Implementation of an Oxygen Therapy Clinic to Manage Users of Long-term Oxygen Therapy*

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Study objectives: **To evaluate the initial benefits of establishing an oxygen therapy clinic (OTC) to manage users of long-term oxygen therapy (LTOT).**
Design: **Cross-sectional observational study.**
Setting: **Military-affiliated, tertiary care hospital.**
Patients or participants: **Current users of LTOT at our institution and patients with new oxygen prescriptions between June 2000 and May 2001.**
Intervention: **The OTC evaluation consisted of a focused medical interview and physical examination by a respiratory therapist. Demographic data, indications for supplemental oxygen, oxygen-related diagnoses, cardiopulmonary review of systems, pertinent physical examination findings, pulmonary function testing, and oximetry data were recorded. Patients prescribed oxygen during hospitalization were followed up for recertification within 90 days based on the recommendations of the Fifth Oxygen Consensus Conference. Also, patients with existing oxygen prescriptions and new oxygen prescriptions during the study period were evaluated in the OTC. Data are provided for the initial evaluation in this clinic.**
Measurements and results: **A total of 283 patients were evaluated in the OTC during the study period. Ninety-seven patients with a new oxygen prescription during hospitalization were evaluated, with a mean ± SE time from discharge to evaluation of 2.6 ± 0.4 months. At follow-up, 50.5% of these patients no longer met Medicare guidelines for LTOT. A significant change in oxygen prescription was required in 27.9% of these patients. A total of 95 outpatients with existing oxygen prescriptions were contacted for recertification in the OTC. Of these patients, 31.6% no longer met Medicare criteria for LTOT and 26% required a significant change to their oxygen prescription. Oxygen therapy was discontinued in 22% of the 91 patients who were referred from other outpatient clinics, and the oxygen prescription was changed in another 29.7%.**
Conclusions: **Results of this initial evaluation suggest that the institution of a respiratory therapist-managed OTC to manage home oxygen patients can significantly decrease inappropriate supplemental oxygen use, which can result in significant cost savings while providing improved health-care delivery. Further evaluation is necessary to identify the long-term benefits and cost savings in this population.** ***(CHEST 2002; 122:1661–1667)***

Key words: COPD; obstructive lung disease; oxygen therapy; reimbursement

Abbreviations: DLCO = diffusing capacity of the lung for carbon monoxide; LTOT = long-term oxygen therapy; OSA = obstructive sleep apnea; OTC = oxygen therapy clinic; Spo_2 = oxyhemoglobin saturation

There were an estimated 741,292 users of long-term oxygen therapy (LTOT) in the United States in 1998, and that number is predicted to increase in subsequent years.[1] The increasing number of prescriptions for LTOT each year corresponds to increasing cost. In 1998, the total Medicare expenditures for stationary home oxygen equipment was $1.3 billion.[1] The benefits of LTOT have been well established in patients with a stable resting oxygen requirement[2–3]; however, the majority of initial oxygen prescriptions are for patients being discharged from the hospital whose oxygen requirement is not stable. Because of this, the Fifth Oxygen Consensus Conference recommended reevaluation within 90 days of discharge from hospitalization with resting arterial blood gas analysis or oxygen saturation measurement.[4] Oba and colleagues[5] retrospec-

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tively reviewed oxygen prescriptions at their institution and found that for patients prescribed oxygen immediately after discharge from hospitalization, only 35% were appropriately reevaluated within the recommended 3-month interval. Of the patients who were reevaluated, 58% could be discontinued from oxygen therapy. This high percentage of users of LTOT who do not meet prescription criteria for oxygen is similar to previous reports.[6,7] Based on these findings and specific institutional considerations, an oxygen therapy clinic (OTC) was established to manage patients with new and established oxygen prescriptions, and provide better continuity of care for patients receiving oxygen therapy.

