

NATIONAL JEWISH CENTER  
FOR IMMUNOLOGY  
AND RESPIRATORY MEDICINE

**Medical/Scientific**

# Update

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## Oxygen Therapy

by Barry Make, M.D.

Long-term oxygen therapy is now widely accepted as the standard treatment for chronic hypoxia caused by chronic obstructive pulmonary disease or other disorders such as interstitial lung disease. Oxygen therapy has also become much more versatile in recent years, as several different types of oxygen delivery devices have become available. The diversity of these devices makes it easier for physicians to select a mode of oxygen therapy that suits the patient's lifestyle.

Many patients require long-term oxygen therapy. The American Lung Association estimates that more than 800,000 Americans are maintained on long-term, chronic oxygen therapy. Oxygen therapy is a significant national health care expenditure; it is the most expensive non-surgical treatment reimbursed by Medicare. The typical monthly cost of oxygen therapy is \$300. Patients with private insurance or Medicare coverage usually pay 20% of the cost, or about \$60 a month.

Because most patients on supplemental oxygen must receive it continuously, and in most cases for the rest of their lives, they may erroneously view oxygen therapy as a treatment of last resort. In reality, it is an important adjunct to other modes of treatment for chronic hypoxia.

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*Liquid oxygen systems provide the greatest degree of portability and versatility, but they are the most costly option, and are not available to all patients.*

Oxygen therapy reduces pulmonary artery pressure and pulmonary vascular resistance, increases exercise capacity, improves oxygenation during sleep, improves neuropsychological performance, and prolongs patient survival.

Many primary care physicians are capable of identifying which patients need oxygen therapy, determining a patient's appropriate oxygen prescription, and establishing an oxygen therapy program. However, there are advantages to having these steps performed by oxygen therapy specialists. National Jewish Center for Immunology and Respiratory Medicine operates a Center for Oxygen Therapy, which welcomes patient referrals.

This Center is designed to assist

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***An adequate oxygen supply maintains an oxygen saturation of 90%.***

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in all phases of oxygen therapy, including determination of the right oxygen dose and delivery method, and educating the patient in the proper use of the system. The Center offers two services that are particularly useful for patients who are not compliant with their oxygen regimen: an educational program that instructs patients in all phases of oxygen therapy, and an opportunity for patients to observe and discuss concerns with other patients who are long-term users of supplemental oxygen. Patients with significant functional impairment may also benefit from treatment at National Jewish, where they can begin a program of pulmonary rehabilitation.

***Who needs oxygen?***

Physicians should assess the need for oxygen therapy in patients with chronic lung disease, especially those who complain of dyspnea and are not completely responsive to

medical management. A general rule is that an analysis of resting blood gases is mandatory for patients with a forced expiratory volume (FEV<sub>1</sub>) of one liter or less despite receiving optimal medical treatment. At high altitudes, such as in the Rocky Mountain region, the minimum FEV<sub>1</sub> that should trigger a blood gas analysis is 1.2 to 1.25 liters.

Chronic hypoxia can be documented in patients who are already receiving optimal medical therapy by drawing an arterial blood specimen for analysis of arterial blood gases. The blood should be drawn from patients at rest, in the seated position. The patient is considered hypoxic and in need of supplemental oxygen if the arterial oxygen pressure (PaO<sub>2</sub>) at rest is at or below 55 mmHg. A diagnosis of hypoxia is made in patients with a PaO<sub>2</sub> of 59 mmHg or less if the patient also has a hematocrit of 55% or more, "p" pulmonale on an ECG, or peripheral edema that indicates right-sided heart failure. A normal PaO<sub>2</sub> at rest does not rule out abnormally low oxygenation during exercise or sleep; oxygen saturation can be measured during these times using an oximeter.

***Selecting the system***

The companies that supply oxygen therapy may provide a patient with the least expensive system unless otherwise directed by the physician's prescription. It is therefore critical that a doctor be as specific as possible in defining the parameters of oxygen therapy. Of particular importance is specification of a supply system that provides the patient with the maximum degree of mobility that is consistent with the patient's lifestyle.

