Ambulatory Care for Emphysema and Chronic Bronchitis*

THOMAS L. PETTY, M.D., F.C.C.P.

Associate Professor of Medicine and Head, Division of Pulmonary Diseases, University of Colorado Medical Center, Denver, Colorado

The immense problem of chronic airway obstruction (CAO)—emphysema and chronic bronchitis—which has now reached epidemic proportions, presents to the practitioner of medicine an increasing number of suffering persons asking for care. These patients are dyspneic, anxious, bewildered by their predicament, sometimes demanding and frightened about prospects for future comfortable life.

Although there has been a tremendous upsurge of interest in the field of respiratory care, and a growing number of nebulizers, humidifiers, physical therapy techniques and drugs, all of the answers on emphysema care are not in. We must admit as physicians that although we are absolutely sure that we save many lives in the organized intensive respiratory care unit in the case of acute respiratory failure (3, 13), no study has thus far convinced the critics of respiratory care that the natural course of CAO is altered from the standpoint of survival. Nonetheless, today's patients cannot wait for all the answers. They flock to hospitals, clinics, and physicians' offices, seeking some relief of their symptoms, some hope for improvement in their status and for prolonged survival. It is therefore mandatory for all physicians interested in chest medicine and interested in their sick patients, to provide some form of service for the growing crowd of puffers and coughers—both pink and blue.

This communication defines a practical clinic and outpatient treatment regimen that is applicable for most individuals suffering severe CAO with disability.

Ambulatory Care Program.

Patient Education. The management of any chronic disease must be based upon a high level of patient indoctrination and education. This has been the reason for success in large measures in diabetes mellitus management where for years, the sufferer has been instructed in nutrition, activity, insulin dosage, self-management, evaluation of glycosuria and proper clothing, leading to the development of an adjustment to the burdens of disease designed for a maximum of serenity in daily life. It does not take a great deal of talent, although it does take time, to describe the airways, the lungs, the circulation and to explain what is wrong in the emphysema-chronic bronchitis spectrum. The office nurse or clinic nurse, once properly trained herself, is a superb individual to assume the responsibility for this task. Patients receive an in-depth discussion of general care with reinforcement in specific instructions guided by the physician's explicit prescription. These sessions are supplemented by a simple treatment manual (17) designed to give the patient material for serious reading which will reinforce the personal instruction and probably develop new questions for the nurses on revisits. We not only teach the patients about their disease process, but what physicians, nurses, and therapists are trying to do in their therapeutic endeavors. We stress the specific facets in man-

* Presented by Dr. Petty at the Symposium on Respiratory Failure, May 26, 1972, at Richmond, Virginia. Reprinted with permission from *Chest,* Volume 58, pp. 441–448, October, 1970. Supported in part by USPHS Contract #108-66-227, Chronic Respiratory Diseases Control Program. Reprint requests to Thomas L. Petty, M.D., 4200 East Ninth Avenue, Denver, Colorado 80220.

agement listed below with details stressed for each individual patient.

Bronchial Hygiene. Much of therapy must be directed at the bronchial element of disease. In many cases we are dealing with the bronchospasm, mucosal edema, retained secretions, and impaired mucociliary clearance. Each patient must learn an effective method of bronchial hygiene to be used each day. Fundamental, of course, is the absolute cessation of smoking. This is best handled in a nursing session where the threat of a physician and his authority is less traumatic to the patient.

In specific therapy, individuals are taught to inhale a bronchodilator aerosol followed by moisture, followed by expulsive coughing on a systematic basis at least twice daily. One of the sympathomimetic amines is inhaled for a period of at least ten deep breaths and a duration of, at times, up to ten minutes. Isoetharine with phenylephrine or racemic epinephrine or isoproterenol is used for this purpose. Aerosolized bronchodilators are delivered by a variety of devices, including a simple hand bulb nebulizer which does require some patient coordination and strength, the newly available pump driven nebulizers[1] or simple hand held IPPB devices which have recently been provided for the practitioner[2] (fig. 1). Ordinarily the drug is diluted with equal amounts of water with individual adjustments based upon side effects and apparent clinical efficacy. Bronchodilators relieve muscular spasm, combat mucosal edema, and probably stimulate mucociliary clearance (8, 10). The use of bronchodilator drugs must become an art with final judgment on the absolute details of therapy, a joint effort between patient and physician, a matter which obviously requires a great trust and orientation on the part of both.

