A special thank you to
Dr. Thomas Petty
for his authorship and
dedication to this booklet.

YOUR PERSONAL OXIMETER:
A Guide for Patients

by Thomas L. Petty, M.D.

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Thomas L. Petty, M.D.

Thomas L. Petty, M.D., a pulmonologist, is a Professor of Medicine at the University of Colorado Health Sciences Center in Denver and Rush-Presbyterian-St. Luke's Medical Center in Chicago. He was previously head of the Division of Pulmonary Sciences at the University and Director of the Fellowship Training Program from 1964-1989.

Dr. Petty, an international authority on respiratory disease, has published over 800 articles in journals, including the Journal of the *American Medical Association*, *Chest*, *Annals of Internal Medicine*, *American Journal of Medicine*, *Archives of Internal Medicine*, and *American Journal of Respiratory & Critical Care Medicine*. He is author or editor of 41 books or editions. The Aspen Lung Conference was named after Dr. Petty in 1991.

Dr. Petty was organizer and founding President of the Association of Pulmonary Program Directors (APD) and has served as President of the American College of Chest Physicians. He is a former member of the Board of Governors of the American Board of Internal Medicine. Dr. Petty was the founding Chairman of the National Lung Health Education Program (NLHEP).

Among many awards, Dr. Petty has received the Distinguished Service Award of the American Thoracic Society (1995), was elected to the Colorado Pulmonary Physicians Hall of Fame (1995), and received the annual award for excellence by the American Association for Respiratory and Cardiovascular Rehabilitation (1995). He was elected the Master Fellow of the American College of Chest Physicians (1995), the fifth such award given by the ACCP in its 61-year history. He also received the Master Award of the American College of Physicians in 1996. He was awarded Master fellowship in the American Association of Respiratory Care in 1999.

Today, Dr. Petty remains active in teaching, patient care and research. He is editor of a quarterly newsletter, *Lung Cancer Frontiers*. He is also a consultant for many developmental efforts in the treatment of lung diseases.

Introduction

Today the use of Long Term Oxygen Therapy (LTOT) is best guided by personal measurements of oxygen levels in the blood, which are easily displayed by a simple, but sophisticated device that attaches to your finger, called an oximeter. This booklet explains the body's need for oxygen, how oxygen delivery systems can provide oxygen, and how it's monitored by a personal oximeter. You should always work with your doctor in your use of oxygen.

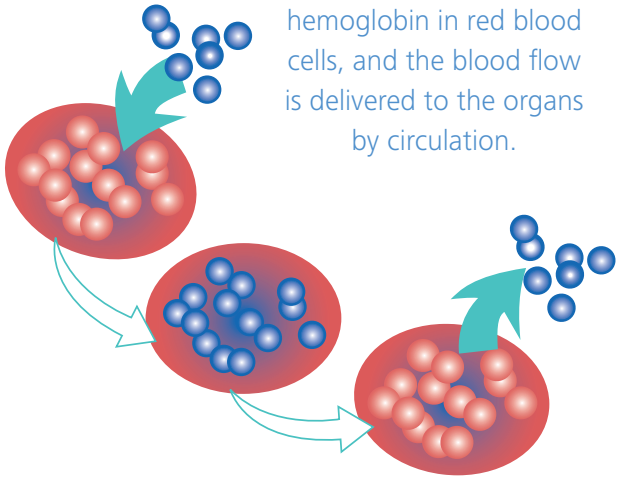
LTOT is now established as an important treatment for patients with chronic oxygen deficits associated with Chronic Obstructive Pulmonary Disease (COPD) and related chronic diseases that create a similar need. Today over 1.2 million Americans receive LTOT.[1] Careful studies have proven that LTOT improves both the length and quality of life for the majority of patients who use it as prescribed.[2]

Rx

Federal law restricts this device to sale by or on the order of a licensed healthcare practitioner.