A complete oxygen prescription must also specify the oxygen flow at rest, during activity, and during sleep. The appropriate oxygen dose

during activity is determined by having the patient engage in these activities while measuring the patient's blood oxygen level with a fingertip oximeter. An adequate oxygen supply maintains an oxygen saturation of 90%.

Other prescription parameters include the frequency of oxygen use each day, the duration of use, and the way by which the oxygen therapy company should monitor whether the patient is correctly using the therapy equipment.

The least expensive and least portable device for oxygen therapy is an oxygen concentrator, which concentrates atmospheric oxygen and provides this as supplemental oxygen to the patient. These devices are usually powered electrically, and are outfitted with an oxygen tube that is, at most, 50 feet long. This design makes the concentrator suitable only for patients who are confined to home. In addition to their low cost, concentrators have the advantage of requiring the lowest number of maintenance visits. A monthly visit to check the operation of the concentrator is typical.

Portable systems, which dispense oxygen from cylinders, are of two basic types based on whether the oxygen is stored as a gas or liquid. Gas cylinders are readily available and of moderate cost. Although more portable than a concentrator, the patient's mobility is still somewhat restricted by the bulkiness of these cylinders. These systems are feasible for patients who require a low oxygen flow.

Because they rely on smaller cylinders that are readily refilled at home from a reservoir, liquid oxygen systems provide the greatest degree of portability and versatility. Liquid oxygen systems are the most costly option, and are not available

to all patients, particularly those who live in rural areas. Liquid oxygen is usually available in most large towns, and within a 50-60 mile radius of most cities. Liquid oxygen cylinders are easier to fill from stationary reservoirs than tanks that hold gas oxygen.

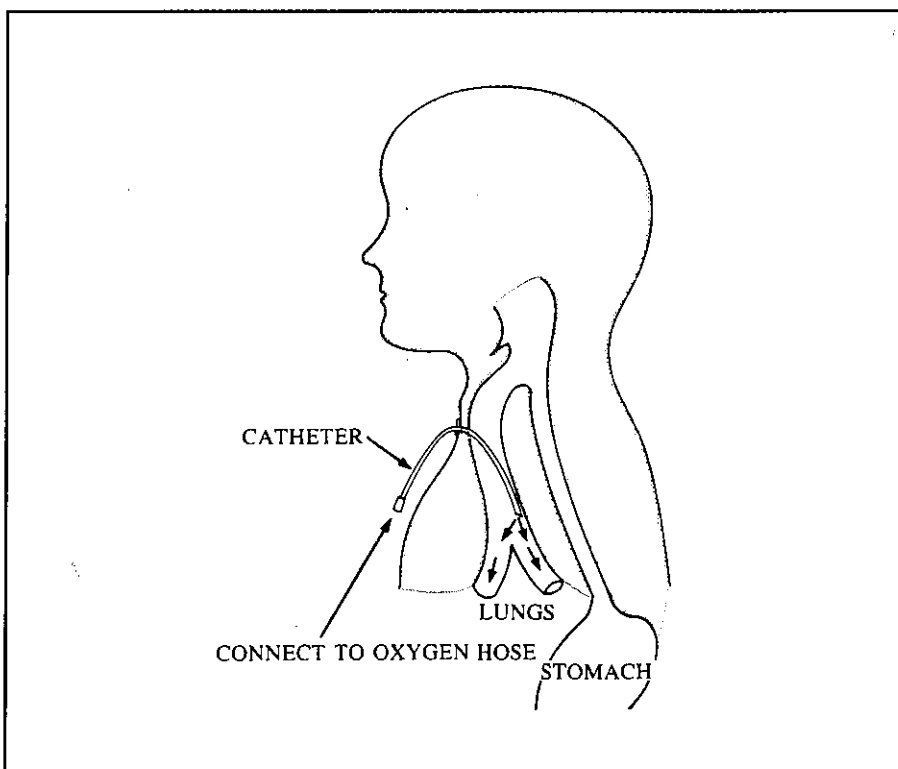
### **Oxygen conservers**

Oxygen delivery systems may be augmented with an oxygen conservation device, which allows a reduction in the oxygen flow rate while maintaining adequate oxygenation. Three types of oxygen conservation devices are available: reservoir devices, demand delivery devices, and transtracheal oxygen catheters.

