

## Pulmonary Function Tests

Pulmonary function tests (PFT's) are breathing tests to find out how well you move air in and out of your lungs and how well oxygen enters your blood stream. The most common PFT's are *spirometry* (spy-RAH-me-tree), *diffusion studies*, and *body plethysmography* (ple-thiz-MA-gra-fee). Sometimes only one test is done, other times all tests will be scheduled on the same day.



### Lung function tests can be used to:

- Compare your lung function with known standards that show how well your lungs should be working.
- Measure the effect of chronic diseases like asthma, chronic obstructive lung disease (COPD), or cystic fibrosis on lung function.
- Identify early changes in lung function that might show a need for a change in treatment.
- Detect narrowing in the airways.
- Decide if a medicine (such as a bronchodilator) could be helpful to use.
- Show whether exposure to substances in your home or workplace may have harmed your lungs.
- Determine your ability to tolerate surgery and medical procedures.

### To get the most accurate results from your breathing tests:

- Do not smoke for at least 1 hour before the test.
- Do not drink alcohol for at least 4 hours before the test.
- Do not exercise heavily for at least 30 minutes before the test.
- Do not wear tight clothing that makes it difficult for you to take a deep breath.
- Do not eat a large meal within 2 hours before the test.
- Ask your health care provider if there are any medicines that you should **not take** on the day of your test.

### What is spirometry?

Spirometry is one of the most commonly ordered tests

of your lung function. The spirometer measures how much air you can breathe into your lungs and how much air you can quickly blow out of your lungs. This test is done by having you take in a deep breath and then, as fast as you can, blow out all of the air. You will be blowing into a tube connected to a machine (spirometer). To get the "best" test result, the test is repeated three times. You will be given a rest between tests.

The test is often repeated after giving you a breathing medicine (bronchodilator) to find out how much better you might breathe with this type of medicine.

It can take practice to be able to do a spirometry test well. The staff person will work with you to learn how to do the test correctly.

It usually takes 30 minutes to complete this test.

### What should I know before doing a spirometry test?

- You may be asked not to take your breathing medicines before this test.
- Instructions will be given on how to do this test. If you do not understand the instructions, ask the staff to repeat them.
- It takes effort to do this test and you may become tired. This is expected.
- If you become light-headed or dizzy during this test, immediately stop blowing and let the staff know.

### What are diffusion studies?

Diffusion tests find out how well the oxygen in the air you breathe in moves from your lungs into your blood.

Like spirometry, this test is done by having you breathe into a mouthpiece connected to a machine. You will be asked to empty your lungs by gently breathing out as much air as you can. Then you will breathe in a quick (but deep breath), hold your breath for 10 seconds, and then breathe out as instructed.

You will do the test several times. It usually takes about 30 minutes to complete this test.

### What should I know before doing a diffusion test?

- Do not smoke and stay away from others who are smoking on the day of the test.
- If you are on oxygen, you will usually be asked to be off oxygen for a few minutes before taking this test.

### What is body plethysmography?

Body plethysmography is a test to find out how much air is in your lungs after you take in a deep breath, and how much air is left in your lungs after breathing out as much as you can. No matter how hard you try, you can never get all of the air out of your lungs. Measuring the total amount of air your lungs can hold and the amount of air left in your lungs after you breathe out gives your healthcare provider information about how well your lungs are working and helps guide your treatment. This test requires that you sit in box with large windows (like a telephone booth) that you can see through. You will be asked to wear a nose clip and you will be given instructions on how to breathe through the mouthpiece. You will be asked to take short, shallow breaths through the mouthpiece when it is blocked for a few seconds, which may be uncomfortable. If you have difficulty with being in closed spaces (claustrophobia), mention this to your provider ordering the test. This will avoid any misunderstanding and discomfort to you. It usually takes about 15 minutes to complete. Some PFT labs will use other tests instead of plethysmography to measure the total volume of air in your lungs.

### What should I know before doing a plethysmography test?

- If you are on oxygen, you will usually be asked to be off oxygen during this test.
- Let the staff know if you have difficulty in closed spaces.

### What are normal results for lung function tests?

Because everyone's body and lungs are different sizes, normal results differ from person to person.

For instance, taller people and males tend to have larger lungs whereas shorter people and females have smaller lungs. It is normal for your lung function to fall slightly as you age.

These standards that your healthcare provider uses, are based on your height, age, and sex at birth. These numbers are called the "predicted values". Your measured values will be compared to these predicted values.

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## Rx Action Steps

- ✓ Ask questions if you do not understand the instructions for the lung function test.
- ✓ If you have a cold or flu, let the test center know because you may need to reschedule your test.
- ✓ If you have difficulty with closed spaces (claustrophobia), let the test center know in case one of the tests involves being enclosed.
- ✓ Ask if there are any medicines you should stop taking before being tested and for how long you should stop it.
- ✓ After your pulmonary function testing is over, you can return to your normal activities.

### Healthcare Provider's Contact Number:

## Other Resources

### American Thoracic Society

- <http://www.thoracic.org/patients/>

### Canadian Lung Association

- <https://www.lung.ca/lung-health/lung-disease/spirometry>

### National Lung Health Education Program

- <http://www.nlhep.org/Pages/Spirometry.aspx>

### WebMD.com

- <https://www.webmd.com/lung/copd/living-with-copd-17/video-spirometry-test>

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# Bronchial Challenge Lung Function Test: Methacholine or Other Agents

A bronchial challenge study is a lung function test that measures what happens when challenged by something that in some people may cause airway tightening (bronchospasm). In the US, the most common inhaled challenge agent is methacholine. Other inhaled agents used include histamine, mannitol and cold air. A challenge study is most often done to see if a person may have asthma. The bronchial challenge test may be called a methacholine challenge test (MCT), methacholine inhalation test, or bronchoprovocation test. This fact sheet will focus mainly on the methacholine challenge test (MCT).



