

What do all these different tests that my doctor orders mean?

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Patients with chronic lung disease frequently are tested to determine their lung function. The lungs basically have just two primary functions. That is to transfer oxygen from the air we breathe into the blood, and to eliminate carbon dioxide from the body. Tests which measure how well your lungs are performing these functions include pulse oximetry, arterial blood gases, specific blood tests, chest x-rays, and pulmonary function studies. They may be done on a scheduled basis during routine visits to your doctor, or whenever you have symptoms your doctor is concerned about. Let's take a moment to explain why each test is so important.

Pulse Oximetry:

When your doctor, respiratory therapist, or nurse puts a finger pulse oximeter or perhaps a probe from a different type of oximeter on your finger, they are checking how well "saturated" your blood is with oxygen. More specifically, the oximeter reflects how well saturated your hemoglobin is with oxygen. Hemoglobin is the protein in the red blood cell that actually delivers the oxygen to all the tissue cells of the body. The average adult has over one trillion (1,000,000,000,000) cells that together make up the body. Each and every one of them needs just the right amount of oxygen to perform their assigned role in the body. In people *without* heart or lung disease, arterial blood is over 90% saturated with oxygen while breathing room air. It is somewhat higher at sea level, and slightly lower at higher altitudes, but always over 90%. Your doctor gets concerned when your saturation drops below 90%. For this reason you may be walked while wearing the oximeter to determine what flow rate is required to keep you over 90% with increased activity or exercise. Use your new oximeter to guide your oxygen therapy. It is far more important to be adequately oxygenated than it is to conserve oxygen. Increase your flow rate with activity to keep your saturations above 90%. Remember, the body is very smart. It will only use the amount of oxygen it needs from minute to minute. Therefore, there is no real physiologic benefit to keeping your saturations above 97%. In fact, you are probably just wasting oxygen. Some patients like a little "oxygen cushion" and there is nothing wrong with that. Other patients want to use the lowest liter flow possible to make their portable oxygen source last longer. There is nothing wrong with this approach either, as long as your saturations stay above 90% under conditions of rest and activity. Keeping your saturations in the mid 90's is probably the best target for all patients. Don't focus on your oxygen flow rate...focus on your saturation!

The first commercially available oximeter for hospital use (around 1979) cost over \$21,000.00, only worked with the old style ear-clip, and was so big it required it's own cart to wheel from patient room to patient room. The oximeter you just purchased utilizes the same principle of operation, is much easier to use, and is just as accurate. Technology has indeed come a long way!

The beauty of pulse oximetry is that it is completely non-invasive. Over the past 30+ years, pulse oximetry has become known as the 5th vital sign. However, even pulse oximetry is limited in that it only gives information primarily regarding oxygenation status. In order to evaluate your lungs ability to eliminate carbon dioxide, an arterial blood gas must be done.

Arterial Blood Gases:

The blood gas gives your doctor, respiratory therapist, or nurse a great deal of information. Both oxygen and carbon dioxide are gases, and as such exert a pressure within the blood. Along with measuring the overall acidity or alkalinity (Ph) of your blood, the arterial blood gas measures the pressure of these two gases. If the pressure of oxygen (reported as your PaO₂) is less than 55 mm breathing room air, you meet the criteria for continuous oxygen therapy. Remember...oxygen is a drug. Your oxygen prescription needs to be written with just as much care and concern as your inhalers, antibiotics, or any other medication prescribed by your doctor. That is why your doctor is so careful to test you to make absolutely sure you will require continuous oxygen therapy. Your doctor looks at all the values on the blood gas report to determine how well your lungs are functioning, and based upon the findings, may adjust your oxygen flow rate and/or medications to maximize your oxygen therapy. No patient enjoys having a blood gas drawn, but the information derived from a single blood gas is well worth any discomfort.

Pulse oximetry and arterial blood gases provide your doctor, respiratory therapist, or nurse with two different ways to evaluate your lung function. Many times your oxygen flow rate will be "titrated" (adjusted) to a satisfactory reading on the oximeter (greater than 90%) and then an arterial blood gas will be drawn to confirm the results. You should be aware that the benefits of oxygen are directly related to hours of use per day. Patients are therefore encouraged to wear their oxygen 24 hours per day as prescribed by their physician.

