



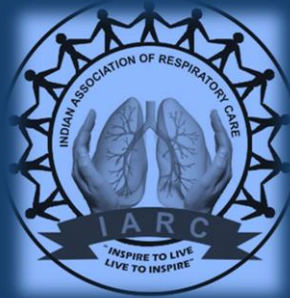
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6-8 October 2017
IMA HALL -KOCHI

The Art and Science of Ventilator Waveform Analysis

DR. PARIMALA PRASANNA SIMHA
PROFESSOR OF ANESTHESIOLOGY
SRI JAYADEVA INSTITUTE OF CARDIOVASCULAR SCIENCES
BANGALORE

Objectives

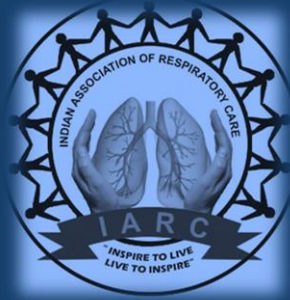
- Identify graphic display options provided by mechanical ventilators.
- Describe how to use graphics to more appropriately adjust the patient ventilator interface.



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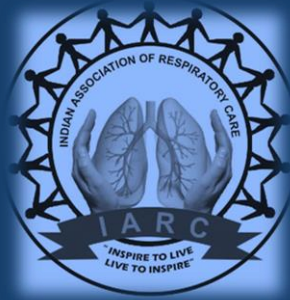
Introduction

Graphics help to determine

how patient is being ventilated

to assess problems occurring during ventilation

Uses of Flow, Volume, and Pressure Graphic Displays



Confirm mode functions

Detect auto-PEEP

Determine patient-ventilator synchrony

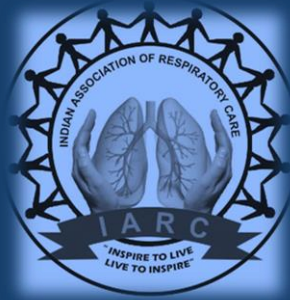
Assess and adjust trigger levels

Measure the work of breathing

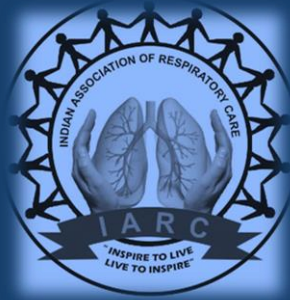
Adjust tidal volume and minimize overdistension

Assess the effect of bronchodilator administration

Uses of Flow, Volume, and Pressure Graphic Displays



- Detect equipment malfunctions
- Determine appropriate PEEP level
- Evaluate adequacy of inspiratory time in pressure control ventilation
- Detect the presence and rate of continuous leaks
- Assess inspiratory termination criteria during Pressure Support Ventilation
- Determine appropriate Rise Time



Graphics

1. scalars:

A. flow- time

b. pressure- time\

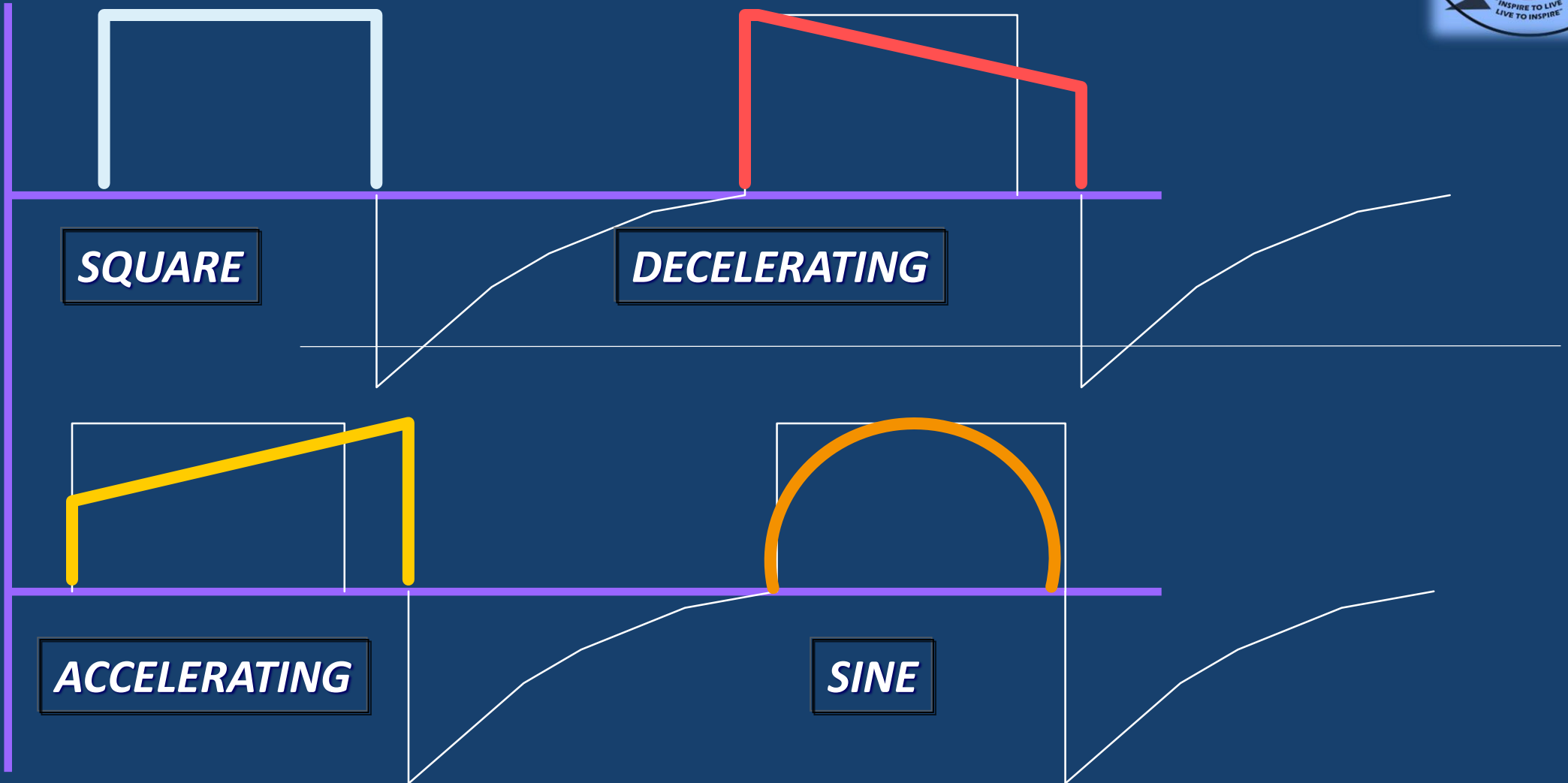
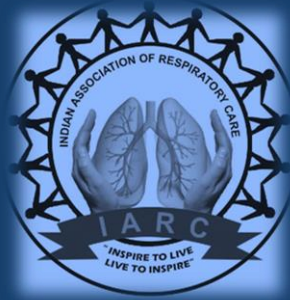
c. volume- time

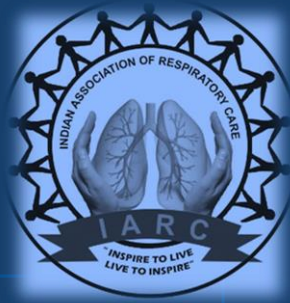
2. loops:

