CHRONIC OBSTRUCTIVE PULMONARY DISEASE: THE RELATIONSHIP OF TOTAL DISTRESS SYNDROME WITH SELECTED PHYSIOLOGICAL PARAMETERS

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CHAPTER I

INTRODUCTION

In human life, man is continuously exposed to stressors. The afflicted individual with chronic obstructive pulmonary disease (COPD) is handicapped with a failing cardiopulmonary system which reduces his ability to cope with stressors. The COPD patient's life and productivity are threatened. He struggles to adjust, to regain a degree of stability, and to decrease his distress. Medicine has little to offer beyond periods of symptomatic relief, prevention of exacerbations, and a trial at rehabilitation. The disease is irreversible, progressively destructive, and debilitating. The suffering and distress remain as a challenge to be alleviated by the health care profession.

Chronic obstructive pulmonary disease is characterized by alterations in static and dynamic lung functions. Consequently, there are disturbances in the distribution of air and blood gas exchange. In advanced stages of the disease hypoxemia, hypercapnia, and acidosis contribute to pulmonary hypertension, the evolution of cor pulmonale, and episodes of right heart failure.

The distress of the COPD patient stems from these physiological alterations which impair the patient's ability to perform activities of daily living, which demand adherence to a complex medical regime, and which interfere with interpersonal relationships. The patient's limited cardiopulmonary reserve may not afford him the luxury of the expression of joy, happiness, anger, or depression. He enters the existence of an emotional "straightjacket." The struggle to breathe may not be worth the effort and the wish to die may appear as the only realistic goal. However, life persists despite a constant fear of death.

Serial studies have documented clinically important features of COPD associated with prognosis. From examination of these investigations and from empirical knowledge of the clinical course of the COPD patient, questions arise regarding the relationship of the pulmonary distress syndrome with the variables of physiological impairment identified as reliable predictors of survival rates.

The health care management of COPD patients is one of the most difficult and discouraging clinical problems encountered daily. One responsibility of the nurse is the assessment of the pulmonary patient's distress syndrome in relation to his physiological impairment. In conjunction with this component of the nursing process, this study

focused upon the assessment of the patient's perceived distress of events in daily living as they correlate with selected physiological parameters. Through comprehensive and systematic assessment it is hoped that improved plans of nursing care can be evolved, patient distress relieved, and new knowledge contributed to the discipline of nursing.

STATEMENT OF PROBLEM

The problem of this study was to examine the relationships of selected physiological variables with the total distress syndrome of the COPD patient.

STATEMENTS OF PURPOSES

The purposes of this study were to:

1. Assess the distress level of events in the daily life of the COPD patient

2. Determine the relationship of the total distress syndrome of the COPD patient with the resting heart rate

3. Determine the relationship of the total distress syndrome of the COPD patient with the one second forced expiratory volume before bronchodilatation (FEV_1)

4. Determine the relationship of the total distress syndrome of the COPD patient with the one second forced expiratory volume after bronchodilatation ($FEV_{1\ ABD}$)

5. Determine the relationship of the total distress syndrome of the COPD patient with the baseline arterial carbon dioxide tension ($PaCO_2$)

6. Determine the relationship of the total distress syndrome of the COPD patient with the baseline arterial oxygen tension (PaO_2)

7. Determine the relationship of the total distress syndrome of the COPD patient with the baseline arterial oxygen saturation (SaO_2)

8. Determine the relationship of the total distress syndrome of the COPD patient with the combined physiological variables including resting heart rate, FEV_1, $FEV_{1\ ABD}$, baseline $PaCO_2$, baseline PaO_2, and baseline SaO_2

BACKGROUND AND SIGNIFICANCE

This section includes content and studies pertinent to the proposed investigation to examine the relationship of selected physiological variables with the total distress syndrome of the COPD patient. It will discuss the scope and magnitude of COPD in the United States; the nature of

COPD; the altered pulmonary function in COPD; the concept of stress, distress, and stressors; the identified stressors in the COPD patient's life; studies performed to assess physiological impairment of the COPD patient and to measure individuals' perceived levels of stress; and the conceptual framework of the investigation.

The Scope and Magnitude of COPD

Chronic obstructive pulmonary disease has become the country's fastest growing health care problem. Bronchitis, emphysema, and asthma have increased 224 percent as a cause of death in the past twenty years. Between 1960 and 1970, the number of deaths from emphysema alone has risen 145 percent (Shapiro, Harrison, and Trout 1976). Chronic obstructive pulmonary disease now ranks ninth as the cause of death from disease (Traver 1974).

Individuals afflicted with COPD composed the second largest group receiving social security disability. There may be as many as 15,000,000 sufferers in the United States. It is estimated by the American Lung Association that over 450,000 new COPD patients are seen each year (Shapiro, Harrison, and Trout 1976).

Definition of COPD

The term COPD refers to diseases of uncertain etiology characterized by persistent slowing of airflow during forced expiration. In addition, there is an increased total lung capacity. Diseases associated with airways abnormality are not standardized in regard to diagnostic terminology (American College of Chest Physicians--American Thoracic Society [ACCP-ATS] 1975). In this study emphysema, bronchitis, and asthma will be included as chronic obstructive pulmonary disease.

Pulmonary emphysema is the abnormal enlargement of the air spaces distal to the terminal nonrespiratory bronchiole. It is accompanied by destructive changes of the alveolar walls.

Asthma is a disease characterized by an increased responsiveness of the airways to various stimuli. The affected individual has slowing of forced expiration that changes in severity as a result of therapy or that changes spontaneously.

Bronchitis is a non-neoplastic disorder of function or structure of the bronchi. It results from noninfectious or infectious irritation. The term is often modified to indicate its etiology, its chronicity, the type of anatomic change, or the presence of airways dysfunction. "Chronic

bronchitis" is associated with prolonged exposure to non-specific bronchial irritants and is accompanied by hyper-secretion of mucus and bronchial structural alterations. Anatomically, there may be hypertrophied mucous glands, epithelial metaplasia, and generalized inflammation (ACCP-ATS 1975). The criterion for diagnosis in epidemiological studies is the presence of cough or sputum production on most days for at least three consecutive months of the year for two years (Ferris 1973).

Cultural Contributions to COPD

There are three conditions within our culture which guarantee the continued rise of COPD as a problem in health care. (1) Cigarette smoking is associated with the incidence and the progression of COPD. It continues to rise within the American population. (2) Air pollution is associated with the incidence and the progression of COPD. Civilization continues to increase pollution of the atmosphere. (3) The geriatric population expands as modern medicine succeeds at prolonging life. The development of emphysema is associated with the aging of lung tissue. These facts signify the need for nursing and medicine to focus efforts in the area of respiratory care (Shapiro, Harrison, and Trout 1976).

The Course of COPD

Chronic obstructive pulmonary disease is progressive, irreversible, and degenerative. Its victims usually have a combination of two or three of the following: asthma, bronchitis, and/or emphysema. The manifestations usually occur incipiently, during the productive years of life, about the fourth decade (Knudson 1973). The incidence of COPD has been higher in males than in females (Cherniak, Cherniak, and Naimark 1972). Chronic obstructive pulmonary disease does not usually produce disability until the sixth to eighth decades (Knudson 1973). The American College of Chest Physicians--American Thoracic Society (ACCP-ATS) defines disability as a legal term referring to limitation in the ability to perform activities of daily living. Impairment is defined as a measurable degree of anatomic or functional abnormality which may or may not have clinical significance.

The individual afflicted with COPD gradually recognizes a decreased energy level with incapacity to perform the accustomed work. He is plagued with a persistent cough, sputum production, shortness of breath, wheezes, and susceptibility to respiratory infections. When the symptoms become incapacitating, the affected individual seeks medical aid. The medical profession strives primarily to control

reversible components of the COPD patient's illness or to control complications. The only hope it offers is palliative and possibly rehabilitative (Knudson 1973).

Significance of Pulmonary Physiology to the Clinical Setting

The proper management of the patient with COPD cannot be undertaken unless some objective measurements of pulmonary function are made. Static and dynamic lung function studies reveal fundamental knowledge of the pathophysiology of the patient and contribute to the successful care of the patient with pulmonary disease (Mead Johnson Laboratories 1970). Comroe (1965) and Cherniak (1972) emphasize that clinical use of pulmonary function testing has led to earlier diagnosis, to a more precise diagnosis, to a more objective evaluation of therapy, and to better guides of prognosis.

Arterial blood gas studies reflect the cardiopulmonary status of the patient. Specifically, arterial blood gas studies are objective means to evaluate the ventilatory adequacy, the acid-base status, and the degree of arterial and tissue oxygenation of the patient. The clinical availability of blood gas and pH values has been the most important single factor in the sophistication of respiratory

therapy. These are essential tools of the respiratory care practitioner.

Sometimes confusion exists in regard to pulmonary function studies and their interpretations. This can be attributed to the clinician's lack of knowledge on the subject. Respiratory care practitioners must strive to establish a working relationship with the use of lung function studies and blood gas values. Otherwise it is not possible to deliver appropriate therapy to the patient with respiratory dysfunction (Shapiro, Harrison, and Trout 1976).

Altered Pulmonary Function in COPD

Emphysema

In emphysema total lung capacity is greater than normal, secondary to chronic hyperinflation of the lung and increased compliance. The functional residual capacity and residual volume are increased. The patient characteristically displays inability to empty the lungs of inspired gas. The vital capacity may be normal or slightly reduced. The FEV_1, maximum midexpiratory flowrate (MMF), and the maximum breathing capacity (MBC) are decreased secondary to obstruction to airflow.

Due to mismatching of ventilation and perfusion in the lung, arterial blood gas (ABG) analysis may reflect

hypoxia and/or hypercapnia. In advanced stages, particularly when associated with chronic bronchitis, the $PaCO_2$ is elevated at rest (Cherniak, Cherniak, and Naimark 1972).

Chronic Bronchitis

The pattern of altered pulmonary function is variable according to the severity of the disease. In mild to moderate chronic bronchitis, if elastic recoil of the lung is normal, standard tests of ventilatory function or flow resistance are not affected. In moderate to severe stages, airflow resistance is increased and there may be some evidence of lung overinflation with an enlarged functional residual capacity and residual volume. Total lung capacity is normal or slightly increased. Vital capacity is normal or low. Forced expiratory volumes and flowrates are reduced. As chronic bronchitis progresses, mismatching of ventilation and perfusion is greater and hypoxia increases. Carbon dioxide retention ensues with the severity of the disease (Cherniak, Cherniak, and Naimark 1972).

Asthma

The patient with uncomplicated asthma appears clinically free of airway obstruction between attacks. During an attack of asthma, airway resistance is increased

and forced expiratory volume and flowrates are reduced. Frequently hypoxia is present but hypercapnia does not develop (Cherniak, Cherniak, and Naimark 1972).

Cardiac Manifestations of COPD

As COPD progresses to advanced stages, cardiac decompensation occurs. Degenerative processes of the alveoli and fibrotic perivascular changes lead to hypoxia, increased pulmonary vascular resistance, chronic pulmonary hypertension, dilatation of the right ventricle, and eventually hypertrophy of the right ventricle. Such a development is termed cor pulmonale (Fishman 1976). When the pathophysiology of COPD results in a failure to meet the body's oxygen demands the cardiovascular system attempts to compensate by altering heart rate and stroke volume. Any stressor which taxes pulmonary reserve of the COPD patient, eventually affects cardiac reserve. The consequence is often right-sided heart and/or left-sided heart failure (Shapiro, Harrison, and Trout 1976).

Stress, Distress, and Stressors

Selye (1974) defines stress as the nonspecific response of the body to any demand made upon it. The stress-producing factors are technically called stressors. Although they are different, they elicit the same biological

stress response. A stressor can be pleasant or unpleasant; its effect on the individual depends on the intensity of the demand made upon the body's adaptive capacity. Harmful or unpleasant stress is denoted by the word "distress."