Hemoglobin and Hematocrit:

As explained above, Hemoglobin is the protein found in red blood cells that actually carries oxygen molecules to all the tissue cells of our body. It is the combination of Hemoglobin and oxygen that gives arterial blood its normal bright red color. Remember, oxygen is necessary to produce the energy you need to get up and do the things you want to do. Hematocrit is simply the ratio of the cellular part of your blood (red blood cells, white blood cells etc.) to the liquid part (plasma). Now here is how it all comes together. When your blood oxygen level is low, your body responds by putting more red blood cells into your circulation. Its sort of like adding more box cars to the train that delivers the oxygen. If your Hemoglobin and therefore Hematocrit is elevated, your blood gets thicker. Your heart will have to work harder to pump the thicker blood through your blood vessels.

This can lead to the development of heart problems and may prompt your doctor to alter your medical therapy. Being appropriately oxygenated 24 hours per day is one of the most important ways your body keeps your Hemoglobin and Hematocrit within normal limits.

Chest X-Rays:

X-rays were first discovered in 1895 and have been used in medicine ever since. For the pulmonary patient the standard chest x-ray gives the doctor a great deal of information. Not only does it indicate the presence of disease or abnormality, but it also allows the doctor to follow the course of the disease over time. Chest x-rays allow the doctor to pinpoint exactly where certain types of lung doctor determine if the treatments they ordered are working or not. While chest x-rays are still an important part of the diagnosis and treatment of patients with COPD, newer and more sophisticated tests such as Cat Scans (CT) and Magnetic Resonance Imaging (MRI) allow the doctor to view your lungs in three dimensions. This allows for even greater visualization of problems, and often much earlier in development. The changes in x-ray technology in the past 10 years have enabled your doctor to make both earlier, and more accurate diagnoses than ever before.

Pulmonary Function Testing:

The ability of your lungs to function properly may be determined by doing tests to measure your lungs capacities and volumes. Pulmonary function studies (PFT's) are also followed over time by your doctor to judge the progression of your disease, and to see what benefit, if any, is provided by the medications that are prescribed for you. Most patients who have been diagnosed with COPD have had pulmonary function testing. You may know this as spirometry, lung volume, or diffusion measurement. These tests measure how much air your lungs contain, how fast you can blow the air out when instructed, and how much oxygen is actually being transported from your lungs into your blood. Patients with COPD often have varying degrees of obstructed airways. Getting the air in isn't too difficult, getting it out is the problem. The air that is trapped in the lungs has a higher level of carbon dioxide that may lead to higher levels of carbon dioxide in your blood. This would show up in your blood gas as an elevated PaCO₂. If your carbon dioxide goes up, you have to work harder to eliminate it. This is why breathing exercises such as "purse lipped breathing" makes it easier for you to breathe. By allowing your airways to remain open for just a few more seconds, you are able to exhale more fully, and do a better job of getting rid of carbon dioxide.

As you can see, patients with COPD are evaluated by a wide variety of tests. Together, they give your doctor a great deal of information that is used in your day-to-day management. I hope this basic explanation of the most frequently performed tests has been useful. If you have specific questions regarding any of the tests you have recently undergone, contact your physician. An informed and educated patient is always one step ahead.

Pulse Oximeter Tips

1. Allow your pulse oximeter a few moments to stabilize as it may take some time to “find” your pulse and display your heart rate and oxygen saturation. *This is normal.*
2. Conditions that affect blood flow to your fingers may cause inaccurate, erratic, or even absent readings. Cold fingers, very low blood pressure, severe anemia or problems with the Hemoglobin itself, as well as diseases such as Diabetes or peripheral vascular disease may also cause absent, erratic, or inaccurate readings.
3. Fingernail polish or false fingernails may cause inaccurate oxygen saturation readings.
4. Excessive movement (called “Artifact”) may cause inaccurate oxygen saturation readings. For this reason, you may have difficulty getting a stable reading while exercising or on a treadmill.

Finger Pulse Oximetry