The Body's Need for Oxygen

Every cell and tissue in the body needs oxygen to be able to function. Oxygen keeps the cells of the body alive and working. Oxygen powers all the organ systems, such as the brain, heart, lungs, kidneys, gastrointestinal tract and muscles of the body. Increased activity of the body requires more oxygen than when at rest. Oxygen is attached to hemoglobin in red blood cells, and the blood flow is delivered to the organs by circulation. Hemoglobin carries the oxygen to the tissues. Anemia causes a greater demand on the heart and lungs for oxygen supply to the tissues. Oxygen in the tissues creates energy and allows us to live, work and play. Any breakdown in the supply system can cause temporary or permanent damage. Lack of oxygen can "break the machinery" of living.



Oxygen is attached to hemoglobin in red blood cells, and the blood flow is delivered to the organs by circulation.

The normal human has a great ability to withstand short periods of low oxygen, and elite athletes can run races, climb high mountains, and achieve high energy production because of a strong heart and good blood supply of oxygen. These adaptations begin to fail in diseases such as COPD.

AT REST

The body requires a basic amount of oxygen at rest, which is based on the size and metabolism of each person. Plenty of oxygen is in the air for normal, healthy people at most altitudes.

EXERCISE AND SLEEP

We require more oxygen when exercising or awake, and less oxygen during sleep. While asleep, people generally breathe less deeply, so it is normal for oxygen levels to drop slightly during this time. Most liter flows are prescribed at rest, usually 2-3 (liters) per minute.

DURING TRAVEL

More oxygen is needed at altitude while driving, or in a train or airplane. Our highest mountain pass is 12,000 feet and many are at 9,000-10,000 feet. Airplane cabin altitudes are usually maintained between 5,000 and 8,000 feet. So you need more oxygen while ascending and less on descent. An oximeter will tell you if you are getting enough oxygen in all situations!

Tip More oxygen may be required at different altitudes – use a pulse oximeter to check.

So Your Doctor Has Ordered Oxygen

DOSING – PRESCRIBED AMOUNT

Oxygen is prescribed by a control of the flow rate, i.e., liter flow. The "usual" 1-3 liters per minute continuous flow is not appropriate in all situations. This could be too much or not enough. Precision in the use of the proper flow, or amount of oxygen, is necessary. The flow of oxygen should achieve the normal amount of oxygen in your blood, expressed as a "saturation" above 90%.

SELF-MONITORING

Many patients commonly check their blood pressure, blood sugar or air flow rate (peak flow) at home. We can measure temperature and weight whenever we have the need. We can now measure our blood oxygen and pulse rate at home as well, using a simple oximeter. I use one myself in the treatment of complications that I have following four heart surgeries!

A common word to those of us who use oxygen is "titration." Titrating is the measurement of what your oxygen equipment and setting is achieving in the arterial blood. It's this blood that energizes the tissues. By making your own measurements, you can adjust your oxygen

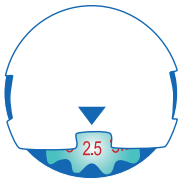
Tip Oxygen saturation over 90% is GOOD.

PULSE OXIMETER

setting for any situation, and with any LTOT device.[3] Non-invasive measurement of oxygen saturation is made by a pulse oximeter. Ask for a prescription from your doctor. Oximeters, like blood sugar measuring devices, are sometimes reimbursed by health care insurance companies.

OXYGEN SYSTEMS

The ultra light ambulatory (wearable) liquid oxygen systems and the new low weight portable ("wheelable") concentrators give oxygen settings by arbitrary numbers, such as 1-4 or 1-5. These refer to the size of the "pulses" of oxygen and are **not** the same as liter flow. They are considered "liter flow equivalents." Also, these devices do not all produce the same amount of oxygen at a given setting.



Liter setting dial example

Pulses don't equal FLOW.