Reservoir devices store oxygen during the expiratory phase of ventilation, and deliver the stored oxygen during inspiration. These devices can achieve a 50-60% oxygen savings in patients with chronic obstructive pulmonary disease, and they are effective whether the patient is at rest or exercising. Although reservoir conservers are inexpensive and easy to use, patients often dislike them because they are more unsightly than standard nasal prongs. This may interfere with optimal patient compliance.

Demand oxygen conservers provide oxygen only during inspiration, and save oxygen by shutting off flow during expiration. These units work by detecting negative pressure at the nose, at which time they trigger oxygen flow into the nasal cannula. Although several demand conservers are available, only four have been proven effective in rigorous studies. These are the Oxymatic, Companion Oxygen Saver, Pulsair, and Companion 550.

Transtracheal oxygen (TTO<sub>2</sub>) delivery involves percutaneously inserting a thin catheter directly into the trachea in the anterior neck. The most widely used catheter for this



*The transtracheal catheter delivers oxygen directly to the lungs. This diagram shows where it is placed and how it works. The simple procedure to place the catheter is done on an outpatient basis (no hospital stay) and causes very little discomfort.*

purpose is the SCOOP system, which is available in two types of designs.

The SCOOP-1 catheter contains only an end port, and is suitable for low flow rates. The SCOOP-2 catheter has side ports in addition to the end port, and is suited to higher flow rates. The SCOOP-2 catheter requires daily removal and cleaning by the patient. The SCOOP-1 catheter can be cleaned in place, although it can also be removed for cleaning.

Studies have documented that transtracheal catheters conserve oxygen and improve compliance with the oxygen prescription. In addition, transtracheal oxygen can provide important physiologic benefits by decreasing the patient-generated inspired volume and dead space. This effect results in reduced work of breathing for the patient. In addition, transtracheal oxygen may

improve the patient's exercise capacity.

The disadvantages of transtracheal delivery are the need for daily catheter cleaning, and complications from tracheal placement. One complication is infection, either in the form of cellulitis at the insertion site, or a lower respiratory tract infection. The most important complication during long-term use is development of mucus balls, which form around the catheter. These balls may become large enough to cause partial tracheal obstruction. Clinically significant mucus balls occur in 10-25% of patients. Despite such complications, patients usually elect to continue transtracheal oxygen because of the treatment's benefits.

The successful use of transtracheal oxygen delivery requires a progressive program of patient support and education during a one

***Review the efficacy of oxygen therapy every six months, or whenever there is a significant change in the patient's clinical status.***

to two month period. For patients who balk at the idea of a trans-tracheal catheter, the educational process might begin by having the patient talk to others who are already using transtracheal delivery, or having the patient watch a video on the subject that is available from National Jewish. The educational program should give the patient a clear understanding of the catheter system prior to its insertion, and should continue until the patient demonstrates successful independent use of the catheter.

***Patient education***

All elements of oxygen therapy require thorough patient education and support if the treatment is to be successful. A physician should begin the educational process when long-term oxygen is initially prescribed, and should continue with help from the respiratory care practitioners who assist the patient with oxygen therapy at home.

It is particularly important to address the patient's concerns and attitudes about oxygen therapy. Patients often react to the news that they require oxygen therapy with questions such as: "Am I that bad?", "Can't I just use it when I feel I have to?", "Will I ever be able to get off it?", and "I could never be seen in public with that on."

