RESPIRATORY FAILURE
NON INVASIVE VENTILATION TREATMENT

Dr. Dhruva Chaudhry
Senior Professor & Chair
Pulmonary & Critical Care Medicine
PGIMS,UHS
Rohtak, Haryana

General Secretary (Elect)
Indian Society of Critical Care Medicine
(ISCCM)

RESPIRATORY FAILURE-DEFINITION

Inability of the Respiratory system to maintain the metabolic demands of the body

Elimination of CO_2
Oxygenation of blood

- **Acute: A sudden catastrophic life threatening event**
- **Chronic: Gradual progressive deterioration of respiratory functions with partial metabolic compensation with little or no reserve**
- **Acute on chronic**

- **Type I/Acute Hypoxaemic respiratory failure**

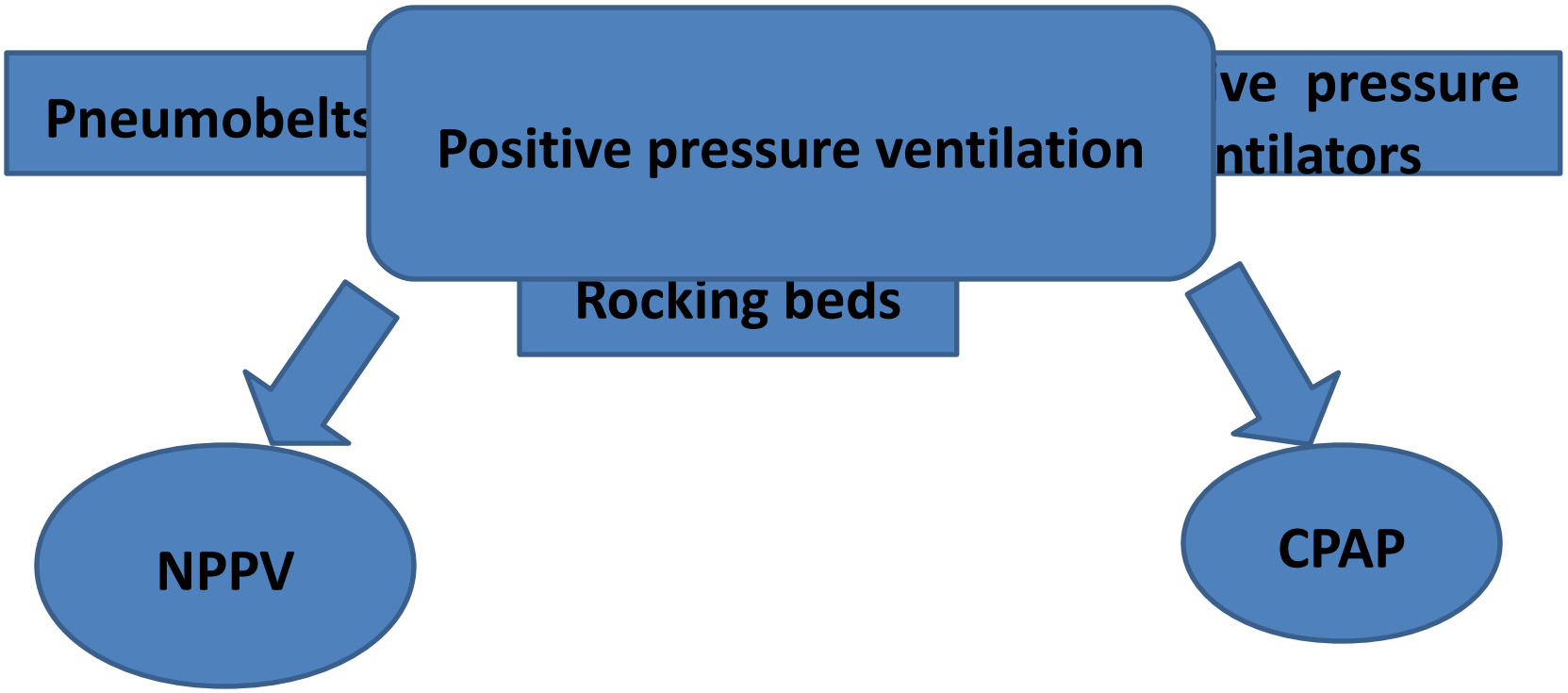
  Pa O2 <60 mm Hg on room air

- **Type II/Acute Ventilatory (Respiratory) failure**

  PaCO2 >45 mm of Hg

- **Type III Respiratory failure**

- **Provision of mechanical ventilation without the need for an invasive artificial airway**

