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Behavioral Interventions for Patients with COPD

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I. Introduction

Behavior and chronic obstructive pulmonary disease (COPD) are inseparably intertwined. Extensive evidence suggests that smoking behavior is the major risk factor for the development of emphysema and chronic bronchitis (Higgins, 1958; Van der Lende, 1969; HIH, 1979; Lebowitz, 1982; Ravenholt, 1985; U.S. Department of Health and Human Services, 1984; Sawicki, 1972). In addition, several epidemiologic studies have shown that the rate of decline in pulmonary function for afflicted patients declines with cessation of smoking behavior (Astin, 1976; NIH, 1981). Thus, individual behavior is a major risk factor for development and maintenance of COPD.

Once a patient becomes afflicted with COPD, the disease comes to have a major effect upon behavior. Many of these effects are reviewed in this volume. For example, COPD may affect psychosocial function (McSweeny, Chap. 4) cognitive and psychomotor functions (Prigatano and Grant, Chap. 3), depression (McSweeny et al., 1982; Katz, 1982; Fix et al., 1981), and sexual behavior (Timms, 1982).
COPD has become an important public health problem for at least four reasons. First, COPD is among the top five leading causes of death. Second, it has a major impact upon activities of daily living. Third, it affects a large number of persons. And fourth, there is an increasing incidence of COPD. Currently, COPD represents this nation's most rapidly growing health problem (U.S. Government Task Force, 1977, 1979). Deaths due to COPD are rising at a rate of 1.4% per year, making it the most rapidly increasing of the top 10 leading causes of death in the United States (U.S. Government Task Force, 1979). From 1970 to 1975, the mortality rate from chronic obstructive pulmonary diseases increased from 16:100,000 of the population to 19:100,000 of the population (Brashear, 1980). COPD now ranks fifth as a cause of death in the United States and accounts for about 56,000 deaths per year (Lenfant, 1982).

Respiratory diseases are generally considered to be of greater importance as causes of disability and ill health than as causes of death. Studies that deal with the long-term course and prognosis of COPD indicate that the process covers a time span of at least 20-30 years and possibly longer (Petty, 1978). Morbidity from COPD results in approximately 34 days of restricted activity per 100 persons per year (Brashear, 1980). In the United States, from January, 1975, through December, 1976, an estimated 163.4 million office-based physician visits were attributed to respiratory diseases. These visits made up approximately 14% of all office visits for any condition during that period. COPD accounts for approximately one-fifth of these visits (Brashear, 1980; U.S. Government Task Force, 1977).

Some of the major impacts of COPD upon the daily lives of patients are summarized in Table 1. COPD is responsible for a substantial number of disability days, hospitalizations, and restrictions in performance of daily activities. These disease consequences translate into a serious economic burden.

Total costs for COPD were estimated to be $4.55 billion in 1972 (U.S. Government Task Force, 1977). By 1979, this estimate had jumped to $19 billion and current estimates go as high as $27 billion per year (Lenfant, 1972). COPD places an enormous demand upon the health care system. In the April 1984 issue of Morbidity and Mortality Weekly Report, it was estimated that COPD patients require well over 2 million visits to U.S. physicians each year.

In summary, COPD may in part result from a behavior pattern and may, in turn, come to affect other behavior patterns. Because of these interrelationships, behavioral programs may be important in the prevention and management of COPD. Numerous reports have called for programs to prevent COPD through smoking prevention and smoking cessation efforts (NIH, 1983; Cali-
Table 1 Prevalence, Disability, and Hospitalizations for COPD in 1979

<table>
<thead>
<tr>
<th></th>
<th>Chronic bronchitis</th>
<th>Emphysema</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prevalence</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of cases</td>
<td>7,474,000</td>
<td>2,137,000</td>
<td>9,611,000</td>
</tr>
<tr>
<td>No. with limited activity</td>
<td>382,000</td>
<td>1,118,000</td>
<td>1,500,000</td>
</tr>
<tr>
<td>Percent limited activity</td>
<td>5.1</td>
<td>5.3</td>
<td>15</td>
</tr>
<tr>
<td><strong>Disability</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bed days</td>
<td>28,519,000</td>
<td>57,132,000</td>
<td>85,651,000</td>
</tr>
<tr>
<td>Restricted activity days</td>
<td>88,165,000</td>
<td>144,927,000</td>
<td>233,092,000</td>
</tr>
<tr>
<td>Work loss days</td>
<td>7,246,000</td>
<td>314,000</td>
<td>7,560,000</td>
</tr>
</tbody>
</table>

| **Hospitalizations**   |                    |           |         |
| Discharges             | 227,000            | 57,000    | 284,000  |
| Hospital days          | 1,608,000          | 556,000   | 2,164,000 |

Health interview survey, NCHS unpublished data.  

As a result, research on antismoking programs has blossomed in recent years. This research is well summarized in several excellent reviews (Flaxman, this volume; Lichtenstein, 1982; Pederson, 1982). Therefore, the prevention of COPD through antismoking efforts will not be covered in this chapter. Instead, we will focus on behavioral programs for the management of patients with active COPD. Two separate aspects of this problem deserve consideration: the value of exercise and rehabilitation programs, and the problem of compliance with lifestyle recommendations (Kaplan et al., 1985).

A. An Alternative Conceptualization of the Objective of Care

According to the American College of Chest Physicians, the goal of pulmonary rehabilitation is to "... return the patient to the highest possible functional capacity allowed by his pulmonary handicap and overall life situation" (Petty, 1977).
Some investigators have argued that the important variables to measure in COPD include dyspnea, decreased ventilatory capacity, respiratory muscle fatigue, and pulmonary hypertension leading to right ventricular dysfunction. Certainly these are the major characteristics of obstructive lung disease. However, these factors are important because they limit function or influence the probability of reduced function (including death) in the future. The objective of health care should be to extend life and provide the highest obtainable quality of life for the longest duration. Pulmonary hypertension should be treated because it may cause limitations in functioning and shortened life expectancy. Thus, pulmonary hypertension can be thought of as a mediator of health status. If pulmonary function did not affect health status, physicians and patients would be unconcerned about it. Our point is that producing the highest quality of life for the longest duration should be the object of health care and that various methods should be used to achieve this objective. These methods may or may not influence important mediating variables such as ventilatory capacity and respiratory muscle fatigue.

We have argued that programs for COPD patients should be evaluated using general health status measures (Kaplan et al., 1984a). These measures consider the impact of the disease upon function and life expectancy.