Every human being copes daily with the stressors of life. The consequence of the COPD-induced physiological changes is reduced energy to cope with stressors, to perform activities of daily living, and to participate in the full range of interpersonal emotional involvement (Dudley, Wermuth, and Hague 1973; Barstow 1974; Petty and Nett 1967).

Stressors in the Life of the COPD Patient

The life of the COPD patient is abundant with stressors. Bathing, grooming, dressing, eating, and mobility demand high energy expenditure for the COPD patient, especially if the disease is advanced. Other examples of difficult tasks identified in the literature include the following items. Showers tend to suffocate the individual. Restrictive clothing is discarded in favor of loose, comfortable clothing. Stooping and leaning over compromise breathing. Therefore, these activities are avoided. Meals are decreased in quantity to prevent over-distention of the stomach and impingement upon the lungs. Sleeping patterns are altered to compensate for interruptions

at night due to shortness of breath or persistent cough. Feeling tired upon waking in the morning is a common problem. Climbing stairs, running, pushing, pulling, and lifting are forms of mobility that are distressing due to the high energy requirements (Barstow 1974).

Sexual activity is often curtailed. The patient may indicate a lack of interest. Impotence often develops in males. Persistent shortness of breath, fears and anxieties concerning chronic illness, and feelings that life is hopeless and useless are assumed to be the causes for the reduced interest (Petty and Nett 1967).

The medical regime itself is demanding upon the COPD patient. On arising each morning, the patient must begin the bronchial hygiene treatments to clear pulmonary secretions that collect at night (Petty and Nett 1967). Bronchodilators often produce undesirable side effects: dizziness, headache, palpitations, and nervousness (Govoni 1971). Interspersed at regular intervals throughout the day are breathing exercises, muscle-strengthening exercises, and repeated bronchial hygiene treatments (Petty and Nett 1967).

Dudley (1969a, 1969b) has studied psychosocial characteristics of the COPD patient. He explained the development of particular behavioral responses on the basis

of the psychophysiology of respiration. The COPD patient uses repression, denial, and isolation to insulate himself from environmental stressors that would increase his disability and distress. These are defense mechanisms necessary for survival when the individual has to cope with a precarious cardiopulmonary imbalance imposed by his illness. The patient tends to avoid interpersonal contact to decrease the likelihood of psychological distress. The effects of disabling sensory inputs are attenuated. The patient lives in an emotional void and may appear bland, unresponsive, insensitive, and lacking warmth.

Studies on Physiological Impairment

The literature contains a number of studies that document the course and prognosis of COPD by measurements of ventilatory capacity, resting heart rate, arterial carbon dioxide levels, recurrence of respiratory infections, and severity of clinical manifestations of COPD. The study of Diener and Burrows (1975) updates the findings of Burrows and Earle (1969) utilizing the same sample of COPD patients. The most significant predictor of the mortality rate was the absolute FEV_1. Brownie (1976) investigated the relationship of activities of daily living and the cardinal symptoms of COPD with pulmonary dysfunction of COPD patients

in an attempt to determine the functional potential of the patient. There appeared to be a relationship between the degree of dyspnea, the ability to perform activities of daily living, and some of the spirometric values.

Stress Studies

A review of the literature reveals few studies pertaining to distress levels of COPD patients. Volicer and Bohanon (1975) performed a study with 261 hospitalized patients to measure general psychosocial stress experienced during hospitalization. They designed a scale to measure the patients' experienced stress based on the previous work done by Homes and Rahe (1967).

The Conceptual Framework

Distress is a negative aspect of stress. Stress is a concept utilized by many nursing theorists presently in explaining the nursing process. It is incorporated into the adaptation model of nursing theory. The primary goal of nursing is to help the patient make maximum use of his adaptive or coping behaviors to combat the stressors imposed by illness and to achieve the highest degree of self-actualization possible (Byrne and Thompson 1972). This goal is approximated via the nursing process: assessment of the patient's problems, planning of care, directing of

care, and evaluation of care (The Nursing Development Conference Group 1973). The need to develop a conceptual framework for the systematic investigation of problems related to practice and the need to develop means for transmitting nursing knowledge remain high priorities for the profession of nursing (Riehl 1974). It is hoped that this study will contribute needed nursing assessment knowledge of the COPD patient's distress syndrome as it is related to specific physiological variables.

HYPOTHESES

The following hypotheses applied to this study:

1. There is no relationship between the total distress syndrome of the COPD patient with the resting heart rate

2. There is no relationship between the total distress syndrome of the COPD patient with the FEV_1

3. There is no relationship between the total distress syndrome of the COPD patient with the $FEV_{1\ ABD}$

4. There is no relationship between the total distress syndrome of the COPD patients with the baseline $PaCO_2$

5. There is no relationship between the total distress syndrome of the COPD patient with the baseline PaO_2

6. There is no relationship between the total distress syndromme of the COPD patient with the baseline SaO_2

7. There is no relationship between the total distress syndrome of the COPD patient with the combined physiological variables including resting heart rate, FEV_1, $FEV_{1\ ABD}$, baseline $PaCO_2$, baseline PaO_2, and baseline SaO_2

DEFINITION OF TERMS

The following definitions applied to this study:

1. Chronic obstructive pulmonary disease (COPD)--a chronic illness characterized by airway obstruction with breathlessness caused by three separate but frequently related diseases, which are chronic bronchitis, asthma, and emphysema (Petty et al. 1974)

2. Stress--the nonspecific response of the body to any demand made upon it (Selye 1974)

3. Distress--the component of stress which is harmful or unpleasant. The body's adaptive capacity is

is taxed excessively, depleted of reserve energy to cope adequately (Selye 1974)

4. Stressor--any event which imposes stress upon an individual. It can have positive or negative effects on the individual's well-being (Selye 1974)

5. Pulmonary distress syndrome--the total amount of distress reported by the COPD patient in performing activities of daily living, carrying out the prescribed medical regime, coping with the symptomatology of COPD, and relating with other persons

LIMITATIONS

The following limitations applied to this study:

1. There was no standardization of therapy of the COPD patients

2. There was no control over the etiology of the subject's COPD

3. There was no control over the subject's socioeconomic status

4. There was no control over the subject's psychosocial assets

5. There was no attempt to measure factors producing distress in the subject other than COPD

6. There was no interpretation of the magnitude of distress reported by the subject

DELIMITATIONS

The following delimitations applied to this study:

1. Each subject was a male ranging in age from forty to sixty-five years old

2. Each subject was diagnosed with COPD for at least two years prior to the time of this study

3. Each subject was capable of reading, writing, and comprehending English

4. No subject had any other complicating progressive illnesses

5. Each subject consented to participate in this study

6. Each subject was not in a state of exacerbation of COPD

ASSUMPTIONS

The following assumptions applied to this study:

1. Assessment of the psychosocial and the physiological status of the patient is a nursing function

2. The COPD patient is a chronically ill individual with physical and emotional impairment that impedes his

ability to cope with the stressors encountered in daily living

3. The amount of perceived distress in adjusting to an event can be assessed by quantitative means

SUMMARY

This study examined the relationships of selected physiological variables with the total distress syndrome of the COPD patients. The continuing rise of COPD as a health care problem within our society signifies the need for nursing and medicine to focus efforts in this area of health care research and delivery. It is hoped that this study will contribute needed nursing knowledge within this area.

The structure of the subsequent chapters is as follows: chapter II, the Review of Literature, discusses topics relevant to the study of the COPD patient in relation to physiological and psychosocial sources of stress secondary to his illness and life situation. The concept of stress, as formulated by scientists of other disciplines, and an outline of concept development in nursing conclude the review of literature. Chapter III, the Procedure for Collection and Treatment of Data, explains the method of data collection and the treatment of these data to meet the

purposes of this study. Chapter IV, the Analysis of Data, describes the statistical analysis of the data obtained. Chapter V, Summary, Recommendations, Implications, and Conclusions, discusses the results of this study along with suggestions for future research.

CHAPTER II

REVIEW OF LITERATURE

This chapter reviews topics relevant to the study of the COPD patient in relation to physiologic and psychosocial sources of stress secondary to his illness and life situation. In particular the clinical manifestations of COPD and the pathology of chronic bronchitis and emphysema are explored. The significance of spirometric tests and ABG analysis in COPD is presented followed by the prognostic value of various features of COPD and the health care management of the COPD patient. Lastly, the formulation of the concept of stress precedes an outline of concept development in nursing.

Pathophysiologic Classification of COPD Patients

In the 1950s, the diagnosis of chronic obstructive plumonary emphysema was applied to patients suffering from chronic severe airway obstruction. Simple ventilatory tests were used to assess patients' physiologic defects. Although some patients may have coughed more, some less; some patients were fat, some thin; some plethoric, others not; these differences were relatively insignificant. Except in

Great Britain chronic bronchitis was a benign disease characterized by chronic cough in individuals who were otherwise healthy (Marks 1973).

Around 1950, British pathologists established a truly anatomic basis for pulmonary emphysema utilizing gross pathologic specimens of inflated lung (Holland 1972). These results subsequently were confirmed by researchers in America and it became apparent that individuals dying of COPD, as determined by clinical and physiologic methods, had sparse or no evidence of the anatomic destruction of parenchyma (Pratt, Hague, and Klugh 1961; Wyatt, Fischer, and Sweet 1964). Meanwhile, Reid (1960) was establishing a histologic basis for the diagnosis of chronic bronchitis via the presence of hypertrophy of the bronchial mucous glands in the bronchitic patient. These findings forced clinicians and physiologists to re-evaluate patient populations and to alter the classification of patients with COPD (Marks 1973).

As early as 1955, Dornhorst recognized on a clinical basis that the classification of patients with COPD varies along a spectrum. He used the terminology "pink puffer" and "blue bloater" to describe the two pathophysiologic extremes on the spectrum (Dornhorst 1955). Although Dornhorst was probably the first physician to use these

terms, it was the classical paper of Fletcher et al. (1963) which described in detail the types of disease observed in chronic airway obstruction. Filley (1967) described in a series of papers the clinical and physiologic findings from a group of 150 COPD patients. Table 1 summarizes characteristics of Dornhorst's "pink puffer" and "blue bloater" nomenclature.

"Pink puffers" are usually thin, suffer from exertional dyspnea, and have little or no cough with sputum. At rest they are not cyanosed and their $PaCO_2$ and PaO_2 are normal, although the PaO_2 and SaO_2 may fall on exercise. Chest infections may increase their dyspnea, but usually this will not lead to hypercapnia and heart failure (Holland 1972).

The prognosis of the "pink puffer" from the time of diagnosis is considered by Jones, Burrows, and Fletcher (1967) to be better than that of the "blue bloater." However, once right heart failure and hypercapnia supervene, survival is likely to be precarious and shortlived.

"Blue bloaters" are often obese, and dyspnea is not predominant in their symptomatology. Instead, they suffer from cough with sputum. Hypoxemia is always present. It may be severe enough to lead to cyanosis. Initially, hypercapnia occurs only during acute exacerbations of the

TABLE 1

PATHOPHYSIOLOGIC TYPES OF COPD

Type A: Emphysema "Pink Puffer"	Type B: Bronchitis "Blue Bloater"
Thin in appearance with frequent history of weight loss	No marked weight loss except terminally
Narrow cardiac shadow on posteroanterior roentgenogram	Cardiac enlargement
No history of heart failure except terminally	At least three successfully treated episodes of heart failure
Hematocrit less than 55 percent--no history of phlebotomy (Filley 1967)	Hematocrit greater than 60 percent--one or more phlebotomies (Filley 1967)
Infrequent history of cough and sputum production	Long history of productive cough
Marked distention of lung on roentgenogram	Lung distention usually not present
Small vessel attenuation on roentgenogram	Small vessel attenuation usually absent
Loss of lung elastic recoil	Relatively preserved lung elastic recoil
Moderate hypoxemia with no carbon dioxide retention	Severe hypoxemia with carbon dioxide retention
No signs of cor pulmonale (Fletcher et al. 1963)	Occasionally signs of right heart failure (Fletcher et al. 1963)

disease, but later it becomes a permanent feature. Chronic or recurrent right heart failure is common in their illness. The chest roentgenogram may be normal. Occasionally it shows evidence of chronic inflammatory disease in the lung parenchyma (Holland 1972).