a. flow – volume

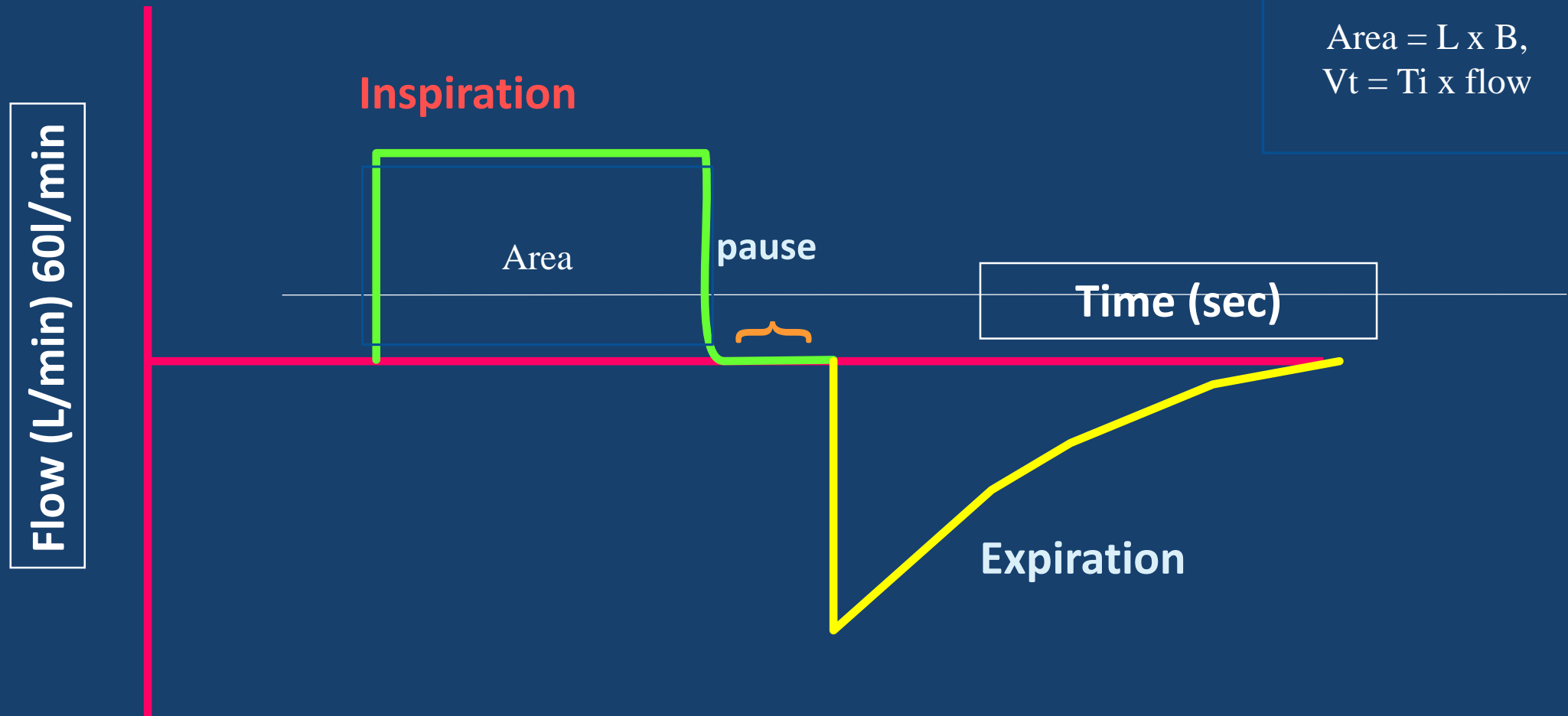
b. pressure- volume

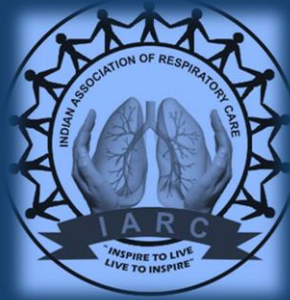
Typical Flow Patterns



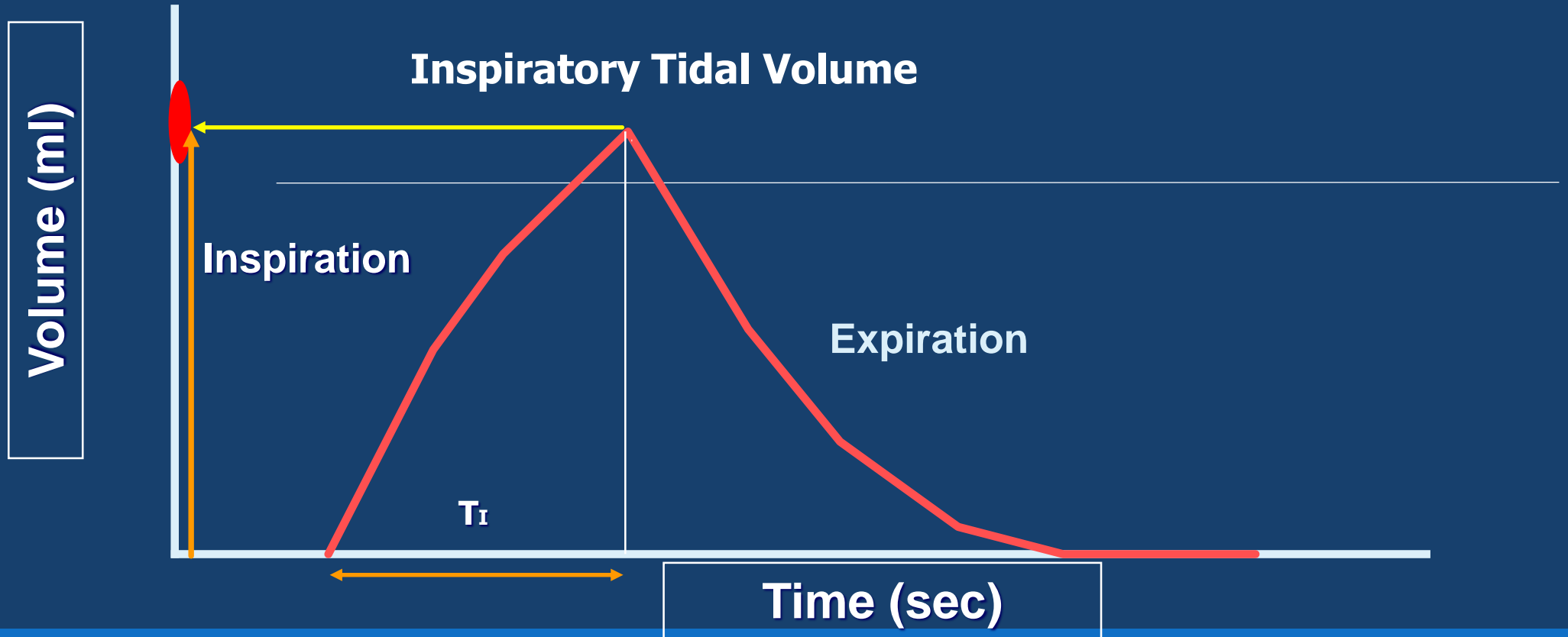


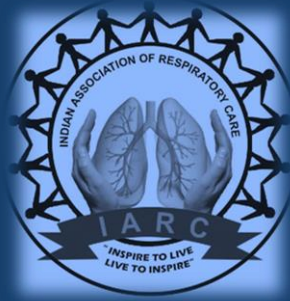
Inspiratory Pause, tidal volume



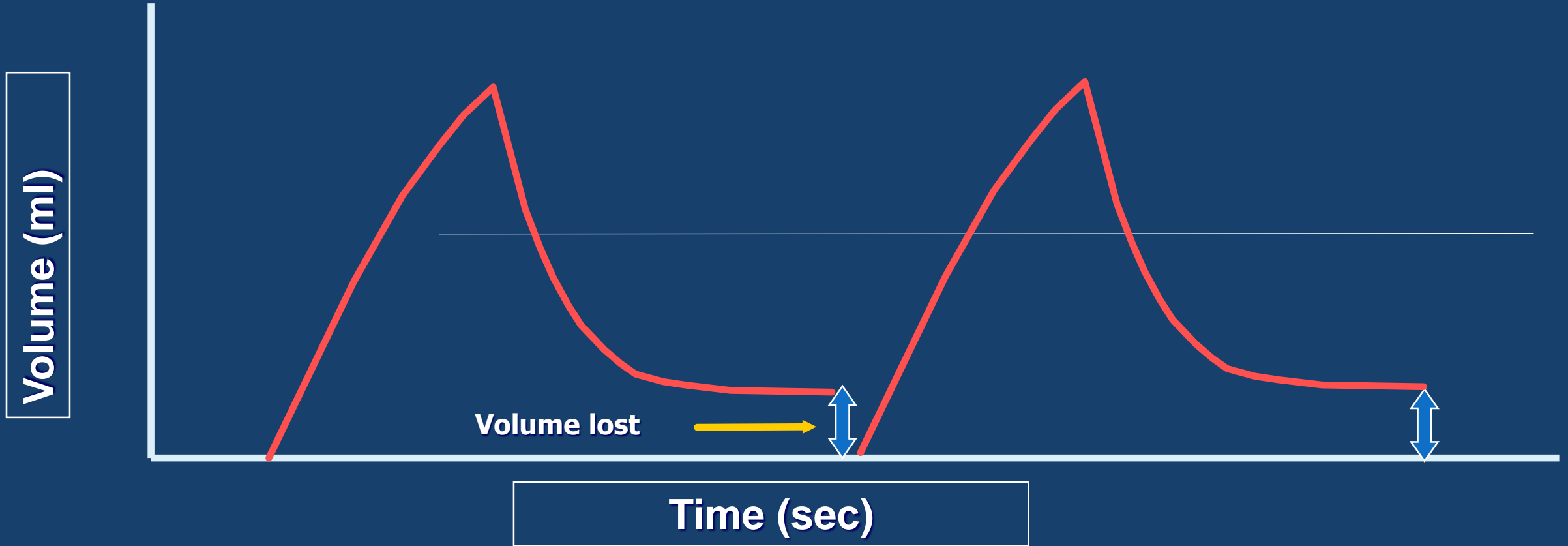


Volume vs Time



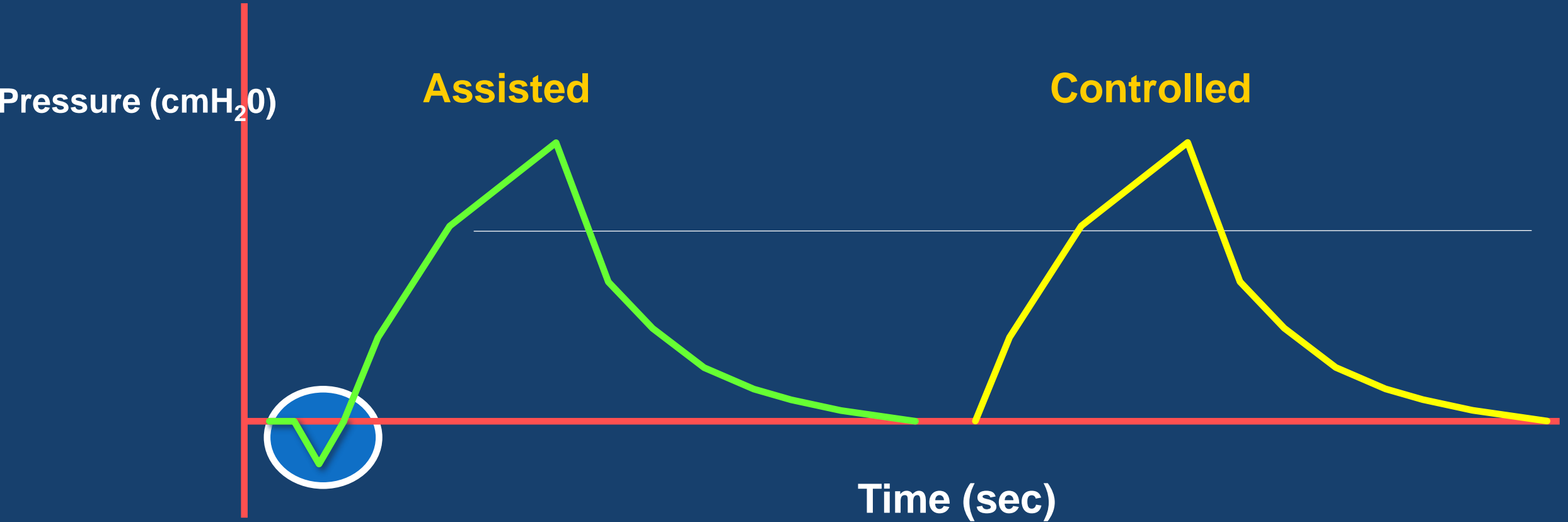


Air Leak/Air Trapping





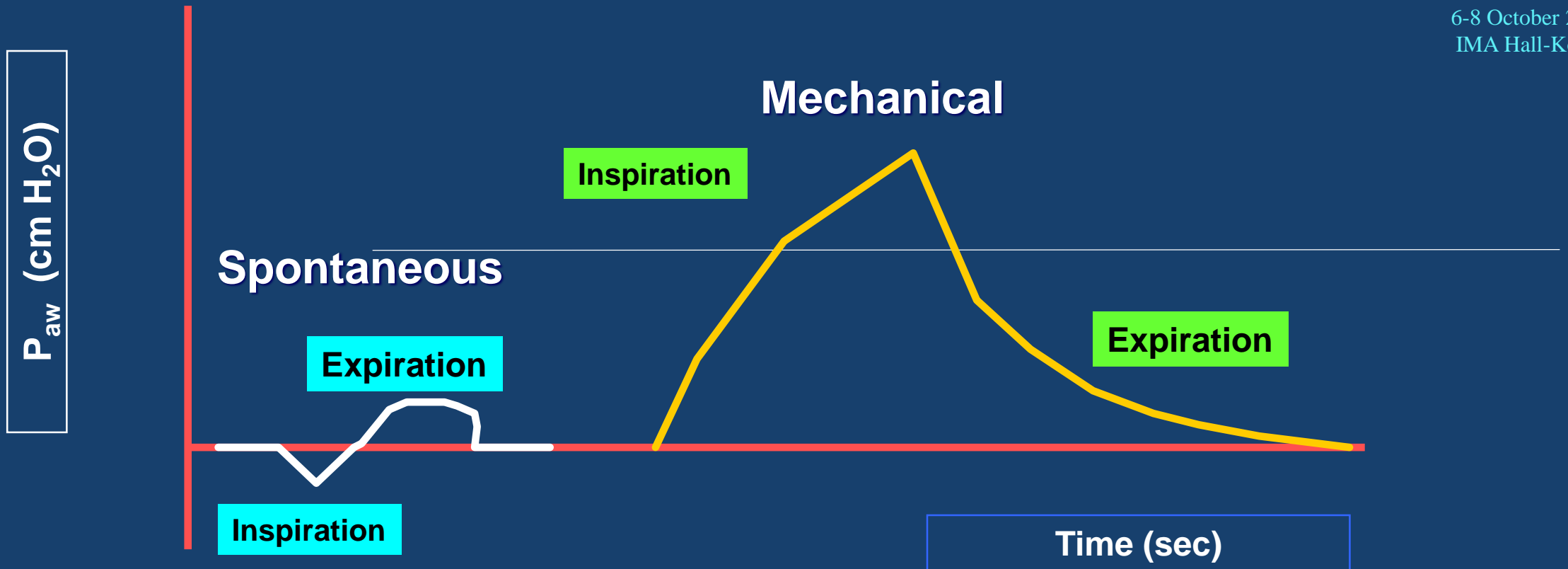
Assisted vs Controlled



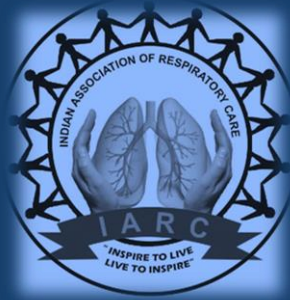
Spontaneous vs. Mechanical



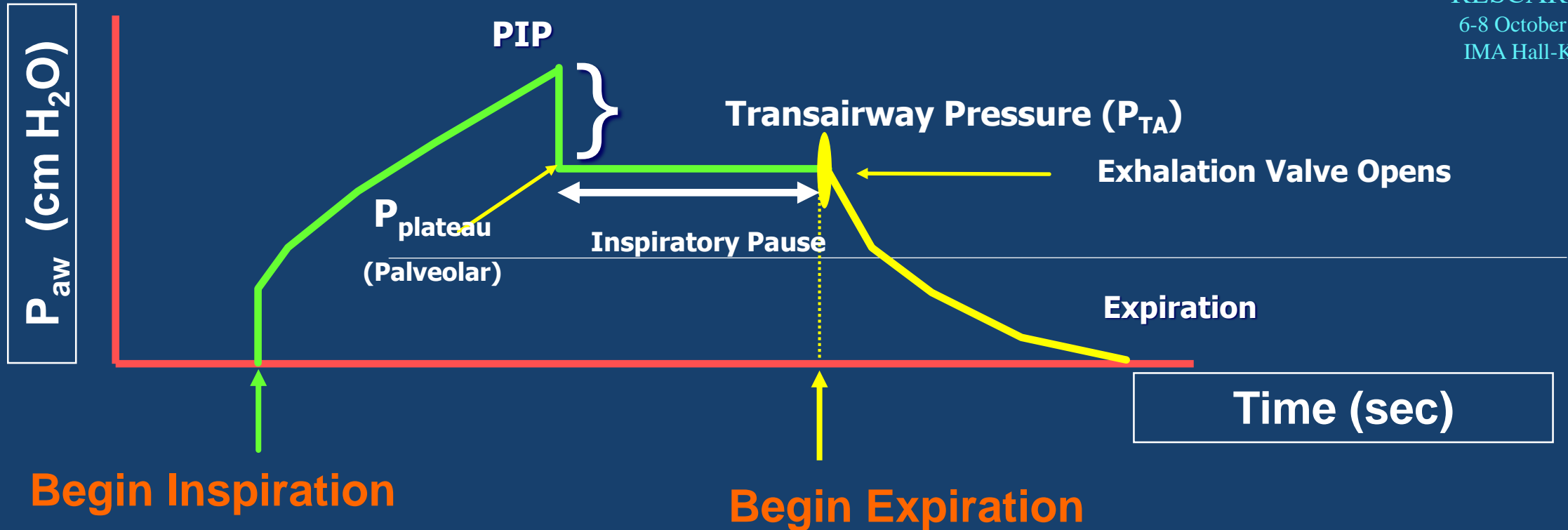
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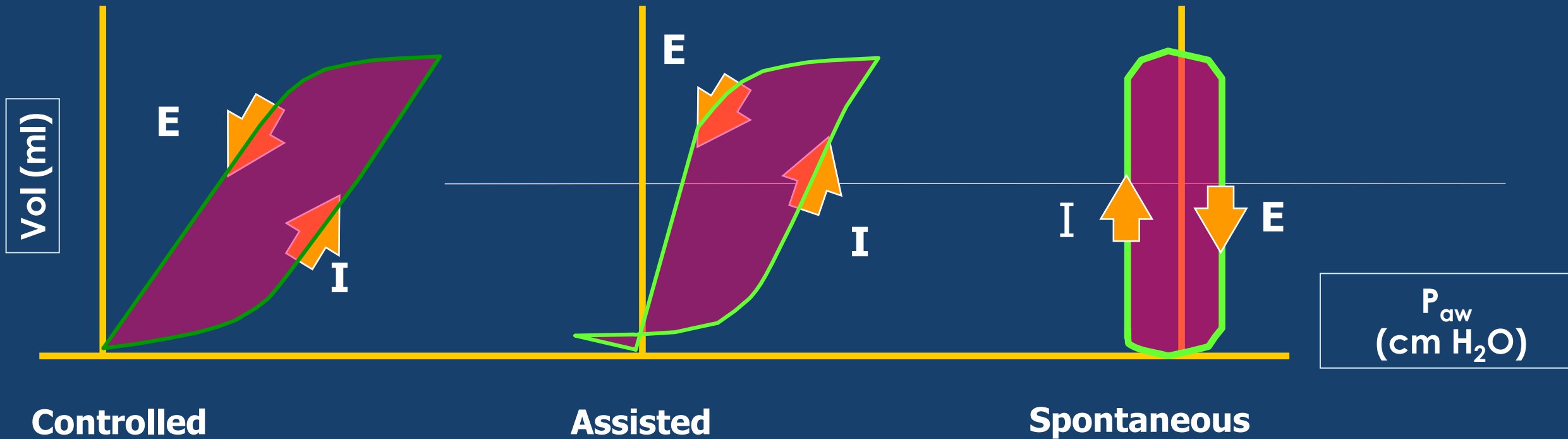
Components of Inflation Pressure



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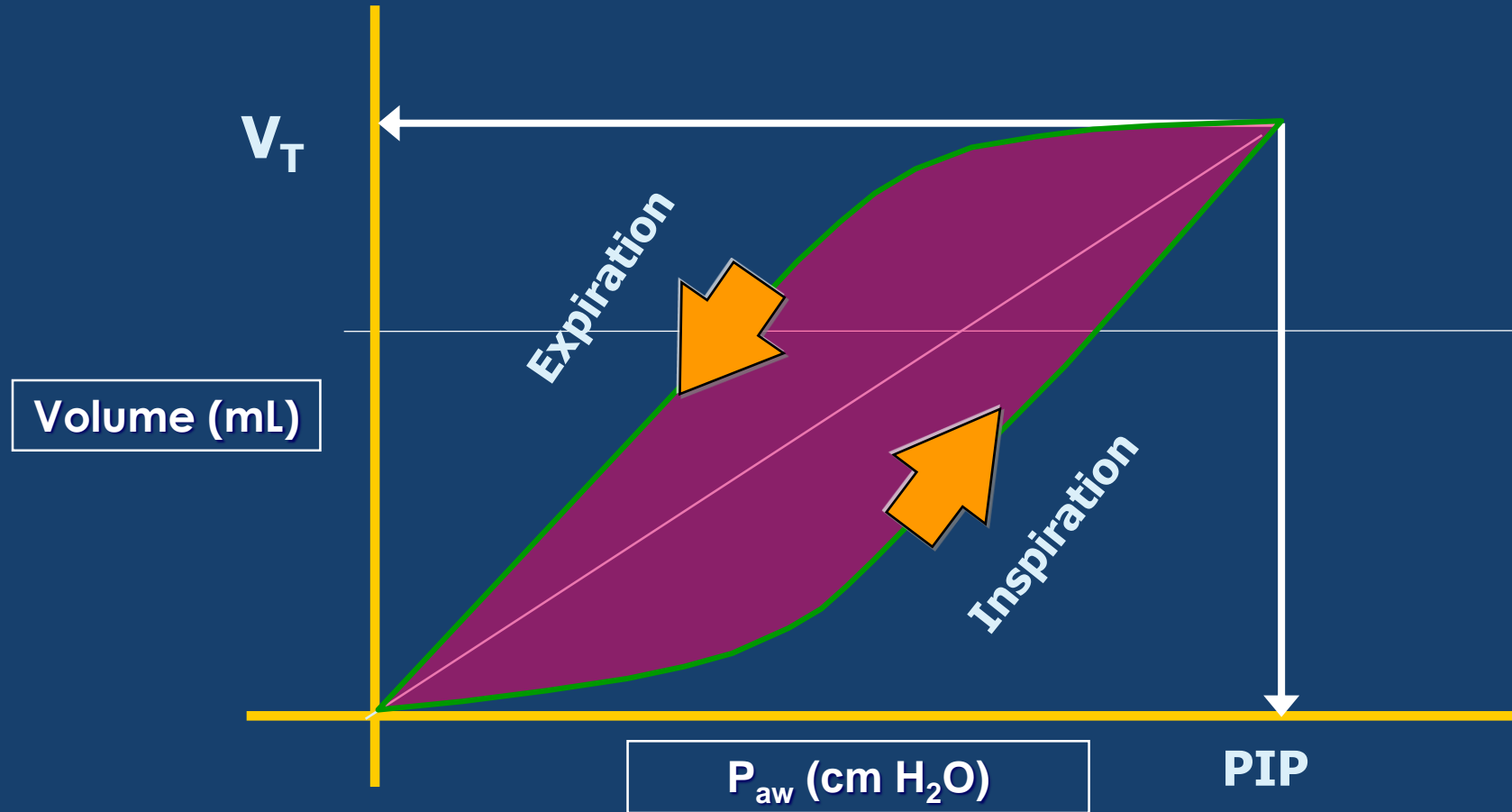
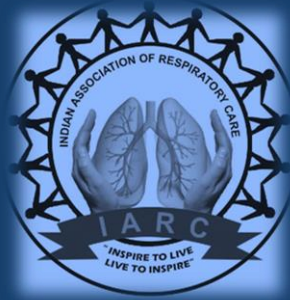


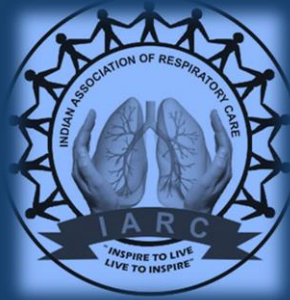
Pressure-Volume Loop (Type of Breath)