Following the bronchodilator administration, inhaled moisture is the next step. This may be done by simple steaming devices, that is, a nursery humidifier, tea kettle, facial sauna and in some cases a more advanced nebulizer including an ultrasonic nebulizer. The choice of device is a matter of judgment based upon the ability to thin and raise secretions. It should be said and emphasized that general hydration in the form of adequate water intake is fundamental in maintaining ade-

Fig. 1—Hand held IPPB device suitable for hospital or home use. It is used in the home with compressor pump and has pressure flow characteristics similar to conventional ventilators.

quate mucociliary clearance. The purpose of the moisture, of course, is to help thin secretions, which also facilitates mucociliary clearance. After approximately ten minutes of moisture inhalation, expulsive forceful coughing helps clear retained secretions. If these endeavors are insufficient, simple postural drainage techniques over pillows in bed often help the situation (18, 19). At times pummeling, or so-called clapping, is useful in removing secretions (fig. 2). This is usually taught the spouse by the physical therapist.

Fig. 2—Technique of percussion taught by physiotherapist. This often aids mucociliary clearance.

[1] Maxi-Myst pump driven nebulizer, Mead Johnson Co., Evansville, Indiana.

[2] Hand-E-Vent, Ohio Medical Products, Madison, Wisconsin.

Breathing retraining stressing abdominal-diaphragmatic control, allowing the abdomen to protrude during inspiration, followed by forceful abdominal contractions during expiration, probably helps empty the lung and improves the efficiency of breathing (1, 2, 11). These maneuvers with exhalation against pursed lips, have been learned by many individuals who suffer dyspnea and who learn that this is a means of relief of symptoms. In a clinical study the pursed-lip maneuver has been shown to reduce the oxygen ventilation equivalent, reduce alveolar-arterial oxygen difference and the necessary minute ventilation for a given level of arterial oxygen tension (12). Therefore the pursed-lip breathing maneuver enhances oxygen transport or at least is a more efficient breathing technique. This should be taught to all patients or at least tried in patients who are well indoctrinated in modern methods of emphysema care.

Physical reconditioning in the form of simple daily exercises with increasing goals from the standpoint of more activity, has been shown to greatly improve exercise ability (6, 22). Most patients can be taught to participate in comfortable exercise on an increasing basis in spite of the fact that their level of chronic airway obstruction may not change a great deal in response to therapy (20). Nonetheless, this training is an important activity for it provides increased facility for daily living. Most patients with chronic airway obstruction find dyspnea on exertion their most disabling symptom and any improvement in comfortable mobility can be translated into a better life. Figure 3 demonstrates the measured improved walk tolerance at various rates and grades for an individual trained daily for the first week and every other day for the second week as part of a rehabilitation program. No measurable change in ventilatory function or blood gases (arterial) were observed during this brief training period[3].

Oxygen. The clinical benefit of ambulatory oxygen therapy has been repeatedly demonstrated (9, 15). In brief, oxygen is valuable for the hypoxemic bronchitic person who is markedly disabled and suffers from heart failure. Oxygen has been shown to reduce the level of pulmonary hypertension by reducing pulmonary arteriolar resistance and also helps combat the secondary polycythemia of the bronchitic hypoxemic state (9). The development of a home based portable oxygen system has made the use of continuous ambulatory oxygen a reality. Figures 4 and 5 demonstrate the apparatus in common use today. The lower canister contains a liquid oxygen supply which usually suffices for three to four days. This canister is capable of filling a smaller device which now provides three to six hours of oxygen therapy. The duration is a function of rate of oxygen administration controlled by a flow rate mechanism on the device. Ambulatory oxygen provides for additional mobility. Experience with these devices for over four years has proved the efficacy and safety in over 200 patients with profound hypoxemia who cannot gain mobility by any other means.

