

# MODULE 8 L03

# Respiratory System: Lung Volumes and Capacities

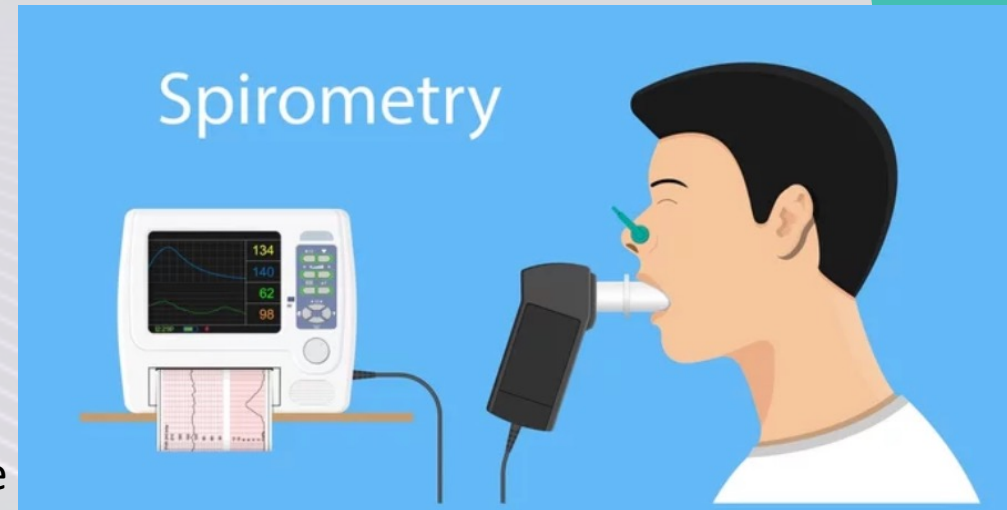
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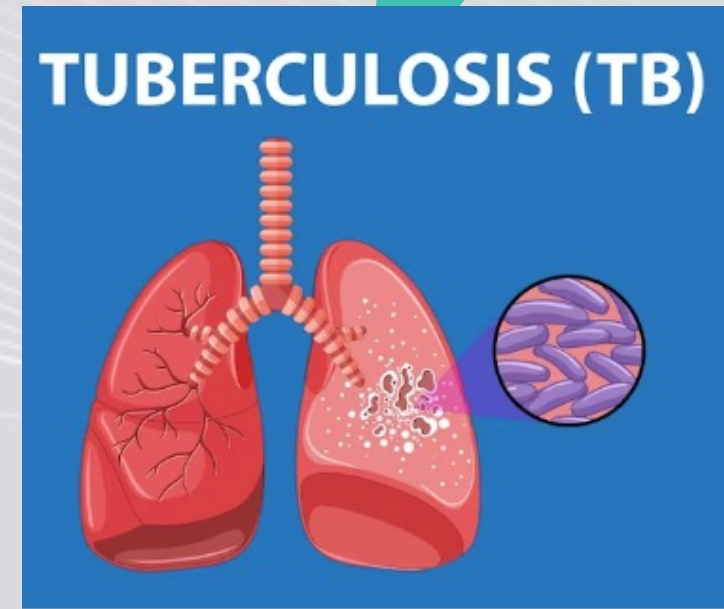
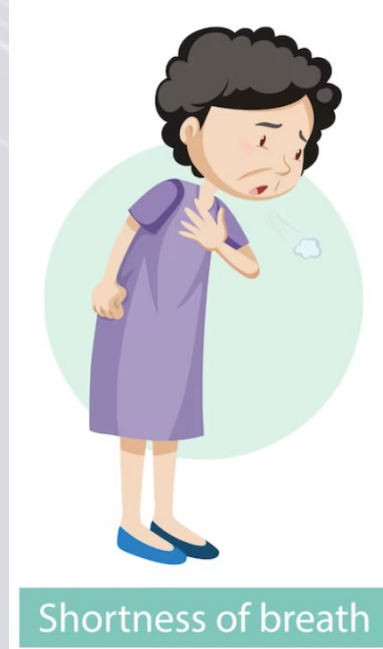
# 3. Lung Volume and Capacities

- A way to assess pulmonary function
  - ❖ Lung volume - volume of gas in lungs at a given time during respiratory cycle
  - ❖ Lung capacities - derived from a summation of different lung volumes
- Spirogram
  - ❖ Record of lung volumes and lung capacities
  - ❖ Device
    - Spirometer
  - ❖ Breathing test
    - Spirometry
  - ❖ Detecting following diseases:
    - Asthma
    - Chronic obstructive pulmonary disease
    - Cystic fibrosis
    - Pulmonary fibrosis