Materials and Methods

Our institution is a military-affiliated, tertiary care center whose patient population is largely made up of military retirees and their spouses. All patients with a new oxygen requirement (according to Medicare guidelines[8]) between June 2000 and May 2001 were referred for evaluation in the OTC at our institution. This evaluation consisted of a focused medical interview and physical examination by a full-time respiratory therapist assigned to manage the OTC. Demographic data, indications for supplemental oxygen, oxygen-related diagnoses, cardiopulmonary review of systems, pertinent physical examination findings, and pulmonary function test data were recorded. Measurements of FEV_1, FVC, and diffusing capacity of the lung for carbon monoxide (DLCO) collected within the prior year were recorded. If no data were available within the prior year, these studies were performed. Multiple measurements of resting oxyhemoglobin saturation (Spo_2) were recorded on room air via a finger probe oximeter (N-200; Nellcor; Pleasanton, CA) at the beginning and end of the initial interview and on subsequent follow-up visits. In patients with a current oxygen prescription, resting oximetry was recorded initially with oxygen at the prescribed flow and repeated after 20 min without supplemental oxygen.

Exercise oximetry was performed on all patients who were physically capable. Patients were asked to walk at their own pace to cover as much distance as possible in 6 min (as measured by a pedometer). A portable pulse oximeter with printer (N-20 PA; Nellcor) was used to record Spo_2 and heart rate at 30-s intervals via a reflectance oxygen transducer placed on the patient's forehead (RS-10; Nellcor). The test was terminated if the patient experienced extreme dyspnea or fatigue to the extent that they could not continue, or if the patient experienced chest pain. Patients with significant oxyhemoglobin desaturations during the test were placed on supplemental oxygen or an increased flow of oxygen delivered via a nasal cannula. The respiratory therapist pulled a wheeled d-cylinder setup (cylinder plus regulator plus two-wheeled cart) and titrated oxygen flow to keep $Spo_2 > 90\%$ during the test. After the test was completed, the patient was asked to quantitate his or her level of exertion to compare to the level that they exert themselves at home. This data were compiled and used to help determine supplemental oxygen need.

Arterial blood gas analysis was obtained when patients demonstrated borderline Spo_2 (89 to 92%) on repeated measurements, or if the patient actively used tobacco. Patients who met Medicare guidelines for supplemental oxygen at rest were given prescriptions for oxygen to use continuously. Patients who had adequate oxygenation during rest but demonstrated a significant desaturation during exercise were given prescriptions for oxygen for use during exertion at a flow rate equal to the minimum flow required to keep $Spo_2 > 90\%$ during exercise testing.

Overnight oximetry was performed based on the patient's answers to the following screening factor for nocturnal desaturations and obstructive sleep apnea (OSA): excessive daytime sleepiness, nocturnal awakening/choking, witnessed apneas, or high score (> 9) on an Epworth sleepiness scale.[9] A pulse oximeter capable of printing a sleep hypnogram (Biox 3740; Ohmeda; Madison, WI) was used. Patients with an oxygen requirement at rest continued their current oxygen flow rate during overnight oximetry. If a prolonged desaturation (averaging $< 89\%$ for at least 5 min) was observed, the patient was prescribed oxygen for use during sleep at a flow rate of 2 L/min. Patients were referred to the sleep disorders clinic if the history suggested significant OSA or the patient experienced nocturnal desaturations in a pattern suggestive of OSA.[10] If overnight oximetry was not performed, the patient was prescribed oxygen during sleep at a flow rate equal to their requirement during exertion.

A pulmonary physician directly supervised the OTC respiratory therapist on a daily basis, and all prescriptions were reviewed and signed by a pulmonary physician. During the study period, patients who had been prescribed oxygen in the past and were receiving oxygen or who had oxygen equipment in their possession were required to come to the OTC to determine eligibility for recertification. As part of the standard evaluation in the OTC, patients were provided with education on safe home oxygen therapy. Appropriate follow-up was arranged at the time of the visit based on the recommendations of the Fifth Oxygen Consensus Conference.[4] New referrals and patients discharged from the hospital with a new oxygen prescription were required to be evaluated in the OTC. Patients with conditions such as congestive heart failure or pneumonia where the oxygen requirement may not be stable were followed up within 1 month, and patients with chronic conditions such as COPD or interstitial lung disease were evaluated between 1 month and 3 months at the discretion of the pulmonary physician. Referrals to other clinics (*ie*, pulmonary medicine, cardiology, sleep disorders, cardiopulmonary rehabilitation, and smoking cessation) were made by the supervising pulmonary physician based on subjective and objective data obtained during the evaluation.