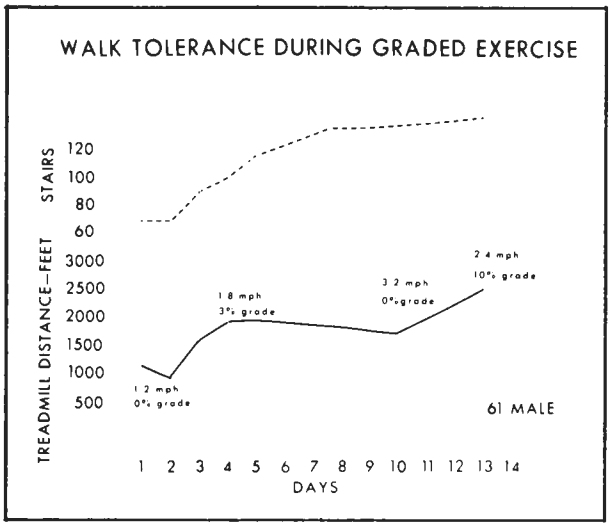

Fig. 3—Improved walk tolerance at increasing rate and grade following daily training for two weeks.

Pharmacologic Therapy. The weight of current evidence suggests that the immediate use of antibiotics for specific episodes of bronchitis manifested by increasing cough, leukocytosis, elevated temperature, and purulent appearing sputum is effective in reducing the duration of symptoms and fever. Since the most common invading bacterial organisms after the original insult, which may be viral, appear to be *D. pneumonia* and *H. influenza,* the rather empiric use of ampicillin or tetracycline seems advisable. Ampicillin is usually given in doses of 4 g daily the first two days followed by 2 g daily for three or four days. Tetracycline is usually given in 2 g doses daily the first two days

[3] MVV 31 L: FEV_1 0.91 L.

Fig. 4—Linde oxygen walker system. Lower container has approximately 3½ days oxygen supply. This can be used directly or used to fill the 7.5 pound canister which the patient uses for ambulatory oxygen therapy.

Fig. 5—Patient carrying Linde oxygen walker system. Depending upon flow, three to five hours supply is available.

followed by 1 g daily for the duration of therapy, which usually covers five to seven days. Many patients with CAO are provided with a supply of antibiotics for home use to be instituted at first signs of a deep chest infection. It is also wise, however, from the standpoint of communication and further advice, to have these individuals contact their physician at the time of institution of these drugs.

Digitalis and diuretic drugs *are* useful in the management of cor pulmonale with heart failure. These drugs, however, are fraught with the difficulty of arrhythmia, but the weight of evidence in recent years indicates that an improved hemodynamic state can be achieved with digitalizing doses of cardiac glycosides along with the use of diuretics if adequate correction of hypoxemia is employed to provide adequate oxygenation of the myocardium and to control the reactive pulmonary hypertension associated with the hypoxemic state (15).

The corticosteroid drugs are definitely useful in some patients with chronic airway obstruction. Indications for their use include the bronchitic patient with marked cough, expectoration, and repeated bouts of wheezing or choking spells superimposed upon the chronic symptom complex. Often these individuals have significant changes in their expiratory flow parameters as they are observed serially. Generally, prednisone 30 mg daily for the first five days, followed by a dose of 15 mg daily for the next five days, followed by a low maintenance dose of 5 to 10 mg, with decisions for further therapy guided by measurements of expiratory flow in the form of forced expiratory volume in one second (FEV_1) or maximum mid-expiratory flow (MMEF). A certain number of patients with apparent chronic irreversible airway obstruction actually have a reversible component of disease if observed carefully under steroid therapy (14).