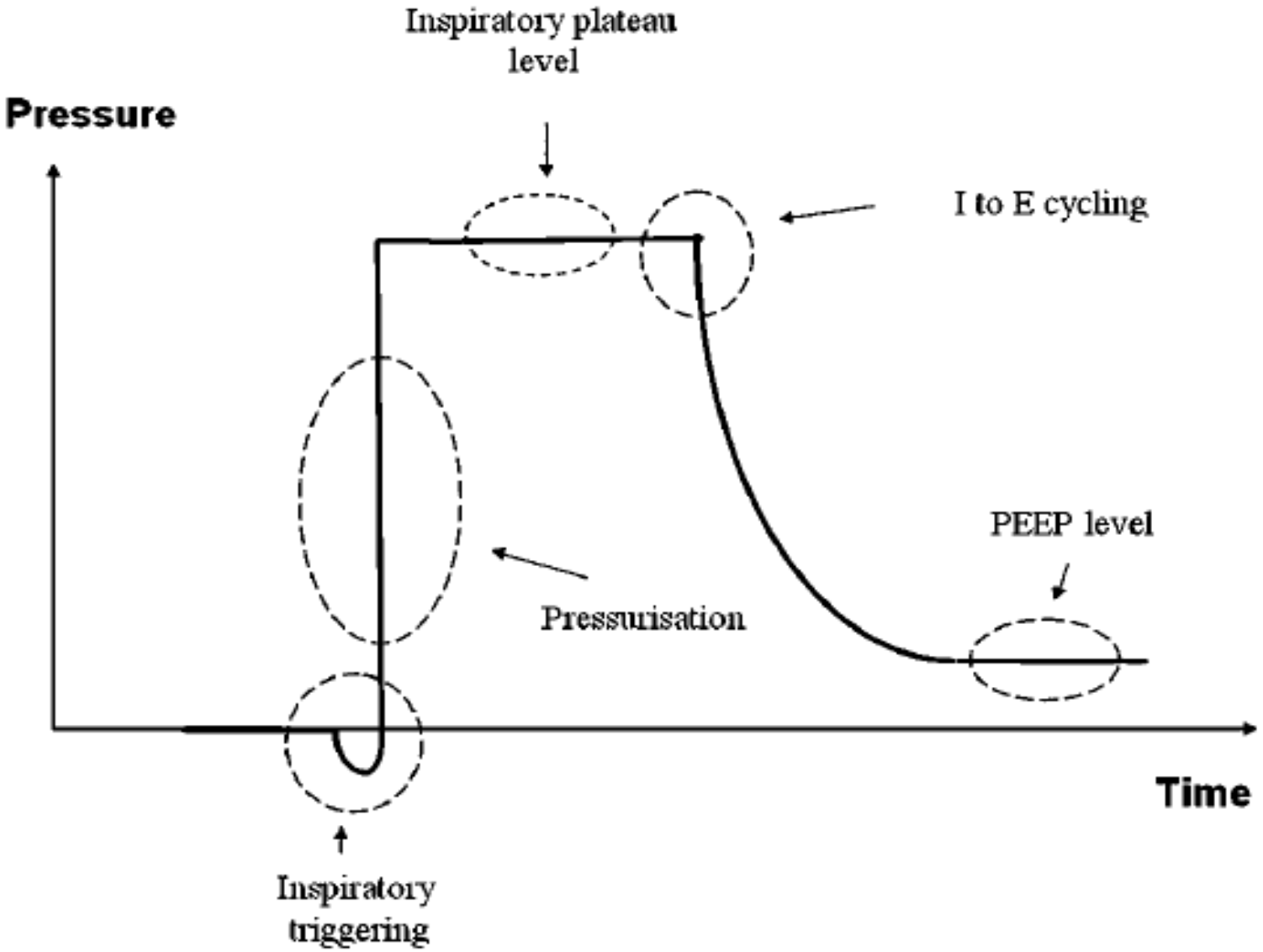


Positive pressure ventilation

- Invasive

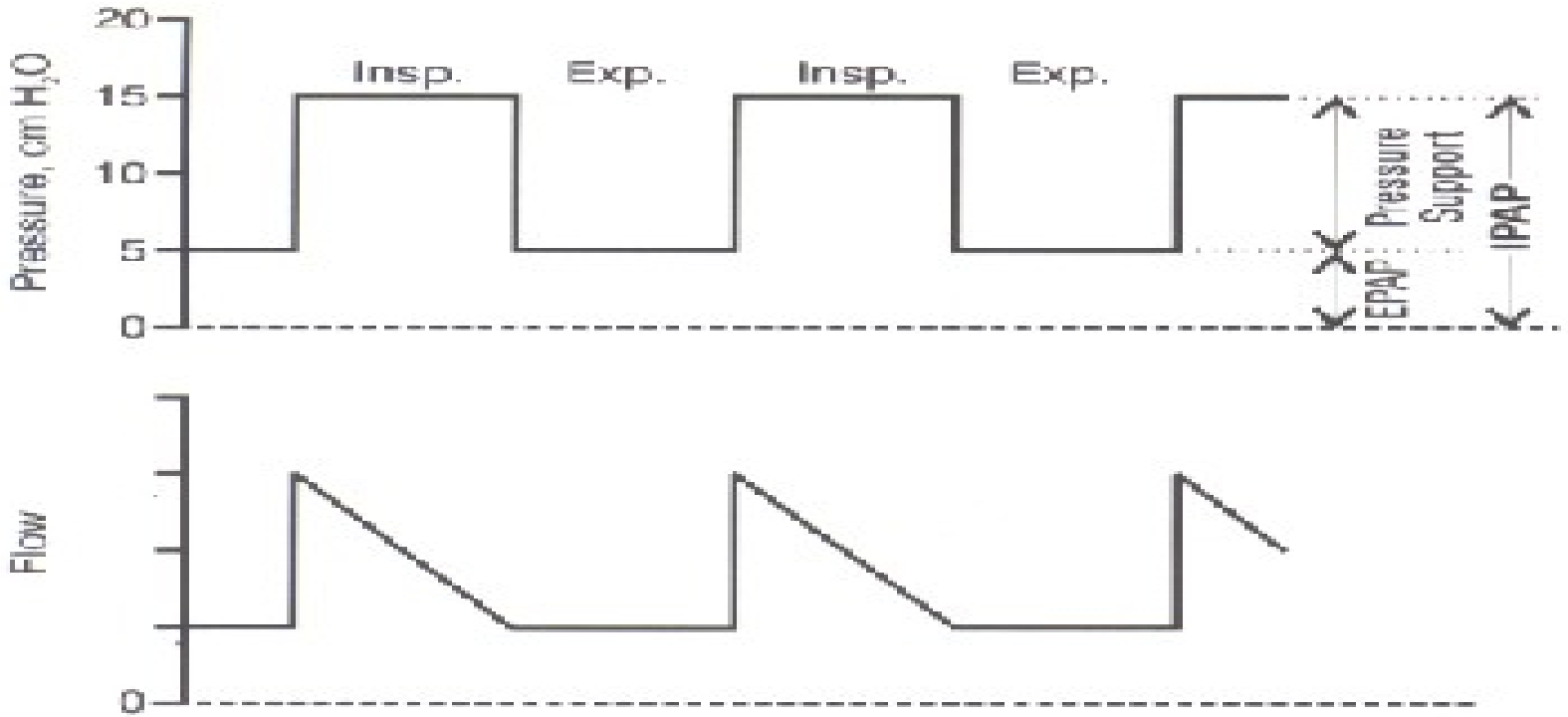
- Non-invasive

NIV – THE BASIC PRINCIPLE

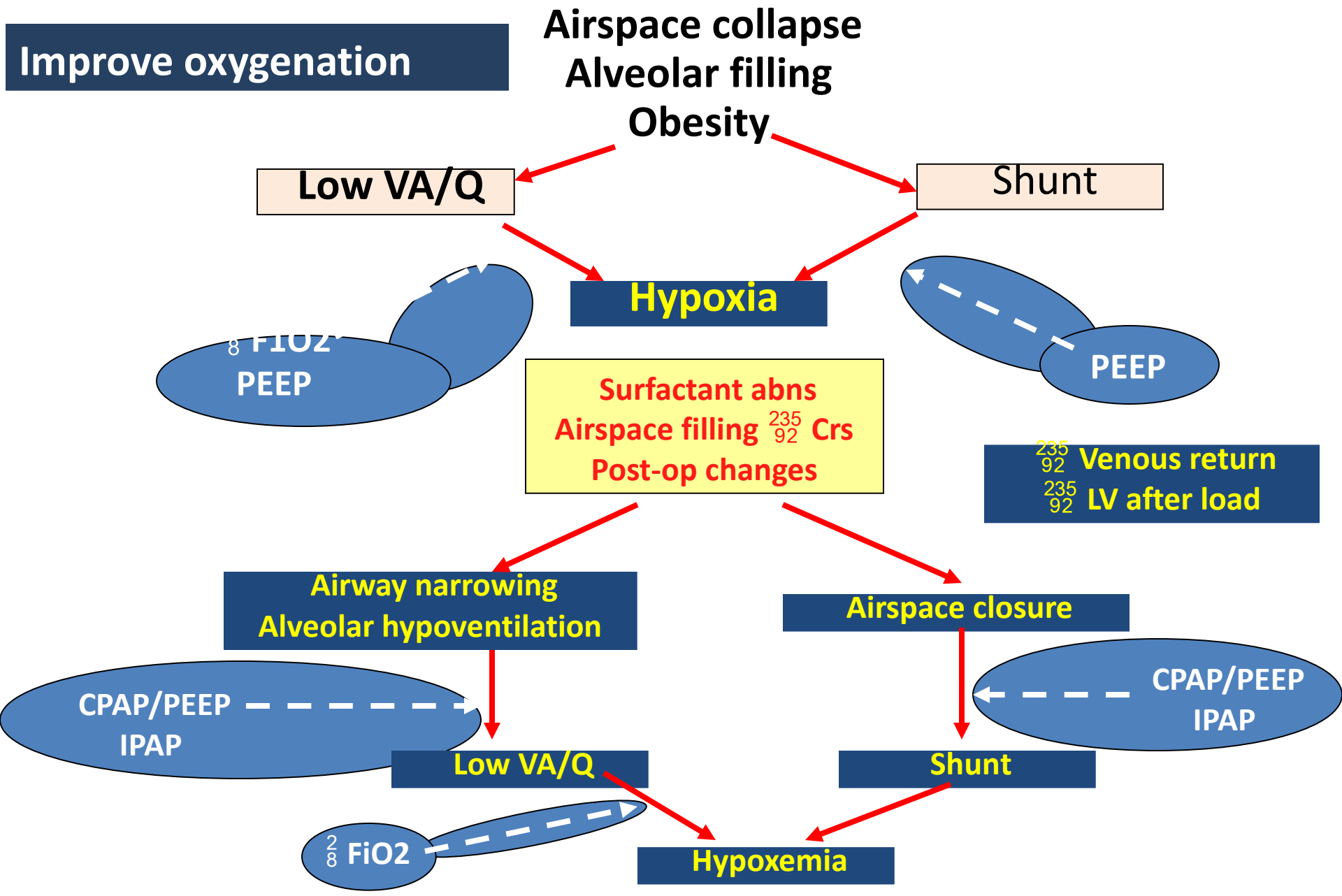


NIV – The BASIC PHYSIOLOGY

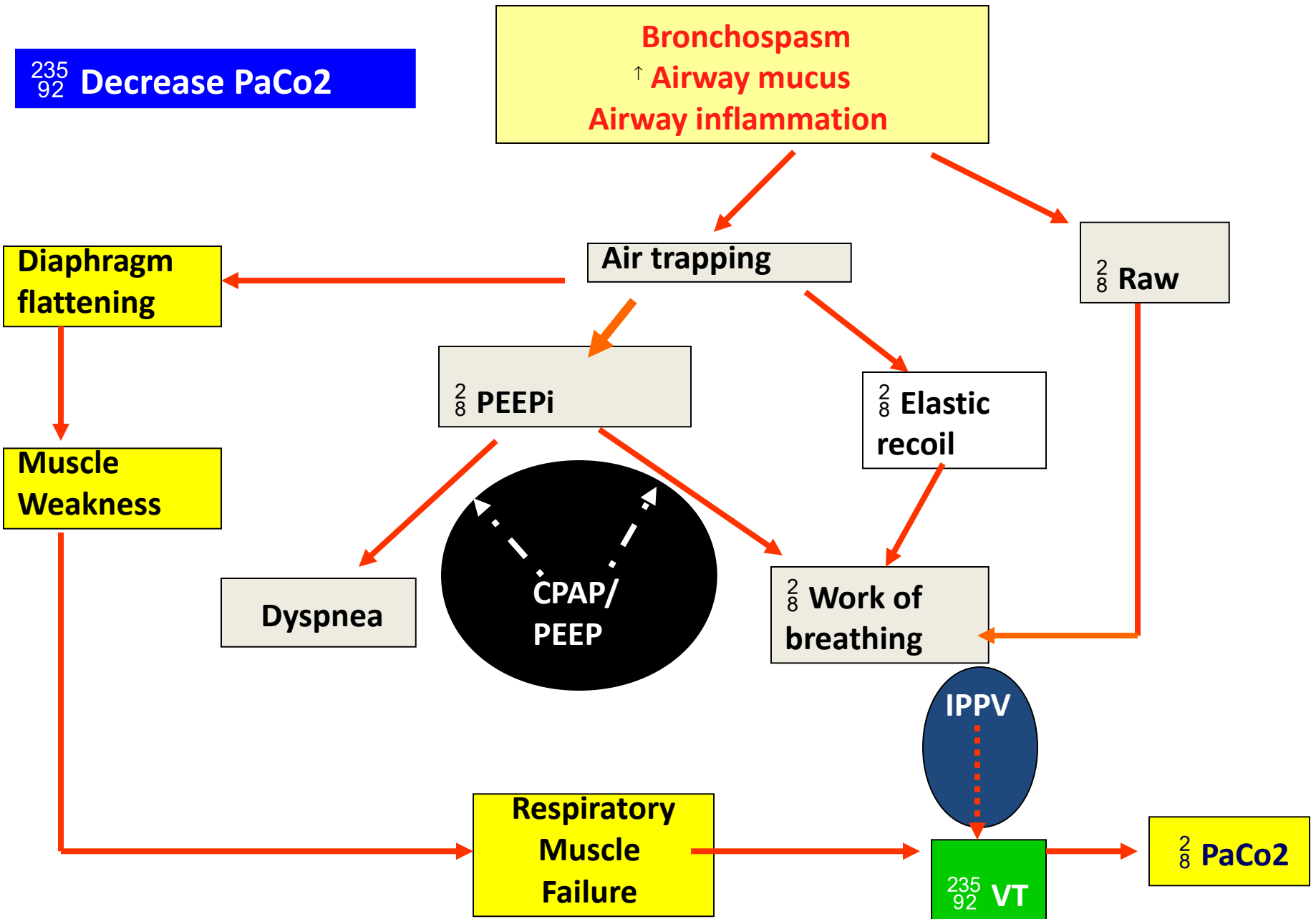
- When **delivering** mechanical ventilation there are 2 ventilatory pumps acting together:
  - the ventilator and