Over the course of the last decade, Bush and his colleagues have developed a comprehensive health decision model (Kaplan and Bush, 1982). The best known component in the model is a general health status index. One of the most important aspects of general health outcome measures is that they allow comparison between heterogeneous patient groups. For example, using these models, it is possible to evaluate the cost-effectiveness of a screening program for thyroid abnormalities (Epstein et al., 1981) with the cost-effectiveness of a treatment such as estrogen replacement for postmenopausal women (Weinstein, 1980). This method is in contrast to approaches that utilize a specific outcome measure for each disease entity.

Obtaining the highest level of function and extending the duration of life should define the objective of any intervention in health care. Medical management of COPD is essential for obtaining these objectives. However, other health status benefits may also result from behavioral interventions. Sometimes the behavioral interventions are directed at improving functioning without regard to the mediating physiological mechanism. For example, Fordyce (1983) has demonstrated that modifying the social environment may result in improved functioning for patients with back pain. There is also some evidence that COPD patients experience improved function following rehabilitation efforts, even though there is no change in traditional indica-
tors of pulmonary function. We have been particularly interested in evaluating the health status benefits of adding behavioral programs as an adjunct to medical care for COPD patients.

B. Rehabilitation Programs in COPD

There is no medical cure for COPD and medical management includes the use of antibiotics, bronchodilators, corticosteroids, and a variety of other medications to prevent influenza and related medical complications (see Petty, Chap. 5). However, long-term use of these medications may cause side effects (Petty and Cherniak, 1981). Oxygen therapy increases survival and improves cognitive performance for COPD patients but is not advised for all patients (Anthonisen, 1983; NOTT, 1980): For most patients, behavioral programs for rehabilitation are highly advocated (Petty, 1985). Petty and Cherniak (1981) have argued that rehabilitation programs produce strong improvements in both survival and quality of life. They suggest that rehabilitation programs result in reduced symptoms, improved exercise tolerance, reduction in hospital days, more gainful employment, slowing of progress of disease, and increased survival. Pulmonary rehabilitation programs for patients with COPD have expanded substantially in the last 10 years (Unger et al., 1980). Most of the programs attempt to restore the patient to the highest possible level of health functioning and to reduce the frequency of hospital visits (Moser et al., 1980; Pulmonary Rehabilitation Study Group, 1974; Unger et al., 1980).

An important component of most pulmonary rehabilitation programs has been the establishment of a regular exercise regimen. Specific physical conditioning exercises, such as walking, can be undertaken by the patient to maintain lung functioning and improve the remainder of the oxygen delivery system (Bell and Jensen, 1977). In several published cases, the improvements in the condition of COPD patients following exercise training have been striking (Bass et al., 1970; Christie, 1968; Fishman and Petty, 1971; Mertens et al., 1978; Moser et al., 1980; Pierce et al., 1965; Unger et al., 1980). Specifically, appropriate physical conditioning exercises can improve oxygen consumption and utilization, reduce heart rate, improve ventilation, and increase tolerance for exercise.

There have been few systematic evaluations of COPD rehabilitation programs. Reports from nonexperimental studies typically suggest that these objectives can be achieved (Bass et al., 1970; Moser et al., 1980; Petty et al., 1969; Pierce et al., 1964; Unger et al., 1980).

Recently, two controlled trials documented the benefits of exercise pro-
programs for COPD patients. Cockcroft and co-workers (1981) randomly assigned 39 patients to a 6-week exercise-training program or to a no-treatment control group. In comparison to the control group, patients in the exercise group experienced subjective benefits and increased the amount of distance they could walk in 12 min. Allison and colleagues (1981) documented the benefits of a bicycle training program for COPD patients by obtaining extensive physiological measures before and after a 12-week training program. However, it is difficult to draw conclusions from their study because no control group was included. Furthermore, we are unable to link the results of this work to important outcomes such as those suggested by Petty and Cherniak (1981). Although the data on exercise for COPD patients appear promising, the number of empirical studies is fewer than the number of review articles claiming the benefits of exercise and rehabilitation programs. In 1981, the American Thoracic Society (1981) officially set standards for physical rehabilitation and exercise training in COPD patients.

Although COPD patients can benefit greatly from exercise, motivating them to comply to a physical regimen is difficult. In less disabled patients there is no "critical incident" to convince them of the importance of exercise. In contrast, the more severely disabled patients tend to think of their situation as hopeless and one over which they have little control (Mertens et al., 1978). In addition, long-term maintenance of physical exercise is rare even among patients who are initially motivated (Carmody et al., 1980). Most studies suggest that the majority of these dropouts occur during the first 3 months of training (Carmody et al., 1980; Oldridge et al., 1978; Wilhelmson et al., 1978). If the patients are not conscientious in adhering to the regimen, it is difficult to measure the precise outcome of an exercise program.

II. Compliance

A burgeoning body of literature indicates that patient adherence to therapeutic regimens is typically poor (Christensen, 1978; Marston, 1970; Sackett and Haynes, 1976; Windsor et al., 1980). Failure of patients to comply with medical regimens has now come to be recognized as a major problem hampering the quality of medical care (Becker and Maimen, 1975). Published figures suggest rates of noncompliance that vary from 15 to 93%, depending on the patient population and the criteria used. In general, reviewers agree that at least 33% of the patient groups in most studies failed to adhere to the recommended therapeutic regimen (Blackwell, 1973; Becker and Maimen, 1975; Davis, 1968; Stimson, 1974). However, noncompliance rates appear to be much higher.
among patients with chronic conditions who must undergo long-term therapy (Blackwell, 1973; Brody, 1980; Davis, 1968; Gillum and Barsky, 1974; Sackett, 1976; Stone, 1979).

Noncompliance rates are also very high for patients who must comply with regimens involving life style changes such as increasing physical exercise (Carmody et al., 1980; Hoepful-Harris, 1980; Kentala, 1972; Oldridge et al., 1978; Wilhelmson et al., 1975). Although compliance has not been studied directly with respect to COPD patients and their particular regimen, (Windsor et al., 1980), results with other patient populations can offer guidance in designing a compliance program for COPD sufferers.

III. An Experiment Comparing Behavioral Interventions

A. Introduction

Within the last few years, several authors have reported that behavioral and cognitive-behavioral methods may be very useful for helping patients adhere to life style changes. We have been particularly impressed with the work of Meichenbaum (1977) and Mahoney (1974) in the development of strategies for creating and maintaining behavior change. In the remainder of this chapter we will present evidence from our current research project on the efficacy of these types of interventions for increasing adherence to a behavioral regimen for COPD patients. The rationale for our interventions and research is as follows.