The patient classified as type X cannot be designated as type A or B using the criteria established by Jones, Burrows, and Fletcher (1967). Marcus et al. (1970) classified type X patients as having mixed disease with both loss of lung elastic recoil and increased resistance to quiet breathing (elevated airway resistance).

Burrows et al. (1972) reported a longitudianl seven-year study of fifty patients with COPD in which the cardiovascular function of each subject was evaluated by cardiac catheterization under conditions of disease stability. Survival was inversely related to pulmonary vascular resistance.

Two patterns of cardiovascular abnormality were identified. The patient with type A or emphysematous lung disease has relatively normal blood gases, low cardiac output, and near normal resting pulmonary artery pressure. The patient with type B or bronchitic lung disease has well-maintained cardiac output and more severe pulmonary hypertension. More often, this patient manifests the

classic clinical and electrocardiographic features of cor pulmonale (Burrows et al. 1972).

Pathology of Chronic Bronchitis and Emphysema

Clinically, chronic bronchitis appears to be a non-specific reaction to a number of different stimuli: air pollution, cigarette smoke, or other irritants. Reid (1954) showed that the main feature of the histological pathology of early chronic bronchitis was hypertrophy of the mucous secreting glands and goblet cells. Hypersecretion of mucus is the basic disturbance in chronic bronchitis, representing the reaction of the bronchial mucosa to a variety of irritants. Reid suggests that excessive amounts of mucus may provide a mechanism for the spread of infection towards the periphery of the lung. Acute exacerbations, including acute bronchitis with muco-purulent sputum, bronchiolitis, and bronchopneumonia may then develop. Other pathological changes in the bronchioles include obliteration and dilation of the lumen. Changes in alveoli include pneumonia, edema, emphysema, and collapse.

Reid (1960) devised an index which relates the thickness of the bronchial wall to the thickness of the bronchial mucous gland layer. This ratio, the "Reid index," is directly proportional to the amount of sputum produced.

Auerback et al. (1961) identified the following histological changes in the epithelium of the tracheobronchial tree which increased in proportion to the amount of smoking of the subject: hyperplasia and disorderly arrangement of basal cells, an increase in the number of cell rows, a loss of cilia, and the presence of atypical cells. Among nonsmokers these changes were usually absent.

The ability to rid the respiratory tract of the excess mucus produced in chronic bronchitis depends to a large extent on ciliary activity. Any inhibitor of ciliary activity leads to the accumulation of secretions in the tracheobronchial tree and to the impairment of respiration. In a review of cilia activity and mucous transport, Kilburn (1967) reported that mucous transport is reversibly decreased by cold, dehydration, trauma, oxidant gases, and viral infections. After severe or prolonged damage, ciliated epithelium is often replaced by goblet cells. It then undergoes squamous metaplasia. Green (1967) summarized the important role of alveolar macrophages in the clearance of particles from the lung. Ballinger et al. (1968) postulated that a reduction in the efficiency of the major cleansing mechanism of the respiratory tract (phagocytosis and mucous transport via cilia) leads to an increased susceptibility to pulmonary disease.

Stuart-Harris and Hanley (1957) described how acute inflammatory changes occurring in the course of chronic bronchitis become manifest in an acute bronchiolitis. The bronchiolar walls are infiltrated with polymorphs. The lumen is plugged with mucus and desquamated cells. There may be absesses around the bronchioles. This may lead to small patches of consolidation which, if not arrested, become confluent and lead to bronchopneumonia.

A chronic inflammatory change includes fibrosis of the bronchioles, which leads to nodules of collapsed alveoli and scar tissue (Hackney et al. 1968). The structural changes result primarily from damage to bronchioles which are destroyed and finally obliterated by infection and fibrosis. Localized or diffuse bronchiolar dilation occurs from destruction of the bronchiolar wall. Some bronchioles are patent during inspiration but collapse in expiration due to the weakness of their walls. The alveoli supplied by these bronchioles dilate, their walls fuse, and their capillaries disappear. As the fibrosis and emphysema extend, the pulmonary circulation is progressively affected. Emphysema is an almost invariable clinical complication of advanced chronic bronchitis, although emphysema may occur in the absence of chronic bronchitis (Holland 1972).

Bates (1968) described the natural history of chronic bronchitis and emphysema and the types of impairment of lung function that occur. He associated chronic bronchitis and emphysema with exposure to cigarette smoking and air pollution, but recognized the difficulty of measuring the relative contribution of these factors to the initiation and progress of the disease.

The primary effect of cigarette smoking, which is enhanced if the subject lives in an area of high levels of air pollution, starts in the small bronchioles. Defense mechanisms against infection are impaired, leading to an increased prevalence of infection. Continued exposure to irritants leads to hypertrophy of mucous glands, the Reid index increases, sputum production ensues, and the FEV falls. Cleansing mechanisms in the lung are impaired and the resistance to infection is lowered (Bates 1968).

The next stage involves breakdown of lung tissue, usually at the end of the respiratory bronchiole. This contrilobular emphysema is accompanied by chronic inflammation or disappearance of the bronchioles. The disordered architecture of the lung leads to drift ventilation, failure of gas equilibration, and chronic hypoxia. Failure of cell nutrition may not be localized at the center of the lobule but may occur generally throughout the lung resulting in

panlobular emphysema causing a general loss of lung elastic recoil. There is progressive closure of small airways and progressively higher lung volume causing further maldistribution of ventilation. Advanced COPD develops and the impairment to ventilation is irreversible (Bates 1968).

Laboratory Tests of Lung Function

Spirometric Tests

The criteria and nomenclature for the diagnosis of cardiovascular diseases, as stated by the New York Heart Association, has, for the past forty years, included physiologic, etiologic, anatomic, and therapeutic diagnoses. Therefore, it is expected that bronchopulmonary diseases would similarly be evaluated with the aid of pulmonary function studies in addition to the usual bacteriological, radiological, and pathological tests (Mead Johnson Laboratories 1970).

Since 1950, with the publication of Comroe's monograph on "Pulmonary Function Tests," the clinical application of both qualitative and quantitative assessment of pulmonary function has proceeded rapidly (Comroe 1950). Today, some of the simpler tests are being performed in the office setting, clinic, and at the patient's bedside (Mead Johnson Laboratories 1970).

The first record of a measurement of a lung capacity dates to 1679, when Borelli measured the maximum inspiratory volume of air in man (Cotes 1965). In 1846, Hutchinson, utilizing the spirometer he designed to measure lung volume, defined the vital capacity as the greatest voluntary expiration of the subject following the deepest inspiration. He demonstrated that vital capacity varies directly with the height of the subject. Age, obesity, and lung disease are factors that reduce the vital capacity (Hutchinson 1846).

Clinically it became apparent that vital capacity, a static lung volume measurement, was not an adequate index of ventilatory function under many conditions of pulmonary impairment. In 1908, a prolonged time for the forced expiration of the vital capacity in the emphysematous patient was first observed by Volhard. The forced vital capacity maneuver (FVC) was described in France in 1947 by Tiffeneau and Pinelli (Mead Johnson Laboratories 1970) and in the United States in 1951 by Gaensler (Gaensler 1951).

Today, determination of static and dynamic lung volumes, both in the resting state and during exercise, constitutes an important phase of any clinical study of pulmonary function. The significance of results for a given patient depends upon a comparison with the nomogram,

a standard of mean values of similar tests on healthy persons of the same sex, height, and approximate age. In the COPD patient serial pulmonary function studies should be made to detect clinical improvement or deterioration. These tests then become a vital part of the medical record (Mead Johnson Laboratories 1970).

The forced expiratory vital capacity maneuver, also referred to as the forced expiratory volume (FEV), is one of the most common tests used today as an index of the non-elastic resistance of the lung, or the expiratory resistance to airflow. The FEV of the individual is the complete volume of a maximally fast expiration starting from a full inspiration. It measures the rate at which gas can be exhaled when maximal effort is exerted by the subject. In the absence of thoracic cage muscular weakness, a decreased expiratory flow rate may be associated with COPD. The subscript ($FEV_{0.5}$, FEV_1) indicates the time in seconds over which a portion of the total FEV is expired (Cherniak, Cherniak, and Naimark 1972).

Recent theoretical approaches indicate that forced expiratory flow can be affected by the loss of lung elastic recoil, the reduction of cross-sectional area of large airways, and/or the frictional resistance of small airways. In

the COPD patient any one or more of these factors operate to reduce forced expiratory flow (Park et al. 1970).

There are numerous limitations associated with spirometric tests. First, spirometric measurement of FEV_1 measures flow at high lung volumes. It is relatively insensitive to "small airway disease." The small airways are considered less than two millimeters in diameter and they contribute less than 20 percent of the total airway resistance in the healthy individual (Ferris 1973). Second, disease is only revealed when the bronchopulmonary lesion is sufficiently great to alter pulmonary function. Slight reductions in ventilatory function are usually insignificant (Mead Johnson Laboratories 1970). Third, pulmonary function tests by themselves are of no diagnostic value (Fitzgerald, Carrington, and Gaensler 1973). Fourth, the sensation of dyspnea does not correlate well with objectively measured functional abnormalities. In a study conducted by Elpern (1977), patient ratings of severity of shortness of breath did not correlate with FEV indices of severity of pulmonary impairment. Nevertheless, unexplained dyspnea or dyspnea due to respiratory disease is an indication for carrying out certain tests of pulmonary function (Rapaport 1971).

Investigators have made useful generalizations relating FEV_1 to clinical data. The mean decline in FEV_1

expected in the individual from aging alone is 20 to 25 ml. per year or less (Ferris, Anderson, and Zickmantel 1965). The mean decline in FEV_1 documented from COPD patients ranges from 75 to 80 ml. per year. At this rate of mean decline COPD would need to progress for twenty to thirty years before ventilatory impairment would become severe enough to produce clinically significant dyspnea. With a FEV_1 of 2.0 liters the subject manifests clinical symptoms of COPD. Usually at a FEV_1 between 2.0 and 1.5 liters mild chronic dyspnea presents. In about six to ten additional years the afflicted subject would progress to severe disability, manifesting a FEV_1 less than 1.0 liter. A FEV_1 less than 400 ml. is incompatible with life, unless the COPD patient is maintained on continuous oxygen therapy. These generalizations are compatible with the clinical histories obtained from patients with COPD (Burrows and Earle 1969).

The following associations between FEV_1 and physical activity can be made concerning the COPD patient. The subject with a FEV_1 greater than 1.5 liters can perform moderate exercise. The subject with a FEV_1 between 1.0 to 1.5 liters can perform light activity but becomes short of breath on hurrying or climbing stairs. The subject with a FEV_1 less than 1.0 liter becomes short of breath on slight

exertion. However, these predictions will vary depending upon the clinical type of COPD and the personality traits of the subject (Howell 1971).

Arterial Blood Gas Analysis

The measurement of ABGs is more important in the rational clinical care and management of patients than in diagnosis (Mead Johnson Laboratories 1970). Arterial blood gas analysis cannot be used to differentiate between various types of COPD. It may be helpful in determining the severity of lung function impairment and the exercise capability of the patient. Serial ABGs are important indices in following the patient's course of illness (Hodgkin et al. 1975).

The partial pressure of carbon dioxide in arterial blood determines the adequacy of ventilation. A $PaCO_2$ of greater than 45 mm. Hg is characteristic of obstructive airway disease. A low partial pressure of oxygen in arterial blood (PaO_2 less than 80 mm.) or low arterial saturation (SaO_2 less than 95 percent) when the subject is breathing room air is also characteristic of obstructive airway disease (Mead Johnson Laboratories 1970).

Cyanosis may be a common sign in cardiac and pulmonary insufficiency. In patients with COPD the presence of cyanosis is associated with arterial oxygen desaturation.