  - the patient's own respiratory pump
- These two pumps must work in harmony to deliver .


Pressure, cm H2O
20
15
10
5
0
Insp.
Exp.
Insp.
Exp.
EPAP
Pressure Support
IPAP
Flow
0

RATIONALE OF VENTILATION- TYPE I



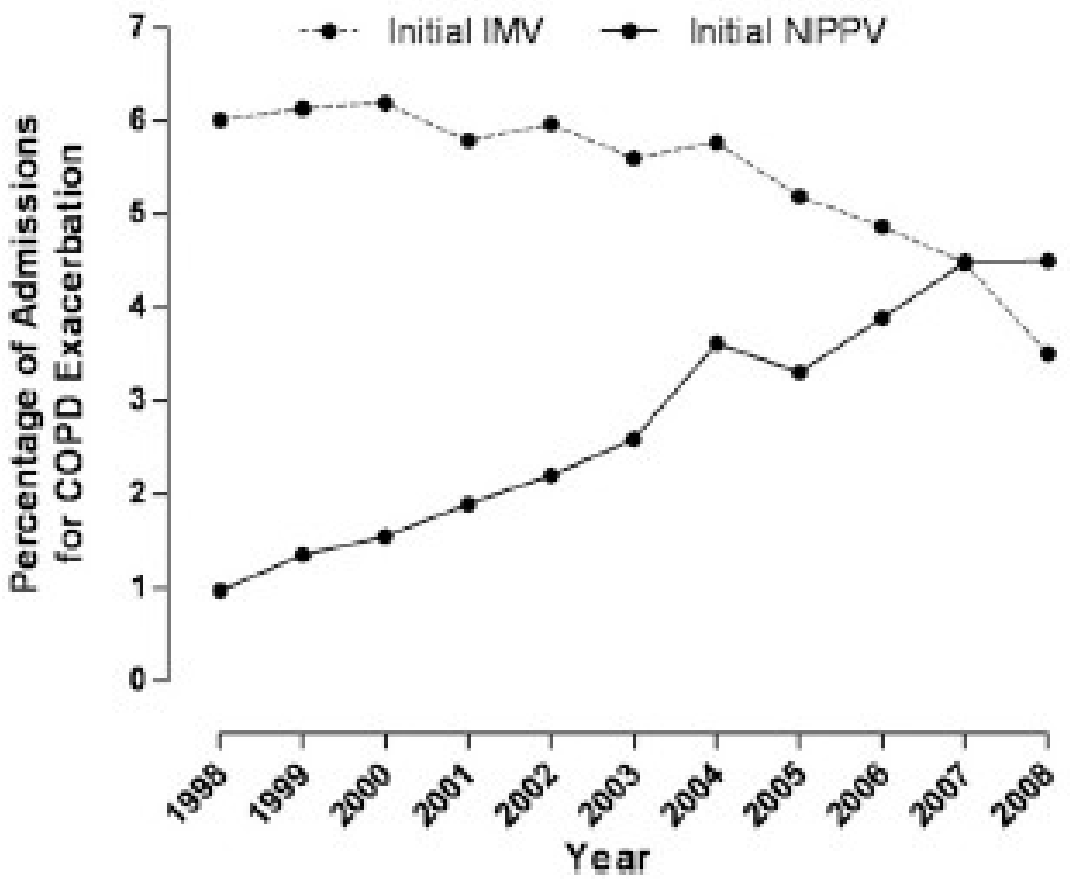
RATIONALE OF VENTILATION- TYPE II



SHIFT IN UTILITY OF NIV DURING LAST TWO DECADES

- More Clinical Indications
- Used in ICU as well as other locations such as ER, HDU, general wards
- Most of the critical care ventilators are equipped with NIV mode
- Paramedical staff increasingly trained to initiate NIV
- NIV increasingly used at home for chronic respiratory failure (besides OSA)

TRENDS IN USE OF INITIAL VENTILATORY SUPPORT IN AECOPD IN USA (Chandra et



Am J Respir Crit Care Med 2012;185:152-159.

