

Ambulatory Oxygen:

Matching the Product to the Patient

by Joseph Lewarski, BS, RRT

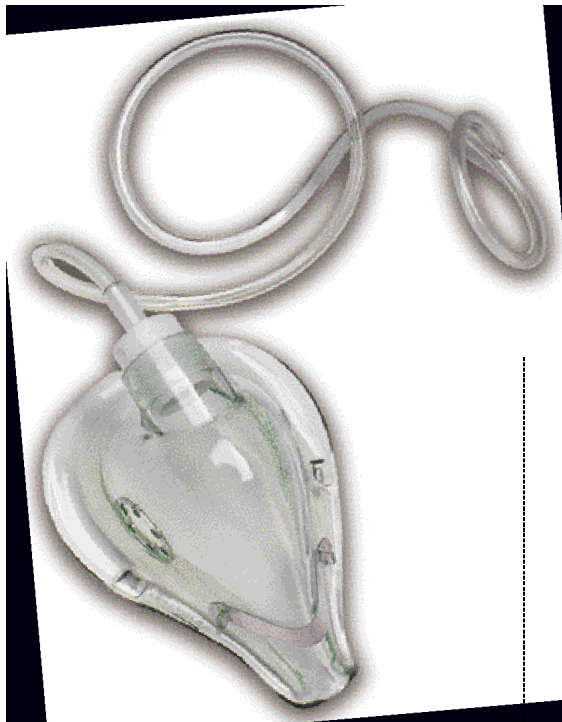
Long-term oxygen therapy (LTOT) is a primary treatment for patients with pulmonary disorders demonstrating chronic, stable hypoxemia. It is estimated to be the largest direct cost associated with managing chronic obstructive pulmonary disease (COPD). According to current literature, there are an estimated 850,000 to 1.2 million home oxygen users, accounting for close to \$2 billion in annual oxygen expenses. Despite the advancements in drug therapies and technology, the management of patients with chronic lung disease hasn't really changed much over the last 20 years. LTOT continues to

be one of the most important therapies, reducing morbidity and increasing patient survival, not to mention the often overlooked and harder to measure quality of life improvements.

Over the last 10 years or so, home medical equipment (HME) providers have seen a change in the type of LTOT patient being referred to them. Unlike the classic, end-stage COPD patient of the past, today's oxygen-dependent patient is much more active and mobile. Although there isn't any great science yet to explain this, it appears that many patients are being diagnosed and treated earlier in their disease process. The

increased availability and use of pulse oximetry in the outpatient setting, along with the availability of memory oximeters capable of high-quality, detailed overnight testing has helped to better identify patients suffering from hypoxemia associated with exercise and sleep. It is this new, highly active, and ambulatory oxygen patient who has created demand for improved portable oxygen delivery systems.

In the early days of home oxygen therapy, heavy steel cylinders were the norm for both stationary and portable oxygen delivery. This was soon followed by the advancements in cryogenic technologies that opened the door



for stationary and portable liquid oxygen delivery in the home. The next major stride in home oxygen therapy was pressure swing absorption technology and the development of the oxygen concentrator. It was the first self-generating oxygen delivery system designed for use in the home. Unfortunately, early generation concentrators were large, loud, unreliable, and energy inefficient, and as a result they weren't always popular with patients (and their physicians). However, the units of today are extremely reliable, very quiet, and much more energy efficient. As a result, they are the primary stationary home oxygen system used in the United States today. The new-generation oxygen concentrator has been a wonderful advancement in LTOT, but it alone hasn't solved the other major obstacle in home oxygen therapy: *efficient portability*.