**This is a general statement. Your physician must prescribe your specific target saturation level.*

This is also true of the home-filling oxygen bottles that come with an oxygen conserver. These conserving devices reduce the actual amount of oxygen that the patient gets in a minute. They only allow a pulse of oxygenated air during inspiration. These smaller amounts of oxygen may be sufficient for rest, altitude and activity, but monitoring by oximetry is particularly important. Be sure an adequate oxygen saturation greater than 90% is being achieved.*

Using Pulse Oximetry

The lungs transfer oxygen from the air into the bloodstream. This oxygenated (arterial) blood is then pumped by the heart to all organ systems. The arterial oxygen blood level can be measured by drawing blood from an artery (arterial blood gas measurement). This accurately measures the oxygen and carbon dioxide (waste gas of metabolism) and levels of each in the blood.

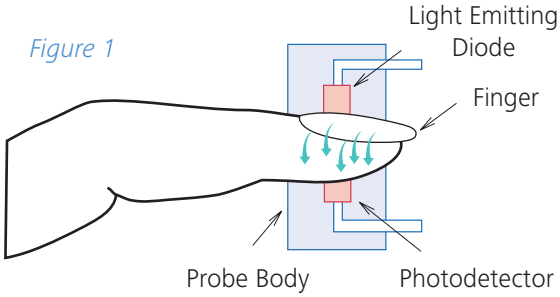
An oximeter, usually attached to the finger, shines two separate light beams into the blood circulating in the small vessels, i.e., capillaries. These light beams reflect the amount of oxygen in the blood, expressed as a percentage along with the pulse rate *(Figure 1)*. Oxygen saturation measures how much oxygen the blood is carrying compared with its full capacity. Oxygen saturation of 96% to 98% is normal at sea level; 92% to 94% is normal in Denver.

Tip

Nail polish and/or artificial nails may affect the oximeter's performance

Nail polish that is very dark may interfere with the oxygen reading. If you are routinely measuring your oxygen saturation you may need to avoid these very dark shades.

Figure 1



USING THE OXIMETER TO EXPAND YOUR LEVEL OF ACTIVITIES

You can use your oximeter to measure your oxygen saturation level at any time, such as at home, at work or during recreation, i.e., playing golf.

You can't use it while actually swimming, since oximeters cannot be submerged. But you can use it at poolside during your exercise regime. You should maintain an oxygen saturation between 90% to 98% in all activities and adjust your oxygen flow setting to achieve this goal. This is a simple biofeedback process. It puts you in the loop.

CONSERVING YOUR OXYGEN – INCREASING YOUR RANGE

By learning the lowest liter flow on an ambulatory portable oxygen setting that will provide an oxygen saturation of 90% to 94%, you can increase the duration of your oxygen supply. This gives you more time away from home and refills. You will also have more confidence that you'll have enough oxygen with you, and this may also increase the time between needed refills.

THE RESTORATIVE EFFECT OF OXYGEN

Some studies have shown that the ability of the lungs to take oxygen into the blood may improve following months of oxygen treatment.[4] This may also help restore the function of the muscles of the body, the heart and the brain.[5]

This is probably because damaged or "stunned" cells can reverse function again, if energy supply is restored. Research shows that more heart, brain and muscle function can be achieved by exercising regularly with ambulatory oxygen.[6]

PRACTICE PURSED LIP BREATHING

The act of pursed lip breathing, i.e., exhaling slowly against pursed lips as in the act of whistling *(Figure 2)*, is useful to your breathing efficiency in many ways.[7] Pursed lip breathing teaches you to breathe in a deeper, slower fashion. In addition, it helps you to empty your lungs

more completely. This is particularly important in emphysema/COPD, where over-inflation of the lungs is a problem.