Patients with chronic obstructive pulmonary disease have been known to benefit greatly from exercise regimens. A major problem with this group is that they have high rates of noncompliance. Several cognitive and behavioral interventions based on current psychological theories appear promising for increasing compliance and these strategies were compared in the present study. The effectiveness of these interventions was evaluated using an outcome measure that reflects the quality of life for program participants. Other outcome measures were used to assess the behavioral and biological processes that mediated desirable outcomes. The effectiveness of the interventions was evaluated against their cost. The ultimate goal of the project was to identify strategies that would optimize the health status of COPD patients.

B. Method

Subjects

The subjects were 75 patients diagnosed as having COPD. The specific criteria for inclusion in the study include (1) a diagnosis of emphysema, chronic
bronchitis, and/or asthma; (2) absence of other significant pulmonary disease (i.e., tuberculosis, fibrosis, or neoplasm); (3) freedom from chronic disabling nonpulmonary disease that would hinder participation (i.e., arthritis, retardation, etc); (4) absence of an acute cardiac disorder (i.e., myocardial infarction within the past 3 months); and (5) an ability to stand and walk unaided for at least 100 yards without complaints of severe dyspnea (shortness of breath).

Design

The patients were randomly assigned to one of five groups: behavior modification, cognitive-behavior modification, cognitive modification, attention control, and no-treatment control. In the experimental groups, patients participated in six sessions over the course of the first 3 months of the program. Patients were seen individually in their own home for these sessions. Behavioral treatment consisted of standard behavioral procedures including individualized daily scheduling of walks, self-recording of walking, charting of progress, goal setting, contracting, and self-reinforcement. Since anxiety can often exacerbate symptoms of dyspnea, patients in the behavioral treatment group were also given relaxation training. Cognitive treatment consisted of self-recording of cognitions and retraining in attitudes and self-statements related to exercise. Cognitive-behavior modification consisted of a combination of the behavioral and the cognitive interventions. The attention-control group received attention equal to that in other experimental groups, but did not receive any training designed to alter adherence. The no-treatment control group participated in the initial assessment and follow-up assessments but did not receive individual in-home instruction or attention. An expanded description of the treatment groups is included as an Appendix to this chapter.

Crude Evaluation Through Spirometry

Spirometry is a relatively simple method for evaluating pulmonary function. The test requires the patient to take a maximum inspiration, filling up the lungs with as much air as possible, and then blow out all of the air into a spirometer as forcefully and as rapidly as possible. A spirometer is a simple mechanical device for determining the volume of expired air and plotting it over time. Measurements are typically presented as volume versus time or flow versus volume.

In our research, a spirometer was used to measure each patient's forced vital capacity (FVC: the number of liters of air that can be expelled from fully inflated lungs) and forced expiratory volume (expressed in liters) at 1,
2, and 3 seconds (FEV₁, FEV₂, and FEV₃). Predicted spirometric values are expressed in terms of a normal range for age, sex, and height (Petty, 1978).

Chronic obstructive pulmonary disease is characterized by reduction in the forced expiratory volume, vital capacity, and forced expiratory volume as a percentage of vital capacity (FEV₁/FVC%) (Petty, 1978; West, 1977). The ratio of forced expiratory volume at 1 sec (FEV₁) to forced vital capacity (FVC) appears to be the most useful measure for monitoring changes in moderate to severe obstructive-disease (Petty, 1978; Sobel and Emirgil, 1977). In addition, FEV₁/FVC% has an advantage of having lower patient variability than other methods for measuring flow rate (Sobel and Emirgil, 1977).

Patients with normal lung function can usually expel 70% or more of their vital capacity in 1 sec. Figures 1 through 3 illustrate the comparison of the FVC tracing or flow-volume curves for three different women of approximately the same age and height. Figure 1 is an example of normal flow-volume curve. The flow-volume curve for Figure 2 indicates moderate obstruction. Figure 3 is illustrative of severe obstructive abnormality.

Development of an Exercise Prescription

A maximal graded exercise treadmill was used to determine exercise tolerance. The variables that were assessed during the test included (1) resting and exercise (after 3 min) blood pressure, (2) resting and exercise heart rate as measured by continuous electrocardiogram monitoring, (3) resting and exercise oxygen saturation as measured by a Hewlett-Packard Ear Oximeter, Model 47201A, and (4) walking tolerance on a treadmill (speed and duration).

The patient was placed on a treadmill with bipolar electrocardiogram (ECG) leads to monitor cardiac rhythm during exercise and a Hewlett-Packard Ear Oximeter to monitor oxygen saturation during exercise. All tests were conducted by either a licensed respiratory therapist or a trained nurse (R.N.). Exercise tests began at 0.6 miles/hr, at 0% grade. Speed was increased 0.2 miles/hr at 1 min intervals. For patients who demonstrated less than 85% resting arterial saturation (SaO₂), the treadmill was increased at 0.1 miles/hr intervals each minute. Heart rate and SaO₂ arterial saturation were recorded during the last 15 sec of each speed increment. In addition, blood pressure was taken prior to the graded exercise test, and at 3 min of exercise. The endpoint of the exercise test was reached when any of the following occurred (1) the patient reached 85% of a predicted maximum heart rate, (2) the patient reported chest pain or dizziness, (3) the ECG displayed heart arrhythmias, (4) the patient reported being exhausted or severely short of breath. Shortness of breath was the most common cause for stopping the
Sex: Female
Age: 61
Height: 60 inches
Weight: 116 pounds

X = Mean normal values
O = 5th percentile of normal range

<table>
<thead>
<tr>
<th></th>
<th>Predicted</th>
<th>Observed</th>
<th>X Predicted</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>2.52</td>
<td>2.58</td>
<td>102</td>
</tr>
<tr>
<td>FEV 1.0</td>
<td>2.04</td>
<td>1.98</td>
<td>97</td>
</tr>
<tr>
<td>FEV1/FVC%</td>
<td>70</td>
<td>77</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1 Spirogram depicting no obstructive abnormality.
Behavioral Interventions

FLOW (L/SEC)

Sex: Female
Age: 63 years
Height: 61 inches
Weight: 136 pounds

X = Mean normal values
O = 5th percentile of normal range

<table>
<thead>
<tr>
<th>Predicted</th>
<th>Observed</th>
<th>% Predicted</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>2.57</td>
<td>1.88</td>
</tr>
<tr>
<td>FEV 1.0</td>
<td>2.06</td>
<td>1.25</td>
</tr>
<tr>
<td>FEV₁/FVC%</td>
<td>70</td>
<td>66</td>
</tr>
</tbody>
</table>

Figure 2 Spirogram depicting moderate obstructive abnormality.
Sex: Female
Age: 58 years
Height: 63 inches
Weight: 137 pounds

X = Mean normal values
O = 5th percentile of normal range

<table>
<thead>
<tr>
<th></th>
<th>Predicted</th>
<th>Observed</th>
<th>% Predicted</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>2.87</td>
<td>1.02</td>
<td>35</td>
</tr>
<tr>
<td>FEV 1.0</td>
<td>2.31</td>
<td>.41</td>
<td>18</td>
</tr>
<tr>
<td>FEV₁/FVC%</td>
<td>70</td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>

Figure 3 Spirogram depicting severe obstructive abnormality.

treadmill. A sample of a typical exercise data sheet is shown as Figure 4. The mean duration of treadmill exercise during the initial visit was 431.53 sec (S.D. = 242.66 sec).