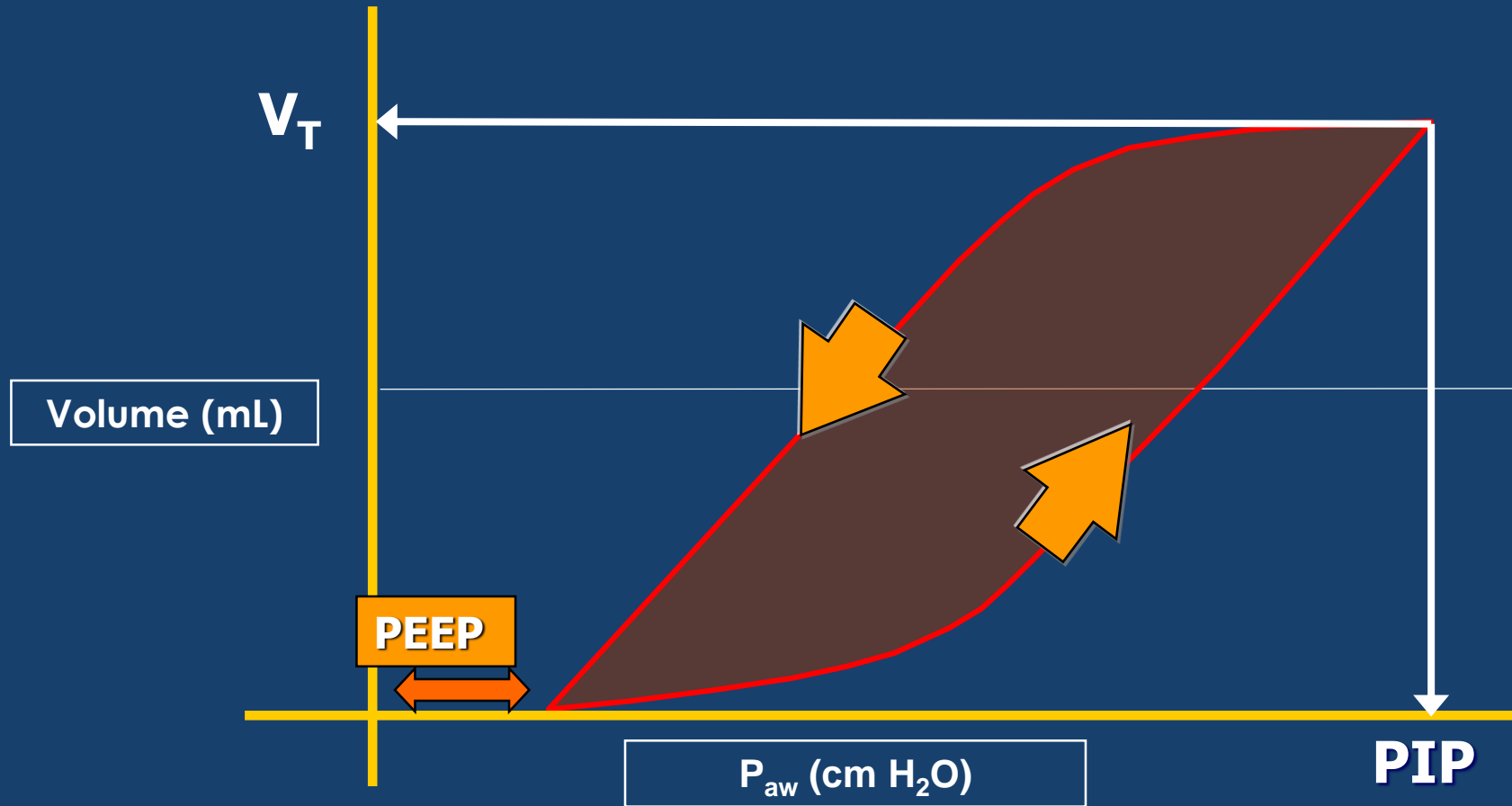
I: Inspiration
E: Expiration

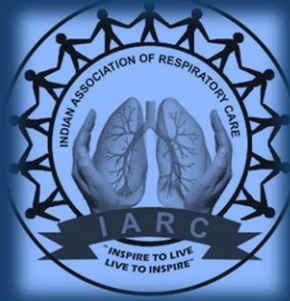
Components of Pressure-Volume Loop





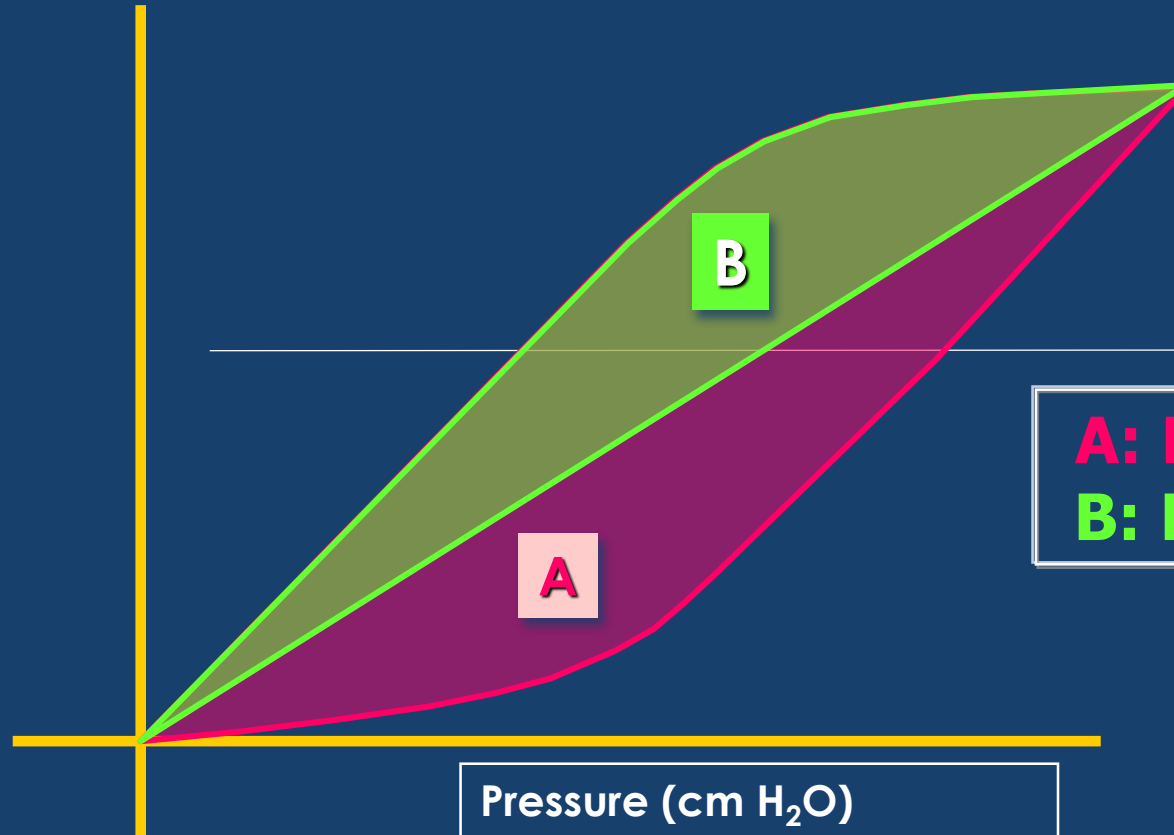
PEEP and P-V Loop





Work of Breathing

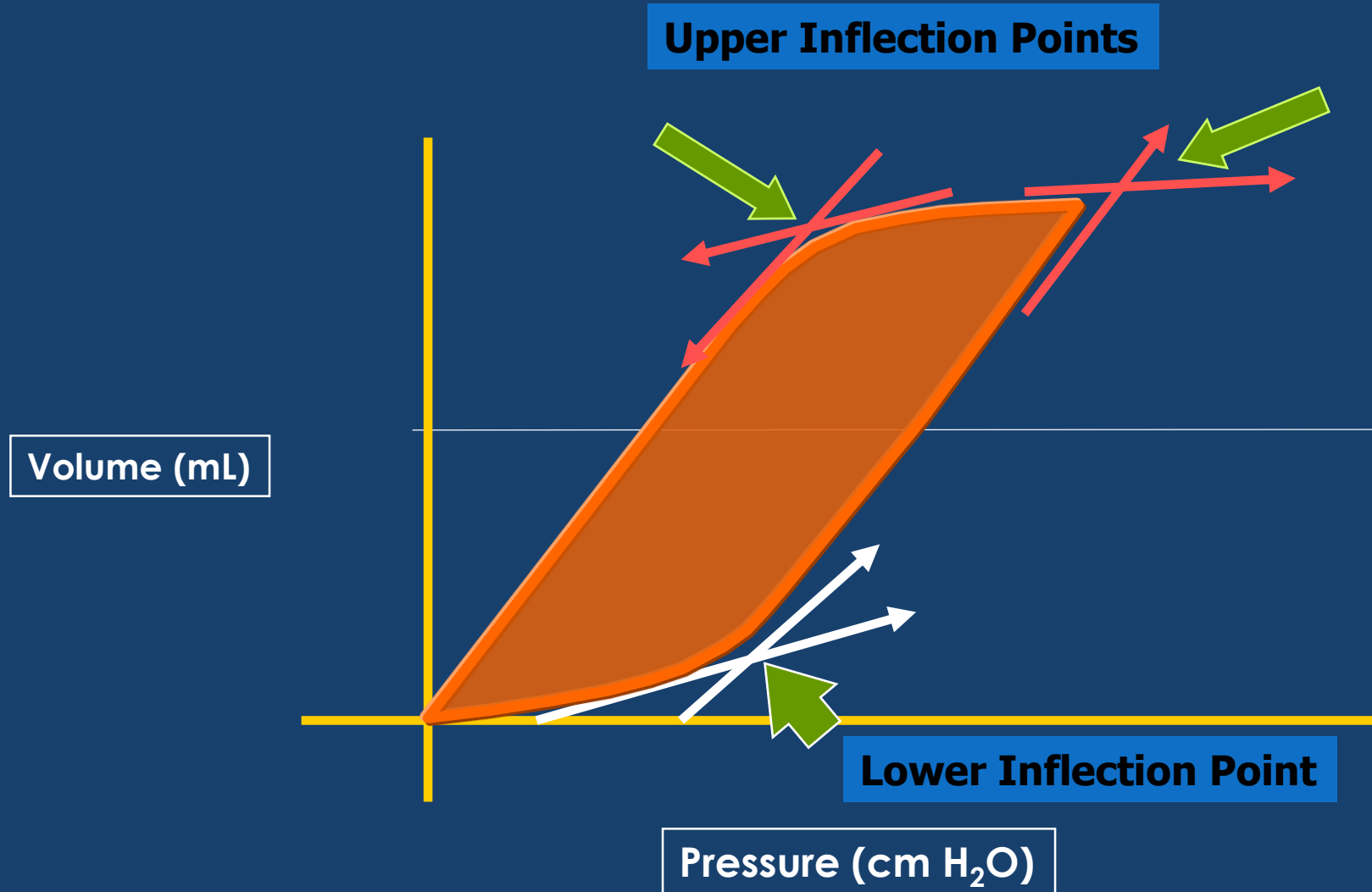
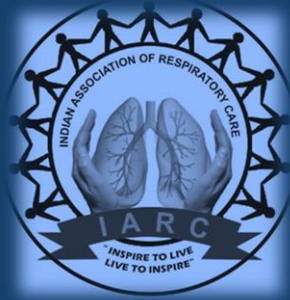
Volume (ml)



A: Resistive Work
B: Elastic Work

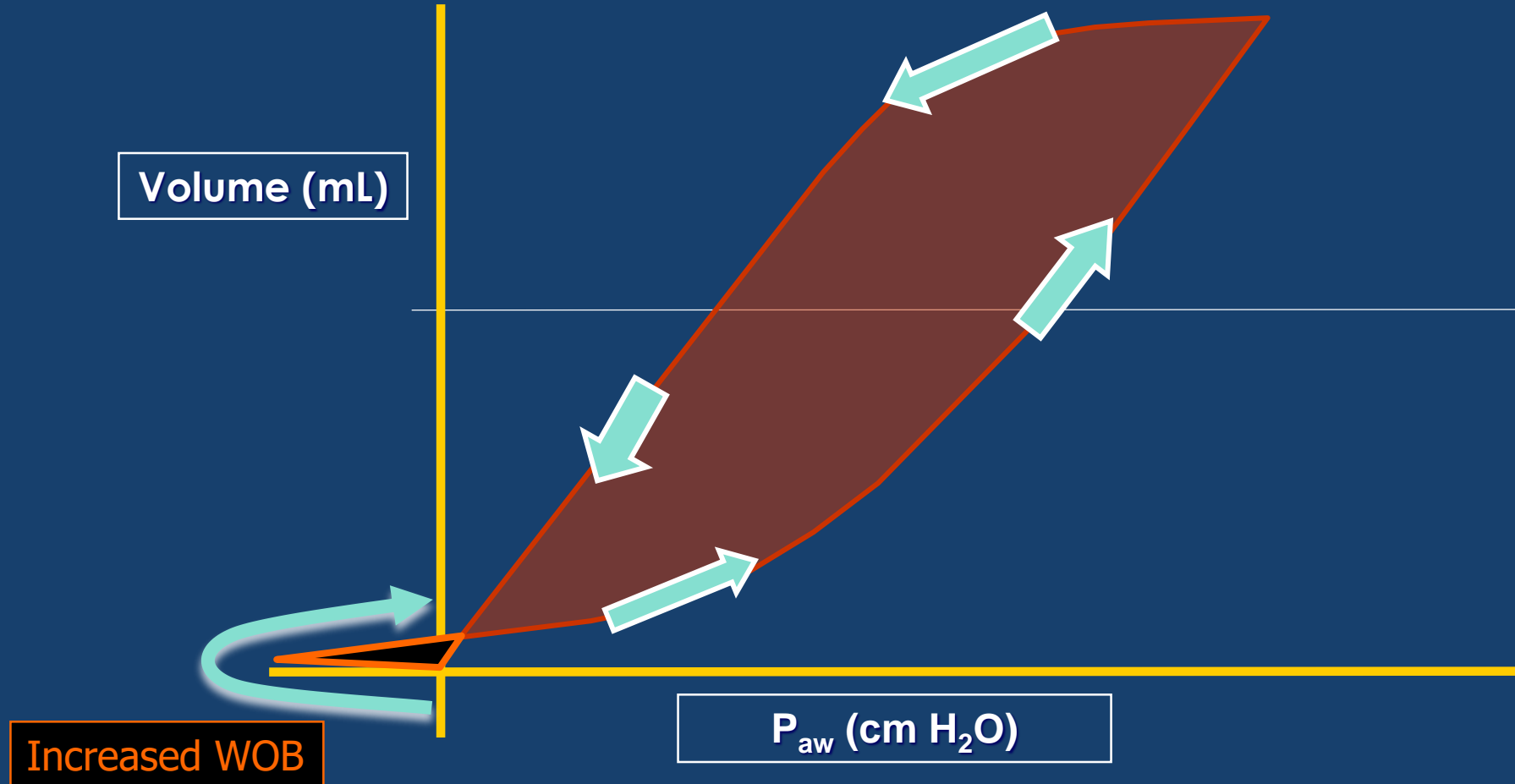
Pressure (cm H₂O)