The transition to routine oxygen therapy is difficult, particularly for patients who are not significantly short of breath and do not feel noticeably different when using oxygen. Physicians should stress the effect of oxygen therapy on quality of life, and avoid the mistake of emphasizing how oxygen therapy

will help prolong a patient's life. Although this is a compelling medical rationale for oxygen therapy, patients may feel that they don't want to live longer if their life will be made miserable by the treatment.

Instead, emphasize that oxygen therapy will help relieve shortness of breath and help improve performance. One approach that is often successful is a tangible demonstration of the benefits of oxygen therapy. Have the patient walk in a corridor or outside for a specific length of time, such as six minutes. Then have the patient walk for the same time interval while on oxygen therapy. Compare the distances walked each time, and emphasize that oxygen therapy can significantly improve the patient's ability to perform routine activities.

The most effective way to educate patients about the use of oxygen

delivery equipment is a hands-on approach that centers on demonstrations with the specific equipment that the patient will use. This places a lot of educational responsibility in the hands of the therapists who help patients set up and use their equipment.

***Follow-up***

No clear evidence exists on how often a patient's oxygen therapy prescription should be reviewed. This question is now being addressed by a research project at National Jewish. Despite this uncertainty, patients clearly need reevaluation as their disease progresses. For the time being, our recommendation is to review the efficacy of oxygen therapy every six months, or whenever there is a significant change in the patient's clinical status.

***Travel Schedule***

National Jewish faculty members frequently travel to national and international conferences and to other institutions to talk about their clinical and research findings. Guest speakers can be requested through the Office of Continuing Medical Education.

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|-------------------------|---|
| Erwin Gelfand, M.D.     | June 15, 1993<br>City Wide Allergy Rounds<br>Boston, MA<br>"Immunoglobulin Therapy"                           |
| Marian Goble, M.D.      | July 1993<br>Sterling Regional Medical Center<br>Sterling, CO<br>"Multi-Drug Resistant Tuberculosis"          |
| Harold Nelson, M.D.     | July 31, 1993<br>California Society of<br>Allergy/Immunology<br>"How Topical are Topical<br>Inhaled Steroids" |
| Lanny Rosenwasser, M.D. | July 8, 1993<br>Colby Allergy Conference<br>"Drug Allergy"  |

## ***"Clinical Update on Asthma"***

**The Omni Sagamore Resort  
Bolton Landing on Lake George, NY  
July 16 - 18, 1993**

This program is designed for general practitioners, internists, pediatricians and others who are involved in the diagnosis and clinical management of patients with asthma. Participants in this program will learn about:

- guidelines for the treatment of asthma
- the impact sleep has on asthma
- the diseases that masquerade as asthma
- new concepts in asthma pharmacotherapy
- increased prevalence and severity of asthma

### ***Meeting Faculty:***

Gary L. Larsen, MD; Head, Division of Pediatric Pulmonary Medicine

Richard J. Martin, MD; Director, Sleep Research

Robert J. Mason, MD; Chairman, Department of Medicine

Harold S. Nelson, MD; Senior Faculty Member,

Division of Allergy and Clinical Immunology

Lanny J. Rosenwasser, MD, Head; Division of Allergy  
and Clinical Immunology

Stanley J. Szeffler, MD; Director of Clinical Pharmacology

## ***"36th Annual Pediatric Program"***

**The Given Institute, Aspen  
August 8 - 12, 1993**

Sponsored by: Department of Pediatrics, University of Colorado School of Medicine, the Children's Hospital and National Jewish. This program is designed to meet the education needs of practicing pediatricians and family physicians and will discuss issues in General Office Practice, Dermatology, Cardiology and Allergy/Pulmonology/Immunology.

### **Program for Wednesday August 11, 1993.**

Evaluation of the Child with Chronic Cough Susan Brugman, M.D.

Evaluation of Joint Pain in Children Terri Finkel, M.D., Ph.D.

Uses and Abuses of Gammaglobulin  
in Pediatric Disorders Erwin Gelfand, M.D.

