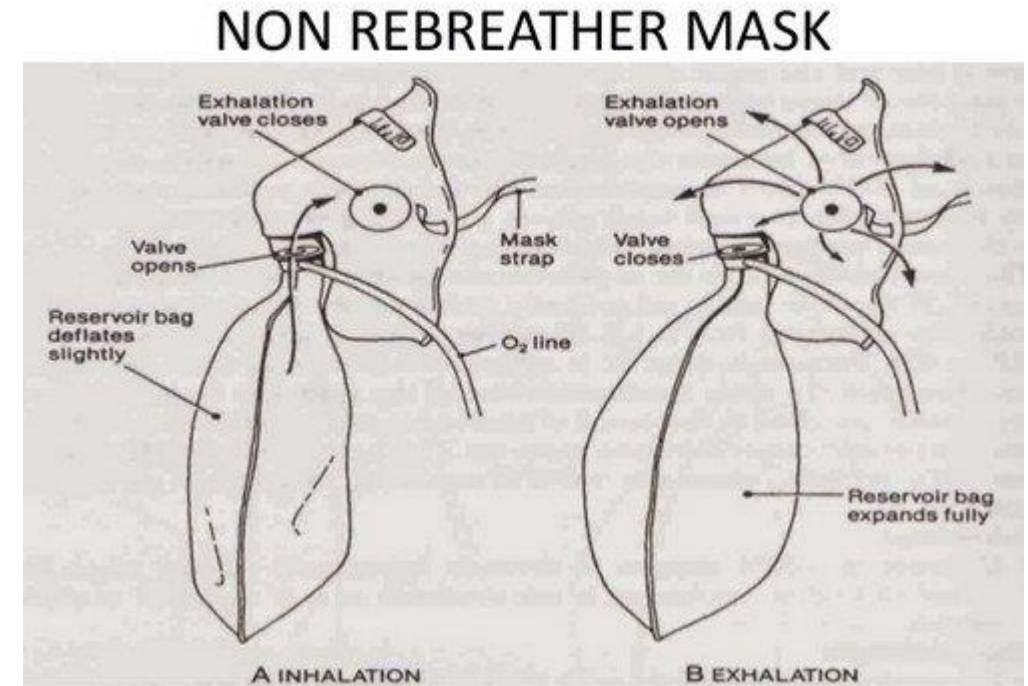
PARTIAL REBREATHER FACE MASKS

- The reservoir bag should not collapse during inspiration
- This can increase the work of breathing
- Ideally at least 8LPM should enter the mask to remove exhaled CO₂ completely and to fill the oxygen reservoir



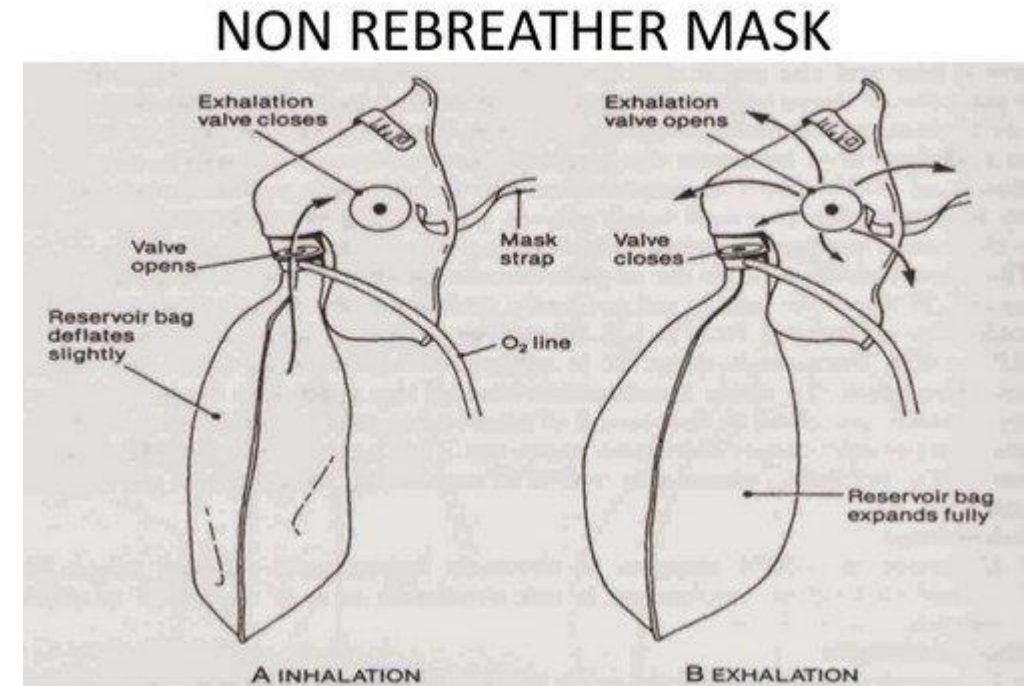
NON REBREATHER FACE MASKS

- Similar to Partial Rebreather masks except that the connection between mask and reservoir also one way valve
- Theoretically, these can deliver 100 percent oxygen
- Practically 0.6-0.8 only