Each patient was assigned an exercise prescription based upon the maxi-
<table>
<thead>
<tr>
<th>TIME</th>
<th>HEART RATE</th>
<th>BLOOD PRESSURE</th>
<th>SATURATION (%)</th>
<th>SPEED (MPH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>rest</td>
<td>80</td>
<td>128/60</td>
<td>94%</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>113</td>
<td>95%</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>111</td>
<td>94%</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>120</td>
<td>160/90</td>
<td>94%</td>
<td>1.0</td>
</tr>
<tr>
<td>4</td>
<td>110</td>
<td>93%</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>117</td>
<td>93%</td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>113</td>
<td>93%</td>
<td>1.6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>107</td>
<td>93%</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>113</td>
<td>93%</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>127</td>
<td>92%</td>
<td>2.2</td>
<td></td>
</tr>
</tbody>
</table>

10 | stepped at 9:24 |
11 |
12 |
13 |
14 |
15 |
16 |
17 |
18 |

Exercise End Point: 85% max R.R. Arrhythmia Chest Pain Exhaustion Muscular Dyapnea
(circle one) Other
FVC 1.2.65 2.2.39 3.2.92
PEV1 1.1.07 2.1.11 3.1.27
85% predicted maximum heart rate 140

Exercise Assignment: Work Load (MPH): 1.3 % of Max. 60 Step/min 65
Frequency: once/day twice/day
Duration: 5 min 10 min 15 min 20 min

Other Observations: Patient reported his legs ached at around 5 minutes.

Figure 4 Sample of a typical exercise data sheet.

miles per hour (mph) he or she obtained on the treadmill. All assignments were made in terms of walking at defined speeds. Five progressive stages of exercise levels were assigned: stage 1—60% of maximum mph for 5 min twice daily; stage 2—60% of maximum mph for 10 min twice daily; stage 3—60% of maximum mph for 15 min twice daily; stage 4—60% of
The results of your exercise stress test show that you can walk 2.2 miles per hour. However, in order not to overexercise an exercise prescription has been developed for you which is based on 60 percent of your maximum exercise tolerance. During the Stage 1 of your exercise program you must walk 5 minutes, 2 times per day at a pace of 1.3  \text{miles per hour}. Based on the amount of distance you cover in one step, this means that you should be taking an average of 65 steps per minute. Over the course of the next few weeks, your exercise program will gradually be modified.

![Figure 5: Sample of a typical exercise prescription.](image)

maximum mph for 20 min twice daily; stage 5—70\% of maximum mph for 20 min twice daily. Most of the patients were started at stage 1 of the exercise prescription. However, if exercise was well tolerated, stage 2 was determined to be the more appropriate exercise prescription. After a 10 min rest, each patient was tested at his or her prescribed exercise level for 5 min. The purpose of the testing was to determine the number of steps per minute the patient would take at the assigned walking speed. The steps were counted and recorded so that the appropriate pace could be replicated during the home program. In addition, each patient was given information defining the appropriate distance he or she could expect to cover in 5 min walking at the prescribed pace. Patients were told to progress on to the next step of exercise as
they felt able to, and they were encouraged not to move too quickly through the stages. A walking exercise program was chosen because of familiarity, cost consideration, and convenience. Figure 5 shows a typical walking prescription.

**Outcome Measures**

In addition to data obtained as part of the exercise test (i.e., exercise tolerance, \( \text{SaO}_2 \), blood pressure, heart rate, etc.), several measures were taken at each clinic visit.

**Health Status Index**

All patients were classified on the Quality of Well-being scale of a general health index (Kaplan and Bush, 1982). This index is the point in time component of the general health decision model developed by Kaplan and Bush (1982). The index places each individual into 1 of 43 mutually exclusive and collectively exhaustive levels of functioning. The levels are obtained from three separate scales of functioning, mobility (with five levels), physical activity (with four levels), and social activity (with five levels, see Table 2). In addition, symptomatic disturbances are noted. The 43 levels of functioning are unique combinations of the steps of scales shown in Table 3. Although there are theoretically 100 possible combinations of these items, only 43 have been observed to date.

In addition to these levels of function, each patient is classified according to the symptom or problem that bothered him or her the most. There are 36 such complexes of symptoms and problems. In summary, each patient is classified according to objective functional limitation and subjective symptomatic complaint to provide a description of functioning. In previous research, each combination of function level and symptom/problem complex has been rated by random samples from the community to determine the weight or preference associated with the classification. Arrival at the correct function level classification requires the use of a survey instrument that is specific for age and employment status. The questionnaire has been validated in previous studies (Anderson and Bush, 1983).

As an example item characteristic of moderate to severe COPD patients, consider the following. At time 1, patient M.R. was described by the following scale steps:
Description | Level
--- | ---
In house | Mobility 3
In bed or chair | Physical activity 1
Had help with self-care activities | Social activity 1
Coughing, wheezing, or shortness of breath | Symptom/problem 11

The weight the community associates with this level of functioning is 0.5129 with the adjustment of -0.0075 for symptom/problem 11. Thus, the preference weight for this case description is 0.5054. In other words, an actual patient has classified into this level of function at time 1. A random sample of community members rated this as 0.5054. This means that community members value this objective level of function of about half-way between

Table 2 Dimensions and Steps for Function Levels in the Quality of Well-Being Scale

<table>
<thead>
<tr>
<th>Mobility</th>
<th>Physical activity</th>
<th>Social activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drove car and used bus or train without help (5)</td>
<td>Walked without physical problems (4)</td>
<td>Did work, school, or household and other activities (5)</td>
</tr>
<tr>
<td>Did not drive, or had help to use bus or train (4)</td>
<td>Walked with physical limitations (3)</td>
<td>Did work, school, or household but other activities limited (4)</td>
</tr>
<tr>
<td>In house (3)</td>
<td>Moved own wheelchair without help (2)</td>
<td>Limited in amount or kind of work, school, or housework (3)</td>
</tr>
<tr>
<td>In hospital (2)</td>
<td>In bed or chair (1)</td>
<td>Performed self-care but not work, school, or housework (2)</td>
</tr>
<tr>
<td>In special care unit (1)</td>
<td></td>
<td>Had help with self-care (1)</td>
</tr>
</tbody>
</table>
Table 3 Ten Sample Symptom or Problem Complexes and Adjustments ($W_i$) for Level of Well-Being Scores