Office Management of Asthma Gary Larsen, M.D.

Eve Was First: The Problem of Non-compliance Marianne Wamboldt, M.D.

## ***"A Comprehensive Review in Adult & Pediatric Allergy/Immunology"***

**The Radisson Hotel, Denver  
August 25-29, 1993**

This course is designed for practitioners and allergy trainees who will benefit from a review of diagnosis, pathogenesis, treatment and future trends in allergy and clinical immunology. It will provide a review of:

- Basic and Clinical Immunology
- Allergic and immunologically-mediated disorders
- Asthma pathophysiology and management
- Immunology laboratory tests and interpretation

Includes talks by National Jewish and University of Colorado School of Medicine faculty Donald Leung, Harold Nelson, Erwin Gelfand, Daniel Hamilos, Talmadge King, Gary Cott, Charles Irvin, Henry Claman, George Eisenbarth, and guest speakers Thomas Casale, Robertson Parkman, and William Henderson.

## ***References***

1. Corsello, PR, Make BJ. Which oxygen-conserving device is best for your patient? *J. Resp Dis* 1992, 13:27-41.
2. Couser, JT, Rassulo, J., Make BJ. Transtracheal oxygen decreases inspired minute ventilation. *Am Rev Respir Dis* 1989, 139:627-31.
3. Couser, JT, Make BJ. Respiratory tract infection complicating transtracheal oxygen therapy. *Chest* 1992, 101:273-5.
4. Lutz, M, Kraft, M., Make, B. Long-term oxygen therapy in patients with chronic obstructive pulmonary disease. *Sem Respir Med*, in press.
5. Tiep, B. Portable oxygen therapy: including oxygen conserving methodology. Futura Publishing Company, Inc., Mount Kisco, N.Y., 1991.

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National Jewish; Assistant Professor  
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School of Medicine

## **Upcoming CME Programs**

### **"Clinical Update on Asthma"**

The Omni Sagamore Resort,  
Bolton Landing on Lake George, NY  
July 16- 18, 1993

### **"36th Annual Pediatric Conference"**

sponsored by the Children's Hospital and  
National Jewish Center for Immunology  
and Respiratory Medicine  
Aspen, Colorado  
August 8 - 12, 1993

### **"1993 Comprehensive Review in Adult & Pediatric Allergy/Immunology"**

co-sponsored by National Jewish  
and the American Academy of  
Allergy & Immunology  
Radisson Hotel Denver  
August 25 - 29, 1993

### **"1994 Update on Allergy and Clinical Immunology"**

Keystone, CO  
February 2 - 6, 1994

*For further information on any of these  
meetings, call 303-398-1000*

## **Medical Advisory Board:**

Mark Boguniewicz, MD, Willi Born,  
PhD, Larry Borish, MD, Barry Make,  
MD, Kenneth Newman, MD, and Uwe  
Staerz, PhD

## **Important Phone Numbers:**

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## **Weekly Education Listings**

All sessions are held in Heitler Hall.  
For more information,  
call 303-398-1380

### **Monday:**

Immunology Course

### **Tuesday:**

Research in Progress

### **Wednesday:**

Denver Allergy Rounds  
(1 hour Category 1 CME credit)

### **Thursday:**

Pediatric Grand Rounds

### **Friday:**

Pulmonary Research in Progress

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medical education office at National  
Jewish, provides information to  
physicians about our clinical and  
research programs in allergic,  
respiratory and immune system  
disorders.

Please send any comments or requests for  
topics to Adele Gelfand, Manager of  
Professional Education, National Jewish  
Center for Immunology and Respiratory  
Medicine, 1400 Jackson Street, Rm M-222,  
Denver, CO 80206.  
We'd like to hear from you.

### **Lung Line® 800-222-LUNG. 355-LUNG (Denver only)**

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by highly qualified registered nurses,  
answers patients' questions about  
respiratory, allergic and immunologic  
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