NON REBREATHER FACE MASKS

- Reservoir bag should not collapse during inspiration
- These partial Rebreather or Non Rebreather masks do not decrease the work of breathing significantly
- Because they do not create PEEP

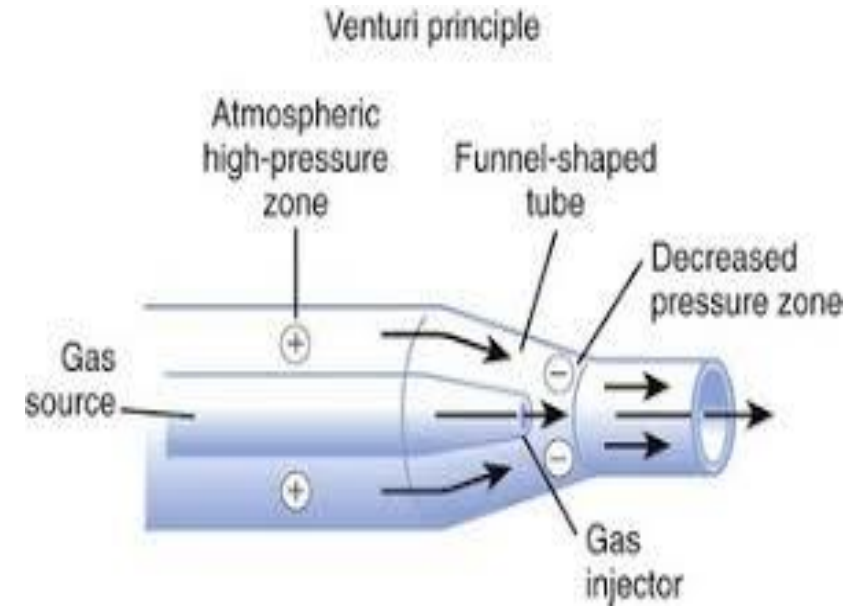
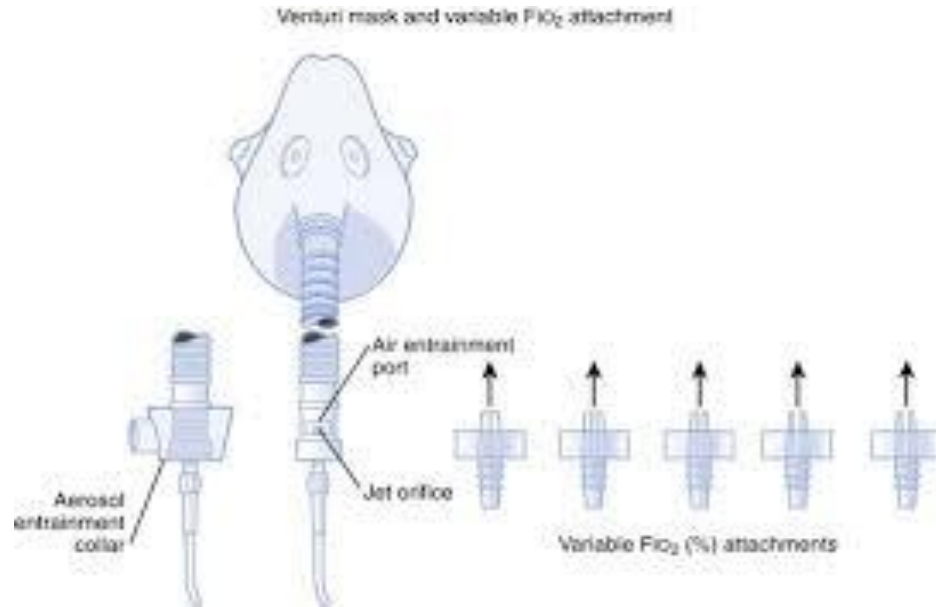