Figure 2

Some patients like to find out how long their oxygen saturation remains above 90% when their oxygen is turned off. It gives them a feeling of confidence when their oxygen flow is stopped for a short period. Pursed lip breathing may elevate the oxygen saturation significantly, i.e., into the 90s, based on breathing room air, which might initially give you readings in the 80s or even lower.*

After you master pursed lip breathing, try doing this with exercise. Use your oximeter as you walk around the house and later outside and around the block. Try to walk at least 100 yards using pursed lip breathing. Use of a pedometer is helpful here. You will probably find out that pursed lip breathing will relieve your shortness of breath as well as improve your oxygen saturation, both at rest and during exercise. This is an important observation.

Tip

When practicing pursed lip breathing, take a full breath, shape your mouth as though you are whistling, and breathe out slowly to resist the speed of the air leaving your lungs.

**Check with your physician before trying this on your own.*

REDUCE SHORTNESS OF BREATH

Overinflation of the lungs puts the breathing muscles at a mechanical disadvantage, adding increased load to the breathing. This is often interpreted as an increased effort to breathe or "dyspnea," which is an unpleasant sensation of breathing. Often patients can reduce their shortness of breath by slow, deep breathing and exhaling *(Figures 3 and 4)*. Practice using your oximeter with pursed lip breathing, using two or three seconds to breathe in, and four, five or six seconds to exhale. Find a comfortable breathing rate and pattern and watch your oxygen saturation increase at a given oxygen setting. **With your doctor's approval**, you might also be interested in trying this while breathing room air. Your oxygen saturation while breathing room air will be achieved by stopping your oxygen for 10 to 20 minutes. It takes this long to use up the residual oxygen in your lungs (the amount of air left after you exhale).**

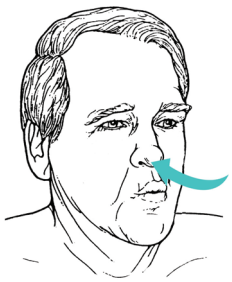


Figure 3

Inhale, 1, 2, 3

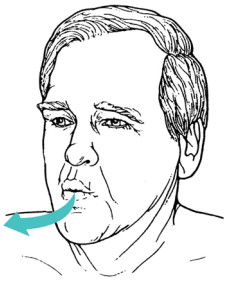


Figure 4

Exhale, 4, 5, 6

***Please be sure to check with your doctor before trying this without your oxygen.*

PARTICIPATING IN PULMONARY REHABILITATION AT HOME

Pulmonary rehabilitation is now established as the standard of care for patients who can and want to do more than simply take conventional therapy, including drugs, and accept limited activity. Rehabilitation can improve your exercise tolerance, reduce your shortness of breath at a given task, and greatly expand your horizons. Also, pulmonary rehabilitation can help you train "through your dyspnea." This sensation of shortness of breath can be reduced or eliminated during a given task such as walking on the level or up stairs.

Try this with your oximeter in place. Don't push your pulse rate higher than 140 to 150. When you get a rapid pulse rate, as seen on your oximeter, stop and rest. It is better if you sit down and do your pursed lip breathing as your pulse returns to normal (i.e., less than 100 at rest) and your oxygenation stays above 90%.

LIMITATIONS OF OXIMETRY

Accurate oxygen measurements by oximetry require a good blood flow through the tissues. When your fingers are cold, the blood flow is reduced and poor or abnormal readings are possible. Warming the hands by rubbing them together or with warm water helps improve blood flow. Also, oximetry does not measure the carbon dioxide in your blood. In the state of a severe breathing attack (i.e., bronchospasm such as in asthma or COPD), it is possible to have a normal oxygen level with severe carbon dioxide buildup. This is not because oxygen reduces the drive to breathe, as is sometimes wrongly concluded. It is because working hard to breathe can cause large amounts of carbon dioxide to be produced, and the breathing muscles may become tired and weak and thus not force enough air for carbon dioxide removal. This can be a medical emergency. Usually this is accompanied by severe shortness of breath, wheezing and increased pulse rate.