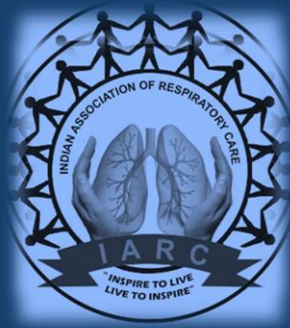
Inflection Points



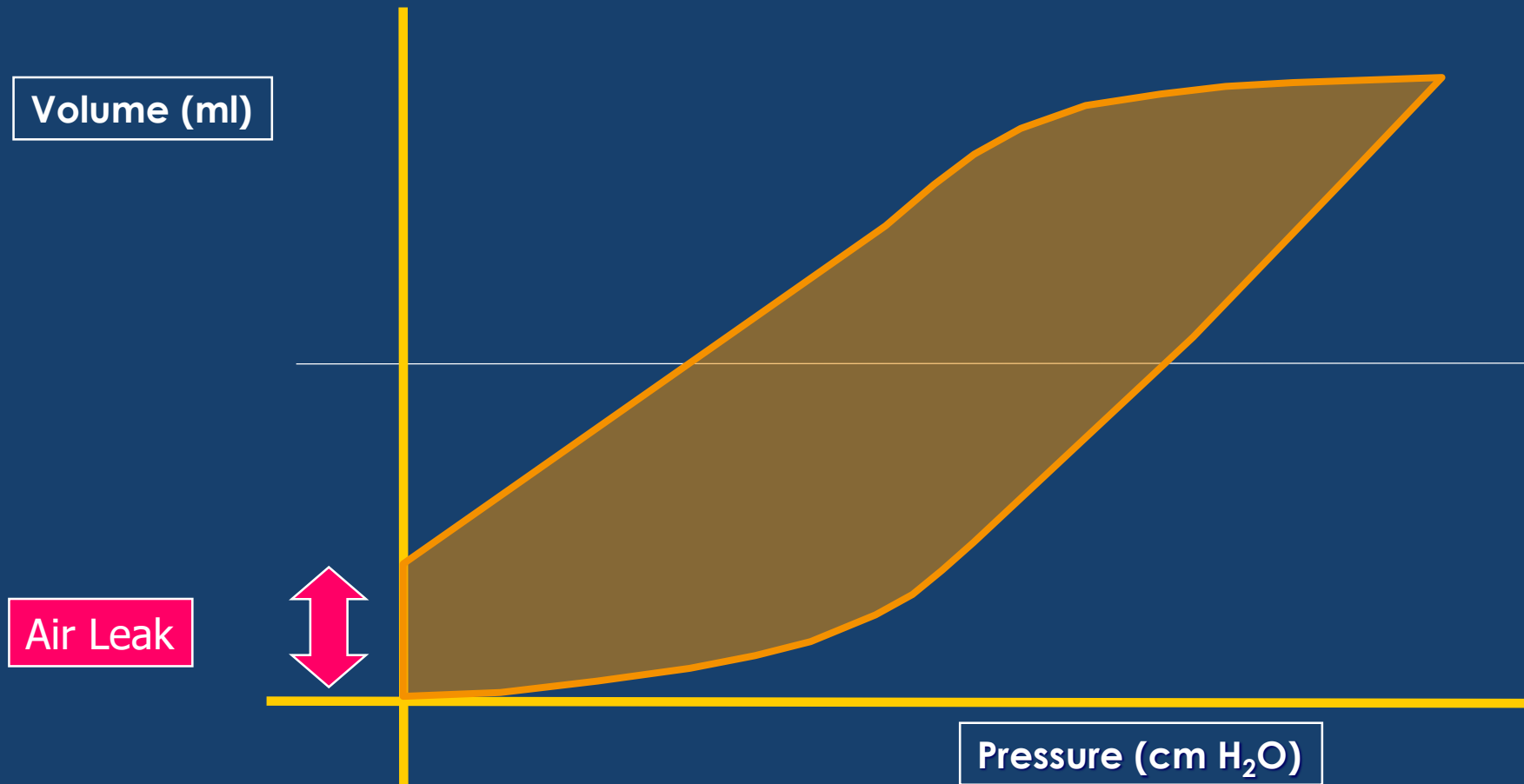


Inadequate Sensitivity





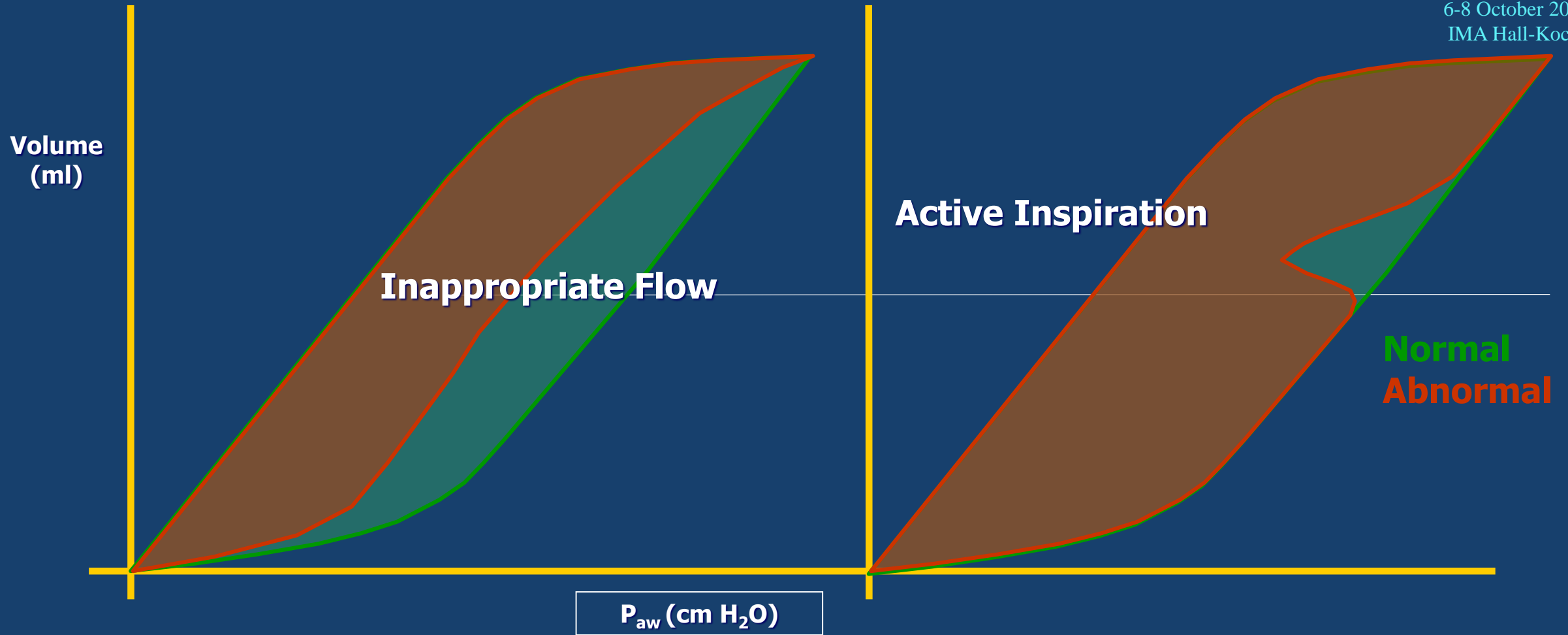
Air Leak/Air Trapping



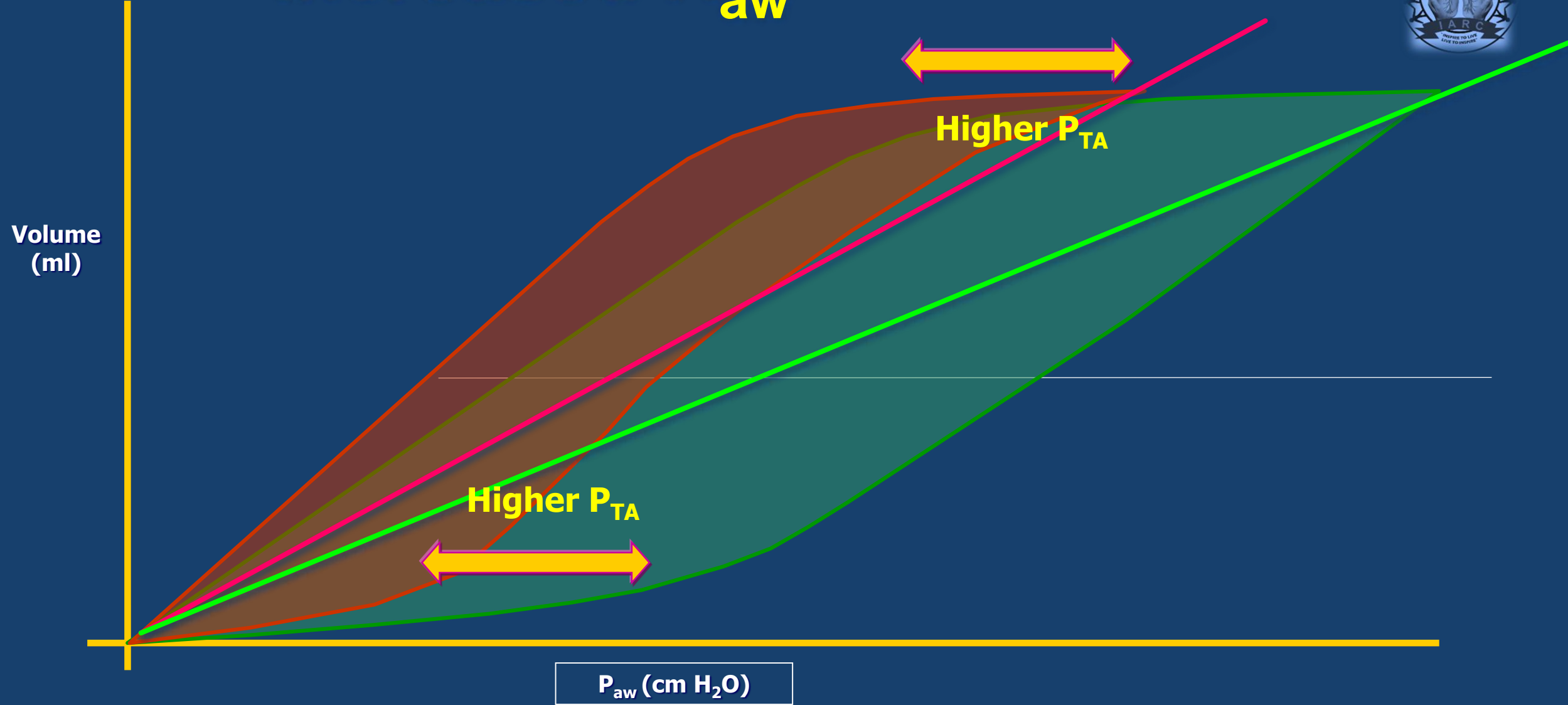
Inadequate Inspiratory Flow



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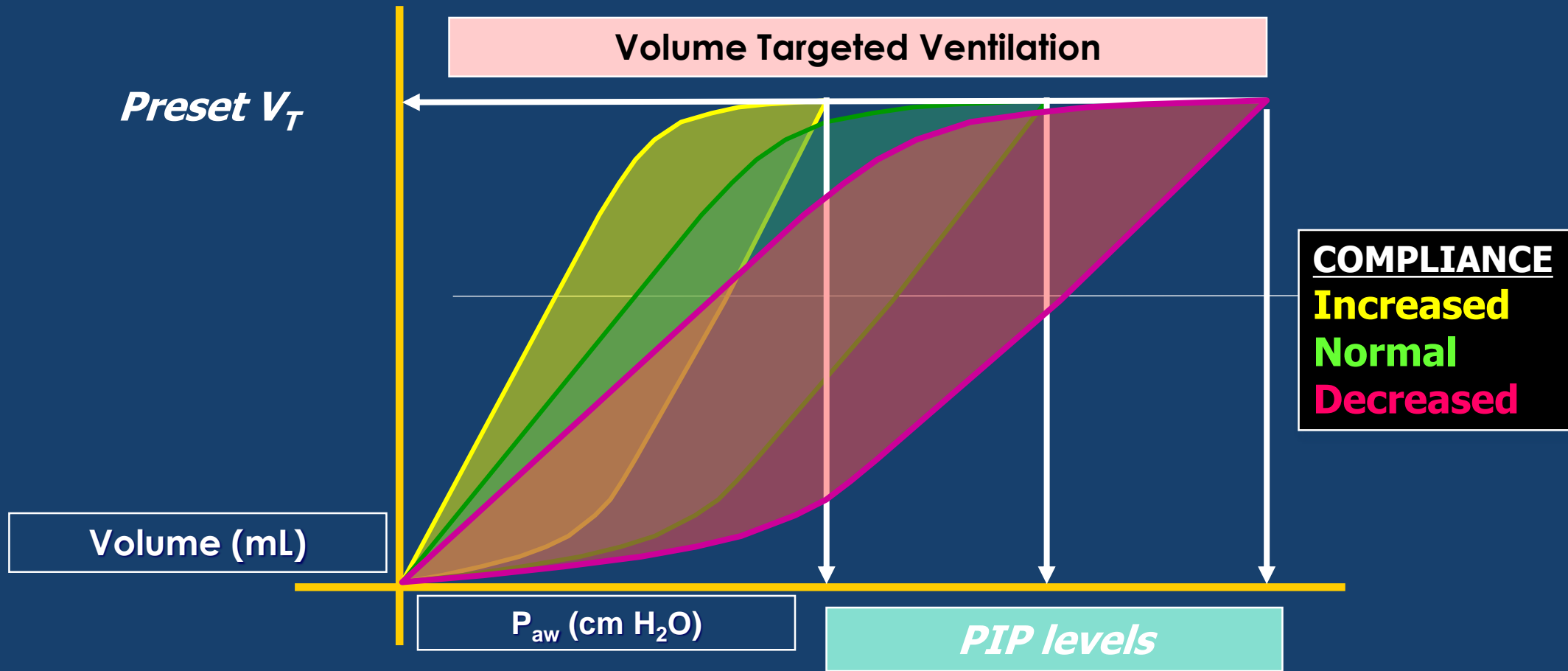
Increased R_{aw}



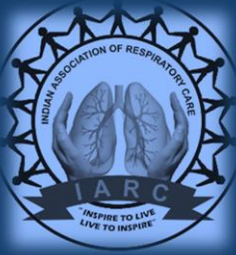
Lung Compliance Changes and the P-V Loop



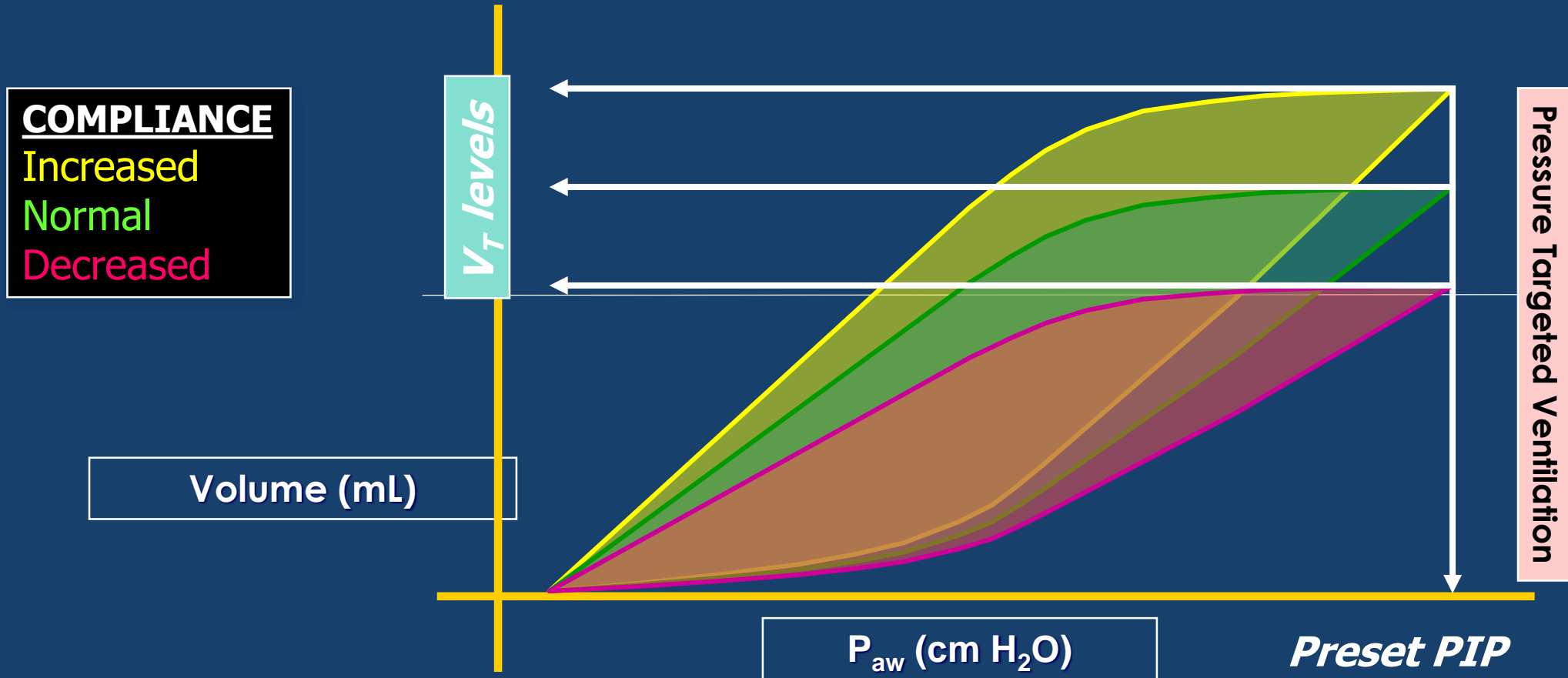
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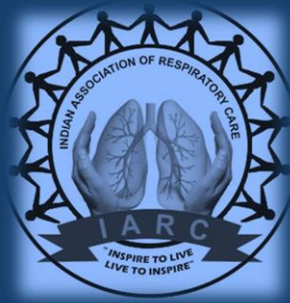


Lung Compliance Changes and the P-V Loop



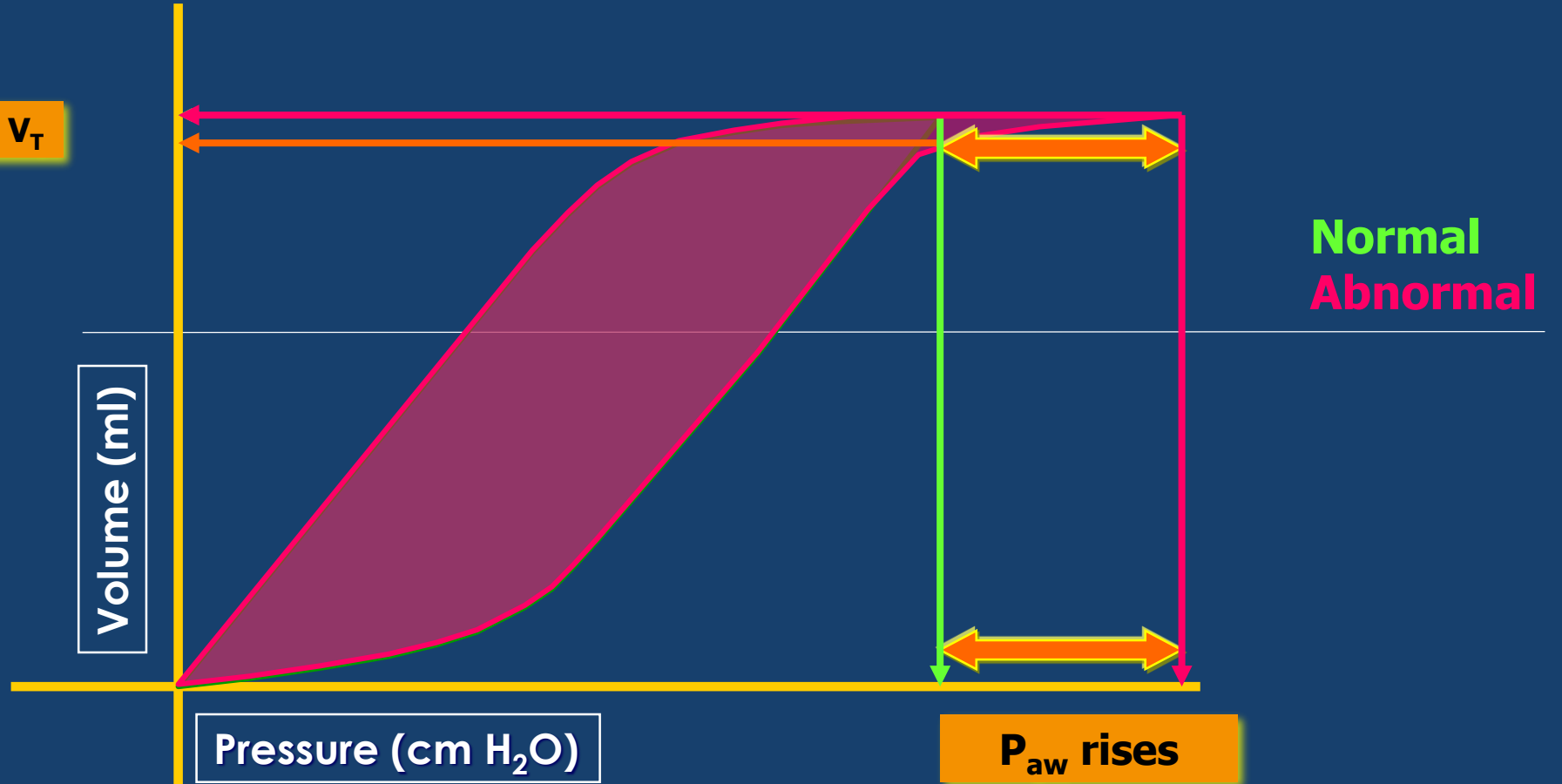
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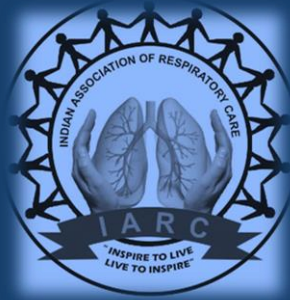




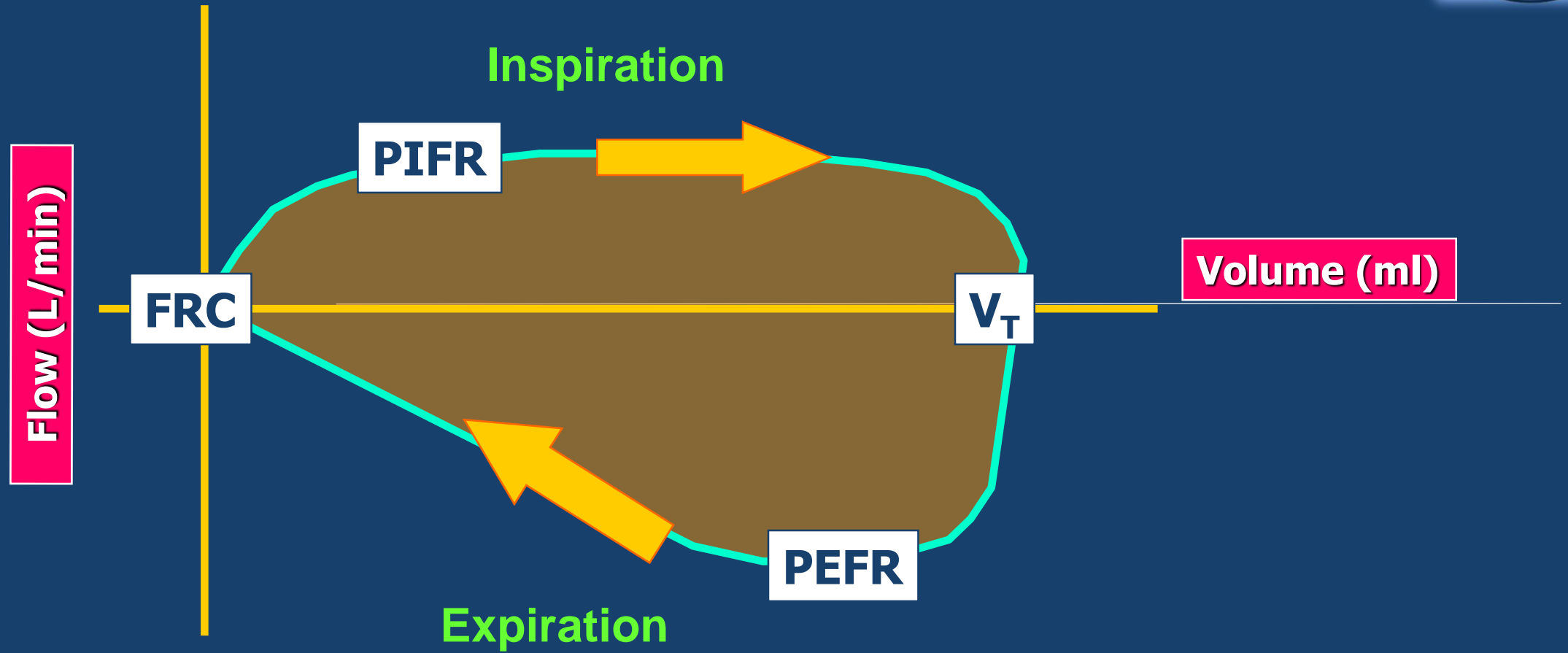
Overdistension

With little or no change in V_T

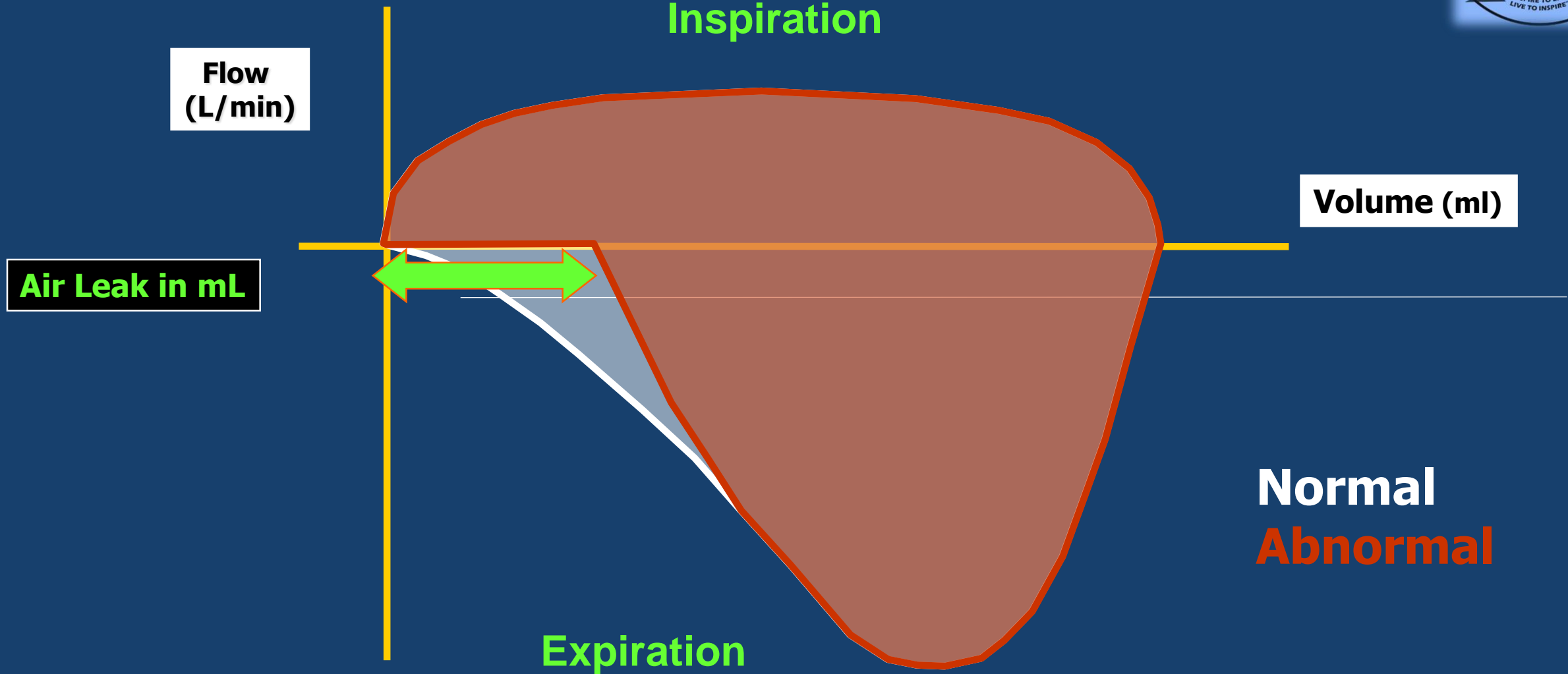
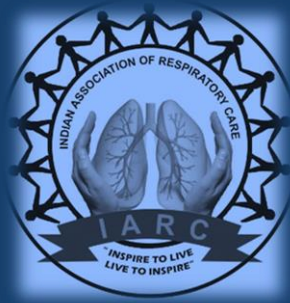




