

Oxygen Therapy, CPAP, and NIV

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Oxygen Delivery Devices

■ Low-flow devices

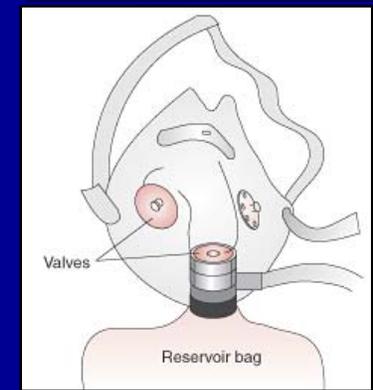
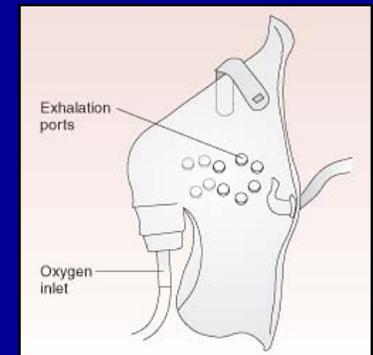
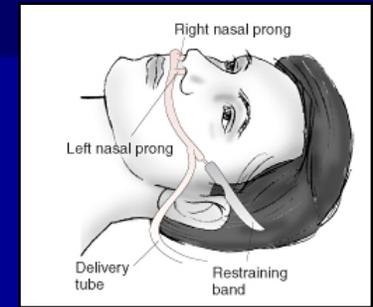
- Oxygen flow less than inspiratory flow of patient
- FIO_2 variable and depends on oxygen flow, volume of reservoir, breathing pattern
- Cannula, simple mask, nonrebreather

■ High-flow devices

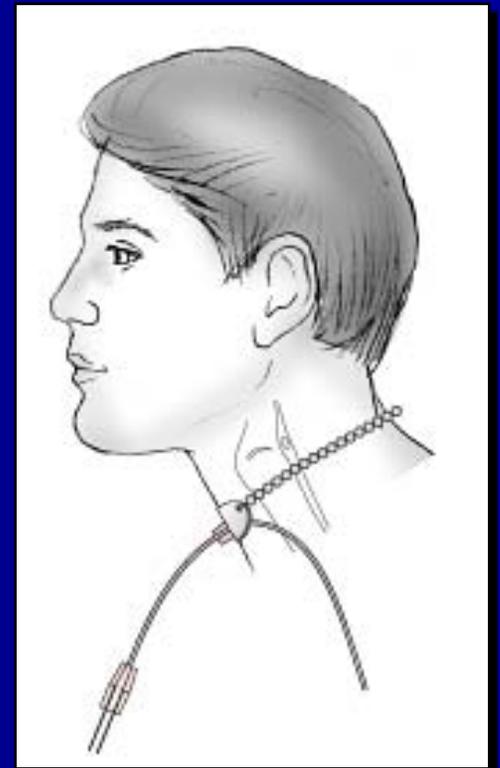
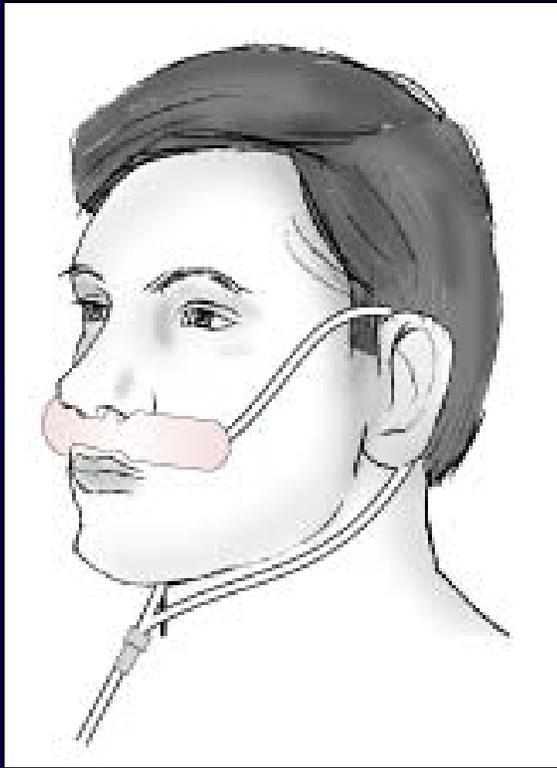
- Flow greater than inspiratory flow of patient