VENTURI MASKS

- Colour coded entrainment devices
- Delivers specific fio₂ at specific flow rate

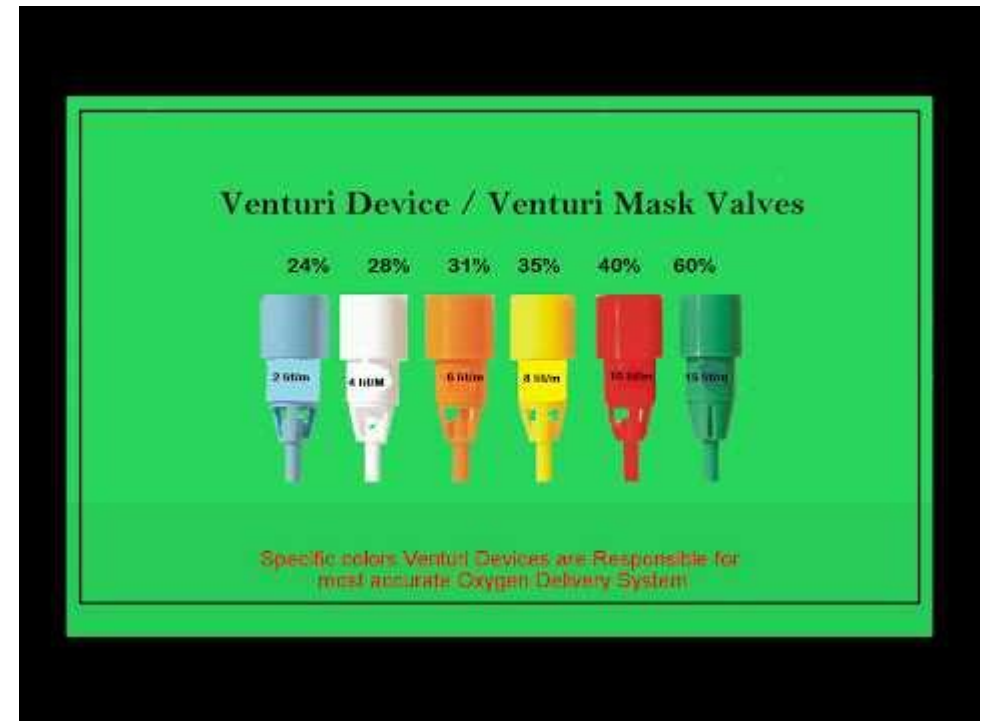


VENTURI MASKS: PRINCIPLE



VENTURI MASKS

- Entrainment device has various ports of restricted sizes through which oxygen flows at high velocities
- The more is the velocity at which the air enters the mask (narrower is the entry orifice), the more is the dilution by atmospheric air and lower is the FiO_2



VENTURI MASKS

Venturi valve



Color	FiO ₂	O ₂ Flow
Blue	24%	2 L/min
White	28%	4 L/min
Orange	31%	6 L/min
Yellow	35%	8 L/min
Red	40%	10 L/min
Green	60%	15 L/min



HIGH FLOW NASAL CANULA

- Generate high flow oxygen at 40-60 LPM
- FiO₂ up to 100% can be delivered
- Choice between HFNO and NIV:
Individualized



HIGH FLOW NASAL CANULA

- HFNO allows patient to eat/speak unlike NIV
- Some patients not settled by HFNO may need NIV or even vice versa



CASE 1

- A 55 year old diabetic, Covid pneumonia has RR 24/min, SpO₂ 88% RA, Which is the best modality to give oxygen?
 - a) Nasal prongs at 2 LPM
 - b) Nasal prongs at 8 LPM
 - c) Simple face mask at 6 LPM
 - d) High flow Nasal Canula

CASE 2

- The same patient after 6 hours has a respiratory rate of 28/minute, SpO₂ of 90% at Nasal prongs 4 LPM, but not much use of accessory muscles of respiration. What should you do next?
 - a) Increase the flow to 10 LPM
 - b) Shift to Venturi Mask
 - c) Shift to HFNC
 - d) Shift to NIV

CASE 3

- A 62 year old male with Covid pneumonia has a RR 34/minute, accessory muscles of respiration in use and SpO₂ of 78% RA, Appropriate modality of oxygen delivery would be
 - a) Nasal Prongs at 6LPM
 - b) Venturi Mask at 60% fiO₂
 - c) Simple face mask at 6LPM
 - d) High flow Nasal Canula

THANK YOU