It is secondary to abnormalities in ventilation-perfusion relationships, diffusion abnormalities, and/or inadequate alveolar ventilation. Oxygen administration will frequently result in immediate amelioration of the cyanosis. The association of clubbing with cyanosis implies a long-standing arterial oxygen desaturation. It indicates a diagnosis of chronic pulmonary disease in the absence of cyanotic congenital heart disease (Rapaport 1971).

Prognostic Value of Features of COPD

A great number of studies have been conducted to define clinically useful criteria which may be of value prognostically and therapeutically. These studies have predicted a poor prognosis of COPD patients with the following features of the disease: the reduction in maximum voluntary ventilation or the severity of expiratory slowing (Boushy and Coates 1964; Boushy et al. 1964; Mitchell, Webb, and Filley 1964; Renzetti, McClement, and Litt 1966; Jones, Burrows, and Fletcher 1967); evidence of cor pulmonale (Mitchell, Webb, and Filley 1964; Boushy et al. 1964; Renzetti, McClement, and Litt 1966; Jones, Burrows, and Fletcher 1967; Simpson 1968); blood gas abnormalities (Boushy and Coates 1964; Mitchell, Webb, and Filley 1964; Renzetti, McClement, and Litt 1966; Jones, Burrows, and Fletcher 1967; Simpson 1968); low steady-state

and rebreathing diffusing capacities (Bates, Knott, and Christie 1956; Boushy et al. 1964; Mitchell, Webb, and Filley 1964); roentgenologic evidence of emphysema (Simon and Medvei 1962; Simpson 1968); low vital capacity (Boushy and Coates 1964; Renzetti, McClement, and Litt 1966); weight loss (Boushy et al. 1964; Sukumalchantra and Williams 1965); early onset of disease (Medvei and Oswald 1962), and residence at high altitude, high residual volume, and high ratio of residual volume to total lung capacity (Renzetti, McClement, and Litt 1966).

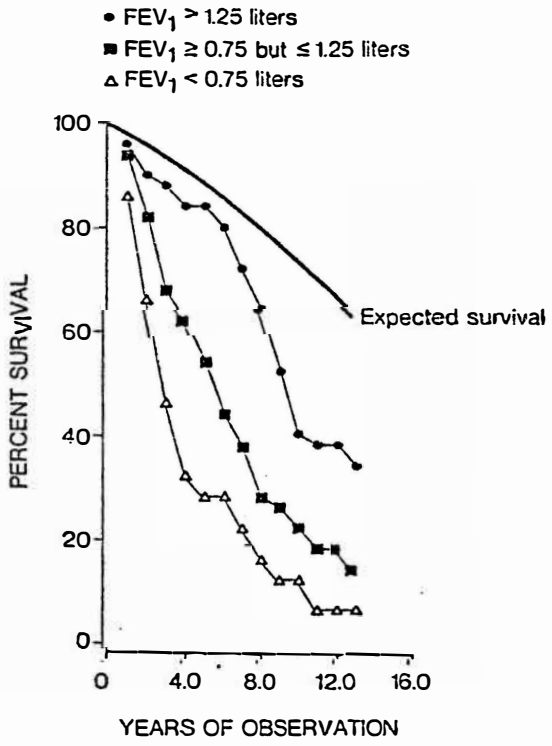
The relative prognostic value and the independent prognostic usefulness of each of these features of the disease had not been determined until the prospective study of Burrows and Earle (1969) was initiated. Measurements of ventilatory capacity (specifically the FEV_1), resting heart rate, and carbon dioxide levels were identified as the most significant predictors of prognosis.

Diener and Burrows (1975) re-examined the mortality rates of 200 COPD patients enrolled in a prospective study about fourteen years prior to their report. Early death rates were closely related to the initial level of ventilatory impairment. As substantiated by earlier reports (Renzetti, McClement, and Litt 1966; Jones, Burrows, and Fletcher 1967; Burrows and Earle 1969; Boushy et al. 1973)

measurements of expiratory slowing are known to be useful predictors of mortality over the next five- to seven-year period. In figure 1, thirteen-year survival is shown in relationship to initial FEV_1 level.

FIGURE 1

SURVIVAL PLOT OF FEV_1 GROUPS



Source: Diener and Burrows 1975, p. 721.

This investigation involved fifty-two subjects with an initial FEV_1 greater than 1.25 liters, ninety subjects in the middle FEV_1 group, and fifty-eight subjects with an initial FEV_1 less than 0.75 liter (Diener and Burrows 1975).

Longer-term observations have not changed previous conclusions regarding the relative usefulness of clinical criteria in predicting survival of COPD patients.

> With mild to moderate expiratory slowing (FEV_1 more than 1.15 liters) five-year life expectancy is near normal in uncomplicated cases and close to 66 per cent [sic] in patients with evidence of cardiac disease or tachycardia at rest.
>
> With moderately severe ventilatory impairment (FEV_1 of 0.75 to 1.15 liters) there is a 66 per cent [sic] five-year survival, but this figure is reduced to 33 per cent [sic] if evidence of cardiac disease, tachycardia at rest, hypercapnia or a very low pulmonary diffusing capacity is also present.
>
> With very severe expiratory slowing (FEV_1 less than 0.75 liter) only 33 per cent [sic] of patients without complications survive for five years, and five-year survival is unusual if there are any of the adverse features mentioned above (Burrows and Earle 1969, p. 403).

These studies indicate that COPD is a relentlessly progressive disorder associated with a high mortality after ventilatory impairment becomes severe (Diener and Burrows 1975).

Neff and Petty (1972) performed a follow-up study on ten COPD patients to determine survival rates of COPD patients under the condition of severe chronic hypercapnia. The study group's mean age was fifty-six years, mean FEV_1 was 0.41 liter, and mean $PaCO_2$ was 90 mm. The patients all manifested components of emphysema and chronic bronchitis and were maintained on continuous oxygen therapy. The study

revealed a mean survival rate of seventeen months after its first determination of laboratory values.

Health Care Management of the COPD Patient

The management of COPD has improved considerably during the past few decades. Many difficult problems continue to face the health care team in the ongoing care of the COPD patient. Although the intensity of the therapeutic program may be reduced when the patient is doing well, it can never be stopped (Lertzman and Cherniak 1976). The increased recognition of the need for sustained intensive therapy and of the important contributions of allied health personnel has led to the development of comprehensive systematized programs with two major goals. The first goal is to control and alleviate the symptoms of respiratory impairment. The second goal is to educate the patient and family to achieve patient independence in carrying out activities of daily living (ADL) and the therapeutic plan. The focus of the health care team on the patient afflicted with COPD is not merely on the manifestations of the disease but includes concern for his personality makeup and his environmental situation (Hodgkin et al. 1975).

Comprehensive care of the COPD patient includes measures designed to reduce the work of breathing, increase

the ability to perform ADL, and lessen the complications of chronic hypoxemia (Lertzman and Cherniak 1976). The components of the program include patient and family education; consideration of metabolic and nutritional factors; medication regimens to reduce airflow obstruction, prevent respiratory tract infection, and maintain cardiac compensation; management of the patient's energy; repsiratory therapy; physical therapy; psychosocial counseling; and vocational rehabilitation (Hodgkin et al. 1975).

The approach to delivery of optimal care to the patient with COPD, especially in its more advanced stages, is by way of the pulmonary rehabilitation team. This team is composed of a physician, respiratory nurse specialist, physical therapist, respiratory therapist, occupational therapist, dietician, and social worker (Hodgkin et al. 1975)

Continuous care for the nonhospitalized COPD patient is time consuming, fraught with frustration, and often burdensome to the health care team. But it has been demonstrated that allied health professionals can provide the regular supervision and guidance for the COPD patient; as is the case with the nurse-directed clinic staffed with respiratory nurse specialists (Nield 1974).

Patient and Family Education

The success of the health care team's intervention is dependent upon patient and family cooperation. Any patient with a chronic disease must understand his disease process and goals of therapy. This is true of other chronic diseases such as hypertension, diabetes mellitus, renal insufficiency, and coronary artery disease. In each of these situations the patient, in collaboration with his family, must make a contribution to his own care in terms of self-regulation of activity, drugs, and treatments (Petty 1974).

The amount and the style of instruction given by the health care team varies with the individual patient. Nield (1971) reported that psychological tests do not indicate a difference in anxiety levels in COPD patients when health education is provided by group interaction, in individual sessions, or by written explanation. Strauss (1975) interviewed COPD patients and identified neglected areas of instruction by the health care team. Reconditioning exercises, respiratory hygiene, and coping strategies for completing ADL were areas neglected. The COPD patient was concerned primarily with the control of symptoms, the completion of ADL despite interference by his symptoms, and the maintenance of normal social relationships despite

interference by his symptoms. Patients reported that just handling their symptoms required so much time that there remained little time for other life activities. In particular the patient was concerned with whether he hurt, fainted easily, trembled visibly, lost energy rapidly, became short of breath in performing tasks, evidenced disfigurement publicly, suffered speech impairment, and suffered mobility impairment. Strauss emphasized the importance to the patient of learning the pattern of his symptoms; when the symptom appears, the duration of the symptom, means to prevent the symptom, and means to shorten or decrease the intensity of the symptom. This is an area representing concern to the patient and signifying inclusion in patient and family health teaching.

In 1974, Barstow investigated the coping techniques of emphysema patients. Three techniques she identified were simplification of ADL, the use of pacing oneself to perform ADL, and the use of panting pauses to economize limited energy and compensate for the ventilatory impairment.

A relationship between duration of disease and amount of disability in performing ADL could not be established from Barstow's study. This suggests that adjustment to the incapacitating effects of COPD by the patient might improve his ability to cope. Although the underlying

pathologic process cannot be altered, the quality of living can be improved by health care team intervention in the area of daily living (Barstow 1974).

The patient with COPD is advised to avoid cigarette smoke and other irritants to the respiratory tract. The fact that smoking contributes to the pathogenesis of COPD is confirmed by numerous studies (Payne and Kjelsberg 1964; Hepper 1969). Smoking increases airway irritation, sputum production, cough, and contributes to anorexia (Hodgkin et al. 1975). The discontinuance of smoking is usually effective in lessening symptoms. Once the disease process is established and the FEV_1 is substantially reduced, the course of COPD continues to deteriorate despite cessation of smoking (Lertzman and Cherniak 1976).

Air pollution irritates the airways of the respiratory tract also (Goldsmith 1970). Inhalation of dust, toxic fumes, and pollens should be avoided. In areas of concentrated air pollution, filters to remove airborne particles should be installed in the home of the COPD patient (Hodgkin et al. 1975).

Preventive measures should be emphasized to the COPD patient. Since sputum production and airway obstruction are aggravated by abrupt changes in temperature and humidity, these conditions should be avoided. Patients

should avoid other individuals with respiratory tract infections or influenza. It is possible that the progression of COPD can be slowed if the number and the severity of acute exacerbations is reduced. Often uninformed or misinformed patients are admitted to the hospital in an acute exacerbation because they have discontinued medications secondary to subjective improvement. It is at this point that patient and family teaching by the health care team assumes importance (Lertzman and Cherniak 1976).

The patient with COPD should understand the importance of proper nutrition to his well-being. A common complaint of the COPD patient is anorexia. The dyspneic patient frequently swallows air. In addition, the medications may produce nausea. The results are loss of appetite and weight loss (Browning and Olsen 1961). To improve caloric intake, a high protein diet with multiple small feedings, between-meal snacks, and vitamins are recommended. Patients should avoid gaseous foods which lead to abdominal distention. Since 30 percent of the cardiac output is shunted to the stomach after consuming a meal, patients may experience greater fatigue (Hodgkin et al. 1975).

Patient and family teaching should also be integrated with each component of the plan of therapy. This

ensures increased patient compliance with the health care requirements.

Management of Energy

One of the major problems confronting the COPD patient is the management of his scarce energy reserve. The resulting paucity of oxygen intake in COPD leads to a decrease of available bodily energy. Any exertion such as talking, crying, or laughing, uses oxygen and can quickly result in respiratory distress. The COPD patient must consider whether he will expend his limited energy supply participating in social interaction, meeting personal physical needs, and/or adhering to the requirements of the medical regime (Strauss 1975).