Low Flow Devices

- Nasal cannula
 - FIO_2 0.24 - 0.40 at 1 - 6 L/min
- Simple mask
 - FIO_2 0.3 - 0.6 at 5 - 10 L/min
- Nonrebreathing mask
 - FIO_2 0.6 - 0.8 at 10 - 15 L/min

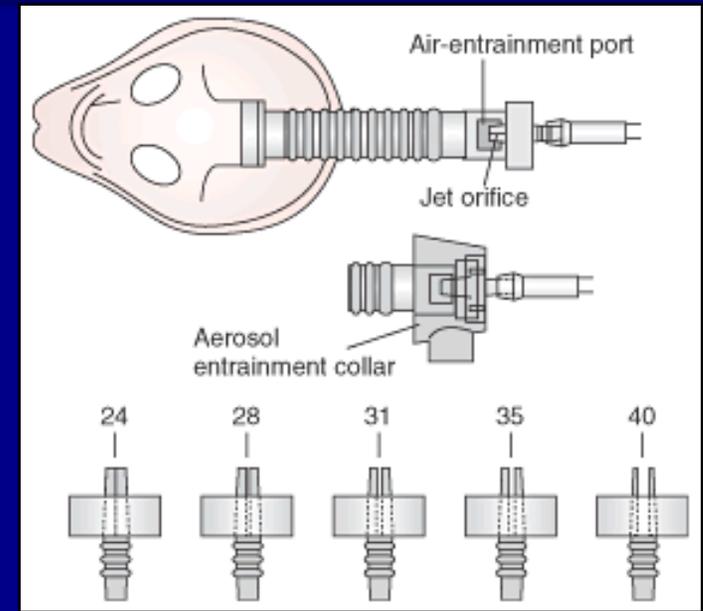


Reservoir Cannula and Transtracheal Catheter

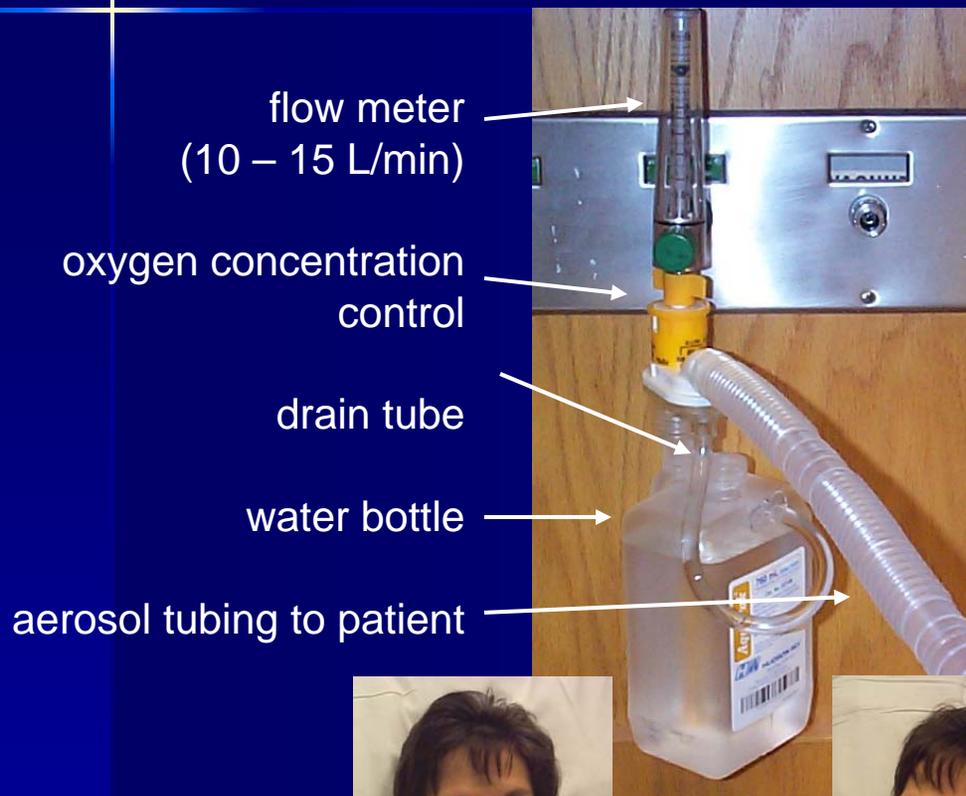


Air Entrainment Mask (Venturi Mask)

- High flow delivery device
- Available in various fixed oxygen concentrations
- Not convenient; requires good mask fit



Cool Aerosol



FIO_2 setting 0.28 - 1.0. At $FIO_2 > 0.50$, the total flow from the nebulizer is significantly reduced and room air dilutes the delivered oxygen concentration.