Although a large number of home oxygen patients have very modest portability needs, the range of portable oxygen needs

is extreme. Today's HME provider is faced with LTOT patients who may require only a few hours of portability per week (that is, an occasional physician office visit or trip to church) to as much as 24 hours per week (patients who work, volunteer, require frequent outpatient care, etc.). It is the latter that presents both economic and technological challenges for HME providers. The Fifth Consensus Conference on LTOT defined "ambulatory" oxygen system as one that weighs less than 10 pounds and provides the equivalent of 2 L/min of continuous flow oxygen for four hours or more. Although this may sound like a "no brainer," there are a number of variables to consider when selecting a portable oxygen delivery system for a patient. Before we discuss these variables, it would be valuable to discuss the portable oxygen technology options that are available today.

Current portable oxygen technology

Over the last four to five years (coinciding with the 30 percent Medicare cut in home oxygen reimbursement), we have experienced a boom in portable oxygen delivery technology. Oxygen-conserving technology has been at the forefront of this new portable oxygen evolution. In addition to the conservation technology, we are also seeing improvements in cylinder design and weight, liquid oxygen systems, and a new generation of oxygen concentrators capable of refilling cylinders in the patient's home. Examples of some of the

new technology include but are not limited to:

- Small, lightweight alloy cylinders
- Small, lightweight click-style regulators
- Pulse-dose oxygen conserving devices
- Demand oxygen conserving devices
- Oxygen concentrators capable of filling small cylinders
- Low-loss liquid oxygen systems and liquid conserving devices.

Unfortunately, the fact that a technology exists does not guarantee that it is always appropriate for each patient. Selecting the right portable or ambulatory oxygen system for each specific patient is a combination of art and science. As mentioned earlier, there are a number of variables related to the selection of the ideal system, and they include:

- The patient's prescribed liter flow
- The patient's actual portability requirement (that is, hours per week)
- The patient's clinical status
- The patient's aptitude and dexterity
- The patient's home environment (electrical, safety of structure, etc.)
- Caregiver availability and support
- Geography, the location of the patient's home in relation to the HME provider and other health care resources.

Each of the aforementioned variables influences the type of portable oxygen system that will best meet the patient's total

needs. The determination of the *ideal* device is derived from a thorough patient history, clinical evaluation, and environmental assessment. Each portable device has features and benefits that may be an *asset* or a liability in actual clinical use, so the choice of device must be weighed against these as part of the overall evaluation and selection process. The end result may be the selection of any one or even a combination of the following home oxygen delivery systems:

- *Standard concentrator, E cylinder, wheeled cart, and standard regulator* — This combination may be ideal for a patient with limited weekly ambulatory needs. It is

reliable, extremely easy to use, and most patients are familiar with the system. For the average 2 L/min flow, it provides about 5.5 hours of continuous oxygen. **Disadvantage:** Weight. Units can weigh between 12 and 15 pounds, depending on the type of cylinder, cart, and regulator.

- *Standard concentrator, D cylinder, carrying bag, and oxygen conserving regulator* — This combination may be used for patients with modest to high portability requirements. An alloy D cylinder with typical oxygen-conserving regulator and carrying case weighs about eight to nine pounds (meeting the LTOT consensus requirement). Many patients can easily manage this

amount of weight in an over-the-shoulder carrying case. Depending on the specific devices conserving ratio (units range from 2:1 to 5:1), with an average 2 L/min flow, this system can provide five to 12 hours of portable oxygen. It is important to note that all conserving devices have different flow, dose volume, and trigger characteristics; therefore, each unit should be titrated to the patient. It is also important to remember that the higher the conserving ratio, the smaller the dose of oxygen provided with each breath. **Disadvantage:** Not all patients can tolerate conserving devices. Inability to trigger some devices and inability to maintain adequate SpO₂ (saturation measured via pulse oxime-

