**Background**

Pulmonary Function Testing (PFT's) are a useful adjunct to defining types of lung disease, level of impairment and monitoring disease progression. PFT's are often part of the pulmonary evaluation in those patients who are able to perform the skill appropriately. The test performed depends on the disease entity and the question or symptoms are being addressed. Referral for PFT’s do not require in-person consultation with a pediatric pulmonary provider yet results must be interpreted in the context of the presentation with clinical correlation.

**Initial Evaluation**

History, physical exam, diagnostic evaluation as indicated for patients pulmonary symptoms/disease.

**Initial Management**

As clinically indicated.

**When to Refer**

Refer to peds pulmonary when indicated.

However, you may consider the following testing without peds pulm eval.

**Pre-Visit Work Up**

As clinically indicated.

List of PFT’s as follows:

**SPIROMETRY (CAN BE DONE AS PRE AND POST BRONCHODILATOR)**

WHAT: Lung volumes and flows are measured during a forced exhalation maneuver. Includes a graphic record, total and timed vital capacity, expiratory flow rate measurement(s), with or without maximal voluntary ventilation.

WHY: As a general rule, distinguish normal from abnormal and divide abnormal into two different patterns; obstructive and restrictive.

HOW: Most common testing. Wearing a clip on your nose, you’ll take a deep breath and exhale as hard as you can into the mouthpiece of the spirometer. It’s important you seal your lips tightly around the spirometer’s mouthpiece and rapidly exhale to the fullest extent until no further air can be exhaled. Usually, this maneuver will be performed at least three times to ensure consistent results.

**LUNG VOLUMES BY PLETHYSMOGRAPHY (CAN BE DONE AS PRE AND POST BRONCHODILATOR)**

WHAT: Measurement of lung volumes such as total lung capacity, volume (the volume of air remaining in the lungs after the most forcible exhalation possible), functional residual capacity (volume of air present in the lungs at the end of a normal, passive exhalation).

WHY: It is impossible to assess air trapping (increased residual volume relative to lung capacity).

HOW: you’ll be seated in an enclosed, partially see-through or totally see-through box that resembles a phone booth. The technician will ask you to wear a nose clip and will instruct you how to breathe through a mouthpiece.

**DIFFUSION CAPACITY (DLCO)**


Measures how well carbon dioxide are diffused (transferred) between the lungs and the blood stream. Diffusing capacity is often low in certain lung diseases in which there is a disruption or reduction the lungs ability to allow CO2 to transfer across the alveolar capillary interphase such as pulmonary fibrosis or connective tissue disorder.

**IMPULSE OSCILLOMETRY**

**WHAT:** Measures small airway resistance and conductance. Airways resistance most often are inversely proportional. (With increasing resistance there tends to be reduced conductance.

**HOW:** The patient is asked to perform normal tidal breathing into a mouthpiece connected to a "loudspeaker" that transmitted pulses and measure the "echo." The pressure-flow oscillations are applied at the mouth superimposed on the subject’s tidal breaths to measure respiratory system resistance and reactance.

**FRACTIONAL EXHALED NITRIC OXIDE (FeNO)**

**WHAT:** FeNO is a quantitative, noninvasive, simple, and safe method of measuring airway inflammation that provides a complementary tool to other ways of assessing airways disease in asthma patients.

Specifically, FeNO is an objective measurement of allergic/eosinophilic inflammation.

Airway inflammation results from the activation of certain inflammatory cells result in the production of cytokines and release of NO

**WHY:** Nitric oxide is a byproduct of airway inflammation and is increased at times of airway inflammation.

**HOW:** Measures the nitric oxide a patient exhales. High values (>35 in patients under 12 and >50 in patients 12 and up) supports a diagnosis of active asthma and the high likelihood that patients will respond to antinflammatory therapy (corticosteroids)

**CARDIOLPULMONARY TESTING / VO2 MAX TESTING**

**WHAT:** Cardiopulmonary exercise testing, including measurements of minute ventilation, CO2 production, O2 uptake, and electrocardiographic recordings

**WHY:** To assess clinical exhaustion, predicted maximum, heart rate [HRmax], oxygen uptake [V' O2] plateau, maximal respiratory exchange ratio.

**HOW:** The first part of this test involves running on a treadmill as a computer monitors your carbon dioxide output. The results reveal:

1. How efficiently your body burns fat for energy
2. Your aerobic threshold, or the maximum level at which you’re still working in your aerobic zone, not anaerobic zone. Aerobic threshold is an intensity you could run at for hours on end.
3. Your VO2 max, the maximum amount of oxygen you can utilize during intense or maximal exercise. VO2 max is generally considered the best indicator of an athlete's cardiovascular fitness and aerobic endurance.
METABOLIC TESTING
WHAT: Helpful in calculating a patient’s daily caloric needs.
WHY: This can be helpful in those patients who are overweight despite interventions
directed at losing weight or slowing down weight gain especially when the diet and exercise
history would predict better success.
HOW: Test requires a fasting patient to simply breath normally in to a breathing apparatus
for one hour. Data is reported as ______ computer analyzes your breath and heart rate to determine your RMR, the minimum
number of calories your body needs to survive.

All testing is performed by one of two registered pediatric respiratory therapists and
interpreted by one of two pediatric pulmonologists.
ALL of the above testing can be performed as part of pulmonary evaluation for those
patients referred to pediatric pulmonology.
ALL of the above testing can be ordered by any community provider and will be interpreted
by a pediatric pulmonologist.

<table>
<thead>
<tr>
<th>Co-management Strategy (as appropriate)</th>
<th>Interpret PFT’s</th>
<th>Discuss results with interpreting physician if/when necessary. Discuss results with patient and/or family as indicated.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return to Primary Care Endpoint</td>
<td>PFT’s without referral to peds pulm may require formal evaluation with peds pulm when clinical indicated in the context of the PFT’s.</td>
<td></td>
</tr>
</tbody>
</table>
Order Set
(Please check all that apply)

☐ Basic Spirometry (includes vital capacity)
☐ Basic Spirometry with DLCO
☐ Basic Spirometry with Maximum Inspiratory Pressure/Maximum Expiratory Pressure
☐ Bronchodilator responsiveness (basic spirometry before and after bronchodilation)
☐ Lung volumes obtained by plethysmography, airway resistance, airway conductance
☐ Full Set (basic spirometry, plethysmography)
☐ Nutrition Metabolic Study (Basal metabolic rate/resting energy expenditure)
☐ Asthma Education (includes initial evaluation with pediatric pulmonologist)

Formal Cardiopulmonary Exercise Testing (includes pre-testing evaluation with pediatric pulmonologist)
☐ Bronchospasm Provocation Testing (utilizing treadmill; pulmonary stress testing for bronchospasm with pre- and post-spirometry and oximetry)
☐ Cardiopulmonary Stress Testing (utilizing treadmill; includes measurements of CO2 production, O2 uptake and electrocardiographic recordings)

*All Pulmonary Function Testing is read and interpreted by Dr. Bruce Bacot, Pediatric Pulmonologist.*

*The PFT lab is staffed by licensed Respiratory Therapists with specialized credentials in pulmonary function testing and asthma education.*