| O_2 Flow | O_2 Setting | Air: O_2 | Total Flow |
|------------|---------------|------------|------------|
| 10 | 0.28 | 10:1 | 110 |
| 10 | 0.40 | 3:1 | 40 |
| 10 | 0.6 | 1:1 | 20 |
| 10 | 1.0 | 0:1 | 10 |



FIO_2 decreases as FDO_2 increases!

High Flow Oxygen

High Flow Air and O₂ Flowmeters to Titrate FIO₂



Face Mask or
Trach Mask

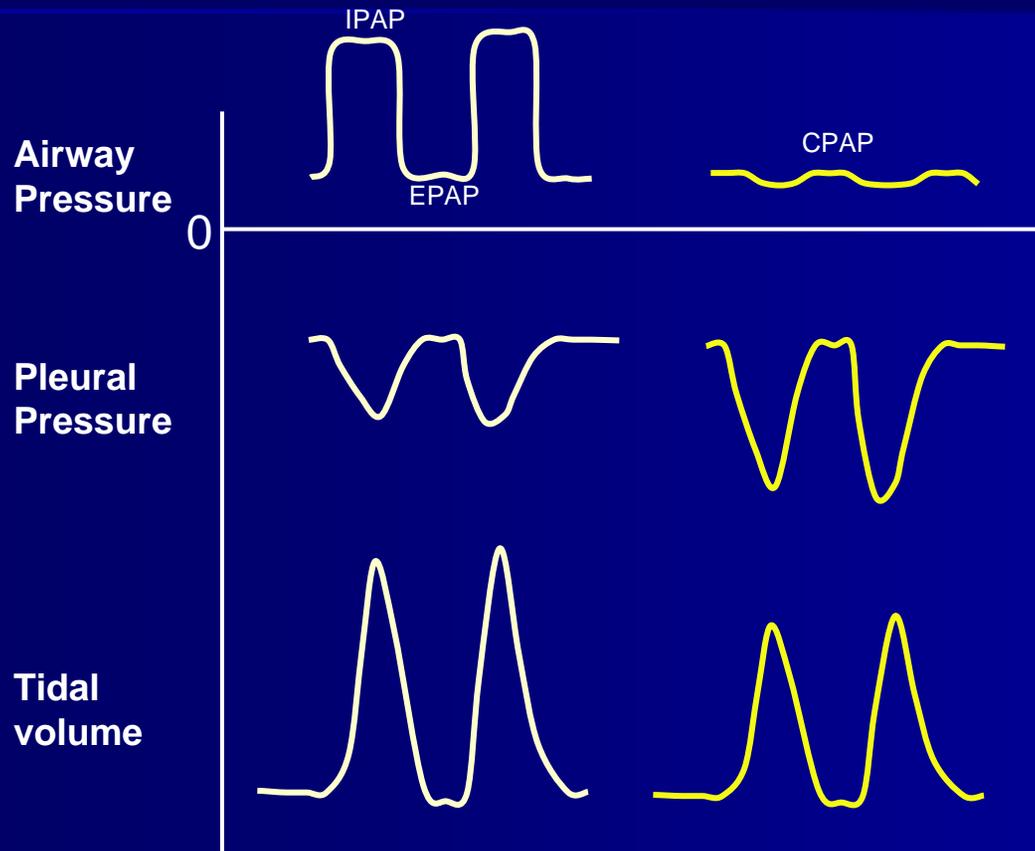
Oxygen Analyzer

Humidifier

Oxygen Therapy Myths

- Oxygen decreases respiratory drive
 - PaCO₂ may increase, but usually not due to suppressing hypoxic drive
- Cannula cannot be used if the patient is a mouth breather
- Nonrebreather delivers 100% oxygen
- Cool aerosols can deliver high FIO₂