Table 1. Portable Oxygen Device Comparison

Oxygen Delivery Model	Portability Grade	Cost to Provide
Standard Concentrator, E Cylinder, Cart, and Standard Regulator	C	\$
Standard Concentrator, D Cylinder, OCD, and Carrying Bag	A	\$\$
Standard Concentrator, Very Small Cylinder (M-9, M-6), OCD, and Carrying Bag	B	\$\$ 1/2
Standard LOX Stationary and Portable	B+	\$\$\$\$
Dual System: LOX and Standard Concentrator	A	\$\$\$\$
LOX and LOX OCD System	A	\$\$\$ 1/2
O ₂ Concentrator with Transfill Ability, OCD, and Very Small Cylinder	A+	\$\$\$\$

OCD = Oxygen Conserving Device, **LOX** = Liquid Oxygen System
Grade Scale: C = Least Portability, A+ = Highest Portability
Cost Scale: \$ = Least Expensive, \$\$\$\$ = Most Expensive

NOTE: This comparison scale is designed to offer a simple, objective reference and comparison of different oxygen delivery systems and is not a recommendation for a particular system. Actual costs vary based on purchasing power, brands, etc. Appropriate selection of an oxygen delivery system is dependent on multiple variables, as noted in the article.

try) with all units has been seen in a small percentage of patients. In addition, some devices have very small controls and print and may be difficult to operate for patients with limited manual dexterity or impaired vision to operate.

- *Standard concentrator, very small cylinder (M-9, M-6, or smaller), carrying bag, and oxygen conserving regulator* — This combination may be used for patients with modest portability requirements and very limited physical strength. Although these cylinders outfitted with a conserver can weigh as little as five to six pounds, an advantage for a fragile patient, it is important to recognize the reduced portability that results. The smaller the cylinder, the smaller the volume of oxygen available. To achieve ideal portability, many of the extremely small cylinders are often teamed with a high-ratio (equal to or greater than 4:1) conserving device to offer adequate portability. **Disadvantage:** Not all patients can tolerate conserving devices, and the very high-ratio conserving devices may be even more difficult to tolerate. Extremely small capacity cylinders may reduce portability (that is, cylinder duration) and defeat the intended purpose.

- *Standard liquid oxygen stationary and portable system* — This is a combination of a typical liquid oxygen-based (generally 35–50 liter) and a mid-sized liquid portable vessel (1–1.5 liter). This combination was the standard for ambulatory patients before lightweight cylinders and conserving devices became preva-

lent. It may be used for someone with modest to high portability needs when continuous flow is required to sustain an appropriate SpO₂ in a patient who cannot tolerate a conserving device. It may also be used in cases where electrical power is scarce or inconsistent. Depending on the liquid portable unit's volume capacity, with an average 2 L/min flow, this system can provide four to eight hours of portable oxygen. **Disadvantage:** Liquid oxygen is more expensive to provide (special trucks, delivery technology, etc.), requires more frequent and scheduled home deliveries, and has a constant loss of product due to warming and evaporation (this increases with more frequent portable fills). Liquid portable filling also requires some skill on the part of the patient or caregiver.

- *Dual or combo system* — Oxygen concentrator as stationary and liquid for ambulation. The model incorporates the use of an oxygen concentrator as the stationary system for use in the home and a liquid system for portability. It offers the advantage of the reliability and economics of a concentrator along with the continuous-flow and portability advantages of liquid. It may be used with high-flow patients (equal to or greater than 3 L/min) who require frequent ambulation and cannot tolerate a conserving device. **Disadvantage:** This is an extremely expensive system to start with, and it carries the same disadvantages of the standard liquid system. As a result, this model is often used selectively.

- *Liquid oxygen conserving system* — This is one of the newer delivery systems available. It operates essentially the same as a standard liquid system with the distinct difference being the liquid portable, which has a built-in conserving device. The new, lightweight liquid portables operate with much smaller volumes of oxygen and, therefore, are substantially lighter (four to five pounds), and at 2 L/min, may last as long as eight to 12 hours. It may be used with highly ambulatory patients who can tolerate the dosing of the conserving system. **Disadvantage:** The same as other liquid systems and conserving devices.