## Why am I being asked to do a challenge test?

A challenge study may be done in a person who has unclear or nonspecific symptoms to try to confirm or exclude a diagnosis of asthma. A person who has known asthma will be asked to do the test to see how sensitive the airways are or how well asthma medicines are working to make the airways less sensitive. Ask your healthcare provider what you will learn by doing this test.

## Are there any reasons I should not, or might not be able to perform the test?

A bronchial challenge test should not be done if you have had:

- Unstable heart pains (angina)
- Poorly controlled high blood pressure (hypertension)
- Recent blood clots (in your lungs or elsewhere in your body)
- Certain types of blood vessels problems (e.g. aortic or cerebral aneurysm)

Check with your healthcare provider before doing the challenge study if you are pregnant or breast-feeding. There may be other reasons the test is not done and your healthcare provider will decide if you are stable to do the test. If you are in doubt about whether or not you should have this test, discuss your concerns with your healthcare provider.

If your O<sub>2</sub> sat is low at rest off oxygen (less than or equal 85%) you may not be tested or may only be tested with

the use of extra oxygen.

If your lung function is too low at the beginning of the test, you will not be able to do the challenge. That is why you will do baseline spirometry before starting the challenge study.

## What are possible risks with a challenge test?

The challenge study may cause an asthma reaction with bronchospasm. You may cough or wheeze. You may feel chest tightness or shortness of breath. You may have no symptoms at all. You should feel better after you are given an inhaled bronchodilator.

The test is usually done in a pulmonary function lab with trained staff who know how to help you if you have problems during the test. A healthcare provider is always available during the study.

## How do I prepare for a Challenge test?

You may need to stop certain medicines before a challenge test. Different medicines have to be stopped at different times based on how long they last in the body. Review your medicine list with your healthcare provider to get directions on which medicines to stop and for how long before your test. For example, you should not take albuterol or levalbuterol for at least 8 hours before testing. Also make a list of any over-the-counter medications you are taking for your breathing or for sinus congestion or allergies. Check with your healthcare provider or testing center to see if you should hold them in case they could affect the test results.

You should avoid eating or drinking any caffeine containing products such as coffee, tea, cola drinks, energy drinks, and chocolate the day of the test. The caffeine can lead to inaccurate test results.

You should not exercise 6 hours before the test. You should not smoke at least 6 hours before the test.

Tell your health care provider if you have had a cold or upper respiratory infection in the 4 weeks before the test. These can also affect the test results.

### What should I expect during a challenge test?

During a challenge study, a person will inhale methacholine or histamine in varying amounts. The airways in asthma will react to exposure to the chemical at a certain amount. The more sensitive the airways are, the lower the amount that is needed to cause a reaction. The muscles in the airway constrict (called bronchospasm) which causes a blockage (obstruction) making it harder for you to blow air out. At any time, if your lungs show a positive reaction (a drop in function of 20% or more), you will be given an inhaled bronchodilator to reverse it.

### How is a Methacholine challenge study done?

You must be able to do a spirometry lung function test correctly in order to do a challenge study. (See ATS Patient Information Series on Lung function testing).

Here are the basic steps for a MCT:

1. You will do spirometry to see what your baseline lung function is. If your function is high enough, you will move to the next step of the challenge test.
2. You may or may not be asked to inhale saline (a salt water solution) and recheck your lung function.
3. If your lung function is stable, you will be asked to inhale a very low amount of methacholine.
4. You will do spirometry right after inhaling the methacholine and again in a few minutes.
5. As long as you do not react to the methacholine, you will continue the test inhaling doses of the methacholine (usually between 5-10 doses total). After each dose, you will perform spirometry for safety and to measure your lungs' response to the methacholine.
6. If your lung function drops, you will be given an inhaled medicine called a bronchodilator (like albuterol or levalbuterol) to help open your airways.
7. You will repeat spirometry to make sure you improve back to your baseline.
8. You will not leave the test area until you have recovered back at your baseline. You may therefore be asked to wait for an hour or more, before being allowed to go home.

### When will I get the results of the test?

Your healthcare provider will review the results of your O<sub>2</sub> sat levels before, during, and after exercise. You may know the results right away but you will want to review them with your healthcare provider.

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## Rx Action Steps

- ✓ If you have a cold, increased coughing, or are feeling ill the day of the test, check with your healthcare provider to postpone your test.
- ✓ Check with your healthcare provider to see if you need to hold any medicine before your challenge test and for how long.
- ✓ Ask your healthcare provider to explain the results of your challenge test..

**Healthcare Provider's Contact Number:**

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### Resources:

#### American Thoracic Society

- [www.thoracic.org/patients/](http://www.thoracic.org/patients/)
  - Lung function testing
  - What is Asthma?

#### ATS/ERS Task Force: Standardization of Lung Function Testing. Get full reference or ATS Standards?

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#### ERS standards

- <https://erj.ersjournals.com/content/49/5/1601526>

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