INDICAITONS

Hypercapnic Acute Respiratory Failure

- Acute exacerbation of COPD
- Post extubation/weaning difficulties
- Post surgical respiratory failure
- Thoracic wall

INDICAITONS

Hypoxemic Acute Respiratory failure

- Cardiogenic pulmonary edema
- Community acquired pneumonia
- Immuno-compromised individuals with opportunistic infections

NIV in COPD Acute Exacerbation

RECOMMENDATION (CLASS-A)

Acute exacerbation of COPD

Respiratory acidosis (PH < 7.35 & $PaCO_2$>45)

Severe respiratory distress

- use of accessory muscles
- paradoxical movement
- Intercostal recession

Respiratory muscle fatigue

GOLD guidelines 2011, CMAJ 2011

CARDIOGENIC PULMONARY EDEMA

Both CPAP & NIV are effective

- **Significant & rapid improvement**
- **$\frac{235}{92}$ rate of intubations (19-47%)**
- **No effect on Mortality**
- **? $\frac{2}{8}$ incidence of MI.**

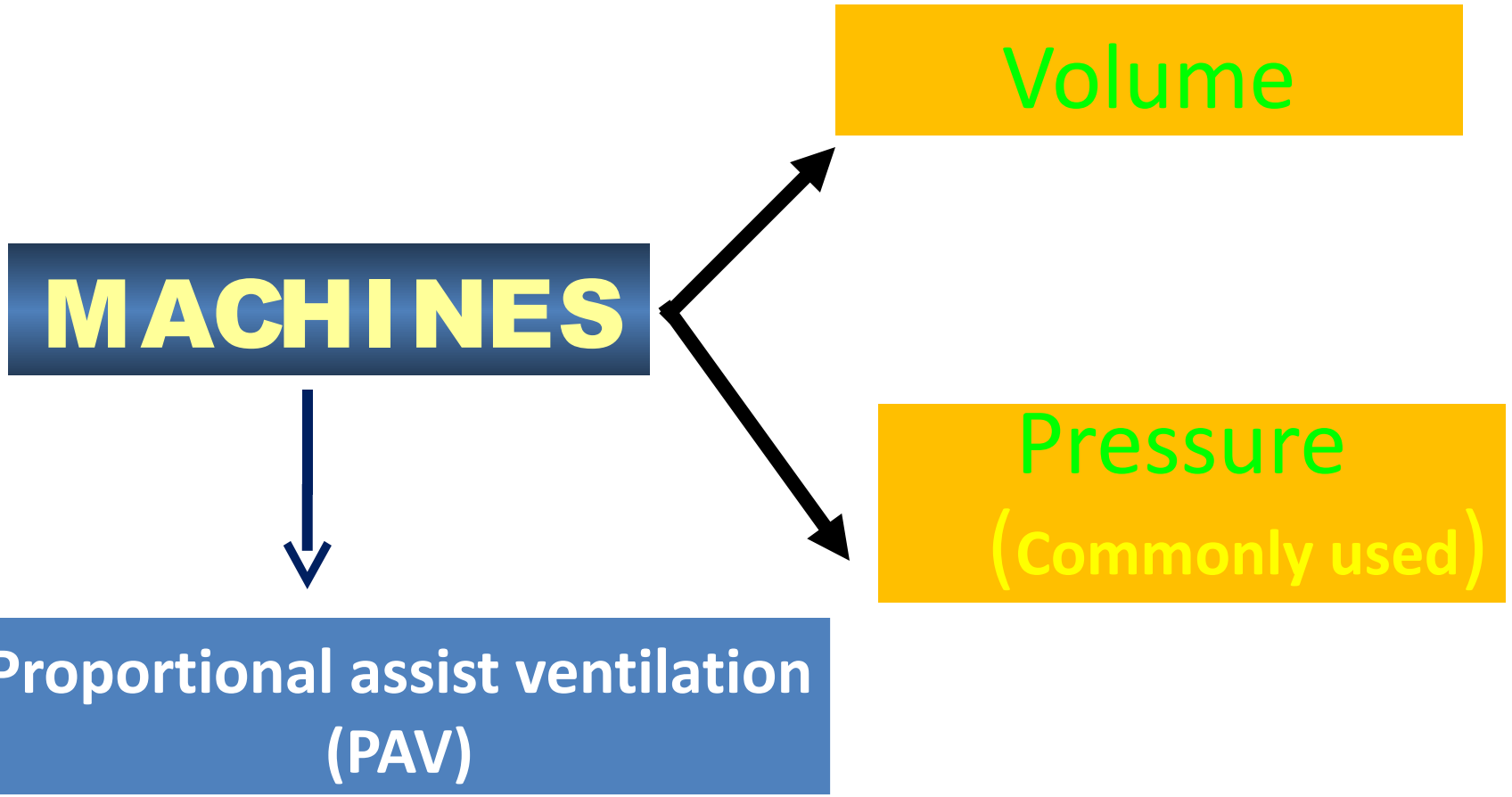
ABSOLUTE CONTRAINDICATIONS

- **Coma**
- **Cardiac arrest**
- **Respiratory arrest**
- **Any condition requiring immediate intubation**