Data Analysis

Standardized clinical intake forms were developed to store key tracking variables. These data were collected and entered into a database created using Microsoft Access software (Microsoft; Seattle, WA) during the clinical evaluation. The database was programmed to generate all necessary forms for home oxygen therapy utilizing data entered during the visit. It also served as a tracking tool to prompt appropriately timed scheduling of follow-up appointments. Various end points were automatically calculated and updated in a real-time manner. These included the proportion of patients requiring a change in oxygen prescription, proportion of patients discontinued from oxygen therapy, average duration of oxygen therapy, and proportion of patients referred to other clinics.

Results

During the study period, 283 patients were evaluated in the OTC. The characteristics of the patients are listed in Table 1. Approximately one third of patients were seen following initiation of home oxygen in the hospital, one third were patients called

Table 1—*Patient Characteristics

Characteristics	Total (n = 283)	Hospital F/U (n = 97)	OTC Reevaluation (n = 95)	New Referrals (n = 91)
Male gender, %	51.6	48.5	50.5	56.0
Mean age, yr	68.9	66.5	70.2	69.3
Tobacco use, pack-yr, %†	51.6	51.9	55.7	48.7
0	6.5	7.4	2.4	8.5
1–20	14.8	13.0	17.0	15.3
21–50	37.4	38.9	36.6	37.3
> 50	41.3	40.7	46.3	39.0
Lung function, % predicted				
FEV_1	56.5	59.5	50.5	57.6
FVC	65.9	67.0	63.8	66.9
DLCO	48.0	54.8	42.7	47.2
Diagnoses, %				
COPD	75.0	67.7	79.4	76.3
ILD	8.1	0	5.9	13.6
Other diagnosis	16.9	32.3	14.7	10.1

*Hospital F/U = patients with initial oxygen prescription during hospitalization; OTC reevaluation = patients with existing oxygen prescriptions seen in the OTC for recertification; New referrals = patients referred to the OTC for evaluation; ILD = interstitial lung disease.
†Data available for 155 of 283 patients.

in for reevaluation, and one third were new referrals from the outpatient setting. Of the 97 patients evaluated after hospital discharge, 50.5% no longer met Medicare criteria for LTOT and were discontinued from home oxygen due to improvement in their conditions. Some significant change in either the dose of oxygen prescribed or in the delivery system (tailored to fit the patient's degree of mobility, physical limitations, and home environment) was required in 27.9% of patients. Notably, 16.5% died prior to their scheduled clinic evaluation. Only 5.2% were continued on LTOT as originally prescribed (Fig 1, *top*). The mean ± SE time from discharge to evaluation was 2.6 ± 0.4 months. Initial oxygen flow rates prescribed on discharge from the hospital (prior to the evaluation in the OTC) and oxygen requirements determined at the first evaluation in the OTC are illustrated by Figure 2.

A total of 95 outpatients on LTOT prior to initiation of the OTC were called in for evaluation during the study period. Data regarding these patients' initial oxygen prescription and follow-up are not available. Of these 95 patients, 31.6% no longer met Medicare guidelines for LTOT and were discontinued from home oxygen services. Another 26% of these patients required a change to either the oxygen dose or delivery system. Through attempts to contact patients, it was discovered that another 32.6% had died, and the oxygen equipment had been recovered by the supplier. Only 9.5% were continued on their original LTOT prescription (Fig 1, *bottom*).

