**Definitions:**

**Forced Vital Capacity (FVC):** the volume delivered during an expiration made as forcefully and completely as possible starting from full inspiration

**Forced Expiratory Volume in the first second (FEV1):** the volume delivered in the first second of an FVC maneuver

**Obstruction:** flow limitation is observed during spirometry. If the observed FEV1/FVC ratio is down 10 or more from the predicted, obstruction is present.

**Restriction:** Spirometry with low FVC (<80%) can only suggest restriction. Further testing is needed to confirm.

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**Acceptability criteria from the American Thoracic Society:** Global Lung Function Initiative (GLI)-2012 multi-ethnic reference ranges are recommended. NHANES III reference values remain appropriate where maintaining continuity is important. Following a grading system range of A-F, spirometry tests with grades of A-C are clinically useful.

**Examples of unacceptable tests**

- Slow start of test
- Rounded peak
- Early termination
- Cough in first second

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**Repeatability criteria for the American Thoracic Society:** Recommended repeatability criteria of 150 ml.

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**Coaching patients through spirometry:**

Instruct patient to breathe normally. When patient is ready, have him/her take his/her deepest breath and blow as hard as he/she can as long as he/she can. There is a learning curve for spirometry. Use positive reinforcement to build on the patient’s successes. (For example, “That was really good; this time take an even deeper breath.”) Always demonstrate the spirometry maneuver, especially if language is a barrier or communication issues arise.

**Appropriate bronchodilator use:**

If testing for reversibility, give patient 4 puffs of bronchodilator with a spacer or a standard nebulized dose. Wait 15 minutes after last dose to perform post-bronchodilator maneuver. If a patient cannot perform acceptable baseline maneuvers according to American Thoracic Society criteria or there is no evidence of airflow obstruction, do NOT give a bronchodilator.

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**References:**

1. Repeatability criteria for the American Thoracic Society: Three (3) acceptable tests must be performed with two (2) tests having FEV1 and FVC within 150 ml of each other.
### SPIROMETRY INTERPRETATION

#### Spirometry Interpretation

**Observed Ratio (FEV₁/FVC) Compared to Predicted:**
- Down 10 or greater = airway obstruction

**ATS/ERS* Degree of Severity of Obstruction Based on FEV₁:**
- Mild: >70%
- Moderate: 60-69%
- Moderately Severe: 50-59%
- Severe: 35-49%
- Very Severe: <35%

- Airway obstruction that is not significantly reversible does NOT rule out asthma.
- To help differentiate COPD from asthma with airway remodeling/fixed obstruction, further testing options include: D_l, CO, chest x-ray, and chest CT.

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### Sample Written Asthma Interpretation:

The FEV₁/FVC ratio being down more than 10 from predicted is consistent with airway obstruction. The FEV₁ being 77% of predicted suggests a mild airway obstruction (based on the 2005 ATS/ERS guide for severity of obstruction). The post-bronchodilator study reveals a significant response to albuterol with the FEV₁ increasing 15% or 550cc. This finding is consistent with the diagnosis of asthma although clinical correlation is needed to confirm. (Based on the 2007 NAEPP guidelines for asthma severity), this 28 year old male with a baseline FEV₁ of 77% has moderate persistent asthma.

### Sample Written COPD Interpretation:

The FEV₁/FVC ratio being down more than 10 from predicted is consistent with airway obstruction. The FEV₁ being 53% of predicted suggests a moderately-severe airway obstruction (based on the 2005 ATS/ERS guidelines for severity of obstruction). No significant response to albuterol was revealed as the FEV₁ only increased 2%. Further testing revealed a diffusion capacity of 50% of predicted. The lateral chest film showed signs of hyperinflation and flattened diaphragm and the chest CT had classic changes seen in emphysema. (Based on the 2007 GOLD guidelines for COPD severity), this 74 year old female with a baseline FEV₁ of 53% has Stage II moderate COPD.

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**Sample Asthma Table:**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>FEV₁/FVC</th>
<th>FEV₁ % Predicted</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-11 years</td>
<td>Normal: FEV₁ &gt;80% predicted</td>
<td>FEV₁ &gt;80% predicted</td>
</tr>
<tr>
<td>12+ years</td>
<td>Normal: FEV₁ &gt;80% predicted</td>
<td>FEV₁ &gt;80% predicted</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Stage</th>
<th>FEV₁/FVC</th>
<th>FEV₁ % Predicted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage I: Mild</td>
<td>FEV₁ &lt;70%</td>
<td>FEV₁ &gt;80% predicted</td>
</tr>
<tr>
<td>Stage II: Moderate</td>
<td>FEV₁ 50-80% predicted</td>
<td>FEV₁ &lt;80% predicted</td>
</tr>
<tr>
<td>Stage III: Severe</td>
<td>FEV₁ &lt;30% predicted</td>
<td>FEV₁ &gt;60% predicted</td>
</tr>
<tr>
<td>Stage IV: Very Severe</td>
<td>FEV₁ &lt;30% predicted</td>
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**Sample COPD Table:**

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*American Thoracic Society/European Respiratory Society*