The oxygen cost of breathing is altered by pulmonary disease. In the resting healthy individual the respiratory apparatus consumes less than 5 percent of total body oxygen consumption in order to perform the mechanical work necessary for breathing. In the emphysema patient the oxygen cost of breathing at rest is about four to ten times that of the healthy individual. At high minute ventilation levels the oxygen consumption of the emphysema patient may amount to 25 percent of his total body oxygen consumption (Cherniak, Cherniak, and Naimark 1972). There is a disproportionate increase in oxygen consumption with the increase

in minute ventilation. The tremendous increased work of breathing against high airway resistance requires a greater proportion of oxygen consumption by the respiratory apparatus than is delivered by the increased ventilation (Nett and Petty 1972). The increased oxygen requirements of the respiratory apparatus under these conditions is a physiologic cause of dyspnea at rest, dyspnea on exertion, and limited exercise tolerance (Cherniak, Cherniak, and Naimark 1972).

The respiratory mechanical efficiency, which is the total work performed in moving the lung, chest wall, and abdominal contents, is low. In the healthy individual the respiratory muscle efficiency varies between 5 and 10 percent as compared to a figure of between 1 and 3 percent in the emphysema patient. The mechanism of this reduction is not fully known. Two contributing mechanical factors present in the emphysema patient are the alteration of the functional residual capacity and the inspiratory position of the respiratory muscles (Cherniak, Cherniak, and Naimark 1972).

The insufficiency of oxygen supply relative to demand is associated with the onset of anaerobic metabolism during exercise. In the COPD patient one or more of the following factors can contribute to a decrease oxygen

supply. These include inadequate ventilation, inadequate pulmonary gas exchange surface, and/or inadequate cardiac output. The limitation of exercise performance in the COPD patient has been presumed to be primarily due to the inability to move sufficient air in and out of the lungs (Linderholm 1959; Bouhuys and Pool 1963; Jones 1966).

The study of Marcus and co-workers (1970) elaborated furtner on this subject. Their generalizations concerning exercise performance in three pathophysiologic types of COPD are described in the following quotation.

> (1) Severe impairment of exercise performance is most likely to occur in patients with COPD when marked loss of elastic recoil (emphysema) and increased transpulmonary airway resistance (Chronic bronchitis) are present in combination.
> (2) In some patients in whom chronic bronchitis is predominant, insufficient lung bellows response in relation to maximal mechanical ability is a factor limiting exercise performance. Patients in whom emphysema is predominant are not limited during exercise by insufficient lung bellows performance.
> (3) The important factor in exercise limitation in patients with emphysema is insufficient effective alveolarcapillary surface area rather than cardiac output or lung bellows performance (Marcus et al. 1970, p. 21).

The most sensitive and reliable indicator that work of breathing has acutely changed is the patient's complaint of dyspnea (Shapiro, Harrison, and Trout 1976). Dyspnea is a rather broad term as used by the medical practitioners. Rapaport (1971) classified ventilatory discomfort as an awareness of an increased need for more ventilation, an

awareness that ventilation has increased excessively, and an awareness of discomfort or difficulty upon ventilating.

It has been suggested that the term "dyspnea" be applied to only labored, uncomfortable, or difficult breathing. The term "breathlessness" would be applied to cases where the individual senses a need for increased breathing. More specifically, the term "short of breath" would refer to the individual sensing an increased need for ventilation (Rapaport 1971).

Dyspnea develops when there is an imbalance between ventilatory demand and ventilatory capacity (Rapaport 1971). There are numerous theories to explain the mechanism of dyspnea production. Probably the most complete theory is the length-tension inappropriateness concept of Campbell and Howell (1966). The individual experiences discomfort or an acute awareness of breathing when he senses an unexpected or inappropriate relationship between the volume of breath achieved (length) and the force required to produce it (tension).

One of the chief complaints of COPD patients is shortness of breath following activities such as bending, tying shoe laces, brushing teeth, brushing hair, and shaving. This prompts the question: Could shortness of breath after brushing one's teeth be due to overexpenditure

of energy? Tangri and Woolf (1973) designed a study to investigate this phenomenon further. Breathing patterns were recorded during and after the performance of ADL by a control group of normal subjects and an experimental group of COPD patients. Increased respiratory rate and increased irregularity of respiratory pattern were common to both groups. Normal subjects exhibited no dyspnea after performance of ADL while the COPD subjects exhibited dyspnea.

During performance of ADL both groups retained carbon dioxide and manifested decreased PaO_2. To restore ABGs to normal after the exercise necessitated hyperventilation. This compensation was easily achieved by the healthy subjects without complaints of difficulty or discomfort. However, the COPD patients exhibited dyspnea in association with the hyperventilation. They also reported fear upon recognizing a change in breathing pattern (shortness of breath) upon minor activity (Tangri and Woolf 1973). Often a vicious cycle emerges with the COPD patient. Shortness of breath limits the patient's activity. This leads to a state of physical unfitness which predisposes to increased dyspnea upon exertion (Bass, Whitcomb, and Forman 1970).

One prospective means by which to combat the severity of distress in the COPD patient secondary to dyspnea and limited exercise capacity is by exercise

reconditioning. Following a program of two to six weeks exercise reconditioning, COPD patients report an increased sense of well-being, appear to function more effectively in performing ADL, and remain in better health. However, there is no improvement in ventilatory function nor lung volume measurements (Lertzman and Cherniak 1976). Presumably there is more effective utilization of oxygen by the exercising muscles and a training effect on the myocardium (Pierce et al. 1964). Supplemental oxygen while exercising increases the COPD patient's maximum tolerated workload. It also decreases the heart rate, respiratory rate, minute ventilation, oxygen consumption, and carbon dioxide production at any given level of activity when compared to inspiration of room air (Pierce, Paez, and Miller 1965).

The ventilatory equivalent for oxygen (V_EO_2) is often used as a gauge of training. It is dependent on the determinants of oxygen consumption and minute ventilation. Changes in V_EO_2 were variable for different COPD patients in the study on exercise training conducted by Bass and co-workers (1970). In many of the patients the magnitude and direction of change was accounted for by factors other than training. For example, if the patient had an episode of bronchospasm at the time of an exercise period, V_EO_2 would rise due to the disproportionate increase in minute

ventilation compared to oxygen consumption (Bass, Whitcomb, and Forman 1970). Since bronchospasm is associated with abnormalities in ventilation/perfusion ratios and increased deadspace ventilation, it is presumed that the increase in minute ventilation was secondary to this pathophysiologic mechanism (Heckscher et al. 1968). Therefore, in COPD patients $V_E O_2$ cannot be used as a guage of successful exercise training.

Gimeno and co-workers (1974) investigated COPD patients with proven exercise-induced airway obstruction (defined as a minimal decrease in FEV_1 of 10 percent of the pre-exercise value) to determine specific distinguishing features of this group of patients. Results indicated no significant differences in history, clinical manifestations of COPD symptomatology, physical fitness, ABGs, and pulmonary function tests between the group with and the group without exercise-induced airway obstruction. The one significant difference was the FEV_1 values pre-exercise to post-exercise. Exercise-induced airway obstruction in the COPD patient is an issue which remains to be clarified with future research.

Relief of Diffuse Airway Obstruction

Although the severity of the obstructing process is the most important physiologic feature in determining

patient longevity, the reversibility of the obstructing factor varies greatly among patients (Knudson and Burrows 1973). In the clinical setting it is the major role of the practitioner to assess the patient for the presence and relative importance of the possible causes of diffuse airway obstruction: bronchospasm, mucosal edema, retained secretions, and airway collapsibility. The practitioner should observe the patient serially, noting the subjective and physical responses to various therapeutic agents, changes in weather and seasons, and the effects of emotion and infection. Serial observations coupled with objective assessments of ventilatory capabilities yield information on the identity and severity of the obstructing mechanisms (Marks 1973).

Bronchospasm

One of several mechanisms of diffuse airway obstruction is bronchospasm. When it is a major cause of the patient's distress, it usually has a sudden onset. Bronchospasm lasts from minutes to hours and may be relieved by any of the following bronchodilators: aerosols, injections of aminophylline, epinephrine, or their derivatives. Sputum production is usually scant. Attacks may be triggered by the following stressors: specific allergens, emotions, changes in weather, inhalation of air pollutants,

or respiratory infections. Between attacks the patient's subjective respiratory function is usually normal with little or no physical impairment. The degree of difference in the patient's physical capability between exacerbation and remission is marked (Marks 1973).

Hodgkin and co-workers (1975) recommended that a trial of bronchodilator therapy be carried out on all COPD patients. Bronchodilator therapy is especially effective in those patients with at least 15 percent improvement in at least two indices of pulmonary function tests, such as forced expiratory vital capacity, FEV_1, or $MMEF_{25-75\%}$ (mean maximal expiratory flow, 25-75 percent of FEV).

Long-term follow-up studies of COPD patients using daily aerolized bronchodilators have shown that the FEV_1 continues to deteriorate despite therapy (Ayres et al. 1974). Investigatory studies show no alteration in the course of the disease by the intervention of aerosol bronchodilator therapy (Emirgil et al. 1969).

New bronchodilator agents are now available to COPD patients. Since 1935, when Graeser and Rowe first demonstrated that inhalation of epinephrine relieved asthmatic symptoms, more potent agents with fewer side-effects have been marketed. In the past the two most common agents were epinephrine (α and β effects) and isoproterenol

(β-1 and β-2 effects). Both agents were associated with cardiac arrhythmias, hypertension, and tremors. The refined β-2 agents, now available, are the bronchodilators of choice because they have fewer cardiovascular and central nervous system side-effects and have more prolonged bronchodilator effect (Ishikawa and Cherniak 1969).

A number of complications are associated with the use of bronchodilators. These are cardiac arrhythmias (Sheldon 1972), a paradoxical fall in PaO_2 (Harris 1972), and paradoxical bronchoconstriction (Keighly 1966). This information should be included in patient and family education.

Mucosal edema

Mucosal edema is freqently associated with bronchospasm. Its role in producing disability has been underemphasized. It appears that therapeutic efforts, the use of the patient's self-administered freon-charged aerosols, can produce edema similar to the manner in which nasal vasoconstrictors generate a relaxation phase with increased nasal mucosa edema. This leads the patient into a vicious cycle of increased frequency of use of the aerosol medication and reactive formation of mucosal edema (Marks 1973).

Secretions

Patients with chronic bronchitis, or the "blue bloater" syndrome of Dornhorst (1955), are characterized as having copious secretions obstructing the airways. Cough and sputum production are predominant in the patient's medical history. There are frequent eqisodes of infection associated with respiratory distress, wheezing, and a change in sputum quality from mucoid to purulent. Expectoration brings some relief of dyspnea. The symptomatology is chronic. Even in periods of remission, one to three ounces of mucoid sputum is produced per day. Symptoms are more severe on arising. Frequently sleep is disturbed by paroxysms of cough and dyspnea.

The upper respiratory tract may also be involved as a source of secretions. Nasal obstruction, hay fever, chronic sinus disease, and/or postnasal drainage is often present (Marks 1973).

Therapy directed at reduction of pulmonary secretions involves alteration of sputum character by thinning of secretions. The patient's fluid intake is increased to two to three liters per day. It is recommended that household humidity be maintained at greater than 50 percent (Cherniak, Handford, and Svanhill 1969). Other agents utilized to thin the secretions are detergents, mucolytics,

water, saline, bronchodilator aerosols, and proteolytic enzymes (Hirsch, Viernes, and Kory 1970; Paez and Miller 1971).

Airway collapsibility

Airway collapsibility is the major problem in patients with anatomic emphysema. The destruction of the alveolar walls leads to a loss of connective tissue skeleton which constitutes the structure of the small airways. During expiration, the nonrigid airways collapse causing a marked increase in expiratory airflow resistance. Patients who increase expiratory effort, and thereby increase the rate of airflow merely produce more collapsed airways (Marks 1973)

Individuals so afflicted comprise the group of "pink puffers" described by Dornhorst (1955). The predominant symptom of these patients is dyspnea. The onset of their course of illness is gradual, progressive, and unremitting. Sputum production is minimal, perhaps one to two teaspoonfuls per day. Cough is rarely prominent. Expectoration produces only minimal relief of distress. Anorexia and weight loss are common features. Wheezing is usually only effort dependent, present with physical exertion or with conscious respiratory effort. Therapy is directed toward the breathing retraining of the COPD patient (Marks 1973).