Most of the new referrals were from either the internal medicine or pulmonary medicine clinics. Of these 91 patients, 27.0% had prescriptions for LTOT initiated as a result of this evaluation, 22.0% were discontinued from LTOT, 29.7% were continued on LTOT with changes to either the dose or delivery system, one patient died prior to the scheduled evaluation, and the prescriptions for 9.9% were continued without change (Fig 1, *bottom*).

Table 2 lists patient characteristics sorted by action taken in the OTC. The values listed in Table 2 for exertional Spo_2 may be falsely elevated because the respiratory technician often began oxygen titration immediately once the Spo_2 dropped below 88% during ambulation rather than observing a true nadir. Also, the resting and exertional saturation values for new referrals who were begun on LTOT are higher than expected due to a high proportion of patients started on nocturnal oxygen therapy based on results of overnight oximetry (36%).

A significant number of patients (12.7%) were noted to have inadequately treated conditions associated with their supplemental oxygen need and were referred to other treatment programs or specialty providers. These secondary prevention referrals included 5 patients to a tobacco cessation program, 9 patients to the pulmonary rehabilitation program, 3 patients to pulmonary specialty consultation, and 19 patients to the sleep disorders clinic.

Discussion

Various methods of evaluating appropriateness of LTOT and managing users of LTOT have been recently proposed. Guyatt et al[7] looked at the benefits of home visits by a respiratory therapist and