<table>
<thead>
<tr>
<th>Complex number</th>
<th>Symptom or problem complex</th>
<th>Adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 1</td>
<td>Any trouble seeing: includes wearing glasses or contact lenses</td>
<td>0.0190</td>
</tr>
<tr>
<td>C 9</td>
<td>Pain in chest, stomach, side, back, or hips</td>
<td>-0.0382</td>
</tr>
<tr>
<td>C 11</td>
<td>Cough, wheezing, or shortness of breath</td>
<td>-0.0075</td>
</tr>
<tr>
<td>C 13</td>
<td>Fever or chills with aching all over and vomiting or diarrhea</td>
<td>-0.0722</td>
</tr>
<tr>
<td>C 15</td>
<td>Painful, burning or frequent urination</td>
<td>-0.0327</td>
</tr>
<tr>
<td>C 19</td>
<td>Pain, stiffness, numbness, or discomfort of neck, hands, feet, arms, legs, ankles, or several joints together</td>
<td>-0.0344</td>
</tr>
<tr>
<td>C 23</td>
<td>Two legs deformed (crooked), paralyzed (unable to move), or broken: includes wearing artificial limbs or braces</td>
<td>-0.0881</td>
</tr>
<tr>
<td>C 32</td>
<td>Loss of consciousness such as seizures (fits), fainting, or coma (out cold or knocked out)</td>
<td>-0.1507</td>
</tr>
<tr>
<td>C 33</td>
<td>Taking medication or staying on a prescribed diet for health reasons</td>
<td>0.1124</td>
</tr>
<tr>
<td>C 35</td>
<td>No symptom or problem</td>
<td>0.2567</td>
</tr>
</tbody>
</table>

Adapted from Kaplan et al. (1976).

optimal function (1.0) and death (0.0). Now consider the same patient at time 2. This time, M.R. is classified as:

<table>
<thead>
<tr>
<th>Description</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>In house</td>
<td>Mobility 3</td>
</tr>
<tr>
<td>In bed or chair</td>
<td>Physical activity 1</td>
</tr>
<tr>
<td>Performed self-care but not work, school, or housework</td>
<td>Social activity 2</td>
</tr>
<tr>
<td>Coughing, wheezing, or shortness of breath</td>
<td>Symptom/problem 11</td>
</tr>
</tbody>
</table>
The preference associated with this state of functioning is 0.5715. The adjustment for the symptom/problem is -0.0075, and the preference weight is 0.5640.

The difference between the two states described above is 0.0586 units of well-being. If this difference is maintained for 1 year, 0.0586 well years have been gained. If this benefit accrued for 100 people, the benefit would be 5.86 well years. Or, if it affected 1 person for 10 years, the benefit would be 0.586 well years. Another way to think of this benefit is that it is a perceived 5.86% improvement in the quality of life.

Since the index is used in a variety of medical studies, it is possible to compare changes produced by our interventions with changes on the same measure that might result from very different medical or health care interventions. Another advantage of the index is that it is linked directly to a general health policy model that is often used for cost-effectiveness studies (Kaplan, 1982; Kaplan and Bush, 1982). The validity and reliability of the index is described in several published papers (Kaplan et al., 1976, 1978, 1979; Kaplan and Ernst, 1983).

Efficacy Expectations

Efficacy expectations were assessed for each patient using an instrument adapted from studies by Bandura (1982). The patients were presented with a list of walking distances from 1 block to 3 miles. They were instructed to designate how far they thought they could walk right now. For each distance the patient designated, he or she was asked to rate the strength of the expectation to walk that distance on a 100-point probability scale ranging in 10-point intervals from high uncertainty through moderate certainty to complete certainty. Studies have shown that efficacy expectations are predictive of performance of patients in cardiac rehabilitation studies (summarized in Bandura, 1982). Further, our own validity data demonstrate that efficacy expectations correlate significantly with health status (r = 0.49), pulmonary function (r = 0.44), and exercise tolerance (r = 0.61).

Walking Logs

Each patient was asked to keep a daily log of walking and exercise activities. The patients were requested to record the time of day of each walk, the distance covered, total minutes spent walking, their heart rate, and any reason for not walking (i.e., illness, travel, guests, etc.). Patients were given a runner's wrist stop watch to time their walks. In behavioral conditions they could earn the watch for completing the walking log. Although walking data were based on self-report, we have some evidence for the validity. For instance, some of
the walks were completed under the supervision of project staff and reporting accuracy was validated. Records demonstrated that patients consistently reported decreased or no walking activity on sick days. In addition, self-reported walking was significantly correlated with improved exercise tolerance determined in an objective graded exercise test administered by a technician blind to the patients' experimental condition and walking history ($r = 0.34 \ p < 0.02$). An example of a page from the walking log is shown as Figure 6.

**Dropouts**

Five patients dropped out of the study before they could be evaluated at the 3-month testing session. Two patients dropped out of the behavior modification group complaining that they did not like to be regimented. One patient dropped
out of the attention control group because she thought the questions were too personal and because she had too many other problems in her life. Two patients dropped out of the no-treatment control group. One of these patients moved away and could not be located. The other patient was not able to comply with the walking prescription and refused to be reevaluated. All of these patients were replaced. In addition, two patients, one from the attention-control group and one from the behavior modification group, refused to appear for the treadmill test and the pulmonary function testing. These patients were not dropped from the study because they agreed to participate in all of the other 3-month evaluation procedures if the experimenter came to their home.

C. Results

Analysis of Walking Data

Self-reported walking compliance was a major outcome variable in the study. Data collection began on week 3 and walking logs were evaluated for weeks 3-12 of the program. The experimental groups differed significantly in number of minutes walked per week during all except the first week. Week 12 was the last time at which there was monitoring of the walking log. The planned comparison contrasting the three experimental groups against the two control groups was statistically significant for all 9 weeks. The attention and no-treatment controls did not significantly differ for any week of the experiment.

Significant differences between the cognitive-behavior modification and the other two experimental groups began to emerge during the eighth week of the program. Thereafter, differences between these groups were statistically significant each week except week 11 (for the week, p < 0.07). The behavior modification and cognitive modification groups did not differ during any week of the experiment. The mean cumulative number of minutes each group spent in weekly walking is presented pictorially in Figure 7. Significance tests for these data revealed that (1) the combination of the three treatment groups produces greater adherence to walking than the control groups, (2) cognitive-behavior modification produces greater adherence to walking than either behavior modification or cognitive modification, and (3) although each treatment is superior to the no treatment control, only the cognitive-behavioral combination is significantly more effective than the attention control.
**Exercise Tolerance**

An exercise tolerance score was created by dividing seconds of treadmill exercise tolerance at 3 months by the seconds of exercise tolerance at the initial visit. This ratio gives the percentage increase in exercise tolerance. Figure 8 displays percentage increases in exercise tolerance for the five groups participating in the study. The greatest average increase in exercise tolerance was obtained for the cognitive-behavior modification group (45%). There was a 36% average increase in exercise tolerance for the cognitive
Figure 8 Exercise tolerance for the five groups at 3 months (percent of baseline).

