Interpreting Spirometry

Pulmonary Function Tests
1. Spirometry
2. Lung Volumes
3. Diffusing Capacity

Spirometry: rate at which the lung changes volume during forced breathing maneuvers

FVC: total volume of air that can be exhaled during forced expiration effort
   a. Patient inhales maximally, then exhales as rapidly and as completely as possible
      (normal lungs can empty 80% of volume in <6 seconds)
FEV₁: Volume of air exhaled in the first second of the FVC maneuver
FEV₁/FVC ratio is % of FVC expired in one second
FEF₂₅₋₇₅%: average forced expiratory flow rate over the middle 50% of the FVC

Indications for Spirometry
Recommendation is to perform Spirometry in patients >45 yo who are current or former
smokers, prolonged or progressive cough, h/o exposure to lung irritants
Detecting pulmonary disease
Assessing severity or progression of disease
Risk stratification of patients for surgery
Evaluating disability or impairment

Contraindications
Acute disorders affecting test performance
Hemoptysis, pneumothorax, recent abdominal/thoracic surgery, eye surgery, recent
mi/unstable angina, thoracic aneurysms

Interpreting Test
1. Validity
   a. At least 3 spirograms, difference between two largest FVC and between
two largest FEV₁ WITHIN 0.2liters, repeat testing until should continue
until criteria are met or until 8 tests have been performed.
2. Determine pattern: obstructive vs. restrictive
   a. When FVC and FEV₁ are both decreased, distinction depends on absolute
FEV₁/FVC ratio.
Normal or increased FEV₁/FVC ratio= likely restrictive pattern
   Static lung volumes: if TLC <80%, then pattern is restrictive
Decreased FEV₁/FVC ratio= obstructive pattern
   a. Bronchodilator challenge: repeat Spirometry several minutes later, test is positive
      if FEV₁ increases by at least 12% and FVC increases by at least 200ml
   b. FEF₂₅₋₇₅%: reduction of less than 60% may confirm obstructive pattern with low to
      normal FEV₁/FVC.
c. Determine severity

Info from AAFP.org and Up to Date
### Severity

<table>
<thead>
<tr>
<th>Condition</th>
<th>Post bronchodilator FEV1/FVC</th>
<th>FEV1 % predicted</th>
</tr>
</thead>
<tbody>
<tr>
<td>At risk for COPD</td>
<td>&gt; 0.7</td>
<td>≥ 80</td>
</tr>
<tr>
<td>Mild COPD</td>
<td>≤ 0.7</td>
<td>≥ 80</td>
</tr>
<tr>
<td>Moderate COPD</td>
<td>≤ 0.7</td>
<td>50-80</td>
</tr>
<tr>
<td>Severe COPD</td>
<td>≤ 0.7</td>
<td>30-50</td>
</tr>
<tr>
<td>Very Severe COPD</td>
<td>≤ 0.7</td>
<td>&lt; 30</td>
</tr>
</tbody>
</table>

*American Thoracic Society*

#### Lung Volumes (TLC):

Helps to determine if there is a superimposed restrictive pattern.

4 methods include helium dilution, nitrogen washout, body plethysmography, chest radiograph measurements.

#### Diffusing Capacity (DLCO):

1. In restrictive disease, helps to distinguish between intrinsic disease (DLCO is reduced) from other causes of restriction in which DLCO is normal.
   - Intrinsic disease: inflammation/scarring of tissue
   - Extrinsic disease: disorders of chest wall/pleura, mechanically compress lungs
   - Neuromuscular disorders: decreased ability of muscles to inflate/deflate lungs (DLCO usually normal)

2. In obstructive disease DLCO helps distinguish between emphysema (decreased DLCO) and other causes such as chronic bronchitis (DLCO not affected), and asthma (DLCO is increased).

**Spirometry and Flow Volume Curves**

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**FIGURE 1. Lung volumes and capacities.**

TABLE 2
Normal Values of Pulmonary Function Tests

<table>
<thead>
<tr>
<th>Pulmonary function test</th>
<th>Normal value (95 percent confidence interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEV₁</td>
<td>80% to 120%</td>
</tr>
<tr>
<td>FVC</td>
<td>80% to 120%</td>
</tr>
<tr>
<td>Absolute FEV₁/FVC ratio</td>
<td>Within 5% of the predicted ratio</td>
</tr>
<tr>
<td>TLC</td>
<td>80% to 120%</td>
</tr>
<tr>
<td>FRC</td>
<td>75% to 120%</td>
</tr>
<tr>
<td>RV</td>
<td>75% to 120%</td>
</tr>
<tr>
<td>Dco</td>
<td>&gt;60% to &lt;120%</td>
</tr>
</tbody>
</table>

Dco = diffusing capacity of lung for carbon monoxide.
Adapted with permission from Saltman SH. Pulmonary function testing: tips on how to interpret the results. J Resp Dis 1999;20:812.