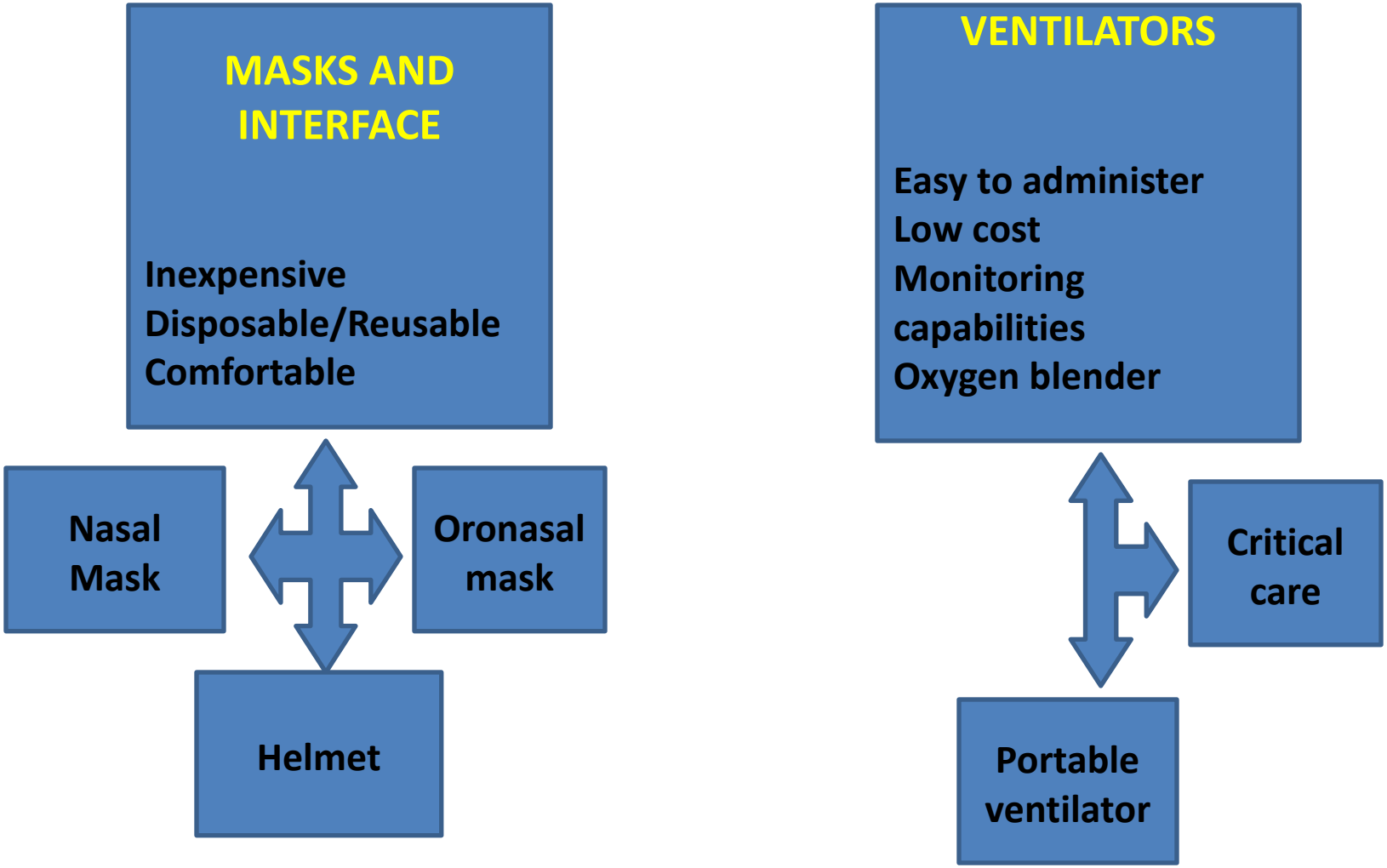
OTHER

- **Cardiac instability**
  - **Shock and need for pressor support**
  - **Ventricular dysrhythmias**
  - **Complicated acute myocardial infarction**
- **GI bleeding - Intractable emesis and/or uncontrollable bleeding**
- **Inability to protect airway**
  - **Impaired cough or swallowing**
  - **Poor clearance of secretions**
  - **Depressed sensorium and lethargy**

PRACTICAL APPLICATION OF NIPPV



DELIVERY OF NIV



MASKS AND INTERFACES

Interface

Interfaces are devices that connect ventilator tubing to patients face

- **Choice of interface --- CRUCIAL**
- **No clear cut superiority of one interface over the other**
- **Full face masks best for acute conditions**
- **Nasal masks best for long term use**

ACCESSORIES

Humidification

- Heated humidifier preferred over heat and moisture exchanger
- Reduces nasal resistance
- Improves compliance
- Reduces mouth dryness

Oxygen supplementation

- Can be given via inspiratory circuit or mask
- Variable delivery of oxygen by portable ventilators
- Critical care ventilators provide high Fio2

Nebulisation

- Can be carried out with most continuous flow circuits without changing the delivered pressures

Power supply

- Most ventilator have in built battery back up
- Newer ventilators have an automatic switch over making battery use much easier

MONITORING

- Clinical Most Important
- Vital Sign Decrease in RR indication of effectiveness
- Symptoms
  - Decrease breathlessness
  - Decrease Sleep
  - Improved neurological status
- Adequate gas exchange
  - SPO2
  - BGA