The three experimental groups differed significantly from the two control groups. However, the three treatment groups did not differ significantly from one another and differences between the two control groups were not significant.

Health Status Index

Data on the health index were obtained at the initial interview and at all follow-up sessions. Kaplan and colleagues (1978) have shown that the mean Quality of Well-being value over 4 days is more reliable than the value obtained on any one day. Therefore, Quality of Well-being data were obtained for the 4 days preceding each visit, and the mean value across the 4 days was used in all calculations. A one-way analysis of variance for Quality of Well-being scores
Figure 9 Mean change in index of well-being scores (multiplied by 100).

demonstrated groups did not differ prior to the interventions. For all other analyses, changes in Well-being scores from the initial 3-month assessment were used.

Differences in well-being scores are displayed in Figure 9. The cognitive-behavior modification group shows a 0.032 increase in well-being over the 3-month period while the cognitive and behavior modification groups each showed 0.024 and 0.019 increases, respectively. The attention-control group showed a decline in well-being of -0.029 units while the no-treatment group showed a decline of -0.075. Significance tests showed that the combination of the three treatment groups differed from the combination of the
two control groups. Further, the three experimental groups did not differ from one another, but each differed from the no-treatment control. The cognitive and cognitive-behavioral groups showed significant improvements over the attention control while differences between the behavior modification and the attention control groups were nonsignificant. The correlation between changes in exercise tolerance and changes in Quality of Well-being was 0.40 (p < 0.01). Changes on the quality of well-being were also substantially correlated with walking compliance (r = 0.42, p < 0.01).

**Changes in Physiological Parameters**

Extensive evidence suggests that COPD cannot be cured through exercise. Thus, differences were not expected for spirometric variables. Indeed, there were no changes over time and no significant differences across groups for changes in vital capacity for forced expiratory volume in 1 sec (FEV1). In addition, the groups did not change for resting diastolic blood pressure or change in systolic blood pressure. Although there were no differences between groups in mean arterial saturation of oxygen in blood after exercise, there was a nonsignificant trend suggesting that the two control groups became more desaturated upon retesting than did the experimental groups. These data confirm the work of many investigators who have demonstrated that exercise cannot reverse the physiological characteristics of COPD. Exercise may improve oxygen delivery as evidenced by the weak change in exercise SaO2.

**Self-Efficacy**

In order to explain differences between groups in exercise tolerance and in walking compliance, self-efficacy ratings were studied. In particular, changes in efficacy ratings were evaluated for walking. Change scores were created by subtracting the efficacy rating obtained at the original visit from the efficacy rating obtained at the 3-month assessment. Efficacy ratings were not obtained from members of the no-treatment control group. There was a significant difference between groups for changes in self-efficacy (p < 0.01), with the experimental groups gaining more in walking efficacy judgment than the attention control group. Although the correlation between changes in efficacy and changes in exercise tolerance was nonsignificant (r = 0.10), the correlation between efficacy changes and changes on the Quality of Well-being was statistically significant (r = 0.28, p < 0.02). At each testing session there was a strong correlation between efficacy and exercise tolerance (session 1, r = 0.47; 3-month assessment, r = 0.61). Similarly, efficacy was strongly
correlated with health status at both the initial \( r = 0.50 \) and the 3-month assessment \( r = 0.49 \).

**Longer-Term Effects on Well-Being**

Following the 3-month assessment, the experimental and control groups continued to differ at each assessment period (see Fig. 10). However, by the last follow-up, the differences were only marginally statistically significant. The reduction in statistical significance results from increased variability in both groups across follow-up sessions.

Table 4 summarizes the observed well-year benefits for the experiment. The first column shows the follow-up periods. The second column shows the change in Well-being score for the treated group while the third column shows the mean change in Well-being for the control subjects. The fourth column shows the difference between the treated and control group defined as mean treated minus mean control. The next column displays the number of patients available at that follow-up period. The second column from the right of the table shows the duration for which the assessment was based. For example, 0.25 means that the data represent assumed average well-being difference over a 3-month period. The final column shows the well-year yield for that period. It is calculated by obtaining the product of the difference in well-being between treated and control groups times the number of patients available for observation. That product is then multiplied by the proportion of the year the assessment represents. For example, at the 3-month follow-up, the
### Observed and Projected Well-Year Benefits

<table>
<thead>
<tr>
<th>n-up</th>
<th>(M) Treated</th>
<th>(M) Control</th>
<th>Difference</th>
<th>N</th>
<th>Duration</th>
<th>Well-years</th>
</tr>
</thead>
<tbody>
<tr>
<td>nth</td>
<td>0.021</td>
<td>-0.055</td>
<td>0.076</td>
<td>70</td>
<td>0.25</td>
<td>1.33</td>
</tr>
<tr>
<td>nth</td>
<td>0.036</td>
<td>-0.021</td>
<td>0.056</td>
<td>55</td>
<td>0.25</td>
<td>0.77</td>
</tr>
<tr>
<td>nth</td>
<td>-0.012</td>
<td>-0.134</td>
<td>0.114</td>
<td>50</td>
<td>0.50</td>
<td>2.85</td>
</tr>
<tr>
<td>nth</td>
<td>-0.032</td>
<td>-0.131</td>
<td>0.099</td>
<td>48</td>
<td>0.50</td>
<td>2.38</td>
</tr>
</tbody>
</table>

Total well-year production over project period

Discounted (at 5%)

---

Projected Benefits for Sensitivity Analysis

- month (1 year after 18-month follow-up) 0.050 50 1.00 2.50

Total well-year production

Discounted (at 5%)

---

- month (2 years after 18-month follow-up) 0.025 25 1.00 1.25

Total well-year production

Discounted (at 5%)

---

*Note: Toevs et al. (1984).*
treated and control groups differed by 0.076 units of well-being. Multiplying this value by the 70 patients included in the analysis yields 5.32. The entire 70 patients were used for this calculation because the program costs accrued equally to the experimental and the control groups. However, this value is obtained only after one quarter of 1 year. To estimate the well-year production, we multiply 5.32 by 0.25 to obtain 1.33. Similar assessments were made for the 6-month, 12-month, and 18-month follow-ups. The total well year production is the sum of the well year produced at each assessment interval. According to this analysis, 7.33 well years were produced. Discounting this figure at 5% gives a well-year production of 6.92 years.