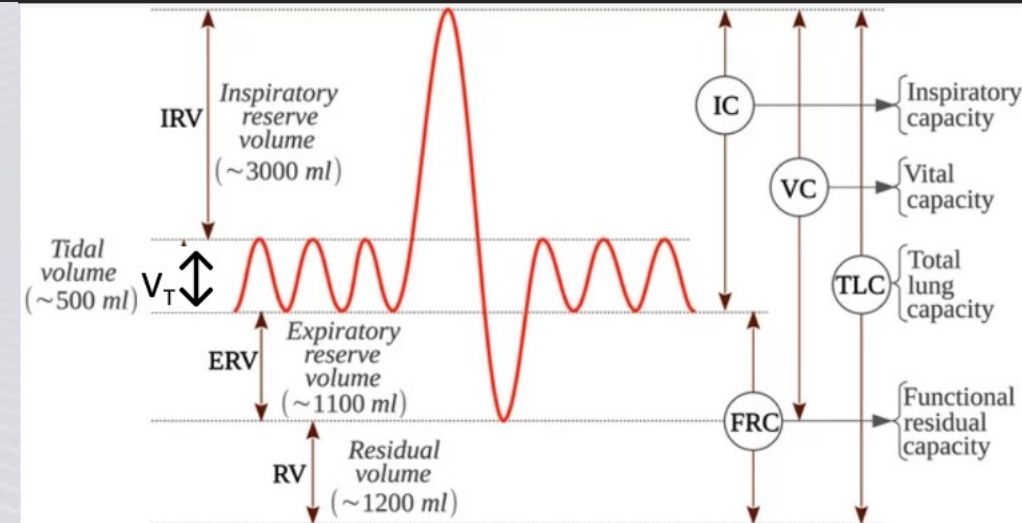
# Other Lung Diseases

- Eupnea – normal, good, healthy and unlabored breathing
- Apnea – low oxygen levels when breathing stops
- Dyspnea – shortness of breath
- Tuberculosis – caused by *Mycobacterium tuberculosis*



# Lung Volumes

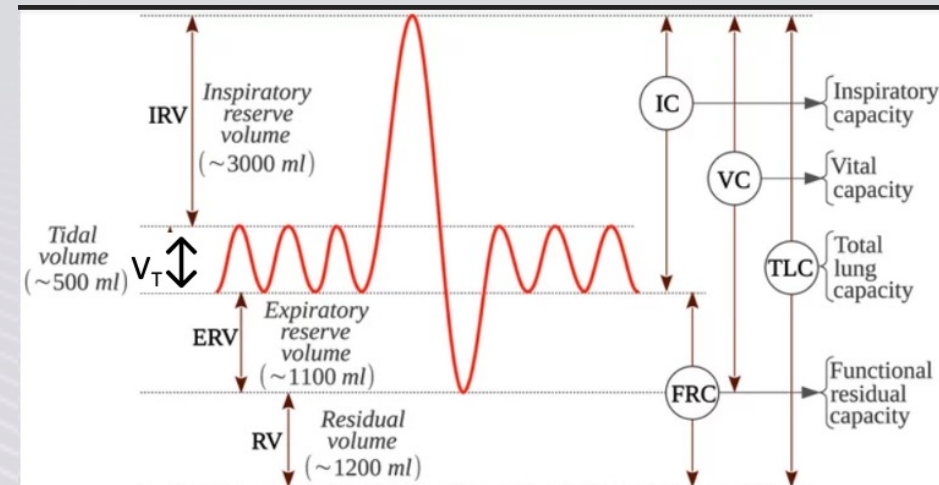
- Larger
  - ❖ Males
  - ❖ Taller individuals
  - ❖ Younger adults
- Smaller
  - ❖ Females
  - ❖ Shorter individuals
  - ❖ Elderly
- Lung volumes:
  - ❖ Tidal volume ( $V_T$ )
    - volume of air inspired or expired during a single breathing cycle under resting conditions
    - = 500 ML in an average adult male or female
  - ❖ Inspiratory reserve volume (IRV)
    - maximum volume of air that can be inspired after a normal inspiration.
    - ~ 3000 mL in average adult male and 1900 mL in an average adult female
  - ❖ Expiratory reserve volume (ERV)
    - maximum volume of air that can be expired after a normal expiration
    - averages 1100 mL in adult male and 700 mL in an adult female
  - ❖ Residual volume (RV)
    - volume of air that remains in lungs after a maximum expiration
    - ~ 1200mL in males and 1100 mL in females





# Lung Capacities

- Calculated by adding two or more specific lung volumes
  - ❖ Functional residual capacity (FRC)
    - volume of air in the lungs at the end of a normal expiration under resting conditions
    - $RV + ERV$ 
      - Males -  $1200 \text{ mL} + 1100 \text{ mL} = 2300 \text{ mL}$
      - Females -  $1100 \text{ mL} + 700 \text{ mL} = 1800 \text{ mL}$
  - Inspiratory capacity (IC)
    - maximum volume of air that can be inspired after a normal expiration
    - $V_T + IRV$ 
      - Males -  $500 \text{ mL} + 3000 \text{ mL} = 3500 \text{ mL}$
      - Females -  $500 \text{ mL} + 1900 \text{ mL} = 2400 \text{ mL}$
  - ❖ Vital capacity (VC)
    - maximum volume of air that can be expired after a maximum inspiration
    - $IRV + \text{tidal volume} + ERV$ 
      - Males -  $4600 \text{ mL}$
      - Females -  $3100 \text{ mL}$
    - Forced expiratory volume ( $FEV_1$ ), - volume of air that can be exhaled from lungs in 1 second with maximal effort following a maximal inspiration
      - 80% of VC
  - ❖ Total lung capacity (TLC)
    - total volume of air in the lungs after a maximum inspiration
    - $VC + RV$ 
      - Males -  $4600 \text{ mL} + 1200 \text{ mL} = 5800 \text{ mL}$
      - Females -  $3100 \text{ mL} + 1100 \text{ mL} = 4200 \text{ mL}$



# Anatomic Dead Space

- 70%  $V_T$  – 350 mL
  - ❖ Reaches respiratory zone
  - ❖ Participates in gas exchange
- 30%  $V_T$  - 150 mL
  - ❖ Remains in conducting zone
  - ❖ Anatomic dead space
    - Contains air that does not undergo gas exchange
- Alveolar ventilation ( $V_A$ )
  - ❖ Volume of air/minute – reaches respiratory zone
  - ❖ 4200 mL/min

Respiratory bronchioles



Alveolar ducts



Alveolar sacs