Control of Infection

Episodes of bronchial obstruction are associated with infection and often lead to acute exacerbations of respiratory insufficiency for which antimicrobial drugs are prescribed. Since each episode of infection is often incompletely resolved, some residual structural damage remains. Early recognition and treatment of upper and lower respiratory infections is imperative (Tager and Speizer 1975).

In as many as 47 percent of reported studies, viral and mycoplasmal infection was assocaited with acute exacerbations of bronchitis. Viral illnesses are often accompanied by opportunistic invaders of Haemophilus influenzae or Streptococcus pneumoniae, which are normal flora of the nasopharynx (Ross et al. 1966).

Therapy should be initiated within twenty-four hours after development of increased sputum production, thicker phlegm, or a change in color from clear/white to yellow/green. The majority of superimposed respiratory infections in COPD patients are treated with tetracycline, ampicillin, or erythromycin for seven to ten days (Hodgkin et al. 1975).

Since most intercurrent exacerbations of bronchitis will respond to the aforementioned drugs, it is not

necessary to Gram stain and culture the sputum each time. In general, if the patient is improving clinically no change in antimicrobial treatment is instituted despite the presence of a resistant organism in the sputum (Lertzman and Cherniak 1976).

Treatment of Heart Failure

Chronic bronchitis and emphysema are commonly associated with a form of heart disease termed cor pulmonale. Cor pulmonale refers to right ventricular enlargement from disorders that affect the structure or the function of the lungs. It is a synonym for pulmonary heart disease. The cardiomegaly is confined to the right ventricle and is in the form of dilatation, hypertrophy, or both. Pulmonary arterial hypertension is the factor which contributes to the right ventricular enlargement (Fishman 1976).

Often the pathophysiologic results of bronchitis in a patient lead to pulmonary hypertension, enlargement of the right ventricle, atheroma of the pulmonary arteries, hypertrophy of the smooth muscle of the arteries, and muscularization of smaller arterioles of the lung (Holland 1972).

Researchers have substantiated that alveolar hypoxia in respiratory failure is primarily responsible for the pulmonary hypertension due to an increase in vascular

resistance. Hypercapnia and acidosis play minor contributory roles (Bishop 1968; Abraham 1968). It is unlikely that pulmonary hypertension is due to hypoxemia of pulmonary arterial blood. When hypoxemia is produced in animals without alveolar hypoxia there is no rise in pulmonary arterial pressure. Pulmonary hypertension is not primarily related to loss of pulmonary vasculature, changes in cardiac output, increase in total or thoracic blood volume, increased blood viscosity, or a rise in alveolar pressure secondary to airway obstruction (Fishman 1976).

It might be anticipated that correction of the hypoxia would lead to a return of the pulmonary arterial pressure to normal. This does not occur immediately but requires several weeks when man returns to sea level from high altitude and when the clinically stable hypoxic COPD patient is administered oxygen (Abraham 1968). However, in patients with COPD who suffer an exacerbation with an acute increase in hypoxia, there is an immediate drop in pulmonary artery pressure when administered oxygen (Bishop 1968).

In the "pink puffer" type of COPD resolution of the acute episode of hypoxemia generally eliminates the cor pulmonale. In the "blue bloater" residual abnormalities in ABGs, pulmonary hypertension, and cor pulmonale preside (Fishman 1976).

Low-flow oxygen therapy is beneficial in the management of pulmonary hypertension. In the case of the development of congestive heart failure, oxygen, salt restriction, diuretics, and potassium are the indicated modalities of treatment. Cor pulmonale increases the patient's sensitivity to digitalis predisposing him to atrial tachycardia, flutter and fibrillation, and premature ventricular contractions (Beller, Smith, and Abelman 1971).

The reduction of mean hematocrit from 60 to 50 percent in patients with stable cor pulmonale decreases right ventricular and right atrial systolic and diastolic pressures, pulmonary artery pressure, and total pulmonary vascular resistance. Also, improved exercise tolerance is associated with phlebotomy. No changes in indices of airway obstruction, gas exchange, or lung elastic recoil are noted. At present it is suggested that phlebotomy may be of value in patients with high hematocrits who are clinically stable, adequately hydrated, and in whom all other modalities of treatment have been instituted (Dayton 1975; Weiss et al. 1975).

Respiratory Therapy

Intermittent positive pressure breathing

The effects of intermittent positive pressure breathing (IPPB) upon the COPD patient remain controversial.

Despite the suggested immediate beneficial effects of IPPB, studies investigating long-term effects failed to confirm subjective or objective improvement in COPD patients (Lefcoe and Paterson 1973). Longitudinal studies report that patients on IPPB therapy are predisposed to greater over-distention of the lung tissue as compared to patients receiving other modes of aerolized bronchodilators (Cherniak and Svanhill 1976).

Currently, IPPB is prescribed for patients with respiratory tract infections and acute decompensation for the prevention and reversal of atelectasis, clearance of secretions, delivery of medicines, and improvement in gas exchange (Curtis et al. 1968). Patients with severe ventilatory insufficiency, inability to take deep breaths, and a persistent productive cough of copious secretions are candidates for home use of IPPB therapy. Most of these patients will have a FEV_1 less than or equal to 1.0 liter, a FEV_1 to vital capacity ratio less than 50 percent, a PaO_2 less than 55 mm. Hg, and a $PaCO_2$ greater than 45 mm. Hg (Hodgkin et al. 1975).

Low-flow oxygen therapy

Continuous low-flow oxygen therapy has a number of uses for the COPD patient with a PaO_2 less than 55 mm. Hg. First, it allows an increased exercise tolerance. Second,

it reduces pulmonary hypertension when administered for at least fifteen hours per day and also reduces the incidence of congestive heart failure when carried out for six to twenty-four months. Third, erythrocytosis is diminished since arterial oxygen saturation is maintained at adequate levels. The hematocrit and red cell volume are reduced (Block 1974). Fourth, there is significant improvement in the patient's neuropsychologic status as confirmed by tests. The patient displays less somatic concern, is more outgoing, and can deal more effectively with emotional stress (Krop, Block, and Cohen 1973). In regard to survival time, presently it appears that there is no prolongation of life secondary to continuous low-flow oxygen therapy for the COPD patient (Stewart, Hood, and Block 1975).

In evaluating a patient's need for supplemental oxygen, a number of factors should be considered. The PaO_2 in the COPD patient may drop during sleep. Sleeplessness, irritability, and headaches are indications for supplemental oxygen at night. Low-flow oxygen (1 to 2 liters per minute which delivers 24 to 28 percent oxygen) is recommended during exercise when the patient's PaO_2 on room air is less than 55 mm. Hg. When the PaO_2 is less than 50 mm. Hg, continuous low-flow oxygen is recommended. Anemic states

require correction to improve the oxygen-carrying capacity of the blood (Hodgkin et al. 1975).

Patients with a $PaCO_2$ above 55 to 60 mm. Hg breathe by way of a hypoxic drive in place of an increased carbon dioxide drive. Increasing the PaO_2 above 66 mm. Hg by increasing oxygen flow may lead to hypoventilation and respiratory decompensation. This should be explained to the patient and family (Cherniak and Hakimpour 1967).

Physical Therapy

Since 1935, various aspects of physical therapy have been prescribed for the COPD patient (Livingstone and Gillespie 1935). The currently used modalities of physical therapy include postural drainage and percussion of the chest, diaphragmatic breathing exercises, pursed lips breathing, and exercise reconditioning.

Postural drainage and chest percussion

The purpose of postural drainage and chest percussion is to increase the elimination of secretions from one or more segments or lobes of the lungs. The short-term effect of this procedure on pulmonary function is controversial, as is the relationship between increased elimination of secretions and a change in pulmonary function (March 1971; Clarke, Cochrane, and Webber 1973).

It is possible that certain groups of patients may benefit by this procedure. Patients with excessive secretions that are difficult to expectorate, as in the case of bronchiectasis, may benefit from postural drainage and chest percussion. The cough of COPD patients with severe disability is frequently inadequate, ineffective, and performed as a rapid succession of small coughs. Manual compression of the patient's lower thorax and upper abdomen after a full inspiration may result in vigorous expulsion of air and the expectoration of sputum (Lertzman and Cherniak 1976)

Breathing retraining

In healthy individuals at reat, the diaphragm controls 65 percent of pulmonary ventilation and the accessory muscles control 35 percent. In the emphysematous patient, the diaphragm is flattened, loses contour, and is weakened. The patient compensates for this dysfunction by changing his breathing pattern so that the diaphragm is responsible for only 30 percent of pulmonary ventilation while the accessory muscles take over 70 percent of the workload. This results in laborious breathing, an increased oxygen cost to the body, and a sensation of air hunger before the expiratory phase is finished, initiating the inspiratory phase prematurely. The inspiratory/expiratory cycle of

breathing becomes asynchronous. The COPD patient manifests a gasping for air and panicky, uncoordinated respirations (Hodgkin et al. 1975). The purposes of breathing retraining are to decrease the work of breathing by restoring the diaphragm to better function as the main respiratory muscle and to increase alveolar ventilation for improvement of gas exchange (Bergofsky 1973).

The long-term efficacy of breathing retraining has not been the focus of many well-controlled studies. Evidence in the published literature confirms the viewpoint of many physicians that breathing exercises performed under trial conditions have had no substantial effect on pulmonary function tests and ABGs in COPD patients. However, investigators have reported considerable subjective improvement in their patients (Levy 1971).

It is possible that the beneficial effects that accrue from breathing retraining are secondary to the change in the respiratory pattern. Motley (1963) observed that slow, deep breathing led to a reduction in the ratio of dead space to tidal volume and an increase in SaO_2 in the majority of emphysematous patients.

Pursued lips breathing is usually taught simultaneously with breathing retraining. It produces increased intra-airway pressure during expiration so that dynamic

collapse of the intrapulmonary conducting airways is thwarted. It is associated with partial relief of dyspnea. It alters the respiratory pattern by decreasing minute ventilation and respiratory rate, increasing tidal volume, and improving ABGs (Mueller, Petty, and Filley 1970).

Psychosocial Management

Chronic diseases are complicated by psychosocial and vocational problems. In many instances, the psychologic and emotional assets of the COPD patient play an important role in the patient's cooperation with his therapeutic regimen. Dominant characteristics of COPD patients as identified by the Minnesota Multiphasic Personality Inventory are depression (with overtones of hopelessness and worthlessness), hysteria, and hypochondriasis (DeCencio, Leshner, and Leshner 1968).

Dudley's studies of the psychosocial characteristics of the COPD patient reveal that many of these patients utilize defense mechanisms of repression, denial, and isolation in order to insulate themselves from environmental stressors that would increase distress and disability, Dudley explained the development of these behavioral responses on the basis of the psychophysiology of respiration. The COPD patient is handicapped with a precarious cardiopulmonary imbalance and attenuates the effects of

disabling sensory inputs by avoiding interpersonal contacts and the full spectrum of emotion. The patient tends to appear bland, unresponsive, insensitive, and he lacks warmth. Experiences of joy, anger, and excitement are diminished or absent (Dudley et al. 1969; Dudley, Wermuth, and Hague 1973).

Failure to utilize these defense mechanisms often leads to further psychologic and physiologic deterioration. Psychosocial assets include facts about the patient's family and interpersonal relationships, the evaluation of the patient's past performance, the patient's personality structure, and the attitude of the patient toward his illness. They are as important as the physiologic assets in the treatment of the COPD patient. Patients with high psychosocial assets are more effective in protecting themselves from dangerous symptoms or behaviors and are more likely to comply realistically with their medical regime (Dudley et al. 1969).