Flow-Volume Loop



Air Leak



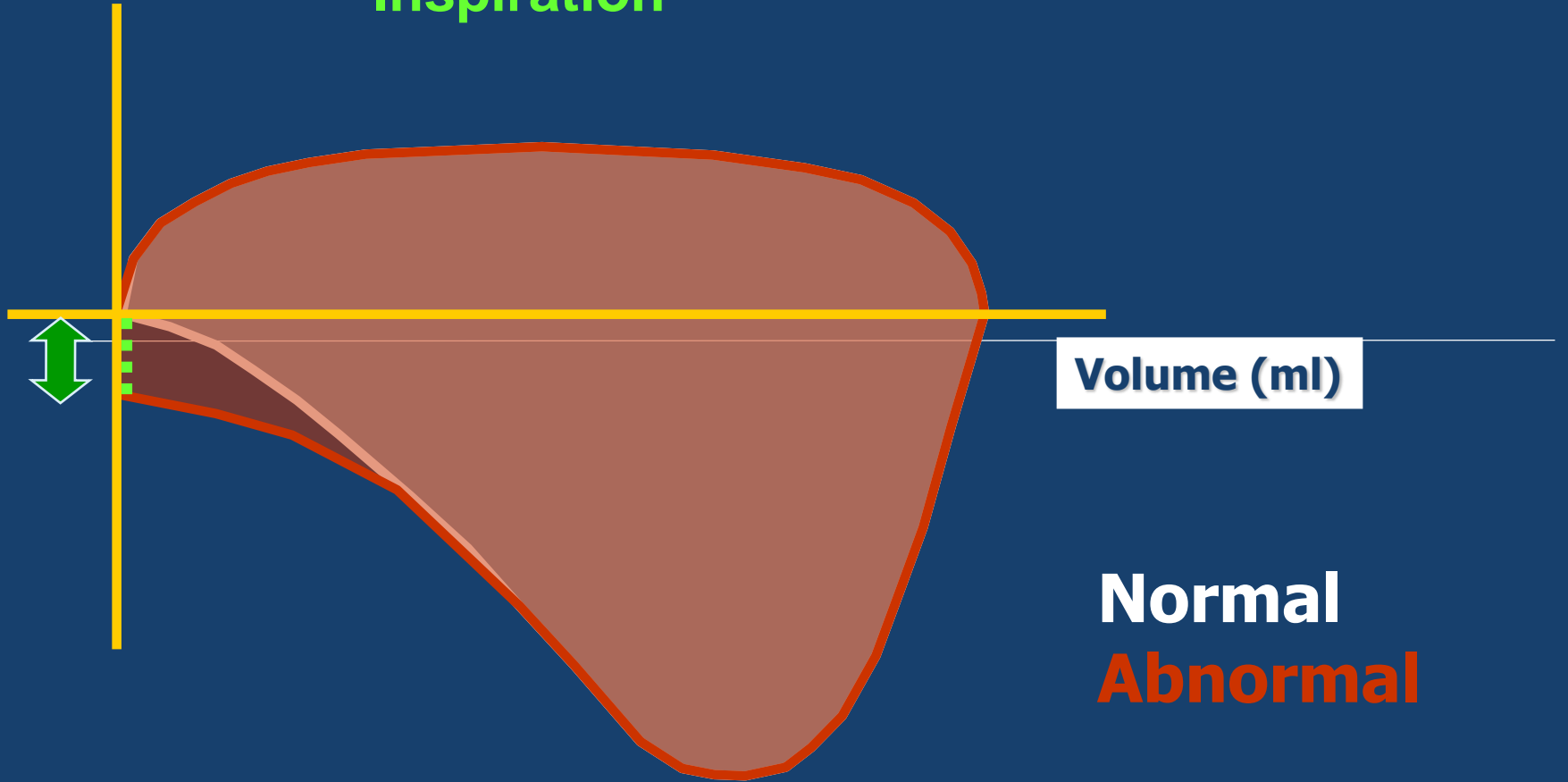


Air Trapping

Inspiration

Flow
(L/min)

Does not return
to baseline

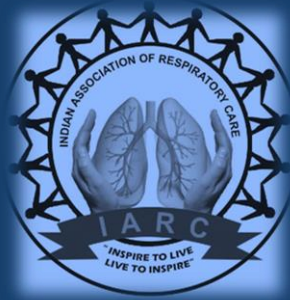


Volume (ml)

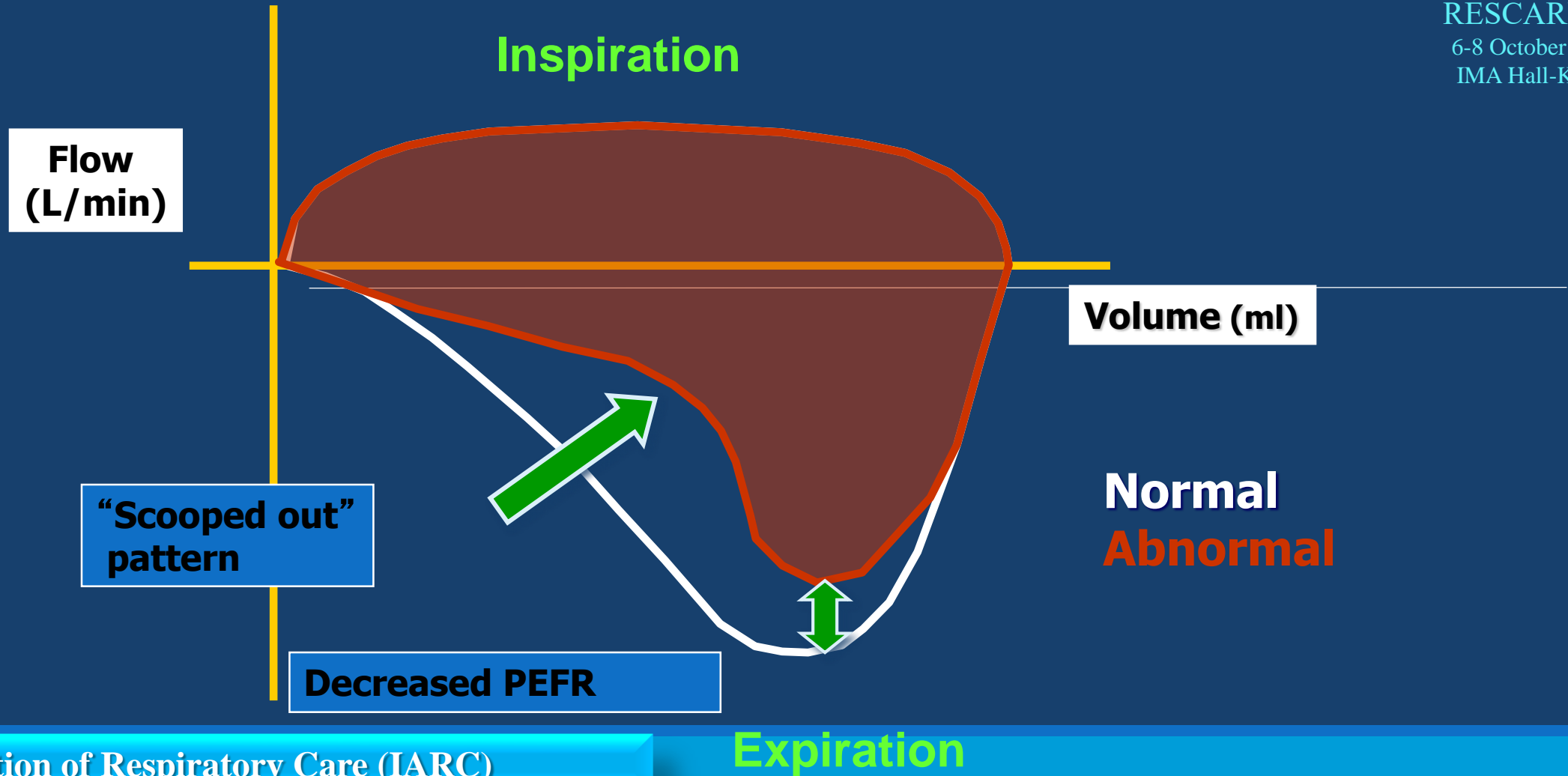
Normal
Abnormal

Expiration

Increased Airway Resistance



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Flow
(L/min)

Inspiration

Volume (ml)

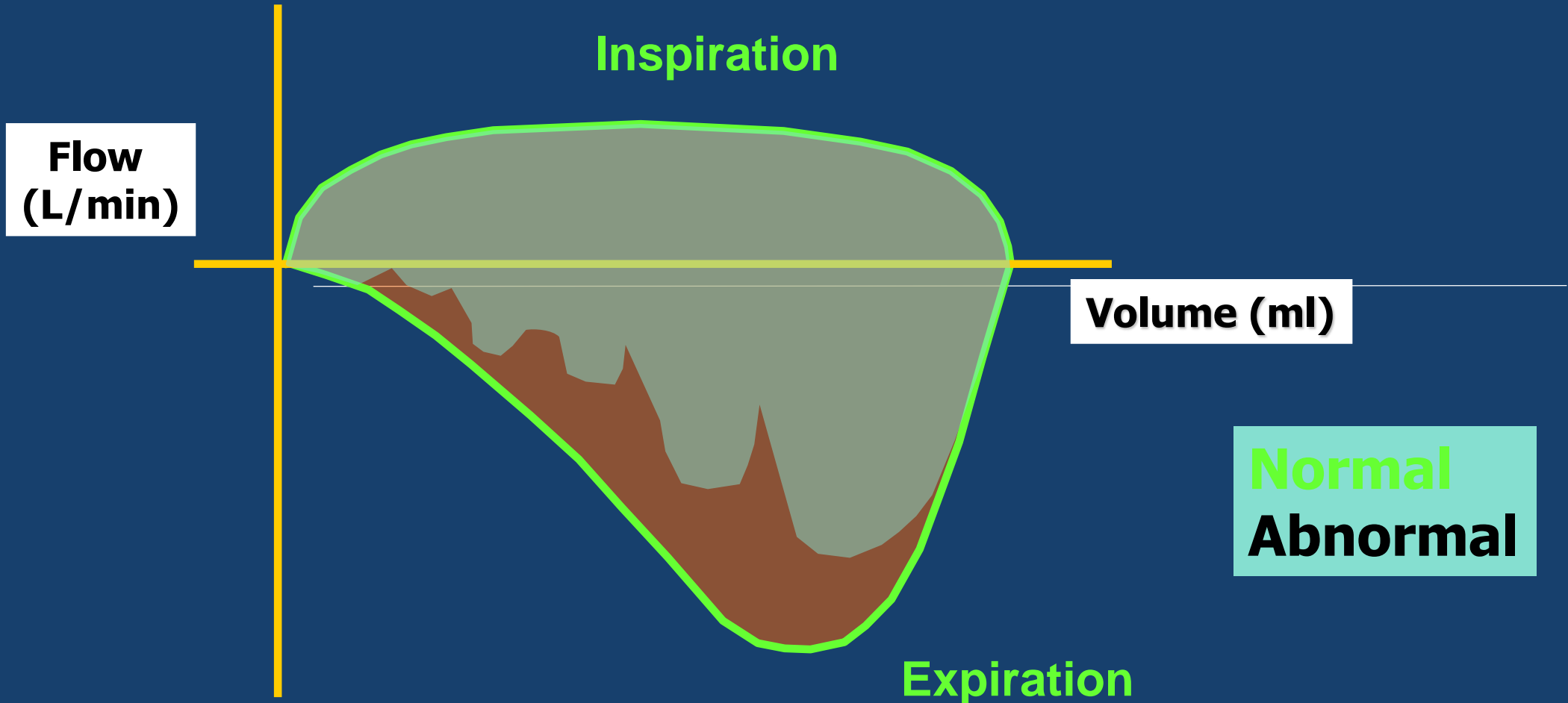
"Scooped out"
pattern

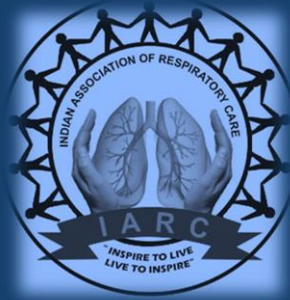
Decreased PEFR

Normal
Abnormal

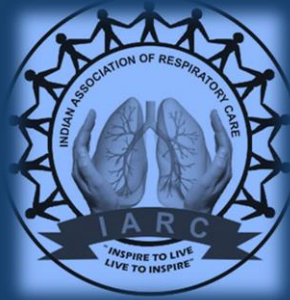
Expiration

Airway Secretions/ Condensate in the Circuit

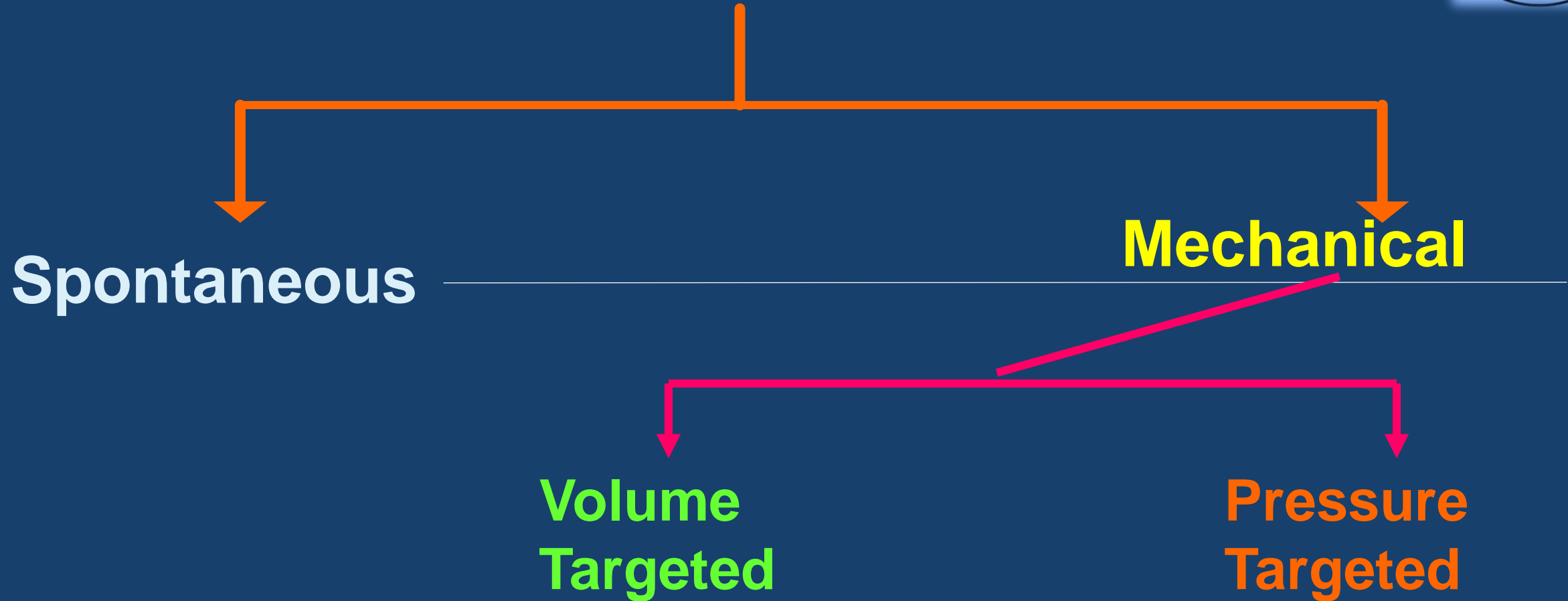




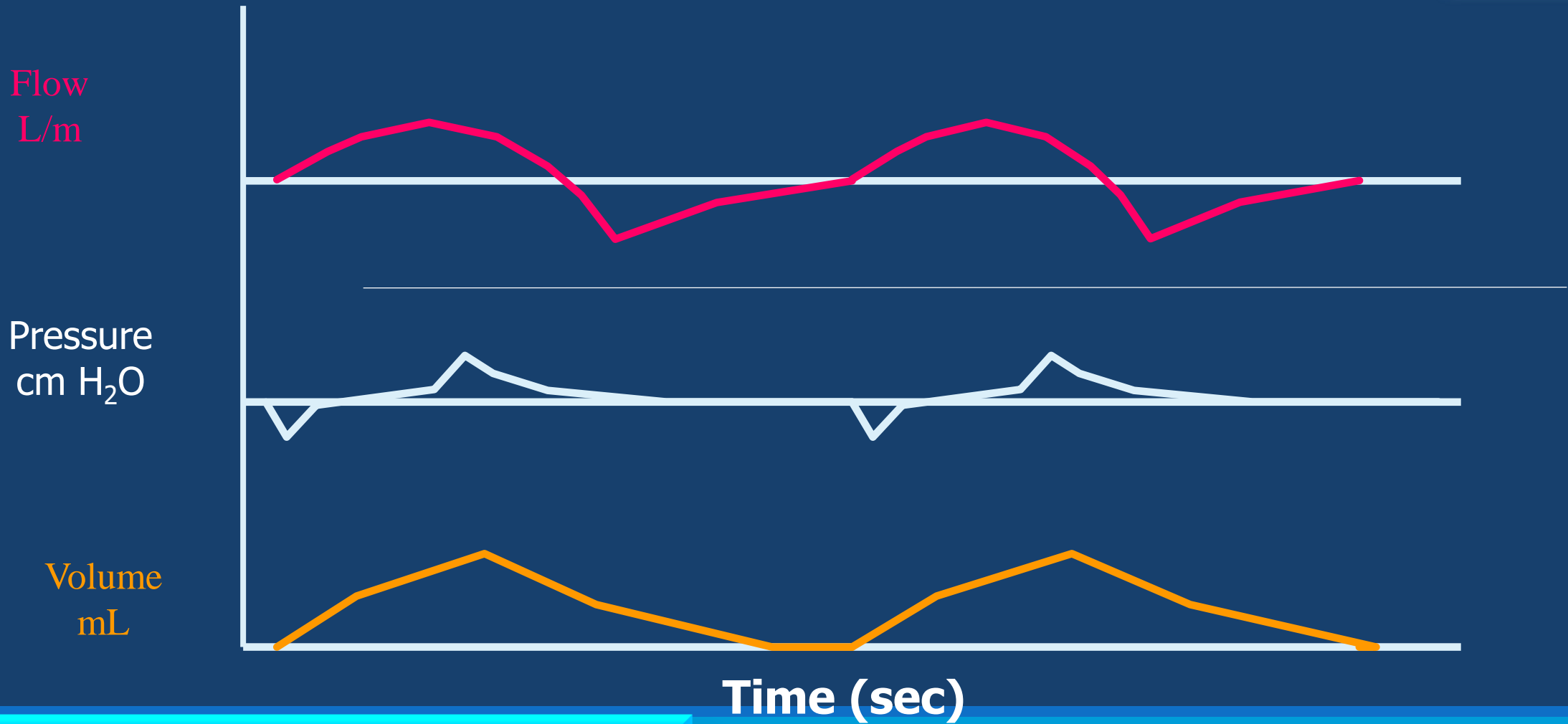
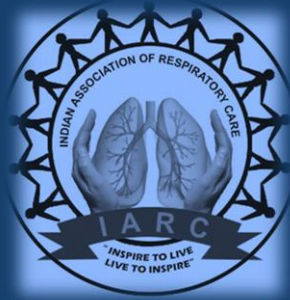
Modes of ventilation