NIV vs CPAP



No ventilation assistance with CPAP, but increased lung volume and intrathoracic pressure.

Mask CPAP for Hypoxemic Respiratory Failure

- Patients randomized to O₂ or mask CPAP
- After 1 hr, subjective response and PaO₂/FIO₂ were higher with CPAP
- No difference in intubation rate or mortality
- Higher number of adverse events in patients receiving CPAP

Delclaux, JAMA 2000; 284:2352

Mask CPAP for Post-Op Hypoxemia

- Patients with hypoxemia after major abdominal surgery randomized to 7.5 cm H₂O CPAP or oxygen
- PaO₂ improved more rapidly for CPAP
- Lower intubation rate (1% vs 10%), lower pneumonia rate (2% vs 10%), fewer ICU days (1.4 vs 2.6 d) with CPAP

Squadrone, JAMA 2005; 293:589

Benefits for Mask CPAP

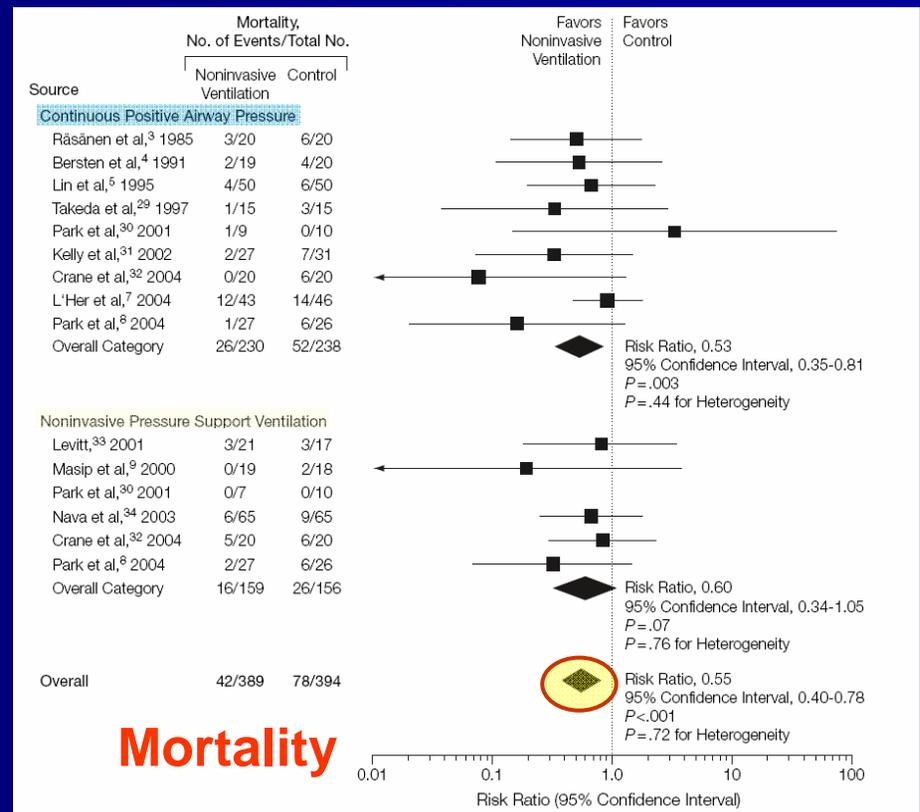
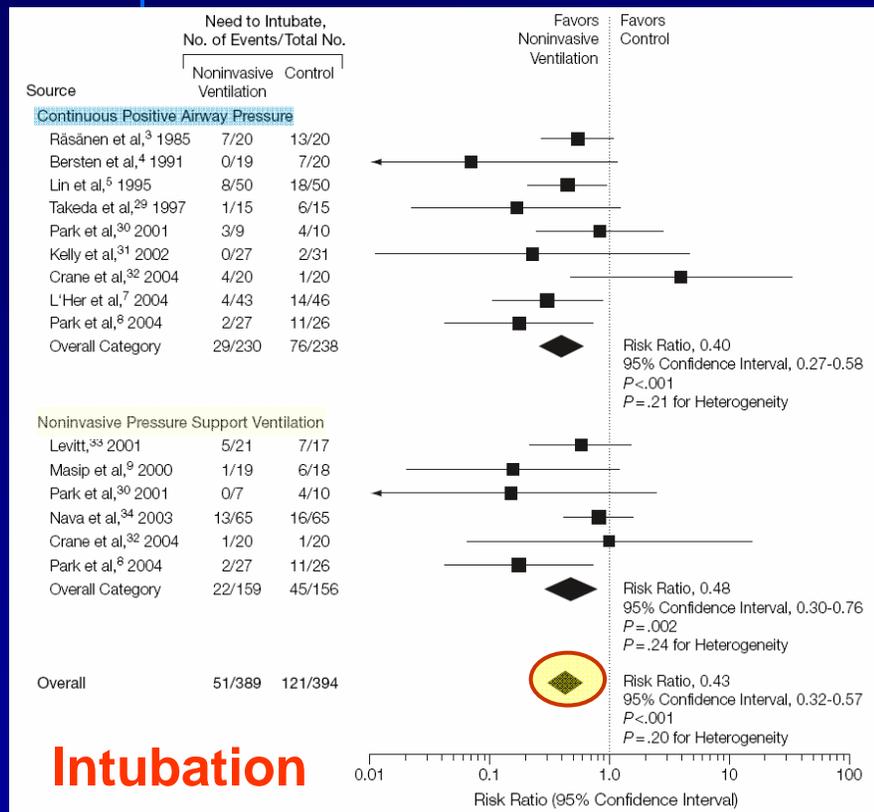
- Acute cardiogenic pulmonary edema
- Post-operative atelectasis
- Obstructive sleep apnea
- OSA, CSR, and CSA associated with CHF