The key to effective comprehensive care for COPD patients is sharper individualization of diagnosis and treatment. Such a focus attends to the whole person, his reactions to his problems caused by illness, and his ability to cope. This requires time expenditure on the part of the health care team with each patient and the

patient's family. The goal is to ensure their understanding of the disease, its implications, and its prognosis (Hodgkin et al. 1975).

The psychosocial management of the COPD patient begins with the psychosocial history which provides information on health-related personal adjustment and maladjustments. Common areas covered include job employment; social, recreational, interpersonal, and family relations; sexual needs; financial resources to meet living needs; and the future orientation of the patient.

The following questions give the health care team insight into the patient's stress-of-life problems: How does the patient perceive the nature and extent of his distress? What alternatives does he see as solutions to his problems? What stressors does he identify in his life situation? What are his strengths, limitations, and weaknesses for coping with these stressors? What are his fears, hopes, and expectations for the future? (Hodgkin et al. 1975)

Goal-setting is a realistic technique for intervention to assist the COPD patient who has lost hope and confidence in his ability to cope with his chronic illness. A previously measured or subjectively experienced baseline is established jointly by the patient and practitioner.

Goals are set up at reasonable increments of progress, moving toward the highest level of functional improvement judged possible by the patient. Problems in such areas as physical activity, self-care skills, and independence can be dealt with (Hodgkin et al. 1975).

Traditional psychotherapy is not recommended for the COPD patient. Dudley and co-workers (1973) recommend not tampering with the defense mechanisms of the COPD patient which he uses as emotional buttresses for his precarious health. In addition, emphysema patients generally do not tolerate insight-oriented group therapy. They feel more secure as "loners." However, individual therapy tailored to the emphysema patient's needs can be successful. For the asthma patient, either group or individual therapy can be effective. Both types of patients can benefit from didactic individual or medical treatment groups (Dudley, Hudson, and Smith 1973).

Evaluation of Therapeutic Programs

It is difficult to determine the degree of success or failure of home care and respiratory rehabilitation programs. Cherniak and co-workers (1969) first pointed out the reduction in hospital admissions and duration of hospital stays secondary to home care programs. The survival

time of these patients was not noticeably improved; these were patients with advanced COPD.

Haas and Cardon (1969) observed that the rate of deterioration of lung function in patients in a five-year respiratory rehabilitation program was not different from that measured in a control group not enrolled in the program. However, a greater number of the patients benefited from the rehabilitation program by remaining gainfully employed, maintaining independence in self-care, requiring less nursing home care, and reflecting lower mortality rates secondary to respiratory failure.

Petty (1975) demonstrated reduced morbidity in patients participating in rehabilitation. There was significant subjective improvement with increased exercise tolerance and increased ability to perform ADL. This was sustained for two years. It was associated with a reduction in anxiety, depression, and somatic concern. Other rehabilitation programs have yielded similar results (Kimbel et al. 1971; Agle et al. 1973). The deterioration of ventilatory function of patients in the rehabilitation programs appears similar to control subjects not involved.

Formulation of the Concept of Stress

Selected aspects of stress theory and research in biology and medicine are reviewed with an emphasis on

Selye's stress formulations, which have been of major importance in the development and popularization of this research area. The fact that the term "stress" is continuously used over broad fields of biology and medicine suggests that it meets widely recognized needs for describing phenomena not sufficiently covered by existing terminology. Durability is sometimes a useful index of the validity of scientific concepts. Perhaps this is true of the concept of stress (Mason 1975).

Stress Concepts Before 1936

The term "stress" was in common usage prior to Selye's introduction of a definition for the word. In English such expressions as "nervous stress" and "strain" were generally used to imply stress (Selye 1956). In 1914, Walter Cannon used the term "stress" in a paper on pseudo-endocrine studies and the interrelations of emotion (Cannon 1914). Beyond this concept of stress as a psychological parameter, Cannon went on to publish an essay in 1938, "Stresses and Strains of Homeostasis." Here he developed an engineering concept of stress and strain to apply to the physiological context. Cannon conceived of stress as involving physical and emotional stimuli. Cold, lack of oxygen, low blood sugar, and loss of blood were categorized as "stresses." He proposed the concept of critical stress

levels which he defined as those stress levels capable of causing decompensation in the homeostatic mechanism of the organism (Cannon 1935).

Evolution of Selye's Concept of Stress

The development of Selye's stress formulations is presented in The Stress of Life (1956). Initially, the work leading to his stress concept involved research to discover a new sex hormone. In 1946, Selye elaborated his concepts of stress and the general adaptation syndrome, a triad of morphological changes within the organism which represents a nonspecific response to virtually all noxious stimuli. At this time Selye was using the term "stress" in the sense of stimulus. In 1950, Selye proposed that the term "stress" be defined as denoting a condition within the organism in response to evocative agents. Selye changed the definition of stress from outside force to bodily response (Selye 1950). At different periods, Selye defined stress variously in terms of either stimulus, response, or interaction between stimulus and response. By 1956, Selye declared that stress was basically a physiological response, the sum of all nonspecific changes within the organism caused by function or damage (Selye 1956). Over two decades this definition has essentially remained the same since his 1974 publication, Stress Without Distress, defines stress as

the nonspecific response of the body to any demand made upon it (Selye 1974).

Selye believes that the subdivision of the stress concept has become necessary as recent work has refined concepts as eustress, distress, systemic stress, and local stress. Confusion between stress as both an agent and a result can be prevented by the distinction between stress and stressor. The stress syndrome or general adaptation syndrome is nonspecific in its causation, but depending upon conditioning factors that can selectively influence the reactivity of certain organs, the same stressor can elicit different manifestations in different individuals (Selye 1975).

Selye (1975) states he did not discover stress, but only the stress syndrome. In this integrated nonspecific syndrome produced by diverse agents, the pituitary-adrenocortical axis plays an important role. The emergency discharge of the adrenal medulla, as produced by an acute psychogenic stressor, was the initiator of Selye's work on the formulation of the stress concept.

The stress syndrome is elicited by demands for adaptation, experienced as agreeable or beneficial. Such demands are designated as eustress in contrast to distress. However, the essential features of stress, the discharge of

stress hormones such as adrenocorticotropic hormone, corticoids, and catecholamines, are common to both eustress and distress (Selye 1975).

Selye has had a remarkable impact upon medical thinking and research in the majority of countries throughout the world with his theories of stress and the diseases of adaptation. His formulations have influenced health care deliverers to think in terms of the medical importance of threatening environmental demands upon the adaptive machinery of the body. However, there are some workers who accept Selye's view of stress, some who use modifications of the view, some who regard the view as a hypothesis, and some who reject or ignore the view. There continues to be controversy within the stress field over acceptance of Selye's theories (Mason 1975).

Concept Development in Nursing

> The future of nursing as a profession and its ultimate effectiveness as a social instrument is contingent upon the degree to which it is able to develop an organized body of knowledge capable of predicting with accuracy the effects of nursing practice (Bryne and Thompson 1972, p. vii).

"Nursing as an applied and socially responsive discipline, must strive to improve its practice through the judicious use of knowledge and methods" (Riehl and Roy 1974, p. xi). As nursing continues to develop as a field of scientific

inquiry, there is a concentrated effort to comprehend conceptual frameworks and to operationalize theory into practice. A theory is a scientifically acceptable principle which governs practice or is proposed to explain observed phenomena. It is a deeper level of reality representation than a conceptual model and it explains the functional relations within the model (Riehl and Roy 1974).

Conceptual models in nursing serve to outline the day-to-day practice of nursing. Given the nature of the practice of nursing, nurses require a prescription for action. Therefore, the elements of the highest level of theory, situation-producing theory, are being incorporated into laws for nursing action and into conceptual models (Dickoff, James, and Wiedenbach 1968).

At this point in time, the conceptual framework of nursing and its application to practice has not evolved into a well-defined and integrated discipline of study. Modern nursing traces the beginning of theoretical nursing models to the work of Florence Nightingale. In her writings of 1859; she stated that the laws of nursing were identical to the laws of health and that these were currently unidentified (Nightingale 1859).

In conjunction with this pursuit, nurses were struggling to define the focus of nursing. In 1932, Bertha

Harmer wrote that nursing has functions and knowledge separate from medicine (Harmer 1932).

Meanwhile nurses continued to emphasize the importance of observational skills in their practice. In 1965, Faye McCain published an article entitled "Nursing by Assessment--Not Intuition" which initiated the development of systematic assessment in nursing practice (McCain 1965). In 1968, Dorothy Smith suggested using tools to collect broader data bases for assessing the patient (Smith 1968). Nursing textbooks, such as Beland's (1970) Clinical Nursing, which offers a five-page "Guide for Data Collection and Nursing Skill Required to Meet Patient Needs," expanded the area of assessment.

Traditionally, assessment was viewed from the nurse's or care-giver's perception of the patient and his situation. Little regard was given for the patient's own perception of his illness and of other stressors imposed by his illness (Riehl and Roy 1974). Currently, the trend is to plan patient care with interventions based upon patient needs formulated with the assistance of the patient. Then total patient data is correlated in such a way as to rank the priority of the patient needs, which will vary with each individual according to the severity of his illness

and his available resources for coping with stressors (Venable 1974).

Ryder, Elkin, and Doten (1971) view patient assessment as a unifying concept, a tool to assist in making decisions concerning the intervention to be made by the health care team. Carnevali (1976) defines nursing assessment as the systematic collection of subjective and objective data from and about the patient, his environment, and his support systems. In developing an assessment tool related to the total patient concept, Neuman (1974) considers two principles as basic. First, assessment requires knowledge of all the factors influencing a patient's perceptual field. Second, the meaning that a stressor has for the patient is validated by the patient as well as by the caregiver.

In addition to the emphasis on the assessment phase of the nursing process, nursing textbooks of the 1970s began to delineate theory guiding nursing practice. Smith, Germain, and Gips (1971) viewed nursing care as preventing, modifying, and reducing or removing stressors upon the patient; supporting adaptive processes of the patient in his attempt to establish a new state of equilibrium in the midst of illness stressors; and recognizing that applying stressors is a necessary part of nursing intervention based upon the principle that stress is necessary for life.

The primary reason for the existence of nursing as a separate professional entity is the assistance to the patient in the maximization of his adaptive processes in daily living. The stress concept is used to indicate a state that is always present but is intensified when there is a change or a threat with which the individual must cope. When it becomes intensified it will usually exceed the limits of homeostasis. The individual will use more energy to adapt. Nurses will be able to observe, identify, and evaluate changes in the patient's voluntary and autonomic behavior. Nurses are concerned with the imbalance between the demands made by the patient's internal and external environments and the responsive capacities of the patient. They focus upon the daily living adjustments necessary to enhance healing, to maintain the patient's homeostasis, and to prevent exacerbation of illness (Byrne and Thompson 1972).

Chrisman and Riehl (1974) designed the "Systems Developmental Stress Model" for application to the entire spectrum of nursing activities. This model employs the stress process approach as a comprehensive means to identify patient problems. In practice it can be applied to technical (monitoring patient variables) or nontechnical (interpersonal problem solving with the patient) nursing therapy.

The authors advocate the stress process as formulated by Selye (1956). They consider this concept universal in its relevance and applicability to nursing.

Neuman (1974) sees nursing as a unique profession being concerned with all of the variables affecting an individual's response to stressors. Based upon Selye's (1950) theory, Neuman describes the human being as maintaining varying degrees of balance by way of interaction and adjustment to his internal and external environments. Tension-producing stimuli, called stressors, have the potential of causing disequilibrium, situational or maturational crises, or the experience of stress within the individual. Neuman has developed the "Betty Neuman Health-Care Systems Model" to assist individuals, families, and groups to attain and maintain the optimal level of wellness. Nursing interventions are directed at reduction of stress factors and adverse conditions which could impede effective functioning in a given client situation.