Oral bronchodilators may be useful in an occasional patient. The only harm of the ephedrine-containing drugs aminophylline, amytal, and ephedrine HC1 (Amesec®), theophylline, phenobarbital, ephedrine HC1 (Tedral®), and so forth, is occasional urinary tract obstruction. Although

these drugs are not very effective, they are frequently used by patients for reasons good or bad. Soluble xanthines in the form of oxtriphylline (Brondecon®) or choline theophyllinate (Choledyl®) may also prove useful in some patients.

The expectorants such as saturated solution potassium iodide and guaiacolate have not been proved by critical study to be effective in patients within this spectrum. Nonetheless, they may be used for apparent symptomatic benefit for short periods but should not be an agent of prolonged use. Polyvalent influenza vaccine should be given each fall for whatever protection is afforded.

Occupational Therapy, Hobbies, and Change of Life Style. If life is to be worthwhile for the emphysema-bronchitis patient, it has to have meaning. The details of therapy enumerated above should not be excessively demanding from the standpoint of time and should be applied in a systematic manner to allow patients to lead a happy and hopefully productive life. A number of patients can be returned to work. Return to work, of course, has to do with many factors and is basically based upon the energy requirement of the job, the patient's physiologic resources, and the patient's personal motivation to maintain a gainful status (16). Certainly the provision of ambulatory oxygen therapy is a great aid for some patients (15, 16). Additional oxygen provides for additional activity and improvement in work capacity while on the job.

For those not so fortunate, occupational therapy in the form of hobbies is tremendously important. Many patients have a longing or desire to paint, write, garden, golf, or simply walk around a bit. This should be encouraged by the total application of the program described above.

Effectiveness of Today's Ambulatory Care Program. Although this is difficult to assess with cool scientific certainty, because no clinical care program ever is totally controlled, a number of statements can be made based upon contemporary knowledge about the effectiveness of organized care for CAO.

Symptomatic Improvement. Most patients seek medical care because of adverse symptoms. There is no question that the development of comprehensive care programs has greatly improved the patients subjective feeling of well being. For example, Table 1 shows the patients' clinical assessment at one and two years following entry into the comprehensive rehabilitation program which has been described in this report. The vast majority of patients remain clinically better or at least the same up to two years and in many cases longer.

TABLE 1.

SUBJECTIVE ANALYSIS OF SYMPTOMS

	One Year	%	Two Years	%
Worse	17	13	18	21
Same	36	28	27	32
Better	76	59	39	47

The application of care principles described above can be assessed by a reduction in hospital needs. A small group of patients requiring hospitalization for respiratory causes was selected, and the need for hospitalization following entry into a comprehensive care program was compared to the patients' prior hospital needs. In brief, Table 2 shows that the total number of patients requiring hospitalizations was reduced, the total number of hospital days was reduced, and the average stay per patient reduced over a one year period compared to the patient's previous performance. It must be admitted that the clinic and outpatient nature of the program emphasized independent existence in order to minimize hospital needs. This makes absolutely no difference, however, and the facts speak for themselves, that is, 326 hospital days saved in this small group of patients. One has only to multiply the number of hospital days saved by the average cost of hospitalization today to gain a quick assessment of a tangible economic saving provided by ambulatory care methods.

Return to work in an aging population is not common (16). Nonetheless, certain individuals

TABLE 2.

REDUCTION IN HOSPITAL DAYS DURING FIRST YEAR OF PROGRAM COMPARED WITH PREVIOUS YEAR*

	Year Before Entry	First Year of Program
Total hospital days	868	542
Number of patients hospitalized (from group)	34	25
Average hospitalized patients	25.5 ± 39.8	21.7 ± 30.2

* Previously reported (20).

can return to gainful employment and, in some, this may represent a striking improvement over past performance. Most individuals who can return to work or at least maintain their level of gainful employment are rewarded by a continued sense of pride over their productive state.