NIV for COPD Exacerbation

| Outcome | Number of studies contributing data | Total number of patients | Relative risk (95% CI) | Number needed to treat (95% CI) |
|-------------------|-------------------------------------|--------------------------|------------------------|---------------------------------|
| Treatment failure | 7 | 529 | 0.51 (0.38 to 0.67) | 5 (4 to 7) |
| Mortality | 7 | 523 | 0.41 (0.26 to 0.64) | 8 (6 to 13) |
| Intubation | 8 | 546 | 0.42 (0.31 to 0.59) | 5 (4 to 7) |
| Complications | 2 | 143 | 0.32 (0.18 to 0.56) | 3 (2 to 4) |

Lightowler, BMJ 2003; 326:185

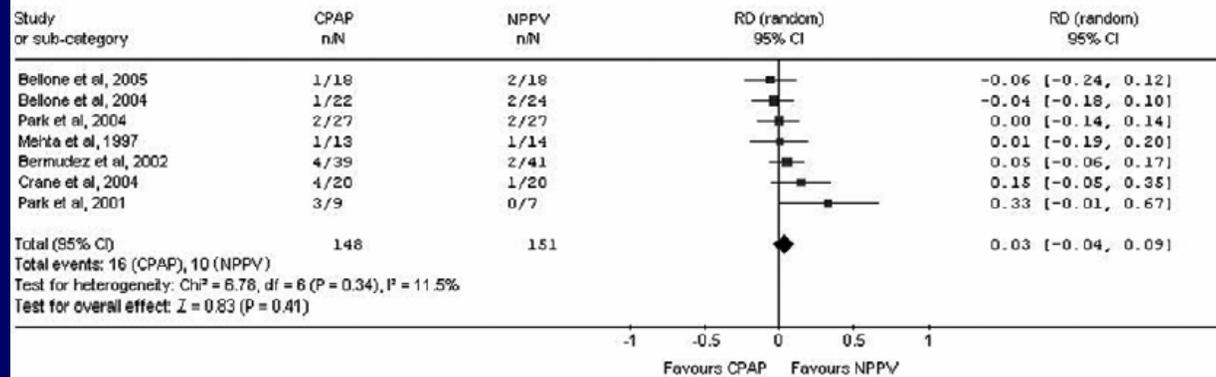
NPPV for Acute CPE



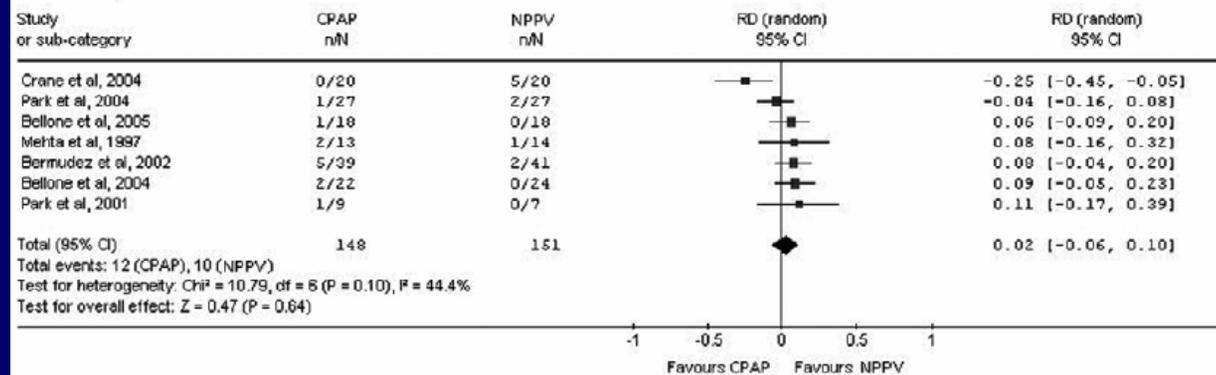
Masip, JAMA 2005;294:3124

Mask CPAP and CPE

Need for endotracheal intubation



Mortality



Winck, Critical Care 2006, 10:R69

Evidence for NPPV

| | |
|--|-------|
| COPD Exacerbations | ***** |
| Acute cardiogenic pulmonary edema | **** |
| Prevent extubation failure | ** |
| Respiratory failure following lung resection | * |
| Transplantation, immunocompromise | * |
| Acute hypoxemic respiratory failure | ? |
| Asthma | ? |
| Do not intubate/Do not Resuscitate | ? |
| Failed extubation | — |

Patient Selection for NIV

Inclusions:

- Respiratory distress
- Tachypnea, accessory muscle use
- Acute respiratory acidosis

Exclusions:

- Airway protection
- Unable to fit mask
- Severity of illness
- Uncooperative patient
- Patient wishes

