Causes of low FVC

- Reduced lung volume
- Gas trapping
- Poor effort
Spirometry Definitions

- **Obstructive ventilatory defect**
  - $\text{FEV}_1/\text{FVC} < 0.70$
  - $\text{FEV}_1/\text{FVC} < \text{lower limit of normal}$

- **Restrictive ventilatory defect**
  - $\text{TLC} < \text{lower limit of normal}$
Flow Volume Loop

Respiratory System Mechanics

- Respiratory System Compliance
- Airway Resistance
Respiratory System Compliance

- Chest wall and Pleura compliance
- Lung compliance

\[ \text{Compliance} = \frac{1}{\text{Elastance}} = \frac{\Delta \text{volume}}{\Delta \text{pressure}} \]

Pressure-Volume Curves

![Pressure-Volume Curves](image)
Airway Resistance during Laminar Flow

Ohm's Law

\[ \dot{V} = \frac{\Delta P}{R} \]

\[ R = \frac{8\eta l}{\pi r^4} \]

- \( \dot{V} \) = flow rate
- \( \Delta P \) = driving pressure
- \( r \) = radius of the tube
- \( \eta \) = viscosity
- \( l \) = length of the tube

Mechanisms of airflow obstruction

- **Intraluminal:** e.g., Secretions
- **Intramural:** e.g., Edema
- **Extraluminal:** e.g., Loss of radial traction
Alveolar Gas Equation

\[ P_A O_2 = P_I O_2 - \frac{P_A CO_2}{R} \]

Oxyhemoglobin Dissociation Curve
Causes of reduced DLCO

- Blood-gas barrier is ABNORMAL or REDUCED in size
  - Thickened in interstitial lung disease
  - Area is reduced in emphysema, pneumonectomy
- Alveolar capillary hemoglobin REDUCED
  - Volume reduced in pulmonary embolism
  - Concentration of red cells reduced in anemia

Alveolar Ventilation Equation

\[ P_a CO_2 \propto \frac{\dot{V}_{CO_2}}{\dot{V}_A} \]
Some Causes of Hypoventilation
1. Depression of the respiratory center by drugs (e.g., barbiturates)
2. Diseases of the medulla (e.g., encephalitis, hemorrhage, neoplasms [rare])
3. Abnormalities of the spinal cord (e.g., following high dislocation)
4. Anterior horn cell disease (e.g., poliomyelitis)
5. Diseases of the nerves to the respiratory muscles (e.g., Guillain-Barré)
6. Diseases of the myoneural junction (e.g., myasthenia gravis)
7. Diseases of the respiratory muscles (e.g., muscular dystrophy)
8. Thoracic cage abnormalities (e.g., crushed chest)
9. Upper airway obstruction (e.g., tracheal compression by the thymoma)