This analysis makes several assumptions including (1) that differences between treated and control means at the assessment date are representative of differences during the preceding interval, and (2) that the number of patients available for follow-up is a representative sample of the original participants. All known deaths are included in the analysis. The reduction in N at successive follow-ups represents drop-outs and those who have moved from the area. There were significant losses after the first follow-up, probably because project staff no longer had regular contact with the patients. The number of patients shown in the table are used because they are the ones upon whom project resources were devoted.

One potential problem is that dropouts could be unequal from the experimental and control groups. In order to evaluate this question, we systematically studied dropouts at each phase of the experiment. Although the number of dropouts accumulated over the 18-month study, there was no evidence for differential dropout rates between treated and control population. Chi square tests for $2 \times 2$ contingency tables (experimental-control versus dropout-continuer) were statistically nonsignificant at each follow-up period. Thus, differential dropouts would not cause systematic underestimation or overestimation of cost-effectiveness.

It is important to note that the benefits of a behavioral program should continue beyond a final assessment period. An important implication of the health index model is that it tracks patients over the remainder of their life expectancy. In other words, we would expect benefits to continue to accrue far beyond the treatment period. However, we are hesitant to estimate benefits we have not observed. For this reason, we projected future benefits to use in a sensitivity analysis. Even though future benefits continue to accrue, costs would remain constant. Behavioral programs do not require the purchase of medication and should not increase medical expenditures. Since many variables in cost-effectiveness analysis cannot be pinpointed exactly, feasible ranges of values should be considered.
Two assumptions about future benefits were considered in the sensitivity analysis. One assumption projects the difference between treated and control groups 1 year after the program as one-half of the 0.099 observed difference at 18 months. The difference between treated and control groups will be 0.05 units of well-being. If 50 individuals received this benefit, the additional well-year production under this assumption would be 0.05 units of well being $\times$ 50 patients $\times$ 1.0 year = 2.5 well years. The total well year production under this assumption would be 7.33 + 2.50 = 9.83 (see Table 4). Discounting at 5% gives a well-year production figure of 9.13.

A second assumption projects benefits 2 years after the close of the treatment. Under this assumption, we assume that one-half the patients are still available for follow-up, and the treated and control groups differ by one-fourth and observed differences at the 18-month assessment. Multiplying the 0.025 difference between treated and control groups by 25 patients produces 1.25 well years if the improvement lasts 1 year. Adding this 1.25 to the previously calculated 7.33 and 2.5 well-years gives a total well year production of 11.08. The final discounted figure for this assumption equals 10.18 well-years (see Table 4). While these two assumptions treat health status as a constant, in fact it varies naturally. The assumptions we have presented are for illustrative purposes only.

In summary, we have observed an estimated 7.33 well years of benefit in the study, and we might expect an additional 2.5 to 3.75 well years under the two assumptions considered in the sensitivity analysis.

D. Discussion

Patients with COPD may benefit from structured exercise programs. However, compliance to behavioral programs in health tends to be low. Various behavioral interventions for weight control (Foreyt et al., 1981) and for smoking (Leventhal and Cleary, 1980) have not produced impressive results.

The results of the present study suggest that patients in the behavioral treatment groups walked more, displayed greater increases on exercise tolerance, and exhibited better health functioning on Quality of Well-being Scale than the patients in the control groups.

Strategies that include a behavioral component appear to be the most useful for motivating and maintaining compliance to a regular walking program among moderate to severe COPD patients. Patients who adhere to the program and gradually increase their walking over time demonstrate measurable improvement in exercise tolerance. Consistent with other research on pulmonary rehabilitation (Bass et al., 1970; Moser et al., 1980; Petty et al.,
1969; Pierce et al., 1964; Unger et al., 1980) patients in the present study did not improve their pulmonary function as measured by spirometry. However, improvements in exercise performance lead to higher levels of health functioning as measured by the Quality of Well-being Scale. This finding is particularly important since the major purpose of rehabilitation is improvement in the patient's abilities to function independently (Moser et al., 1980).

Self-Efficacy Theory and the Dyspnea-Panic Cycle.

Some COPD patients may experience a vicious cycle of fear and dyspnea. Activity may cause shortness of breath which in turn causes panic. The panic results in more dyspnea and the cycle becomes self-perpetuating. Many patients come to think that the situation is beyond their control and may avoid activities because of fear (Dudley, 1981; Mertens et al., 1978). One of our patients described becoming very short of breath while running to escape the rain. He fell and lay on the wet pavement in fear of dying because of his shortness of breath. After this experience he greatly restricted his activity and left home only when absolutely necessary. In other words, he felt unable to cope with dyspnea brought on by activity.

Information may have little impact upon patients affected by the panic-dyspnea cycle. They may understand that panic will complicate the problem but may question their skill in coping with dyspnea. Bandura describes this as a problem in self-efficacy. Self-efficacy is defined as the degree of confidence that a specific behavior can be enacted.

Bandura's self-efficacy theory maintains that behavior is mediated by expectations that particular behaviors can be executed in specifically defined situations. Programs that provide mastery experiences in particular situations will enhance expectations for success in similar situations on future occasions. These expectations in turn serve to mediate future executions of the behavior. Patients in our study were given an individually tailored exercise prescription. In the experimental groups, patients worked out a clearly defined strategy for implementing the walking program. As the focus remained on walking—when, how, where, how long—patients' perceived efficacy for accomplishing exercise improved. A typical answer while filling out the self-efficacy questionnaire at the three-month follow-up was "I know I can walk three blocks because I have done it. I don't know if I can walk five blocks, but I can try."

Past experience serves as a mediating cognitive process (Bandura, 1982), and accomplishing changes in one particular behavior serves to increase expectations that behavior can be executed in the future. At the end of the 3-month training period, patients' expectancies for related exercise behavior, such as
climbing stairs and moving furniture, did not change as much. Patients showed least improvement for capacities that were not the focus of training (Kaplan et al., 1984b).

IV. Conclusions and Recommendations

The major objectives of health care should include the extension of the life expectancy and the improvement of quality of life. Preliminary evidence suggests that behavioral programs (as adjuncts to medical treatment) for COPD patients may enhance life quality and provide a relative improvement in health status. The cost-effectiveness of these programs has been evaluated and shown to be comparable with other widely advocated health care services (Toevs et al., 1984). We believe that the mechanism for this improvement is an enhanced sense of self-efficacy (Bandura, 1982) gained through the performance of coping behaviors. Principles of social learning and reinforcement are probably required in order to achieve the enactment and maintenance of these behaviors (Atkins et al., 1984; Kaplan et al., 1984b).