Step 1: Patient needs mechanical ventilation

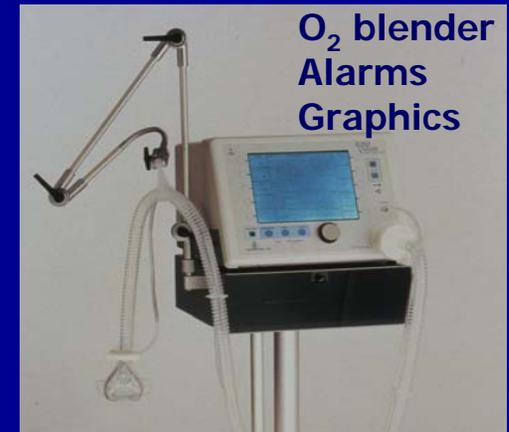
Step 2: No exclusions for NPPV

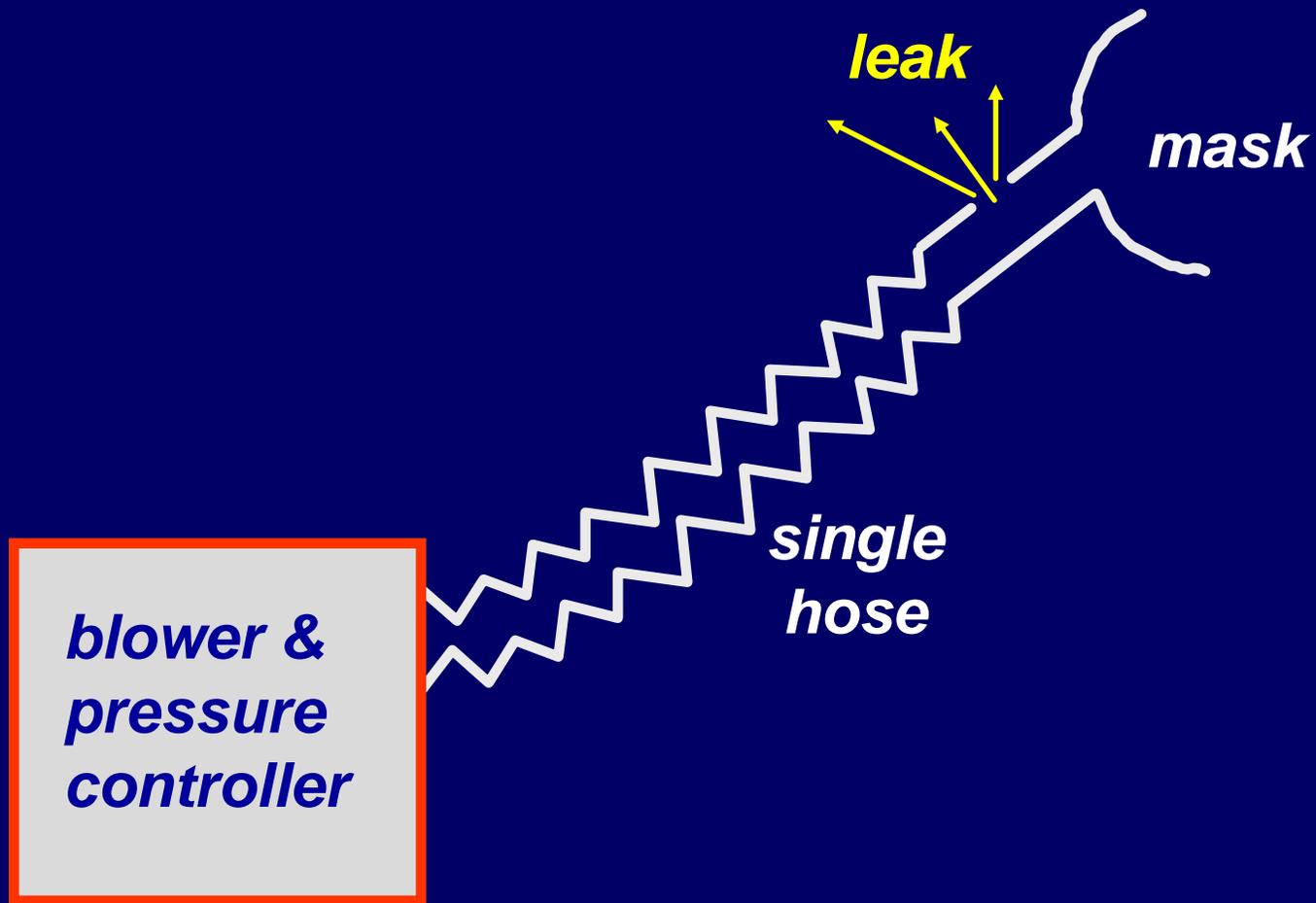
Knowing When to Stop

- Lack of improvement within 1-2 hrs of initiation of therapy
- Patient intolerance of therapy
- Adverse effects: hypotension
- Patient wishes

When to keep patient on ward, when to transfer to ICU or RACU?

Equipment for NIV/CPAP





IPAP

EPAP

PS (or PC) = IPAP - EPAP

Noninvasive Respiratory Support

- Oxygen delivery devices
- CPAP
- NIV

- Aerosol bronchodilator
- Airway clearance
- Heliox