Physiologic Changes. One hundred and eighty-two patients were evaluated for CAO and entered into the comprehensive care program which is reported here. They were selected on the basis of having irreversible airway obstruction with *expected* pulmonary function deterioration with age (4, 5, 6, 7, 9, 11, 12, 14, 15, 16, 20, 21, 22). The overall physiologic changes in our series suggest that the expected pulmonary function deterioration is retarded. For example, patients at risk for one and two years are the subjects of Tables 3 and 4[4]. It

[4] Symbols explained in Tables 3 and 4.

TABLE 3.

COMPARISONS: PRELIMINARY VERSUS ONE YEAR

	Preliminary			One Year		
	Mean	SD	No.	Mean	SD	P
VC	2.66	.80	120	2.63	.81	
FEV_1	1.00	.39	120	.95	.49	
MMF	.44	.23	120	.41	.31	
MVV	38.5	51.1	118	37.3	19.4	
All Patients						
pH	7.40	.04	109	7.40	.04	
P_{CO_2}	40.2	8.3	108	43.6	11.7	.0002
P_{O_2}	57.2	8.2	95	60.1	11.5	.025
O_2 sat.	87.5	6.3	109	88.8	5.8	.05
Dist. walked*	609.8	570.0	91	1280.3	862.6	<.0001
Stairs	42.3	23.5	77	68.3	32.4	<.0001
Work on stairs	581.6	304.0	59	874.8	438.6	<.0001
Non O_2 Patients						
pH	7.40	.04	73	7.40	.04	
P_{CO_2}	38.8	7.4	73	39.4	6.0	
P_{O_2}	59.0	7.4	67	61.2	9.1	.05
O_2 sat.	88.8	4.7	73	90.0	4.1	.02
Work	626.0	323.5	44	956.1	457.1	<.0001
Dist. walked*	671.5	616.6	67	1449.1	906.9	<.0001
Stairs	49.7	20.9	52	76.2	28.6	<.0001
O_2 Patients						
pH	7.40	.04	36	7.38	.04	.01
P_{CO_2}	43.0	9.2	35	52.5	15.2	<.0001
P_{O_2}	53.1	8.7	28	57.4	15.7	
O_2 sat.	84.8	8.1	36	86.4	7.9	
Work	451.3	192.3	15	636.1	273.2	.025
Dist. walked*	437.5	370.9	24	809.2	487.1	.01
Stairs	36.7	18.3	16	54.6	28.6	.01

VC —Vital capacity (liters)
FEV_1 —Forced expiratory volume (liters/second)
MMF —Maximal mid expiratory flow (liters/second)
MVV —Maximal voluntary ventilation (liters/minute)
pH —Expression of hydrogen ion concentration (Negative Lung Volume)
P_{CO_2} —Carbon dioxide tension in arterial blood
P_{O_2} —Oxygen tension in arterial blood
O_2 sat. —Oxygen saturation in arterial blood
Distance walked—On treadmill (various increasing rates and grades)
Stairs —Number walked until dyspneic
Work —Kilogram meters vertical work on stairs
* Various increasing rates and grades.