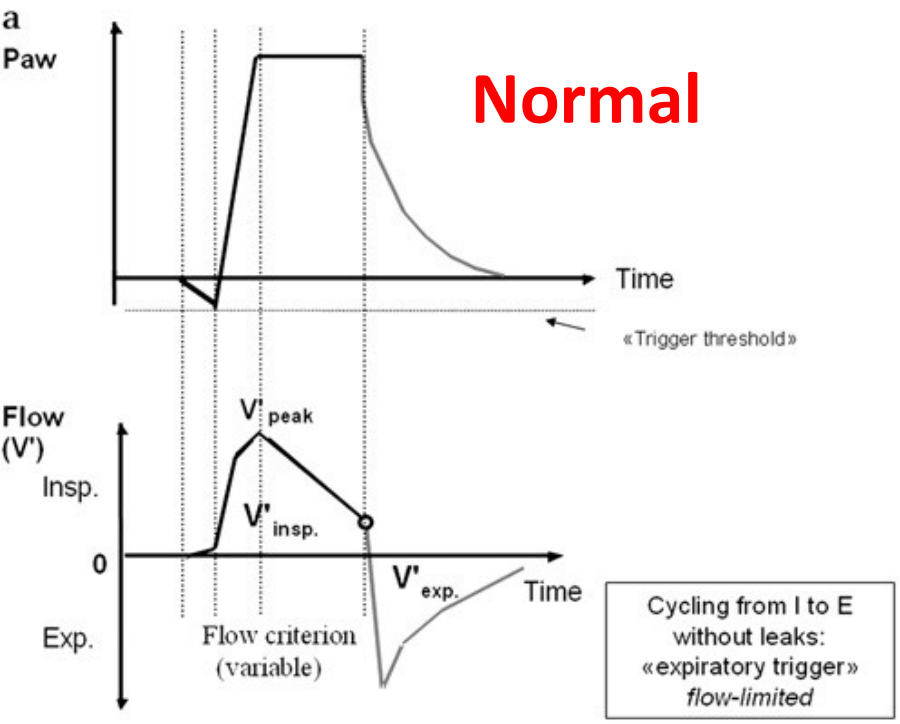
PATIENT AND MACHINE INTERACTION

- Synchrony ---- *KEY*
  - Chest wall movement
  - Mouth leak
  - Mask pressure
  - Esophageal pressure
  - Respiratory EMG activity

MASK LEAK

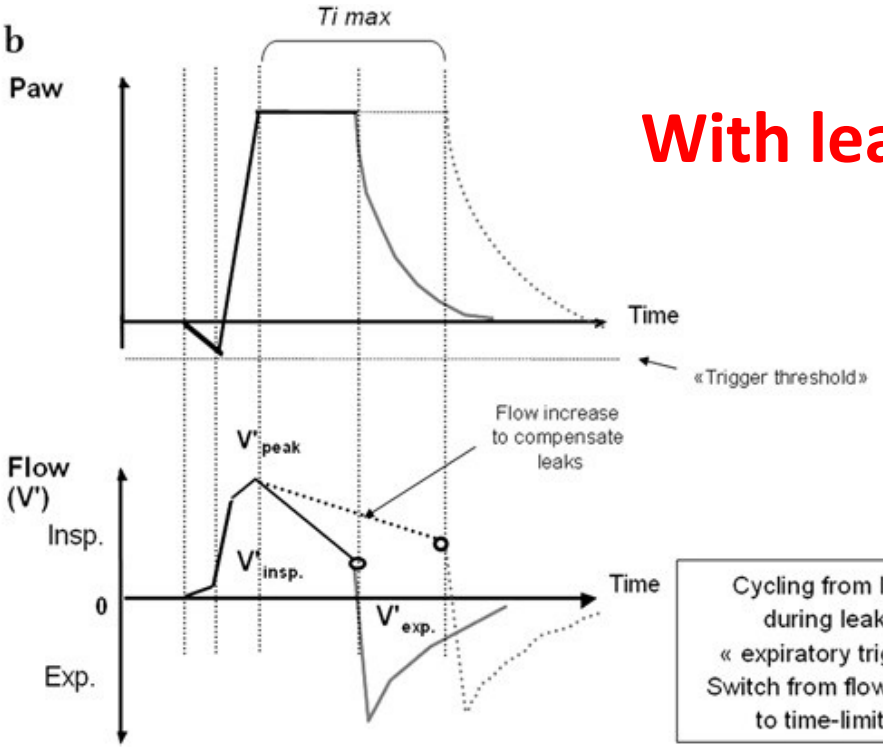
- **REASON**
  - High IPAP
  - Severe acute respiratory failure
  - Small Jaw/ overbite
  - Sleep
- **EFFECT**
  - Decrease expiratory triggering sensitivity of the device
  - Asynchrony between patient and device
  - Worsening gas exchange
  - Sleep fragmentation

Effects of leak on ventilation



Normal

Cycling from I to E
without leaks:
«expiratory trigger»
flow-limited



With leaks

Cycling from I to E
during leaks:
« expiratory trigger »
Switch from flow-limited
to time-limited

LOCATION

Emergency Department vs. ICU

Benefits of use in ED :-

Reduction in the need for intubation

Reduction in mortality

Decrease Hospital stay

CONTD.

EMERGENCY DEPARTMENT vs. ICU

FACTORS To be Considered Whether NIV Should be performed in an ICU or an ED

- Severity of respiratory failure
- Significant co morbidity
- Will the patient be intubated if NIV fails
- Patient's nursing requirements
- Staffing level, expertise & experience

EMERGENCY DEPARTMENT vs. ICU

(a) 50 patients of ARF-variable etiology like CHF, COPD, Pneumonia, Status Asthmatics etc.- 86 % success rate

Pollock et al, Ann Emerg Med 1996,27,189

(c) Wood et al Chest 1998, 113339

(i) 43 % on NIV needed intubation vs. 45% on CT

(ii) $\frac{2}{8}$ mortality on NIV.

