

SPIROMETRY & PEAK COUGH FLOW INSTRUCTIONS

Time

It is advisable to perform some respiratory testing on all patients with spinal cord injuries (SCI) where the respiratory muscles have been affected. This would include those with neurological level injury of L1 (i.e. any cervical or thoracic injury) or above.

Admission: Early assessments may be at the bedside, and wouldn't necessarily include all values; however, some spirometry assessment within the first 24 hours of the patient being cognitively aware enough to complete them is advisable in the acute care setting; in the rehabilitation setting, within seven days of admission is considered standard.

Discharge: Within seven days of discharge is advisable to ensure proper supports are set up for discharge to community.

Step 1: Get Ready

Collect supplies:

- **For the unventilated patient without a tracheostomy:** plastic mouthpiece or mask (if weakness or other injury prevents patient from being able to create a tight seal with their lips).
- **For the patient with a tracheostomy:** suitable connector tube.
 - Noseclips.
 - Filter.
 - Volume measurement gauge or digital spirometer for spirometry values.
 - Peak flow meter for peak cough flow and peak expiratory flow rates if your spirometer does not have flow measurement capabilities.
 - If your spirometer does not have pressure measurement capability, a respiratory pressure metre for MIPs and MEPs.
- Ensure your equipment has been calibrated to the manufacturer's specifications.
- Inform patient of intervention and obtain consent to proceed.
- Check the chart or ask the patient about any bronchodilators or respiratory medications they are on.
- In bed, position the patient in semi-fowler's position with no abdominal binder and apply nose clips.
- If they are in a chair, ensure they are sitting as upright as possible.
 - Please note which of the positions they test in so that future tests can be repeated in that position.

NB: How you instruct each spirometry test is very important; allowing the patient to deviate from the correct instructions, as defined by the American Thoracic Society guidelines, can change the values drastically.

Step 2: Vital Capacity

“Please empty your lungs totally and then inhale as much air as you can. Close your lips tightly around the mouthpiece and blow out at a steady rate.”

- The ATS guideline suggests doing a VC before the FVC because of concerns regarding muscle fatigue.
- These instructions are for an open circuit spirometer; if you have a closed circuit version, you can insert the mouthpiece before they begin.
- Demonstrate the technique first for optimal result.
- Encourage a constant flow rather than a forced or fast flow.
- Do not let them hold their breath at maximal inspiration longer than one second.
- Do not let them change their posture (especially at the end of exhalation).
- Repeat as required by your facility; a minimum of three tests is recommended by the ATS guidelines. The results should be repeated until they are reproducible.
- Watch for signs of respiratory distress or syncope and terminate the test if necessary for patient safety. **Patients less than one month after a myocardial infarction should NOT perform this test.**

Step 3: Forced Vital Capacity (FVC), Forced Expiratory Volume in 1s (FEV1), Peak Expiratory Flow Rate (PEF)

“Please inhale as much air as you can. Close your lips tightly around the mouthpiece and then blast all the air out of your lungs as quickly and forcefully as you can.”

- **Coach loudly and vigorously during the test until they have totally finished emptying their lungs.**
- These instructions are for an open circuit spirometer; if you have a closed circuit version, you can insert the mouthpiece before they begin.
- Do not let them hold their breath at maximal inspiration longer than one second.
- Do not let them change their posture (especially at the end of exhalation).
- Repeat as required by your facility; a minimum of three tests is recommended by the ATS guidelines.
- Depending on your equipment you will need to use the spirometer for FVC and FEV1 and the peak flow metre for the PEF.
- Watch for signs of respiratory distress or syncope and terminate the test if necessary for patient safety. **Patients less than one month after a myocardial infarction should NOT perform this test.**

Step 4: Maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP)

MIP: "Please exhale as much air as you can and pull the air into your chest as fast as you can for 1.5 seconds"

MEP: "Please inhale as much air as you can and blow out as hard as you can for 1.5 seconds"

- The ATS does not require nose clips for this test.
- Equipment may vary – some respiratory flow metres require you to occlude ventilation ports, so read the manufacturer's instructions or your facility's policy document.
- It is recommended that the maximum pressure sustained for one second should be used in place of peak pressure because it is more reproducible.
- The normal ranges for these tests vary depending on the equipment and testing procedure.
- Do not let them change their posture (especially at the end of exhalation).

Step 5: Peak unassisted cough flow

"Please cough as forcefully as you can."

- Ensure that the patient is able to maintain a seal around the mouthpiece during this test, as this can be quite difficult. If they are unable to do so, use a face mask instead. Note this in your charting so it can be repeated for future tests.
- The ability of the patient to close the glottis is instrumental in cough function.
- Visual feedback can help to obtain the best values.

Charting instructions

- Please ensure the values you put on the form are in the correct denomination, i.e. litres not milliliters.
- Percent predicted calculations are usually equipment specific. Most electronic based pulmonary function tests automatically calculate this. Generally, only MIPs, MEPs and PCF are expressed as absolute values alone, while VC, FVC, FEV1, PEF are expressed as percent predicted values. This may vary among sites for equipment and policy reasons.