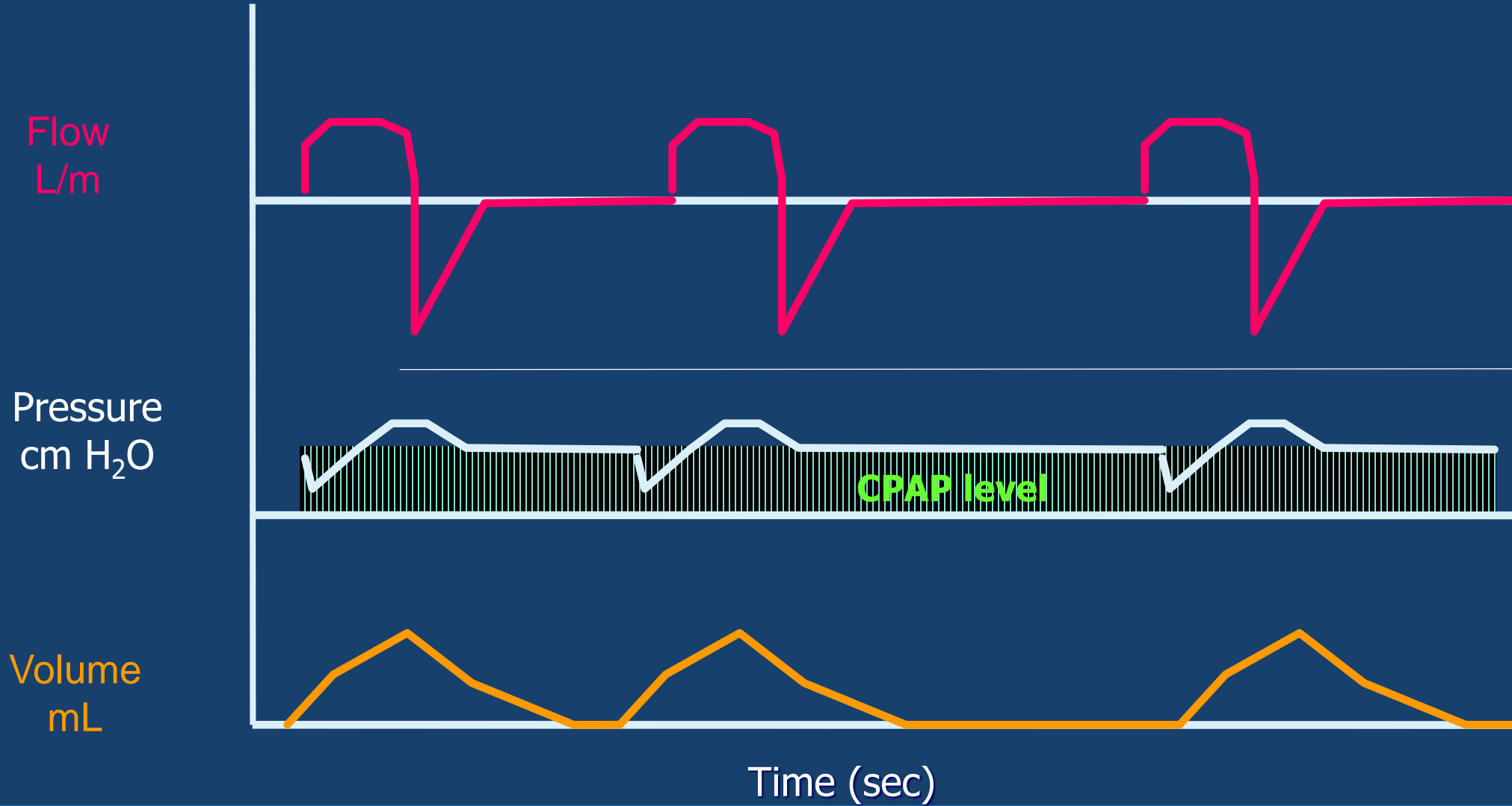
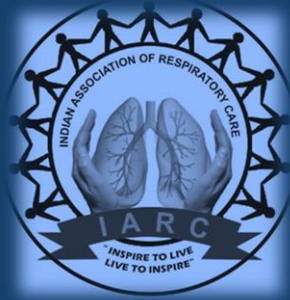
Modes of Ventilation



Spontaneous Breath



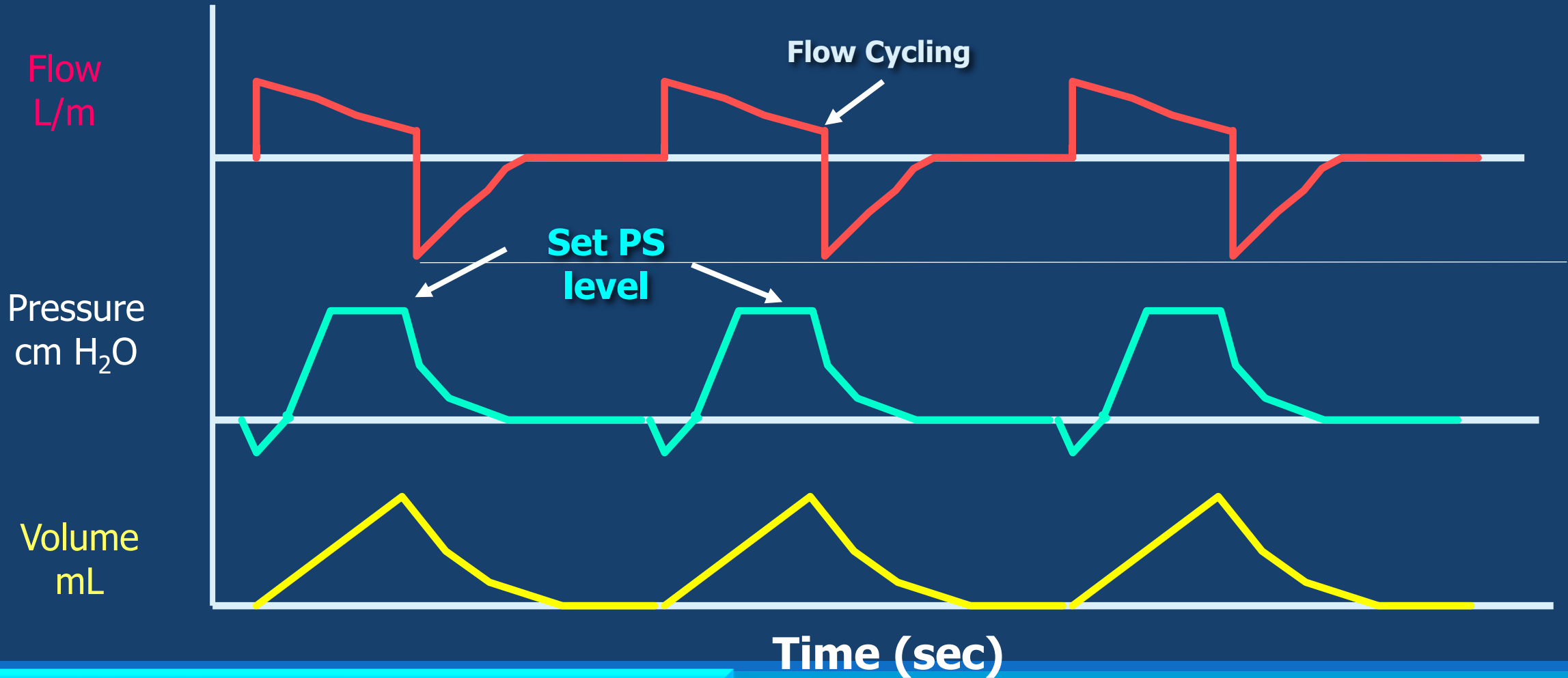
CPAP



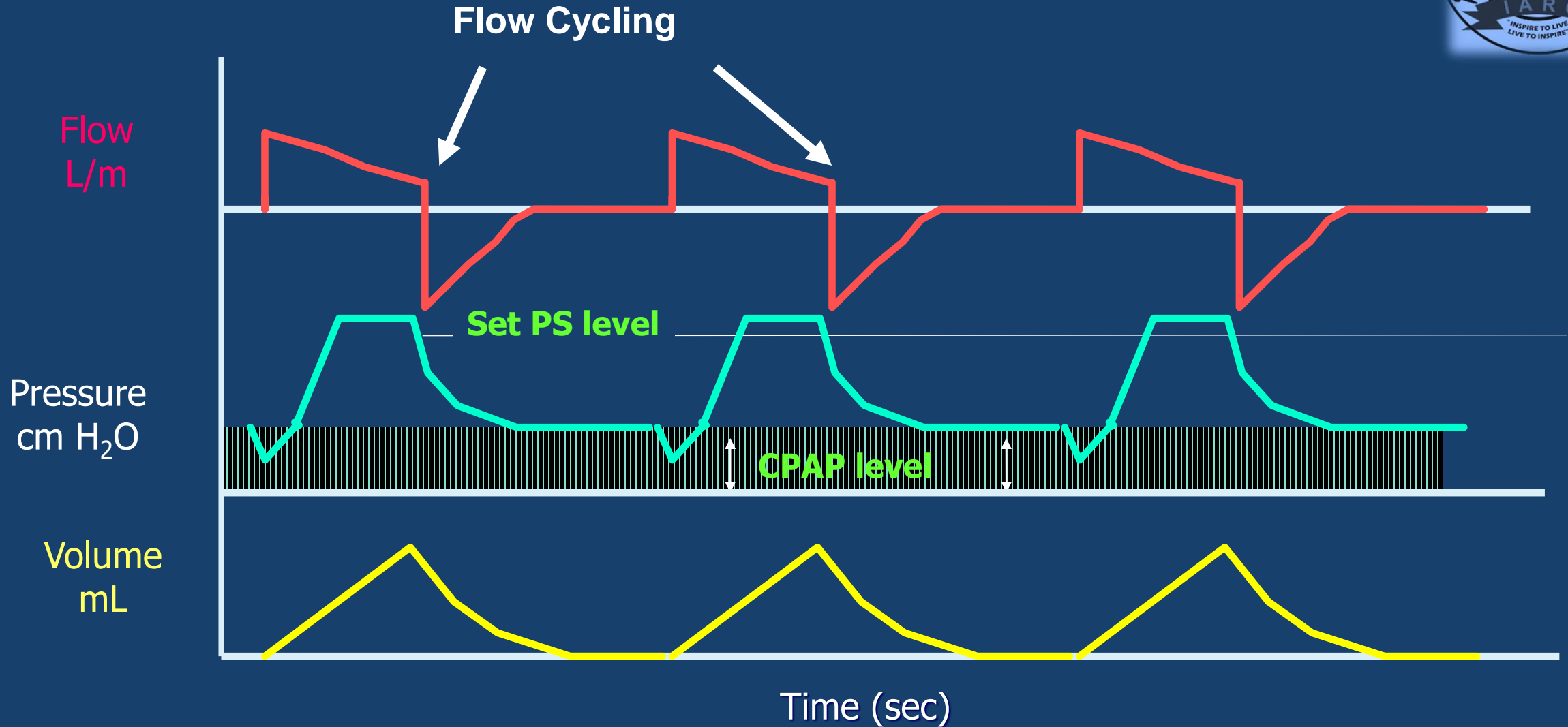
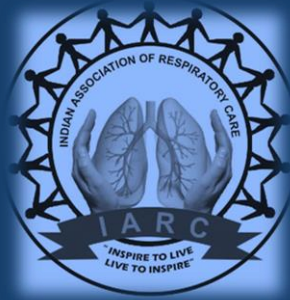
PSV

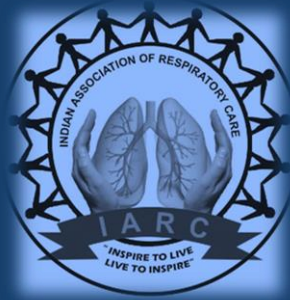


Patient Triggered, Flow Cycled, Pressure limited Mode

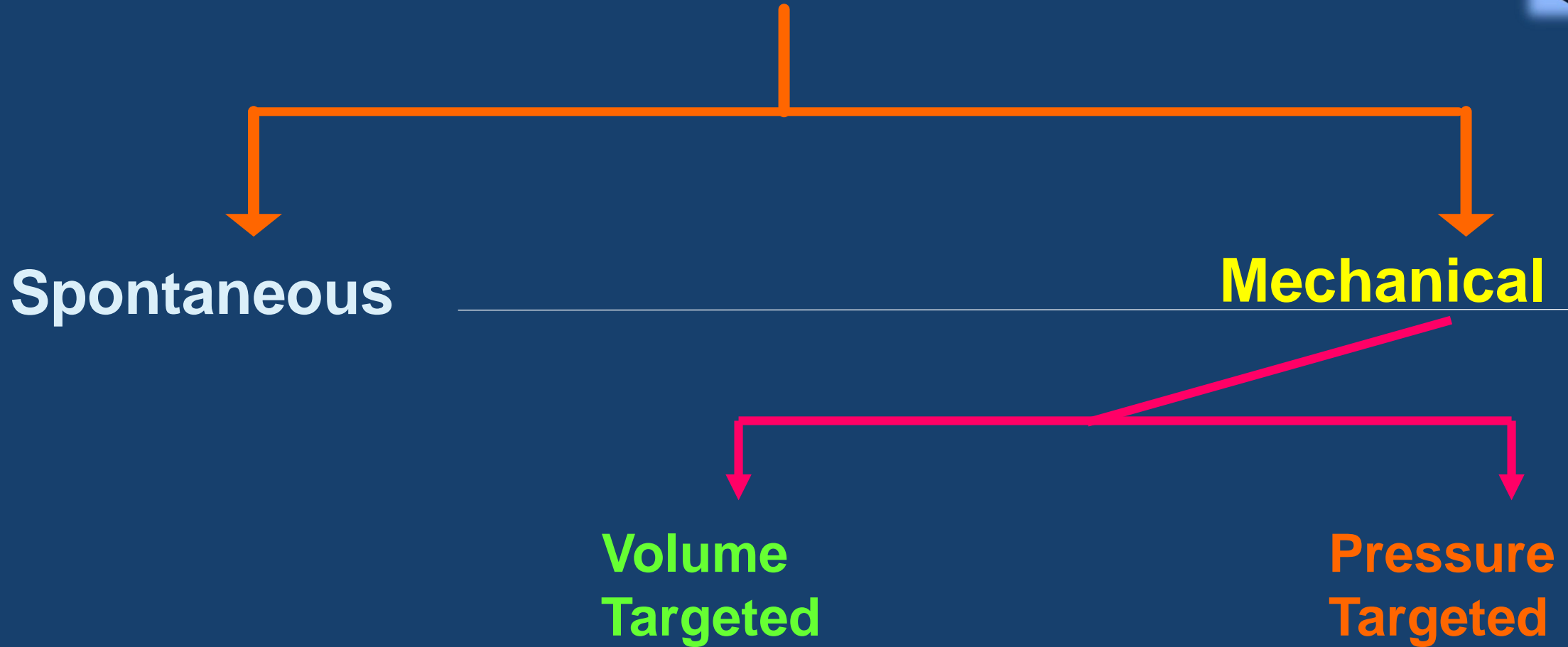


CPAP + PSV

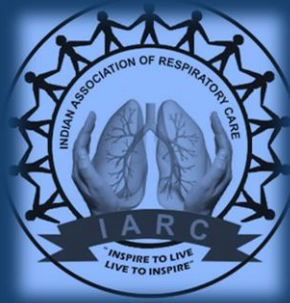




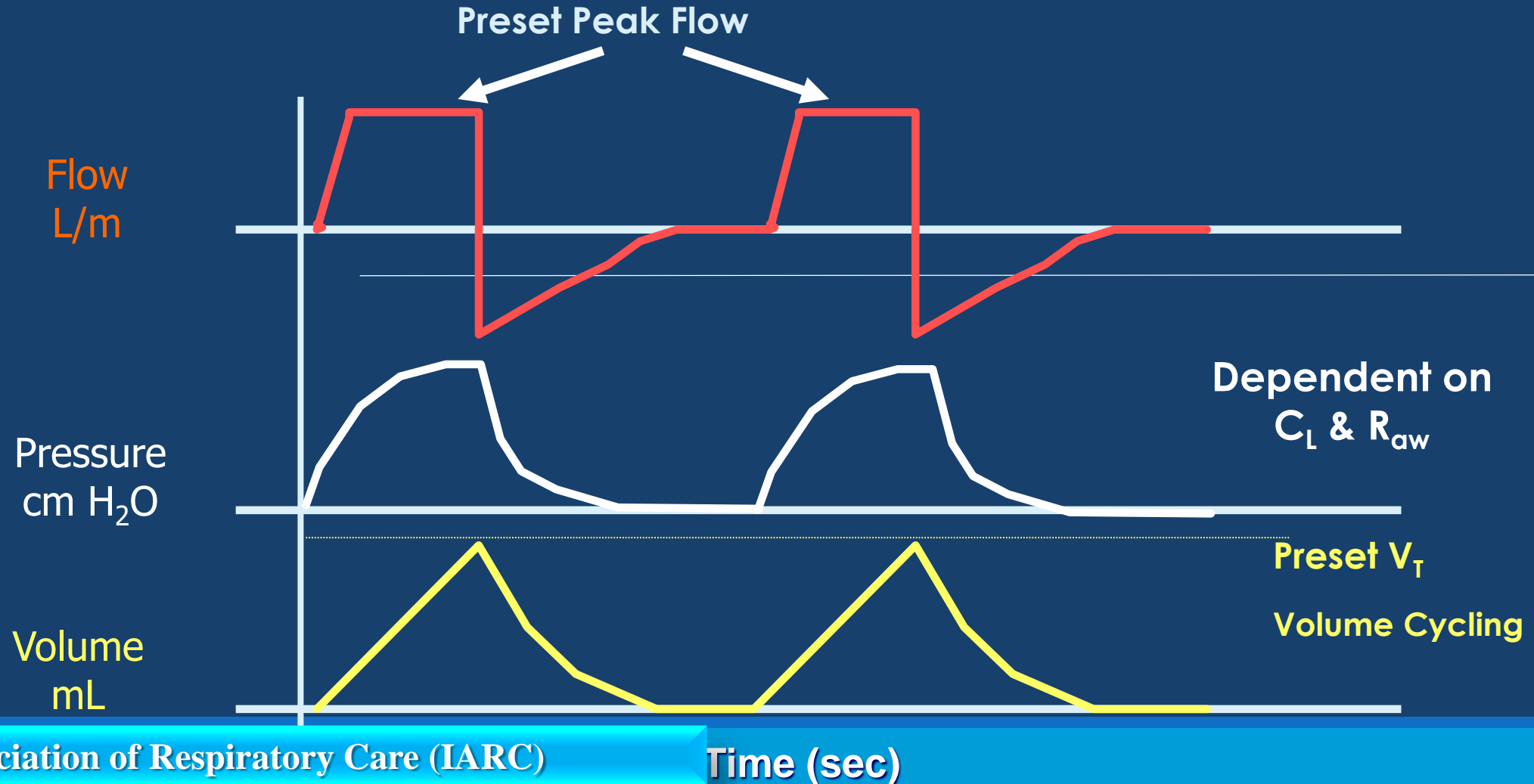
Modes of Ventilation



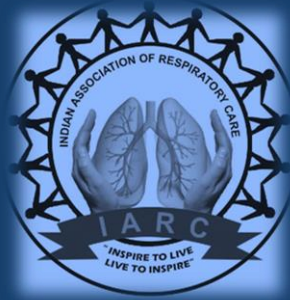
Controlled Mode (Volume- Targeted Ventilation)



