### Pulmonary Function Testing Interpretation

<table>
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<tr>
<th>Clinical Presentation</th>
<th>Recommended Testing</th>
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<tr>
<td>Dyspnea</td>
<td>• Spirometry before/after bronchodilator, volumes, DLCO</td>
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<td>• Ambulatory pulse oximetry</td>
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<tr>
<td>Cough</td>
<td>• Spirometry before/after bronchodilator</td>
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<td>• Consider Methacholine challenge</td>
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<tr>
<td>Asthma</td>
<td>• Spirometry before/after bronchodilator</td>
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<td>• Consider Methacholine challenge</td>
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<tr>
<td>COPD</td>
<td>• Spirometry before/after bronchodilator, oximetry</td>
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<td>• Consider lung volumes and DLCO in initial evaluation</td>
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<tr>
<td>Suspected ILD</td>
<td>• Spirometry, volumes, DLCO, oximetry</td>
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<tr>
<td>Neuromuscular disease, diaphragmatic weakness</td>
<td>• Upright spirometry, volumes</td>
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<td>• Max inspiratory and expiratory force</td>
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For initial, diagnostic PFTs, ask the patient to hold their bronchodilators so that bronchodilator response can be assessed. Hold short acting for 4 hours and long acting for 12 hours.

### Lung Volumes and Capacities

<table>
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<tr>
<th>Spirometry: forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and their ratio (FEV1/FVC).</th>
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<td>• Normal ratio is &gt;70; other normal are &gt;80% of predicted in general</td>
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<tr>
<td>• Supine spirometry to evaluate diaphragm dysfunction: supine decrease in VC by 25% unilateral and 50% bilateral</td>
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**Post-Bronchodilator:** significant with increase in FEV1 more than 12% and 0.2 liters

**Lung Volumes:** vital capacity (VC), functional residual capacity (FRC)- this is the end of a tidal breath, residual volume (RV), expiratory reserve volume (ERV), inspiratory capacity (IC), total lung capacity (TLC)

- Decreased vital capacity alone may be due to air trapping in severe obstruction. You can see air trapping when the FRC or RV is increased >120%

**DLCO:**  
- **Restriction, Reduced DLCO**
  - Intrinsic disease: ILD, fibrosis
  - Extrinsic restriction, i.e., obesity, DLCO is normal or slightly reduced
- **Obstruction, Reduced DLCO**
  - Emphysema
  - Normal in other obstructive disease
- **Isolated decrease in DLCO**
  - Pulmonary vascular disease, PAH, CTEPH

**Maximal Inspiratory Pressures:** MIP and MEP- used to follow patients with neuromuscular disease

- Neuromuscular disease pattern: increased RV, normal FRC, low MIP and MEP, low MVV
In obstructive disease, forced expiratory volume in the first second is decreased (FEV1). Expiratory flow in the latter two-thirds of expiration are effort independent and vary directly with elastic recoil of the lung and inversely with airway resistance. In COPD elastic recoil is decreased due to loss of lung parenchyma and airway resistance is increased due to secretions, bronchospasm, or loss of small airways.

**Upper Airway Obstruction Flow Volume Loops**

**A: Normal**

**B: Fixed obstruction**

**C: Variable extrathoracic**

**D: Variable intrathoracic**

B: intra- and extra-thoracic masses, adenopathy, fixed airway stenosis
C: laryngomalacia, tracheomalacia, vocal cord abnormalities, i.e., paradoxical vocal fold motion
D: introthoracic tracheomalacia, bronchogenic cysts, tracheal masses, i.e., malignancy

**Approach to pulmonary function test interpretation**

- **Spirometry**
  - Low ratio: Obstruction
    - Bronchodilator
      - Negative: COPD vs asthma
      - DLCO
        - Low: emphysema
        - Normal: asthma/COPD
  - Normal ratio
    - Clinical asthma/chronic cough?
      - Check for reduced FEF 25-75%
        - Methacholine challenge
      - Isolated DLCO decrease: pulm vascular disease
    - DLCO
      - Low: ILD
      - Normal: extrinsic – obesity, NMD
  - Normal ratio Low FVC: Restriction
    - Confirm with lung volumes