Several alternative behavioral methods are available and it is sometimes difficult to select them. We found an initial benefit from a cognitive-behavioral approach. However, differences between different methods were small and tended to be undetectable by the 6-month follow-up. If asked to recommend a single method, we would choose cognitive-behavior modification. In all analyses, the cognitive-behavioral group was rank ordered first. In addition, cognitive-behavior modification is well understood by older adults and may be better tolerated than a strictly behavioral approach (Thompson and Gallagher, 1980).

There is still a shortage of data on the efficacy of expensive behavioral and rehabilitation programs for COPD patients. We are currently conducting a randomized clinical trial to compare a comprehensive COPD rehabilitation program with didactic education. The evaluation will include a detailed assessment of the costs, risks, and benefits of behavioral rehabilitation.

V. Appendix: Treatment Groups

A. Behavior Modification

The strategies used to help patients in this group (N = 15) follow a regular walking program were based on behavior modification principles. Specifically, the subset of behavior modification principles aimed at developing self-control
were utilized. Early in the second session, the patient's daily schedule was outlined, and the patient was asked to identify highly probable behaviors in his or her daily life. Each was then asked to make the self-administration of these reinforcers contingent upon daily walking. In addition, patients signed a behavioral contract specifying the time for their daily walk and the reinforcer that would be used for its achievement. The experimenter went for a 5 min sample walk with the patient to identify the proper pace and distance. Then the experimenter provided instructions in self-reinforcement following the walk. For example, some patients made morning coffee contingent upon completing their walk. After the sample walk, the experimenter would have coffee with the patient.

During the third and fourth sessions, the patients were taught progressive muscle relaxation. Anxiety is commonly experienced by patients with COPD and may exacerbate dyspnea or shortness of breath, which in turn may make a patient more anxious. Many COPD patients do not feel they have any control over this vicious cycle. Progressive muscle relaxation was used to help patients gain control over anxiety (Dudley et al., 1980a,b). Breathing exercises were also used in accordance with standard pulmonary rehabilitation procedures. The experimenters stressed appropriate diaphragmatic breathing, purse-lip breathing, and 2:1 exhalation/inhalation ratio during the relaxation sessions (Moser et al., 1980).

B. Cognitive Modification

Recent research has demonstrated the importance of cognitive change in maintaining behavior over time. This other type of strategy that was developed to increase and maintain walking among COPD patients is called cognitive modification (Ellis, 1962; Mahoney and Mahoney, 1976). According to this strategy, individuals are trained to become aware of their own negative and maladaptive thoughts, feelings, and behaviors, and to replace them with more positive cognitions. The assumption underlying this approach is that walking or exercising may be influenced by what the patient says to him or herself during walking. Since exercise is uncomfortable for many COPD patients, they may be actually talking themselves out of walking. Patients who were randomly assigned to receive cognitive modification (N = 16) were first encouraged to monitor their own self-statements, paying particular attention to negative self-statements that might interfere with walking (i.e., "I can't walk very far without getting short of breath, so what's the use?"). They were then trained to substitute negative self statements with more appropriate positive
and goal-oriented self-statements (i.e., "This walking is uncomfortable, but I can handle it. Soon I will be able to walk farther").

As in the behavior modification strategy, the experimenter went for a 5-min walk with each patient to familiarize him or her with the approximate pace and distance that had been prescribed. In addition, the experimenter pointed out 1/4, 1/2, and 3/4 of the total distance and modeled the appropriate self-cognition (i.e., "Gee, I've already walked 1/4 of the way, that wasn't so bad; halfway there, that didn't take long").

While the cognitive approach is aimed at changing negative self-statements that could interfere with maintaining the walking regimen over time, it is a didactic approach. Patients are not given the specific instructions on how to fit walking into their daily schedule nor are they given any instructions in relaxation. A number of research studies suggest that specific instructions on how to carry out a proposed action should maximize adherence. Thus, a third approach that involved a merger of the cognitive and behavioral techniques was also included.

C. Cognitive-Behavior Modification

The cognitive-behavior modification strategy combined the cognitive, insight-oriented therapy with standard behavior modification and self-control techniques. As in the cognitive modification group, patients who were randomly assigned to this group (N = 16) were encouraged to monitor their own self-statements and they were trained to substitute negative self-statements with more appropriate positive and goal-oriented self-statements. Since contact hours were equivalent across all groups it was necessary to reduce the amount of time spent on cognitive activities in order to make time for the behavioral component. A literal combination of the cognitive and behavioral packages would have taken twice as much time, thus confounding treatment and contact time.

On the behavioral side, the package included relaxation and breathing techniques (two sessions), such as 2:1 expiration-inspiration ratios, diaphragmatic, and pursed lip breathing. Patients were encouraged to practice the relaxation and breathing techniques daily. Since compliance with a regular walking regimen requires self-control, some of the behavioral self-control techniques were also included in the package.

The behavioral components for improving self-control included the specification of regular daily activities and contingency-management techniques for self-administration of reinforcers. The writing and signing of a behavioral contract was not included in this package in order to make time for the cognitive modification component.
As described in the previous two strategies, the experimenter went for a 5-min walk with each patient to familiarize him or her with the walking prescription. As in the other groups, the experimenter pointed out 1/4, 1/2, and 3/4 of the total distance and appropriate self-cognitions were suggested to the patient.

D. Attention Control

The three strategies outlined previously all require personal contact time with each patient. Many researchers have argued that merely spending time with or attending to a patient will lead to increases in compliance (Evans et al., 1970; Hall et al., 1974; Haynes, 1976; Mann and Janis, 1968; Meyer and Henderson, 1974). An attention control group was included in this study (N = 15) to evaluate the effect of attention alone. Patients who were randomly assigned to this group were given information about the importance of stressful life events, personality characteristics, family support, and previous health history on chronic lung disease. As in the other groups, the experimenter met with the patient for five separate hourly meetings in the patient's home. The experimenter also collected walking log information from the previous week or weeks, and administered the self-efficacy measure. The remainder of each session was spent on various paper and pencil tasks. The data from these tasks were used to generate discussion with the patient. The paper and pencil scales included a Social Support Inventory, the Trail Making Test, part B, the Minnesota Multiphasic Personality Inventory, and the Social Readjustment Rating Scale (Rahe, 1972).

E. No-Treatment Control

The no-treatment control group (N = 13) was exercise tested at the first session, given an exercise prescription and a walking log, and advised to implement the walking program. The experimenters were available to these patients for advice via the telephone contact. At the end of 3 months, these patients were invited back to the clinic for a reassessment.

Acknowledgment

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