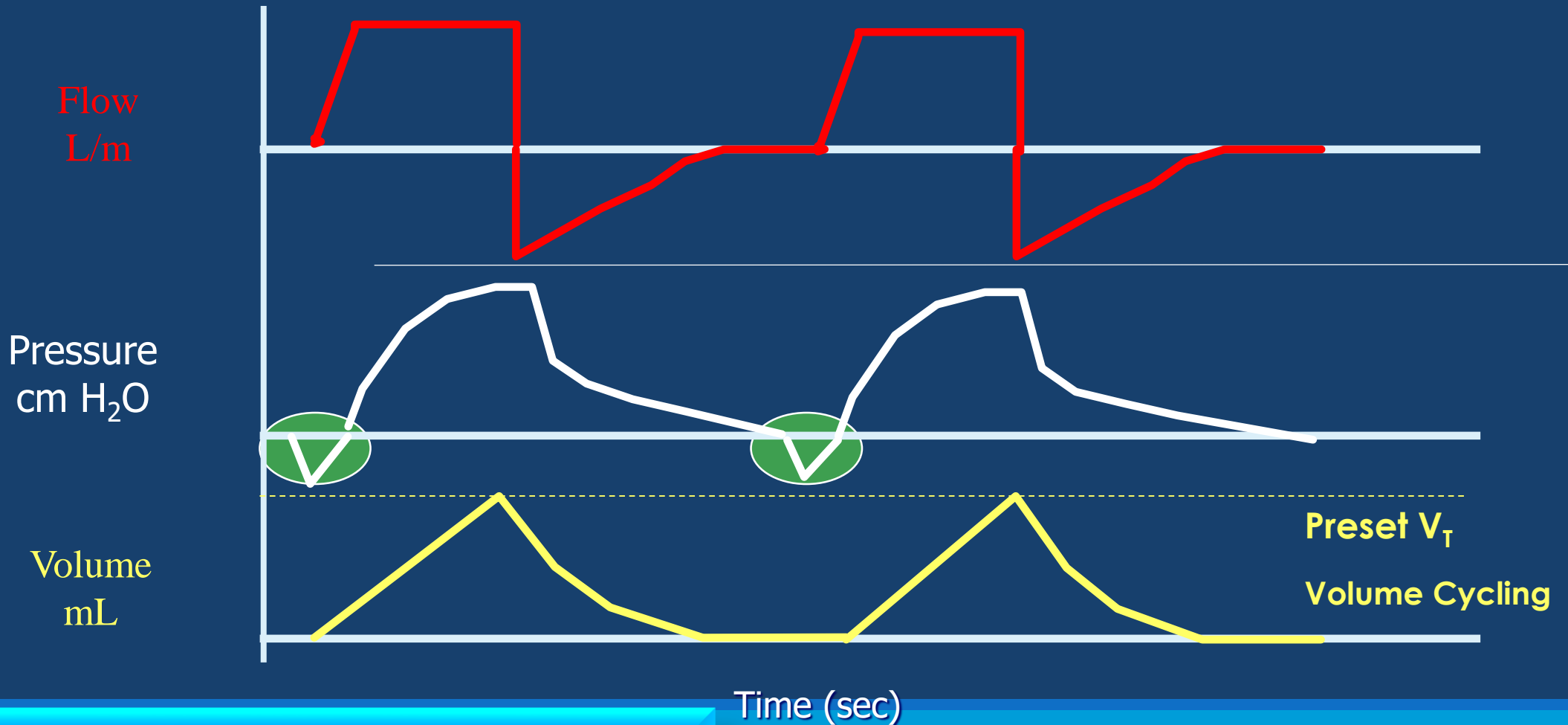
Time triggered, Flow limited, Volume cycled Ventilation



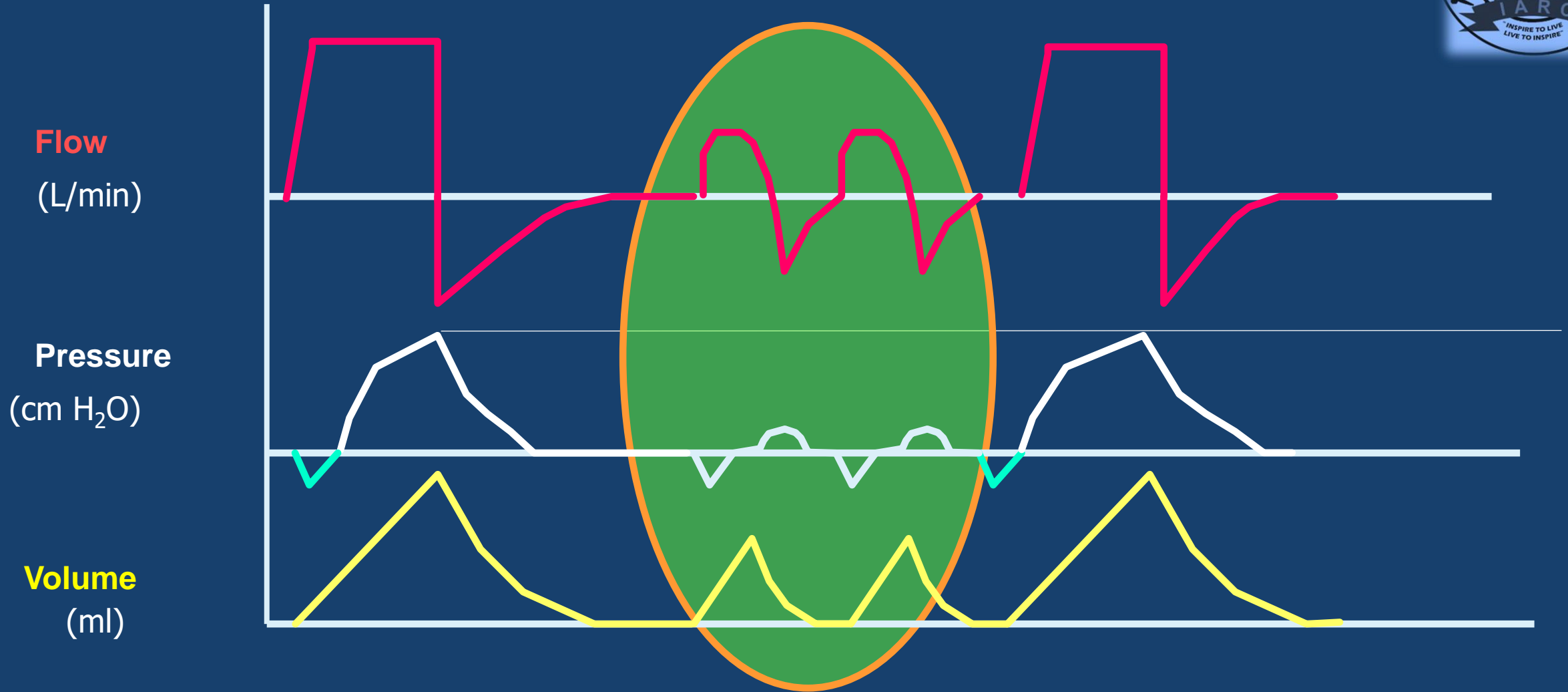
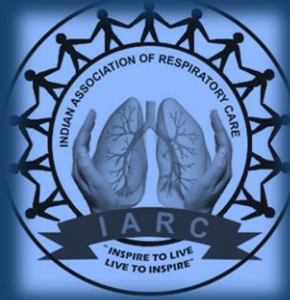
Assisted Mode (Volume-Targeted Ventilation)



Patient triggered, Flow limited, Volume cycled Ventilation

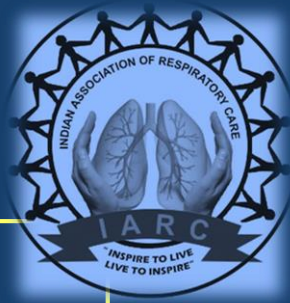


SIMV (Volume-Targeted Ventilation)

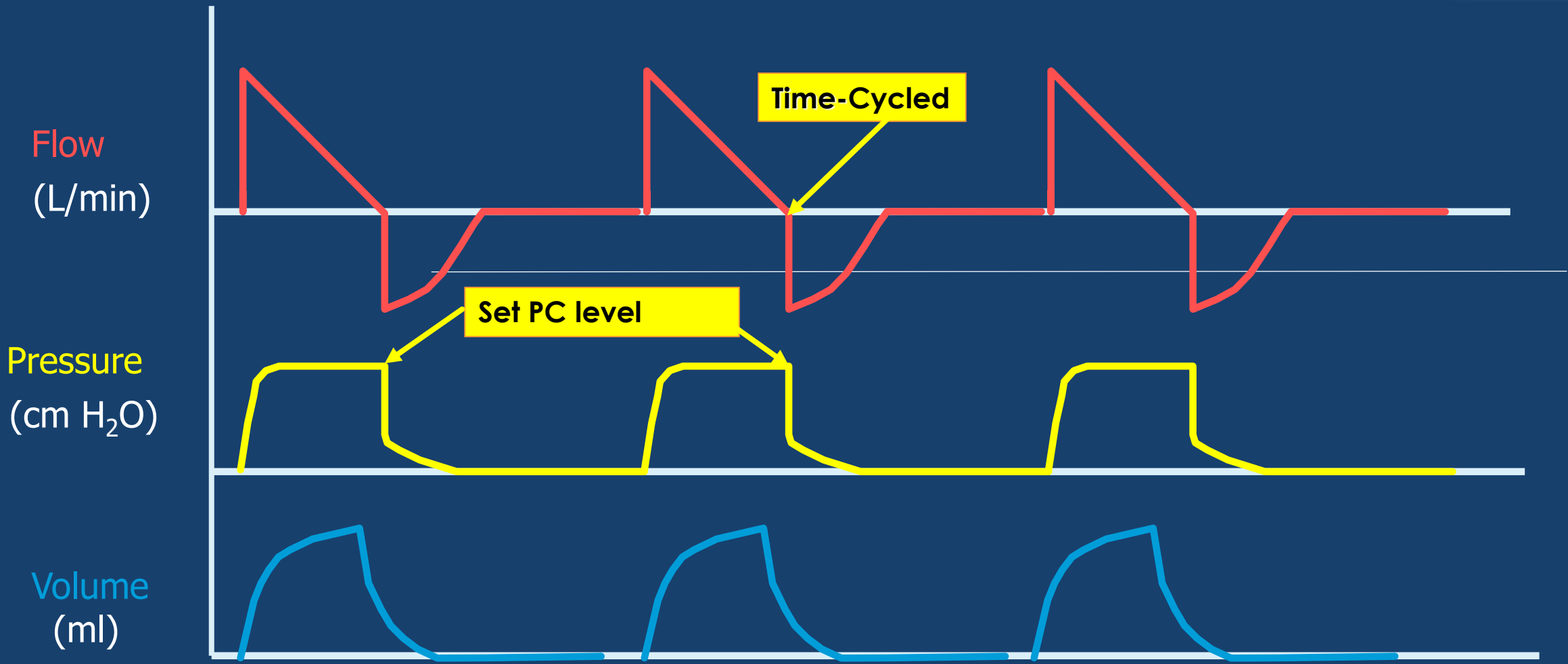


Spontaneous Breaths

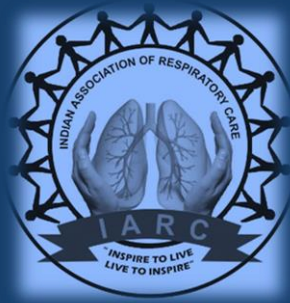
Controlled Mode (Pressure-Targeted Ventilation)



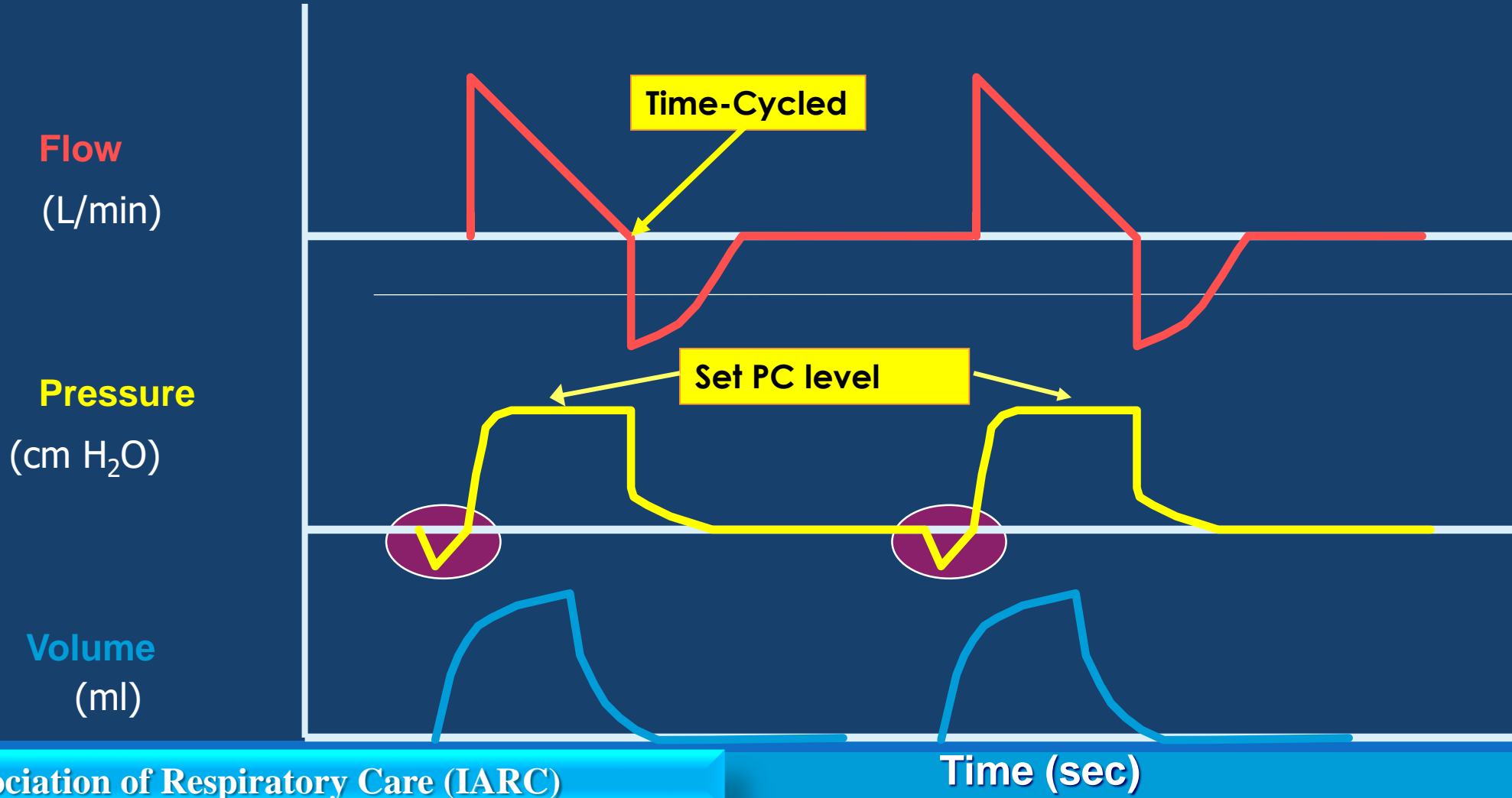
Time Triggered, Pressure Limited, Time Cycled Ventilation

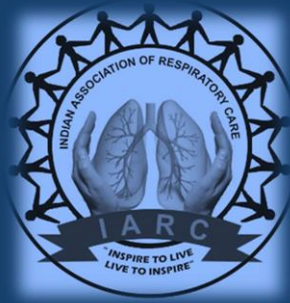


Assisted Mode (Pressure-Targeted Ventilation)