WARNING SIGNS

A sudden drop in your oxygen level – for example, during a severe cold or the flu – can be a sign of trouble. Call your doctor if your normal oxygen setting is no longer maintaining your saturation and you feel sick. Also, call your supplier if you feel your oxygen system is not working. A high resting pulse of greater than 100 or a low pulse of less than 40 are also reasons to call your doctor.*

**Please be sure to check with your doctor to determine your own pulse rate ranges.*

Conclusion

Today 1.2 million Americans receive LTOT.[8] The vast majority of these individuals should be active, and many are. Many more are achieving higher levels of functioning using truly ambulatory oxygen systems. This improves the quality of life. Active patients should all have oximeters to guide their oxygen use during all their activities of living. This is particularly important during travel, such as when driving to high altitudes, or during flight, when cabin altitudes can reach 8,000 feet.

Your personal oximeter is a marvelous device available at low cost. It should become part of your daily routine!

Frequently Asked Questions

1. Why am I still short of breath when my oxygen saturation is normal, i.e., 90%-94%?

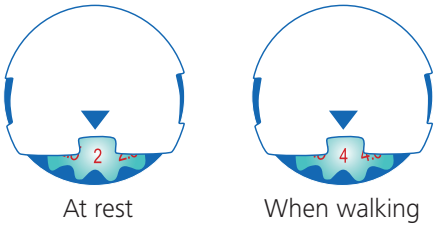
Answer: Shortness of breath is related to the work of breathing – that is, how hard it is to move air in and out of the lungs. This does not directly relate to oxygen saturation. You may be more short of breath when your oxygen is low, but oxygen alone will not relieve shortness of breath. Exercise training and pulmonary rehabilitation are usually helpful.

2. What about getting too much oxygen and retaining carbon dioxide?

Answer: This is an old myth based upon misconceptions about oxygen. Oxygen itself will not eliminate or even reduce the drive to breathe. This is true even when patients retain some carbon dioxide.

3. Can I use a higher flow rate if I am short of breath while exercising?

Answer: Yes, and it may be helpful in providing extra oxygen for your muscles as you are walking. You should return to your normal flow rate after exercise. Monitor your saturation during both rest and exercise with your oximeter.



Liter setting dial examples

4. Will smoking affect my results?

Answer: Yes. Smoking actually increases the apparent oxygenation by causing carbon monoxide to attach to hemoglobin. Don't fool yourself! Carbon monoxide replaces the oxygen in red blood cells and starves the body of oxygen. Smoking is harmful in any patient who requires oxygen.

5. Will oxygen explode?

Answer: No. Oxygen will not explode, but it supports combustion. Keep away from open flames. You may use candles in your home if kept at least three feet from the oxygen tubing. Don't use any oil-based lubricants on your nose.

6. Can I re-adjust my oxygen dose myself?

Answer: Work this out with your doctor. Certainly you should be able to adjust your oxygen just as people with diabetes adjust their own insulin, based upon measurements made at home. It is very important for you and your doctor to work as a team, guided by your oximeter. You and your doctor should have a frank talk about the necessity of adjustments and the fact of different oxygen flows from different systems, as well as the issue of oxygen conservation and "flow equivalents." Not all doctors are made aware of these technological differences by the suppliers.

Activity Log

Use activity log sheets to record your activity and oxygen saturation (SpO_2) so you can discuss and share this information with your physician.

Prescribed flow rate or setting _____

M.D. determined target SpO_2 % _____

Date	Time	Activity	Duration min./hr.	Borg Scale	SpO_2 Reading	Pulse Rate	Oxygen Flow Rate	
							Continuous Flow	OCD Setting
6/15	2:30	Walking	30 min.	1	96	90	2l e tank	4 - eclipse

Borg Scale for Breathlessness

Rating	Severity
0	No breathlessness
1	Slight
3	Moderate
5	Severe
7	Very severe breathlessness
10	Maximum – can't catch breath

Name of oxygen system _____

Activity Log sheets may be downloaded at the Nonin Medical, Inc. website, www.nonin.com/petty

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