TABLE 4.
COMPARISONS: PRELIMINARY VERSUS TWO YEAR

	Preliminary			Two Year		
	Mean	SD	No.	Mean	SD	P
VC	2.73	.80	78	2.65	.89	
FEV_1	1.04	.42	78	1.00	.58	
MMF	.46	.24	78	.43	.40	
MVV	41.7	15.6	78	38.5	23.2	
All Patients						
pH	7.40	.04	73	7.40	.04	
P_{CO_2}	39.0	7.3	73	41.9	9.0	.002
P_{O_2}	58.7	8.3	63	61.4	11.1	
O_2	88.2	5.9	72	89.3	5.1	
Work	612.8	358.4	29	939.6	608.1	.0001
Dist. walked*	789.7	557.5	41	1276.8	794.3	.001
Stairs	45.1	24.9	34	73.6	38.3	.0001
Non O_2 Patients						
pH	7.40	.04	52	7.41	.04	
P_{CO_2}	37.4	5.6	52	38.9	5.3	
P_{O_2}	60.0	7.8	49	60.2	8.0	
O_2 sat.	89.3	4.6	52	89.6	4.0	
Work	663.0	366.8	24	1064.2	593.2	.0001
Dist. walked*	773.5	578.2	31	1429.4	801.8	.0002
Stairs	50.3	24.1	25	79.6	36.8	.0001
O_2 Patients						
pH	7.40	.05	21	7.40	.03	
P_{CO_2}	43.1	9.2	21	49.2	11.8	.01
P_{O_2}	54.5	9.1	14	65.4	18.2	.025
O_2 sat.	85.5	7.8	20	88.4	7.3	
Work	371.7	194.8	5	341.7	159.0	
Dist. walked*	839.7	513.1	10	803.6	576.7	
Stairs	39.3	15.7	7	50.0	43.1	

VC —Vital capacity (liters)
FEV_1 —Forced expiratory volume (liters/second)
MMF —Maximal mid expiratory flow (liters/second)
MVV —Maximal voluntary ventilation (liters/minute)
pH —Expression of hydrogen ion concentration (Negative Lung Volume)
P_{CO_2} —Carbon dioxide tension in arterial blood
P_{O_2} —Oxygen tension in arterial blood
O_2 sat. —Oxygen saturation in arterial blood
Distance walked—On treadmill (various increasing rates and grades)
Stairs —Number walked until dyspneic
Work —Kilogram meters vertical work
* Various increasing rates and grades.

is apparent that ventilatory function abnormalities do not change significantly. Oxygen tension and saturation are significantly increased at one year. Carbon dioxide rises occur only in the oxygen patients, but not to an important degree since pH remains normal (compensated).

It is probably most noteworthy that in spite of the fact that the patients essentially remain about the same from a physiologic standpoint, they have not deteriorated at the expected rate. Moreover, it may be quite important that increased exercise tolerance is sustained for periods up to two years.

Mortality. Within a 3.5 year period, 56 pa-

TABLE 5.

MORTALITY DATA

Months	At Risk	Dead	Cum Mor %	Surv Rate %
0–6	179	8	4.5	95.5
6–12	169	9	9.6	90.4
12–18	158	10	15.5	84.5
18–24	139	12	23.2	76.8
24–30	111	12	32.6	67.4
30–36	74	1	33.8	66.2

tients have died (mean survival 1.4 years). This is expressed in life table form by year in Table 5. An analysis of death indicates that at any point in time, early deaths are related to the poorest pulmonary function measurements at time of entry into the program. The most common cause of death is combined cardiac and respiratory failure. No claim is currently made that the mortality rate is decreased except in the case of acute respiratory insufficiency. Nonetheless, our population, averaging 61 years with an FEV_1 of 0.94 liters on entry, represents a most adverse population from the standpoint of age and loss of pulmonary function. Clearly patients with less severe forms of disease will have a better prognosis (5, 21).

Summary. An ambulatory care comprehensive program for emphysema and chronic bronchitis has been described. The basic modalities of therapy are patient education, bronchial hygiene using simple home techniques, breathing retraining, physical reconditioning, oxygen, and ancillary chemotherapeutic agents. The application of these principles in care provides great symptomatic benefit, improved exercise tolerance, and a reduction in hospital needs. A reduction in the progressive pulmonary function deterioration which is expected in this disease spectrum has been observed up to two years.

In view of the immense number of patients with CAO, suffering and disabled, the application of outpatient care programs on a nationwide basis will help to reduce the overall social and economic impact of this disease complex.

REFERENCES

1. BARACH, A. L. Diaphragmatic breathing in pulmonary emphysema. *J. Chronic Dis.* 1:211, 1955.

2. BARACH, A. L., CHUSID, E., AND WOOD, L. Ventilatory effect of decreasing functional residual capacity in pulmonary emphysema. *Ann. Allergy* 25:211, 1967.