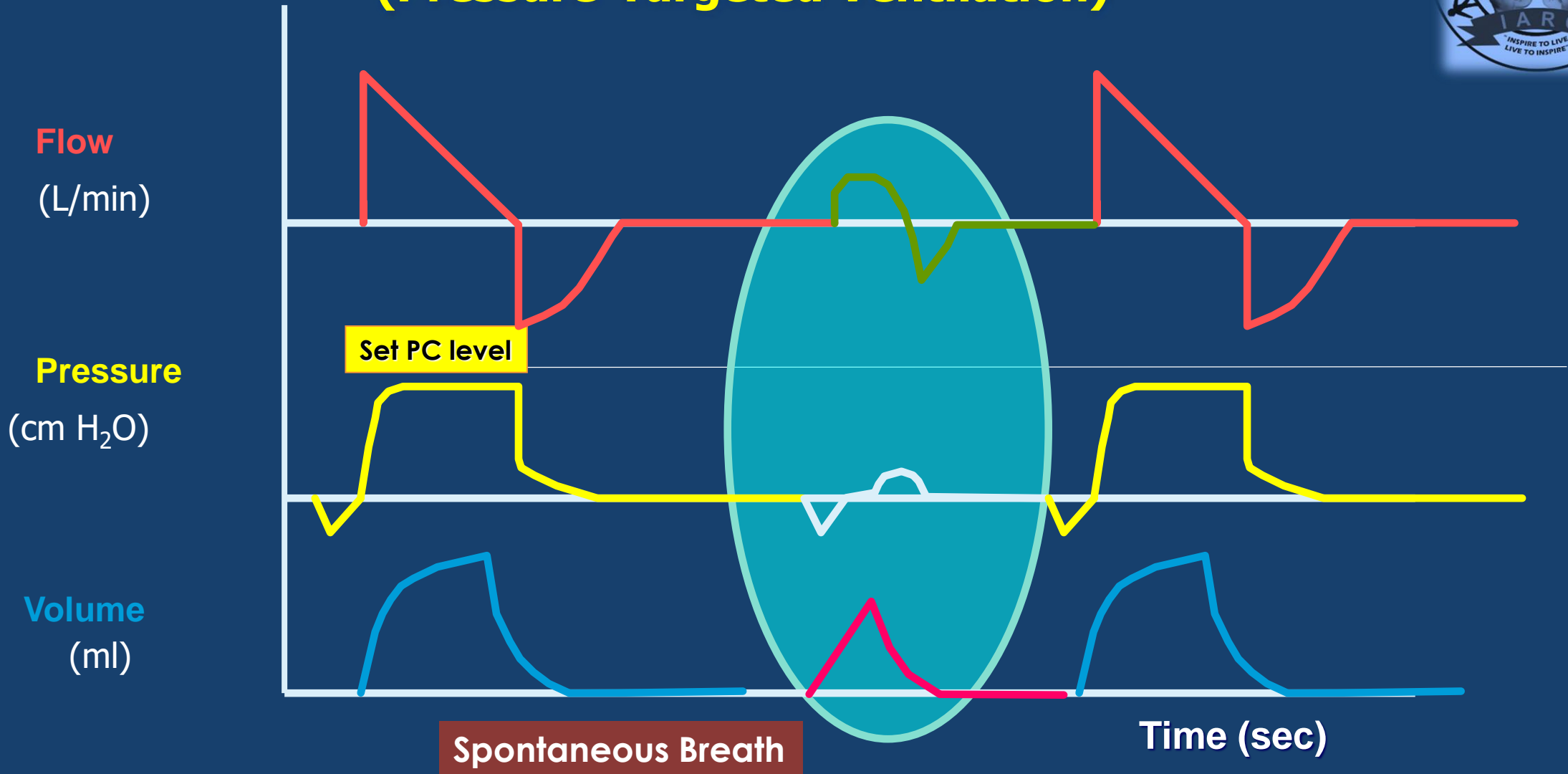


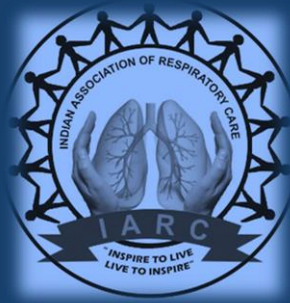
Patient Triggered, Pressure Limited, Time Cycled Ventilation





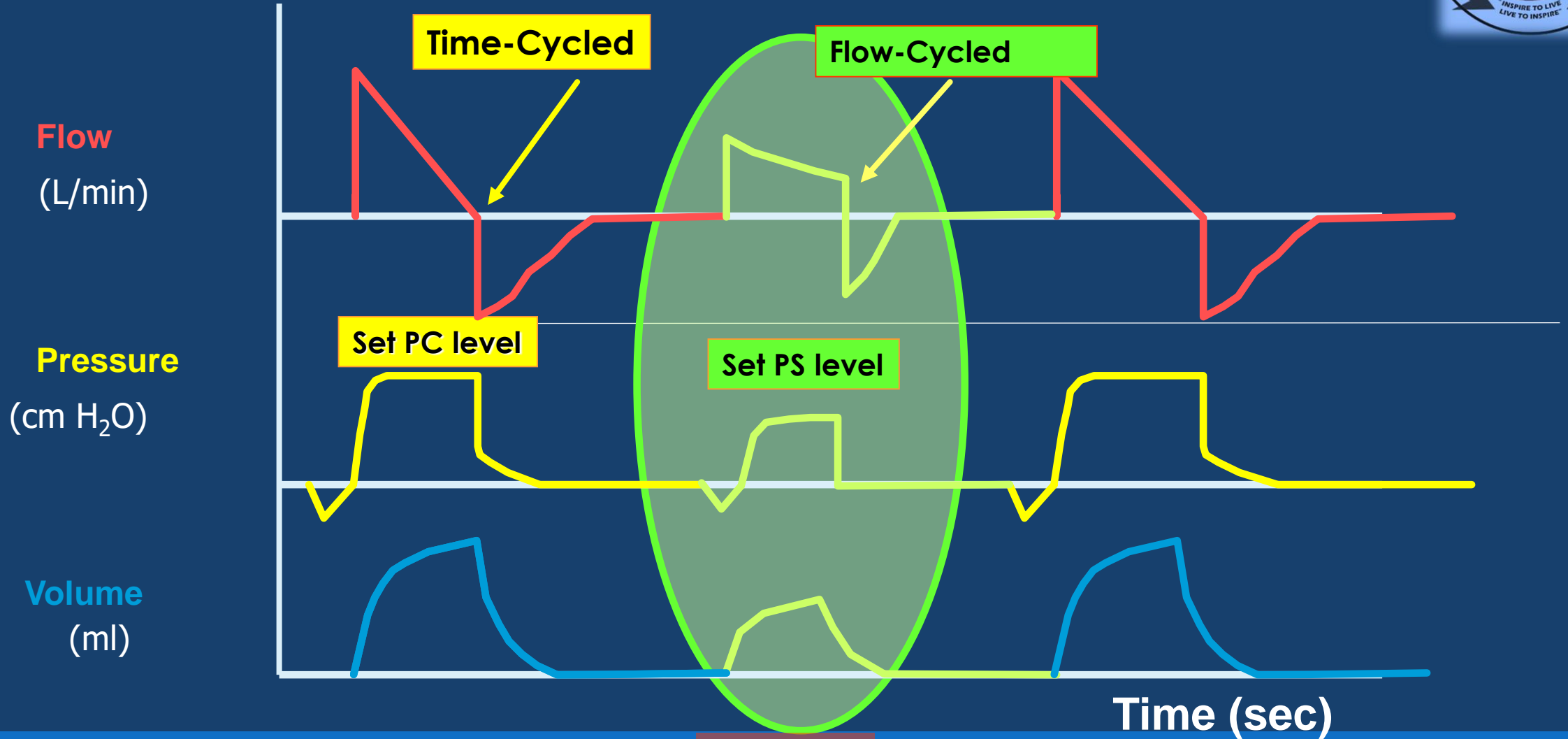
SIMV Mode (Pressure-Targeted Ventilation)





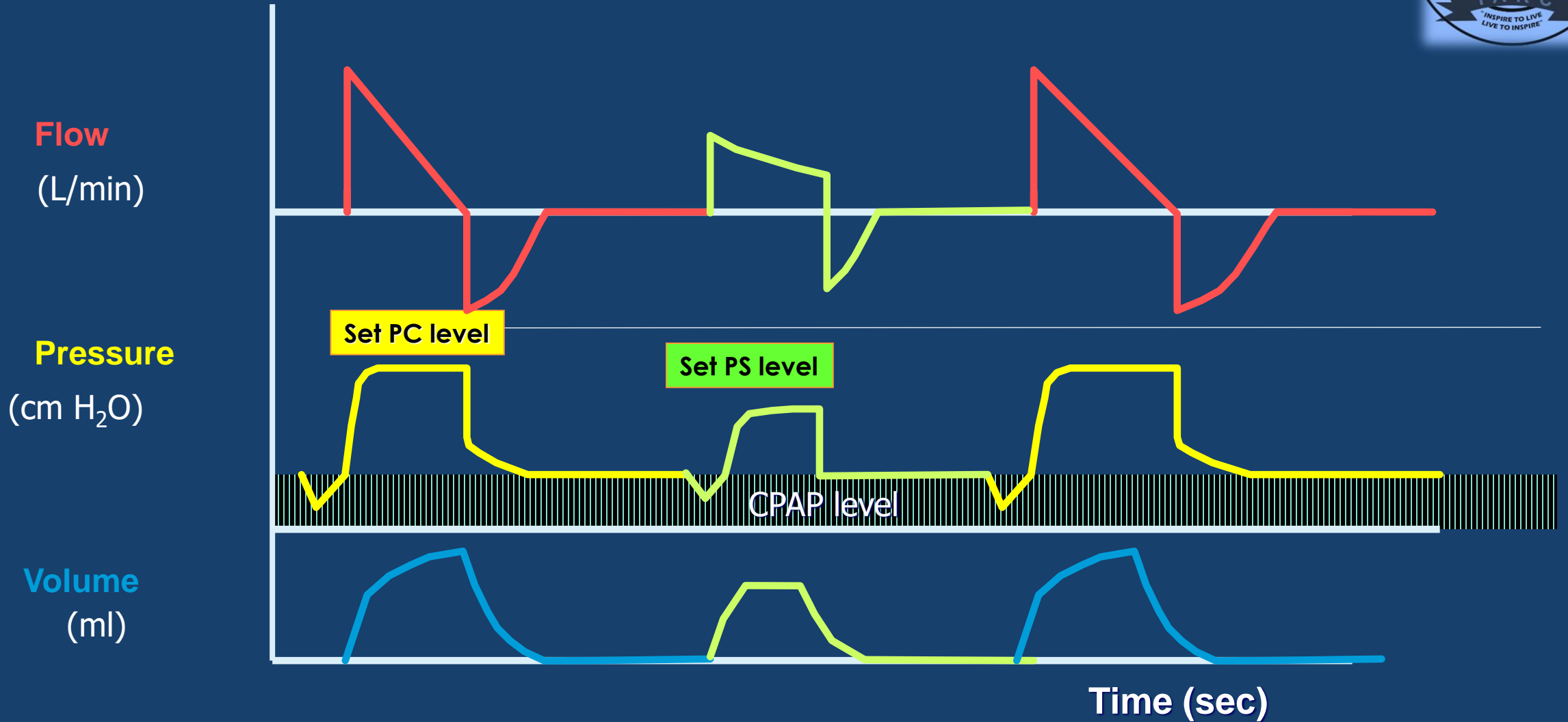
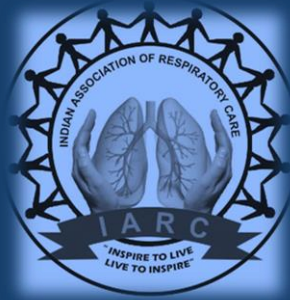
SIMV + PS

(Pressure-Targeted Ventilation)

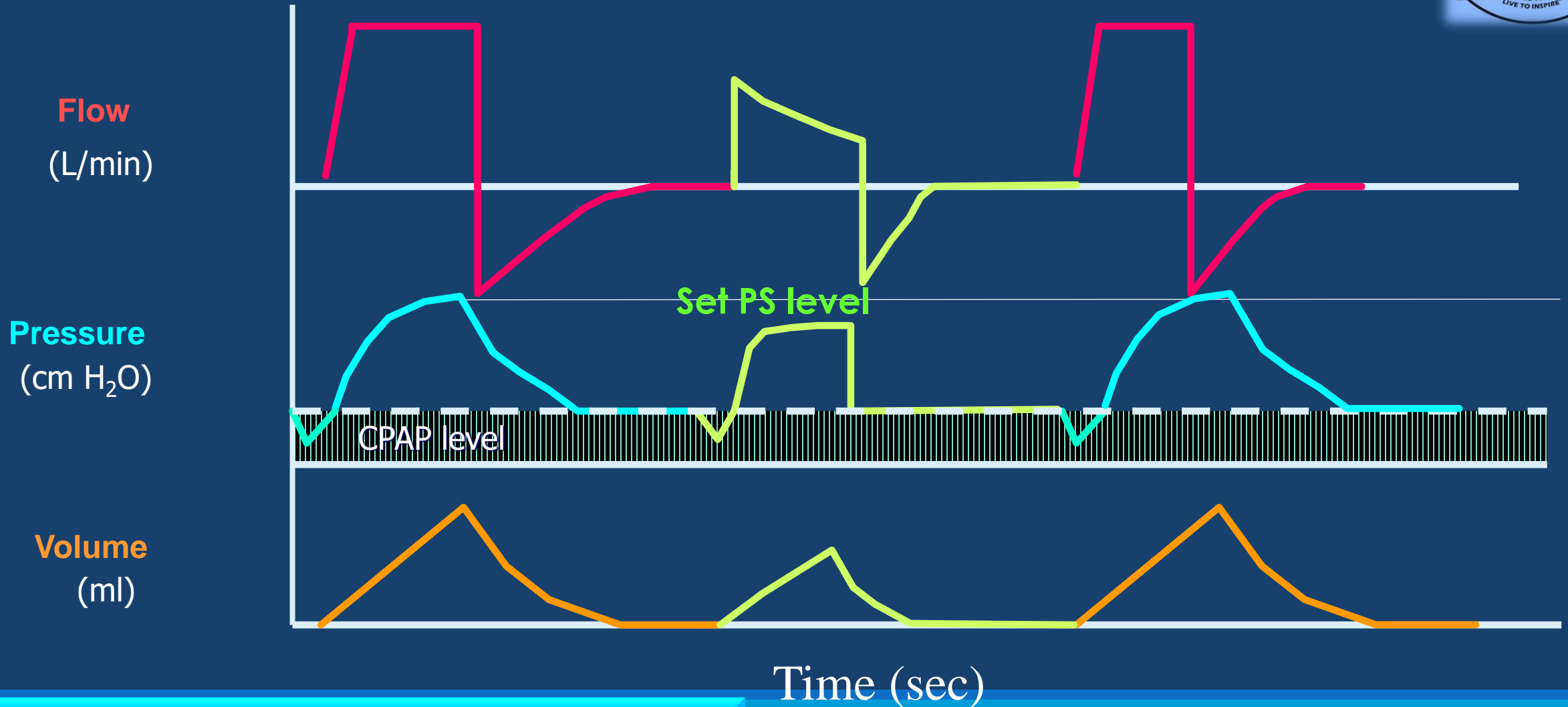


SIMV + PS + CPAP

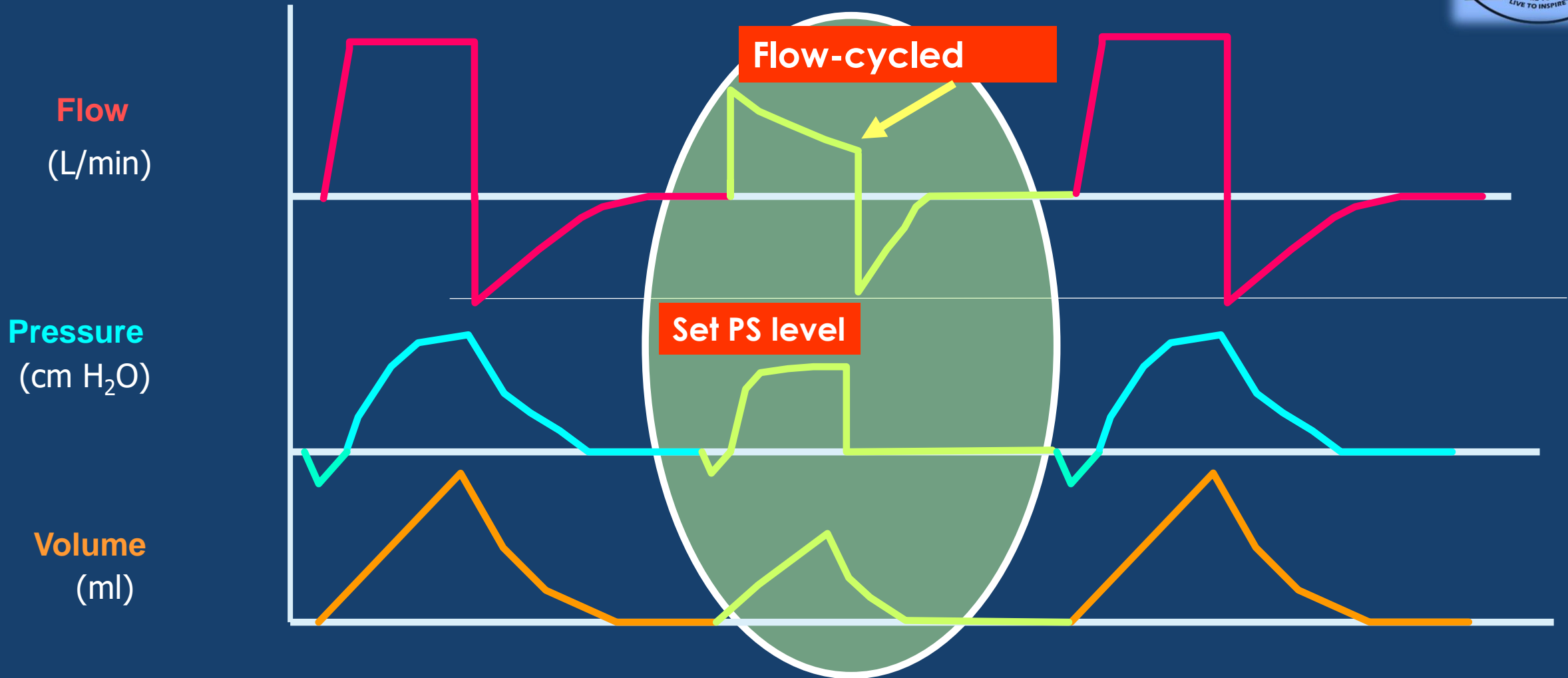
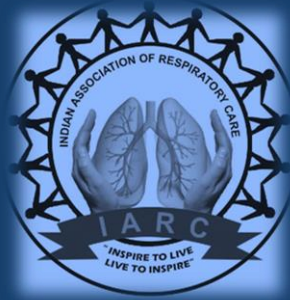
(Pressure-Targeted Ventilation)



SIMV+PS + CPAP (Volume-Targeted Ventilation)



SIMV+PS (Volume-Targeted Ventilation)



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Thank you