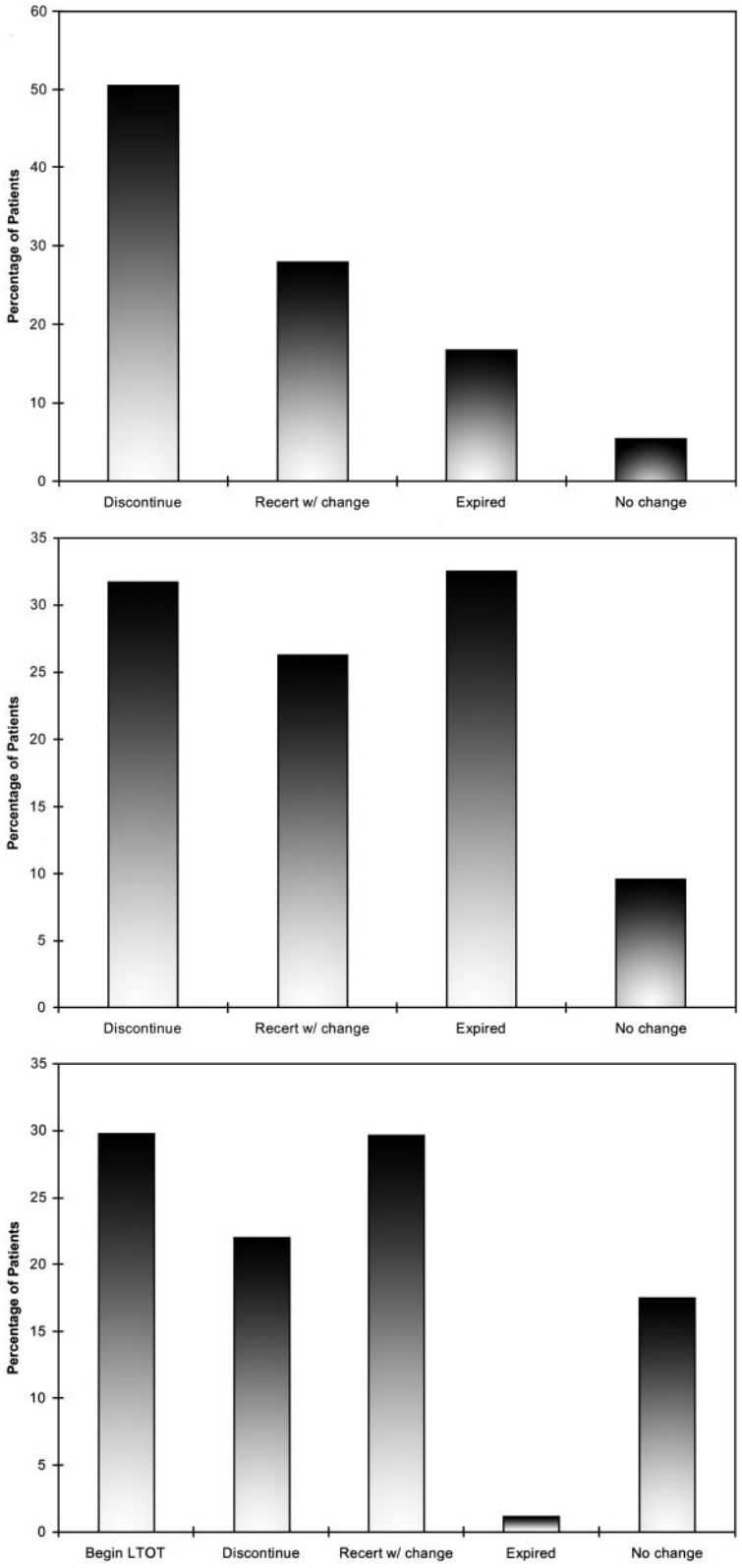

FIGURE 1. *Top*: Patients evaluated in the OTC within 90 days of hospital discharge (n = 97). *Middle*: Patients evaluated in the OTC who had existing LTOT prescriptions (n = 95). *Bottom*: Patients evaluated in the OTC following clinic referral (n = 91). Recert w/change = recertified with change in prescription.