3. BIGELOW, D. B., PETTY, T. L., ASHBAUGH, D. G., *et al.* Acute respiratory failure: experiences of a respiratory care unit. *Med. Clin. N. Amer.* 51:323, 1967.

4. BOUSHY, S. F. AND COATES, E. D. The diagnostic value of pulmonary function tests in emphysema with specific reference to arterial blood studies. *Amer. Rev. Resp. Dis.* 90:553, 1964.

5. BURROWS, B. AND EARLE, R. H. Course and prognosis of chronic obstructive lung disease. *New Eng. J. Med.* 280:397, 1969.

6. CHERNIACK, R. M. The management of respiratory failure in chronic obstructive lung disease. *Ann. N. Y. Acad. Sci.* 121:942, 1965.

7. HOWARD, P. Evaluation of the ventilatory capacity in chronic bronchitis. *Brit. Med. J.* 3:392, 1964.

8. LAURENZI, G. Adverse effect of oxygen on mucociliary clearance. *New Eng. J. Med.* 279:333, 1968.

9. LEVINE, B. E., BIGELOW, D. B., HAMSTRA, R. D., *et al.* The role of long-term continuous oxygen administration in patients with chronic airway obstruction with hypoxemia. *Ann. Intern. Med.* 66:369, 1967.

10. MILLER, W. F. Rehabilitation of patients with chronic obstructive lung disease. *Med. Clin. N. Amer.* 51:349, 1967.

11. MILLER, W. F. Physical therapeutic measures in the treatment of chronic bronchopulmonary disorders. *Amer. J. Med.* 24:929, 1958.

12. MUELLER, R. E., PETTY, T. L., AND FILLEY, G. F. Ventilation and arterial blood gas changes induced by pursed lip breathing. *J. Appl. Physiol.* 784, 1970.

13. PETTY, T. L., BIGELOW, D. B., AND NETT, L. M. The intensive respiratory care unit: an approach to the care of acute respiratory failure. *Calif. Med.* 107:381, 1967.

14. PETTY, T. L., BRINK, G. A., AND CORSELLO, P. R. Objective functional improvement in chronic airway obstruction. *Chest* 57:216, 1970.

15. PETTY, T. L. AND FINIGAN, M. M. The clinical evaluation of prolonged ambulatory oxygen therapy in patients with chronic airway obstruction. *Amer. J. Med.* 45:242, 1968.

16. PETTY, T. L., MCILROY, E., SWIGERT, M. A., *et al.* Chronic airway obstruction, respiratory insufficiency, and gainful employment. *Arch. Envir. Health* 21:71, 1970.

17. PETTY, T. L. AND NETT, L. M. *For Those Who Live and Breathe. (A Manual for Patients with Emphysema and Chronic Bronchitis).* 2nd ed. Springfield, Illinois, Charles C. Thomas, Publisher, 1972, p. 108.

18. PETTY, T. L. AND NETT, L. M. Effective treatment for emphysema and chronic bronchitis. *J. Rehab.* 33:10, 1967.

19. PETTY, T. L. AND NETT, L. M. Patient education and emphysema care. *Med. Times* 97:117, 1969.

20. PETTY, T. L., NETT, L. M., FINIGAN, M. M., *et al.* A comprehensive care program for chronic airway obstruction: methods and preliminary evaluation of symptomatic and functional improvement. *Ann. Intern. Med.* 70:1109, 1969.

21. PETTY, T. L. AND NEFF, T. A. Prognosis in selected patients with chronic airway obstruction receiving comprehensive respiratory care. In preparation.

22. PIERCE, A. K., TAYLOR, H. F., ARCHER, R. K., *et al.* Responses to exercise training in patients with emphysema. *Arch. Intern. Med.* 113:78, 1964.