(iii) $\frac{2}{8}$ Time before intubation

(iv) No difference in length of stay, duration of ventilation in both groups

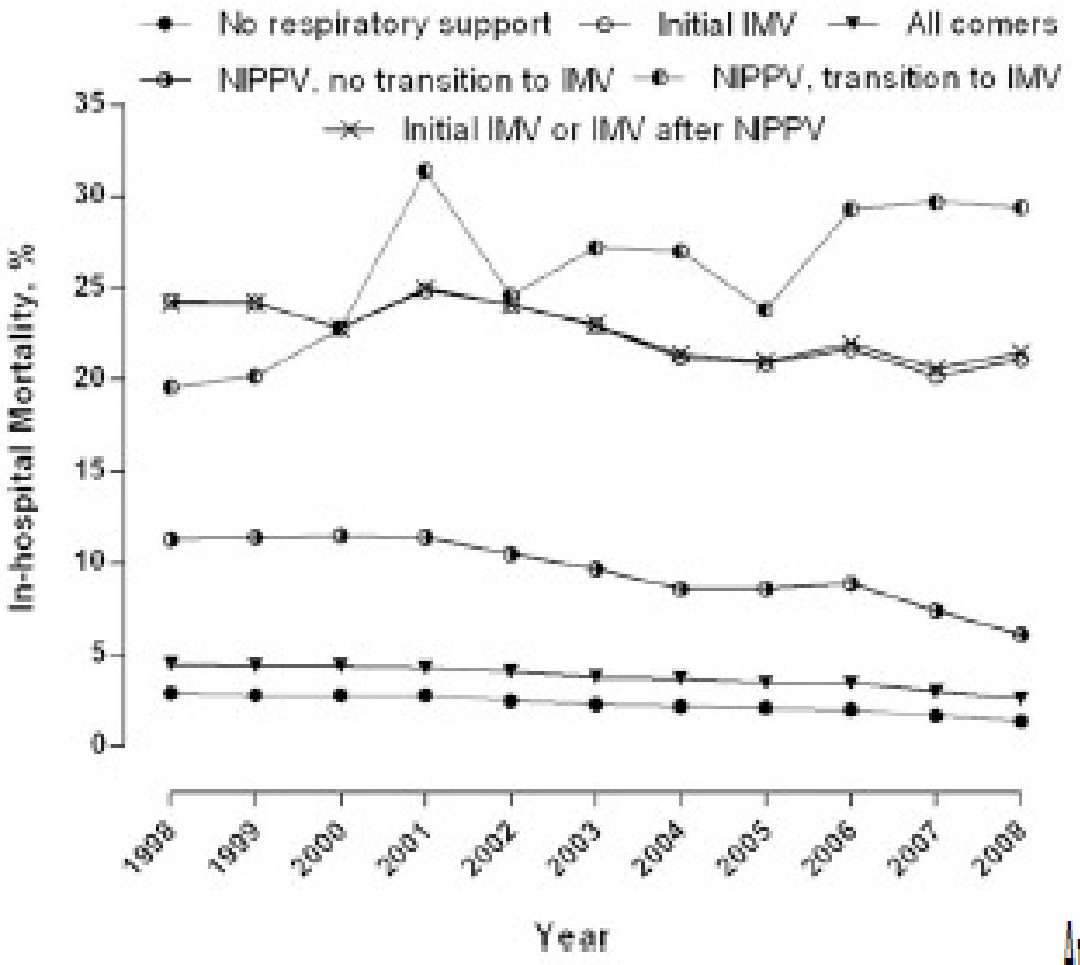
(c) Nava et al – studied NIV for Pulmonary Edema in ED AM J Respiratory crit care Med 2003 168; 1432

rapid improvement in gases without $\frac{235}{92}$ in intubations rate except in patients with hypercapnia.

Causes of NIV failure (Approx. 40%)

- **Acuity of illness**
- **Poor clinical tolerance (Incudes patient ventilator asynchrony**
- **Failure to correct hypercapnic acidosis in first hour of NIV**

IN HOSPITAL MORTALITY AMOMG ALL COMERS – Chandra et al (AJRCC)



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RESPRITORY FAILURE IN COPD (ROHTAK STUDY)

(N=25)	GROUP I (CONSERVATIVE) (MEAN ±SD)	GROUP II (NIPPV) (MEAN ±SD) (N=25)	p VALUE
DAYS OF RESOLUTION	2.6 ± 2.88	1.4 ± 0.763	<0.02
LENGTH OF HOSPITAL STAY	9.6 ± 4.5	7.2 ± 3.12	<0.02
INTUBATIONS	6	1	<0.05
DISCHARGE	19 (76%)	25 (100%)	<0.05
NO. OF DEATH (%)	6 (24%)	0 (0%)	<0.05

Ref. Thesis for M.D in Medicine ;MDU Rohtak 2003

HYPERCAPNIC RESPRITORY FAILURE IN CARDIOGENIC PULMONARY OEDEMA

	Group 1 (N=25) (Control)	Group II (N=25) (NIV)	P value < .05
Duration of resolution (Hr.)	42±26.92	9.2±3.38	HS < .001
Length of hospital stay (days)	9.06±4.35	4±1.603	HS < .001
Discharge	23	23	NS
No. of death	2	2	NS
No. of Intubations	2	0	

Ref. Thesis for M.D in Medicine ;MDU Rohtak 2004

NIV vs PSV IN WEANING IN COPD (ROHTAK STUDY)

	Group I (NIV) N=15	Group II (PSV) N=15
Duration of ventilation (in days)	6.20 ± 5.20	7.47 ± 6.38*
Duration of weaning (in hours)	35.17 ± 16.98	47.05 ± 20.98
Duration of ICU stay (in days)	8.47 ± 4.79	10.80 ± 5.28
Death in ICU	3 (20%)	5 (33.33%)*
Death at 30 days	5(33.33%)	9(60%)
Nosocomial pueumonia	1(6.66%)	5(33.33%)

Recommendation; should be used when conventional weaning fails. (B)

Evaluation of Role of Non-Invasive Ventilation in Management of Acute Bronchial Asthma

- **NIV leads to faster resolution of breathlessness & use of AMR.**
- **NIV in AA though improved pulmonary function but did not do significantly.**
- ***Routine use over & above*** **medical management in Acute Asthma can't be recommended at present**

Chaudhry D , Indora M, Sangwan V, Sehgal IPS. Thorax,2010;65(4):S68

SUMMARY

- NIV use has increased remarkably over last two decades
- Ventilation of choice in AECOPD & CPO
- Patients needs close monitoring while on NIV
- Mask leaks are the commonest cause for patient ventilator asynchrony & failure
- Can be used safely across all age groups
- Failure of NIV is associated with increased mortality

RECOMMENDATIONS FOR NIV IN ED

(1) **Initiate NIV in ED only after adequate Training of staff**

(2) Patients with severe Acidosis (ph<7.3) should be ventilated in ICU

(3) Lack of improvement in Clinical state & BGA of patients after 1-2 hr of NIV use, should be shifted to ICU/HDU [C]

(4) In patients of ARF, Where the role of NIV is not yet clearly established should receive NIV in ICU

BTS guidelines 2002.


thanks