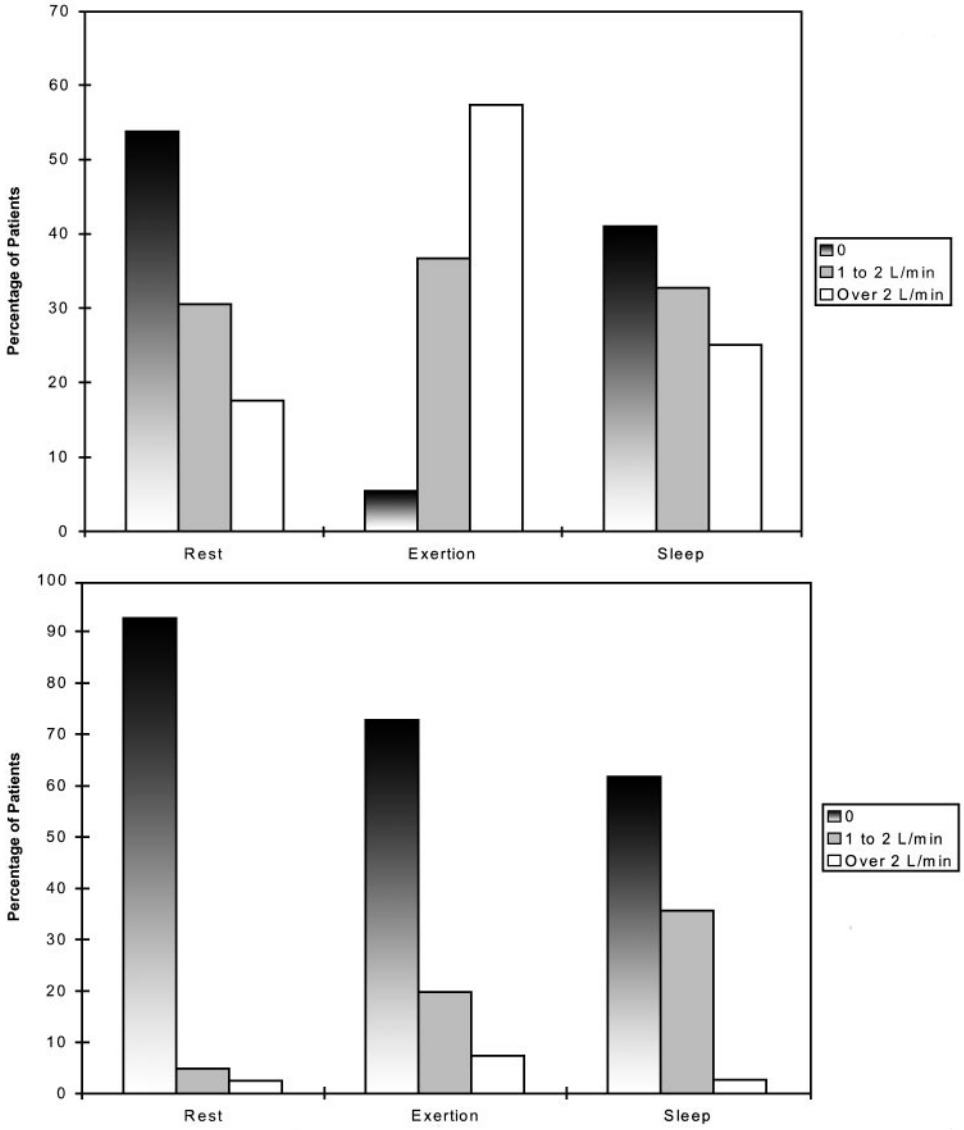

FIGURE 2. *Top*: Initial oxygen flow rates prescribed for patients on discharge from the hospital (prior to OTC evaluation; n = 92). *Bottom*: Oxygen flow requirements at follow-up in OTC for patients prescribed oxygen during hospitalization (n = 81).

found that 40.5% of patients did not meet criteria for LTOT. Similarly, in our study, LTOT could be discontinued in more than one third of patients who had existing oxygen prescriptions. Farrero et al[11] studied the potential benefits of a hospital-based home-care program in COPD patients receiving LTOT. The intervention consisted of a monthly telephone call and home visits every 3 months, which led to a significant decrease in emergency department visits, hospital admissions, and length of hospital stay.

The OTC provides a unique concept with multiple benefits. The clinic manages all patients placed on home oxygen to ensure the following: (1) appropriate up-to-date evaluation of oxygen needs, (2) identification of related medical conditions that may impact on oxygen need or delivery, (3) education on safe home oxygen therapy, (4) tailoring of the oxygen delivery system to the patient, and (5) appropriately timed follow-up and reevaluation. It improves communication and facilitates initial prescription and reevaluation, as well as serves as a centralized resource for patients, primary care providers, and vendors. By providing case management of patients and strictly adhering to Medicare guidelines for LTOT and the recommendations of the Fifth Oxygen Consensus Conference,[4] a significant impact on oxygen expenditures and patient care was realized. More than one half of patients who were prescribed oxygen during hospitalization could have oxygen

Table 2—*Patient Characteristics Sorted by Action in the OTC

Characteristics	Average Age, yr	FEV_1	FVC	DLCO	Resting SpO_2	Exertional SpO_2
Hospital follow-up						
Discontinued (n = 49)	65.4 ± 2.1	64.2 ± 3.8	68.0 ± 3.0	58.8 ± 4.2	96.3 ± 0.46	93.0 ± 0.40
Recertify with change (n = 27)	66.1 ± 2.3	53.2 ± 4.4	66.3 ± 4.5	46.3 ± 4.4	94.6 ± 0.64	87.4 ± 1.2
Died (n = 16)	70.2 ± 1.7	59.5 ± 6.1	64.5 ± 6.3	55.3 ± 6.6		
No change (n = 5)	62.6 ± 6.0	44.0 ± 14.2	57.6 ± 11.7		92.8 ± 2.1	86.2 ± 2.5
OTC reevaluation						
Discontinued (n = 30)	68.7 ± 3.7	59.3 ± 4.1	73.0 ± 4.6	49.6 ± 4.7	97.3 ± 0.40	92.8 ± 0.64
Recertify with change (n = 25)	70.0 ± 1.8	46.2 ± 4.4	65.8 ± 3.3	29.5 ± 4.1	93.0 ± 0.55	86.2 ± 0.75
Died (n = 31)	71.7 ± 1.8	46.2 ± 3.7	57.0 ± 3.0	37.7 ± 4.7		
No change (n = 9)	70.6 ± 4.5	50.7 ± 9.9	56.1 ± 7.1	61.5 ± 13.1	93.0 ± 2.4	89.9 ± 1.5
New referrals						
Begin LTOT (n = 27)	71.8 ± 1.6	57.9 ± 3.6	64.7 ± 3.7	48.0 ± 5.3	95.2 ± 0.65	88.3 ± 1.0
Discontinued (n = 20)	69.2 ± 2.2	61.5 ± 6.4	65.9 ± 4.3	40.1 ± 7.4	95.6 ± 0.80	93.0 ± 0.83
Recertify with change (n = 27)	69.6 ± 1.7	56.6 ± 4.3	69.5 ± 3.1	47.3 ± 4.7	93.7 ± 0.81	86.1 ± 0.91
Died (n = 1)	68	35	40	24		
No change (n = 16)	68.2 ± 2.0	58.2 ± 6.8	67.9 ± 4.9	53.8 ± 9.0	89.9 ± 3.7	87.1 ± 1.9