- *Oxygen concentrator with cylinder transfill capability* — This is the latest advancement in oxygen delivery technology. This new generation of devices diverts oxygen from the concentrator to slowly transfill high-pressure cylinders, without affecting the oxygen delivery to the patient. This is normally used in conjunction with a lightweight cylinder and conserving device. The concept mimics that of filling a liquid portable from the stationary system, except in this case, you are filling a cylinder. **Disadvantage:** The technology is very new and not widely available or used, so the performance and reliability haven't yet been proven in the field. It also has a start-up cost higher than that of a standard concentrator system. However, if the technology proves reliable and it functions well both clinically and economically, this type of system may change the standard of home oxygen delivery for highly ambulatory patients.

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Ambulatory Oxygen

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Home respiratory therapy has truly evolved into a clinical subspecialty. As such, there is a knowledgebase and skill requirement that sets this sector of the profession apart from the rest. Although the idea that selecting the ideal portable oxygen system for a patient seems rather rudimentary, it is clearly more involved than it appears on the surface. This process is a combination of closely evaluating the physician's order and the patient's clinical needs, environmental needs, technical skills, and aptitude, and then matching it all to the HME providers' home oxygen programs.

As a home care respiratory therapist for almost 10 years, I wouldn't be qualified to select the best critical care ventilator to meet an ICU patient's needs; this decision is outside my area of expertise. If you are involved in ordering home oxygen and/or discharge planning, please respect the knowledge and experience of your home respiratory care partners. Hospital-based therapists can work effectively with home respiratory experts to select oxygen systems that will best meet each patient's clinical and lifestyle needs. 🐾

Joseph Lewarski is director of the National Respiratory Network for the MED Group in Richmond Heights, OH, and serves as chair of the AARC's Home Care Section.

Nicotine Dependency

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often get discouraged. However, we occasionally get that little boost that lets us know our efforts are worthwhile. As I was doing a PFT on a patient recently, I asked her if she smoked. She replied: "Don't you remember? You came into my room and gave me a breathing treatment about four years ago. We talked about smoking and you told me you thought it would help my emphysema if I stopped smoking cigarettes. I haven't had another cigarette since that time."

Thank you, Joe. 🐾

Wanda Beltz is the pulmonary rehabilitation coordinator at Lapeer Regional Hospital in Lapeer, MI.

EDITOR'S NOTE

If you would like a list of materials that are available for low or no cost and addresses or telephone numbers, send a stamped, self-addressed envelope to: Wanda Beltz, Lapeer Regional Hospital, 1375 N. Main St., Lapeer, MI 48446.

Success Stories

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helping to ensure a bright future for the profession. "I learn something every time I participate," says Bartow.

As an RRT with deep roots in home care, Bartow is a big supporter of recent efforts by the AARC to acquire greater access to respiratory therapists' ser-

vices for Medicare home care beneficiaries. "The AARC efforts are appropriate and on target," he says. "In fact, I do not believe expanding the Medicare benefit to include RTs would even be a point of discussion right now were it not for the efforts of the AARC. It is the right thing to do, and this is the right time to pursue it."

A winning combination

Looking back at the beginning of his career in respiratory care, Bartow says he never imagined he'd still be at it three decades later. "Upon graduating from respiratory therapy school, I thought I would use this form of employment as a stepping stone to other fields — fields with more opportunity. Thirty years later, I am still finding opportunities — in fact, more so than ever before." He credits all the people who have helped him along the way with much of his success but also notes that for an old entrepreneur like him, the fact that the profession has always had so much room to move forward has been a big motivator.

"At times it appears we are the underdogs in the fight for recognition and reimbursement," says Bartow. "I think this appeals to me." Add to that the fact that RTs have a specialized knowledgebase and a core set of values aimed at providing high-quality care to those who need it, and you have the winning combination. "Respiratory care gives me a sense of satisfaction and fulfillment, and not every profession has that!" 🐾