*Data are expressed as mean ± SE. Values were reported only if data were available on > 50% of patients.

discontinued at the initial follow-up visit in the OTC. Not only does this translate into obvious cost savings, but it also directly relates to quality of life for patients by discontinuing an inconvenient and potentially hazardous treatment in those patients without continued need. Also, active case management allows tailoring of treatment to the clinical requirement, lifestyle, and home environment of those patients with a persistent home oxygen need.

O'Donohue[12] expressed concerns regarding the discontinuation of LTOT after 3 months of treatment in patients with previously established supplemental oxygen need who experience an improvement in Pa_{O_2} during oxygen therapy. This improvement may be related to the beneficial effects of oxygen therapy rather than a change in the patient's clinical condition. This is a legitimate concern when such strict adherence to Medicare guidelines is enforced. Therefore, a case management approach to individualize the care of these patients is extremely important including regular follow-up in patients who are discontinued from LTOT. The rate of reinitiation of LTOT or long-term outcome in patients whose treatment has been discontinued is not known and is currently being explored by our group.

The institution of the OTC was an efficient utilization of resources that lead to significant cost savings. Typical LTOT costs per patient at our institution are approximately $3,855/yr (OxeNET; Lubbock, TX) for 2 L of continuous flow via an oxygen concentrator system. If one extrapolates the number of patients taken off oxygen during the first year of operation of the OTC (130 patients), the estimated cost savings in oxygen expenditures is > $500,000. This estimation assumes that the patients no longer meeting requirements for LTOT would not have had therapy discontinued by another provider, an assumption that is validated by the high percentage of patients who had established oxygen prescriptions that no longer met Medicare requirements or who had died (31.6% and 32.6%, respectively). In order to accurately analyze the cost benefit of establishing an OTC, one must also consider personnel cost, facility cost, and equipment cost. A typical respiratory therapist working in the United States earns a median base salary of $42,063.[13] Required equipment includes a portable pulse oximeter, a sleep oximeter, a stationary and portable oxygen source, and oxygen tubing. Laboratory support for arterial blood gas analysis and CBC count determinations is also necessary.

The institution of a respiratory therapist-managed OTC to manage patients receiving home oxygen can result in a significant cost savings while providing improved health-care delivery by ensuring appropriately timed follow-up care, education on safe home oxygen therapy, and timely identification of related and potentially modifiable comorbid conditions such as tobacco abuse, deconditioning, or sleep-related breathing disorders. Further studies are needed to determine if the practice of discontinuing patients from LTOT after improvement in oxygenation occurs will have any detrimental effects on exercise capacity, quality of life, or mortality.[14] Whether or not the use of an oxygen therapy clinic translates into significant alterations in emergency department treatments, hospital admissions, or long-term health-care expenditures is yet to be determined.

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