In the late 1960s and early 1970s the nursing profession emphasized the assessment phase of the nursing process and nurses began introducing systematic tools for data collection regarding the patient's functioning in wellness and illness. In conjunction, the techniques of problem solving and decision making were incorporated into

the nursing process to improve the delivery of health care to the patient. Although the nursing process is well delineated, Walter and co-workers (1976) point out that the content of the process remains ambiguous and variable. Currently, the tools developed for the assessment of the patient tend to be all-inclusive and nonspecific to the client population. These authors challenge contemporary nurse theorists to define more specifically the focus of the nursing process. To meet this challenge, the differentiation of the focus of the physician versus the focus of the nurse in contributing to the health care of the patient must be clarified. As health care has expanded in the past decade many allied health professionals intervene in the patient's life to alter particular areas of stress. The physician deals primarily with biologic or intrapsychic stressors, while the nurse focuses primarily upon stressors in the interpersonal and external environment of the patient (Hadley 1969; Newman 1974).

Feinstein (1967) distinguishes between disease and illness. He defines disease as the abnormal structure and altered biologic function within the individual secondary to specific pathological processes. Illness constitutes the effects of the pathology upon the individual's ability to function physiologically and psychosocially. This

differentiation can be expanded to explain the concept of disease prevention, which would constitute the prevention of deviant structure. Likewise, the concept of wellness would constitute optimal physiologic and psychosocial functioning. The current nursing focus is to enable individuals to live constructively with illness and to promote wellness in the general population (Walter, Pardee, and Molbo 1976).

Carnevali (1976) states that the primary focus of nursing's unique contribution to health care is the impact of health-related issues and problems on client life style and the management of these problems with the demands of daily living. The nurse is concerned with balancing the patient's life goals and daily demands with the patient's resources to meet these demands in a personally satisfying way.

Recently, the nursing process has expanded to the extent that a new phase has been proposed for incorporation following the assessment phase. Nurse theorists are currently compiling a taxonomy of nursing diagnoses. A nursing diagnosis can be considered a judgment of conclusion which occurs as the result of a nursing assessment. The phase of diagnosis is the analysis of patient data collected in the assessment against a specific theoretical framework followed by the statement of conclusion. Any stressor can be the

genesis of a nursing diagnostic statement. When the patient's ADL are unsatisfactory or difficult as a result of one or a combination of the following three factors, problems must be diagnosed: (1) stressors related to health decrease the patient's ability to cope, (2) new coping demands emerge which are outside of the patient's skills or resources, and (3) the risk of ineffective coping in the future is perceived by the patient or health care team (Gebbie and Lavin 1975).

The foregoing discussion exemplifies the trend in nursing from Nightingale into the decade of the 1970s. The outline of an evolution of nursing concepts can be traced. Nightingale's challenge to identify and define the laws underlying nursing practice is being met. Murphy (1971) discusses the intensified search in nursing during the past decade for models and theories to unify existing information, to explain phenomena, and to enable prediction of outcomes. Proliferation of new knowledge, recognition of the interrelatedness of knowledge from various disciplines, dissatisfaction with compartmentalized knowledge, and expanding roles which create the need for new insights all contribute to the urgency of theory development in nursing. Nursing practitioners are becoming more aware of the need for a conceptual basis for their nursing care, as

illustrated by the increasing numbers of textbooks explaining theoretical frameworks for nursing and the proliferation of articles of conceptual model building in nursing journal literature.

The importance of nurses learning more about the concept of stress in relation to a conceptual framework to guide nursing practice is aptly expressed by Dumas (1966) when she says:

> In nursing we must move . . . toward developing a perspective that will facilitate a better understanding of the nature and consequences of stress in man and a clearer conception of nursing practice in relationship to this phenomenon. There we will begin to articulate a rationale to guide nursing practice, which should enhance the contributions of this profession to human welfare. . . . It is my belief that a clearer conception of the nature and consequences of stress with respect to both physiological and psychosocial processes will lead to a better understanding of the nature of effective nursing practice (pp. 193, 194).

This chapter reviewed topics relevant to the study of the COPD patient in relation to physiologic and psychosocial sources of stress secondary to his illness and life situation. The clinical manifestations of COPD and the pathology of chronic bronchitis and emphysema were explored. The significance of spirometric tests and ABG analysis in COPD was discussed followed by the prognostic value of various features of COPD and the health care management of the COPD patient. Lastly, the formulation of the concept of stress preceded an outline of concept development in nursing.

CHAPTER III

PROCEDURE FOR COLLECTION AND TREATMENT OF DATA

This study is classified as a hypothesis-testing quantitative-descriptive study (Fellin, Tripody, and Meyer 1969). The design is the cross-sectional survey (Abdellah and Levine 1965). This chapter discusses the setting for the study, the population, the tools used, the methodology, and the treatment of data.

Setting for the Study

This investigation was undertaken in two 1000-bed hospitals in a large metroplitan area of the Southwest. The chest clinic of a city-county hospital was utilized. The 32-bed chest-medicine floor and the chest clinic of a veterans' hospital was utilized. Written permission to perform this study was obtained from the hospital administrators prior to its initiation (appendix A).

Population

The sample of this study was composed of thirty COPD patients divided into three subgroups. Subgroup I contained ten subjects with a FEV_1<0.75 liter. Subgroup II contained

ten subjects with a FEV_1 from 0.75 liter to 1.25 liters. Subgroup III contained ten subjects with a FEV_1>1.25 liters. The subjects met the criteria stated under "delimitations" and were selected by the convenience method (Abdellah and Levine 1965).

Tools

Several tools were used for this study. The most recent pulmonary function tests as recorded in the patient's medical records were utilized. The patient's most recent baseline ABG values were utilized. These values had to be measured on the patient by the hospital's cardiopulmonary laboratory within one week of the interview of the patient for data collection. Resting heart rate was determined by taking the average of three apical rates by a stethoscope under the absence of noxious stimuli and with the patient in a sitting position.

Each subject's pulmonary distress syndrome was represented by the total score derived from a forty-seven item questionnaire (appendix D). The content of the tool was obtained from a review of the literature of COPD. It includes events in the life of the COPD patient associated with activities of daily living, symptomatology of COPD, the medical regime, and interpersonal relationships. The subject responded to each item with a quantitative score,

reflecting the amount of perceived distress in adjusting to the event. Corresponding to each event is a Likert scale quantitated as follows:

no distress					severe distress
0	1	2	3	4	5

The method for assigning a magnitude to the items was developed for use in psychophysics, which is the study of the psychologic perception of the quantity, quality, intensity, and magnitude of physical phenomena. The subjective assessment of the responding individual against the dimension perceived provides a reliable measurement of man's ability to quantify his experiences. This innate psychologic capacity of man for making quantitative judgments about psychophysical and psychosocial phenomena has been utilized to assess individuals' subjective stress levels. Several sources cite the validity and reliability attributed to tools constructed according to these premises (Holmes and Rahe 1967; Volicer and Bohannon 1975).

The pulmonary distress syndrome questionnaire was developed for a pilot project to assess distress levels of COPD patients in March 1977. At that time the tool contained thirty-seven items. The items were validated by three professional nurses who work with pulmonary patients: two respiratory intensive care unit nurses and one pulmonary

staff nurse. The panel of nurses was in accord that the items were relevant to the problem under investigation, that the items reflected clarity of content, and that the items were concise.

In September 1977, the pulmonary distress syndrome questionnaire with a cover letter was submitted to three chest physicians in the Pulmonary Department of Southwestern Medical School (appendix E). The three physicians evaluated the tool for clarity and validity of content. The following additions were made in accord with their recommendations. Items were regrouped according to their similarity in content. A total of ten items were added. Most of these additions concerned items representing a scale of physical exertion and development of the disabling symptomatology of COPD. One item concerned distress levels during an attack of bronchospasm. Another item concerned fear of dying when sleeping.

Method of Data Collection

Written permission to perform this study was obtained from the Texas Woman's University Human Research Review Committee prior to its initiation (appendix B). The subjects were selected by the convenience method from two 1000-bed hospitals located in a large metropolitan area in the Southwest over a data collection period extending from

October 28 through December 3. The subjects met the stated criteria under "delimitations," as substantiated by a review of their medical records prior to the interviews. Pulmonary function test and ABG values were obtained from the medical records. Each subject was interviewed in an examining room of the hospital setting that was free of noxious stimuli. Examples of noxious stimuli include noise, interruptions, and other psychosocial and physical distractions. The general nature of the study was explained and patient permission was solicited. Each patient was advised orally (appendix F) that no risk would be involved, that participation in the study would be voluntary, and that the identity of each subject would remain confidential. Written consent for voluntary participation was obtained at this time. The three resting apical heart rates with the patient in a sitting position were taken with a stethoscope prior to the interview. The items on the demographic data sheet not collected from medical records were elicited from the patient. The pulmonary distress syndrome questionnaire was then administered verbally. The subject was instructed to respond to the item by indicating a numerical distress level from 0, no distress, through 5, severe distress. The subject was instructed to perceive each item as a possible cause of physiological and/or psychological distress as the

item related to the subject's current life situation. The patient's response was recorded by paper and pencil. The total distress score was derived from this questionnaire by summing the distress scores and constituted the subjective data which was statistically analyzed in relation to the specified physiological variables.

Treatment of Data

Characteristics of the sample were summarized by frequency distributions. The mean, standard deviation, and range were computed for each of the physiological variables of the sample. The sum of the distress scores obtained from the pulmonary distress syndrome questionnaire was computed for each subject. The median value and the range values were reported for each item of the sample. The items were ranked in descending order of distress scores.

Utilizing the Spearman rank correlation coefficient, the total distress score was correlated with each physiological variable including FEV_1, $FEV_{1\ ABD}$, resting heart rate, baseline $PaCO_2$, baseline PaO_2, and baseline SaO_2. Correlation coefficients were also calculated between each of the physiologic variables of the sample. The Spearman rank correlation method is a nonparametric statistic involving the computation of a coefficient of correlation, called r_s. This coefficient varies between -1 and +1. Its

value is a measure of the degree of association between the variables related. The degree of relationship between the specified variables is higher when the computed value of r_s is closer to -1 or +1 (Siegel 1956).

Multiple linear regression analysis was used to predict the total distress score from the combined physiological variables. The multiple linear regression technique is a parametric test used in studies to determine the form of the relationship between independent and dependent variables both measurable in terms of quantitative scales. The test of significance for the relationship between the variables is based on the evaluation of the slope of the line that is fitted to the data. This slope is called the regression coefficient. Multiple linear regression analysis involves relating more than one independent variable to a dependent variable (Abdellah and Levine 1965).

Summary

This chapter was concerned with the procedure used in collecting and treating data to meet the purposes of this study. The pulmonory distress syndrome questionnaire was developed and validated to measure distress levels in three subgroups of COPD patients. The data were collected during a personal interview by using the pulmonary distress syndrome questionnaire, the demographic data sheet, the

patient's medical records, and a stethoscope to measure the resting apical heart rate. Analysis of the data was made by determining frequency distributions of demographic variables; calculating means, standard deviations, and ranges of the physiological variables; investigating correlations using the Spearman rank correlation coefficient and multiple linear regression analysis.

CHAPTER IV

ANALYSIS OF DATA

A nonexperiemental research study was conducted to examine the relationship of selected physiological variables with the pulmonary distress syndrome of the COPD patient. The design was the cross-sectional survey. This chapter is concerned with an analysis of data gathered from medical records and patient interviews. Data collected from the three subgroups of COPD patients composing the sample are presented and interpreted in this chapter.

Description of the Sample

The sample selected for this study consisted of thirty male COPD patients ranging in age from forty to sixty-five years. The sample was divided into three subgroups according to FEV_1. Subgroup I was composed of ten subjects with a $FEV_1 < 0.75$ liter. Subgroup II was composed of ten subjects with a FEV_1 from 0.75 to 1.25 liters. Subgroup III was composed of ten subjects with a $FEV_1 > 1.25$ liters. The subjects met the criteria stated under "delimitations." Tables 2 through 10 present summaries of the

demographic data for the three subgroups compsoing the sample.

The sample was composed of elevent (36.7 percent) black patients and nineteen (63.3 percent) white patients. The racial distribution of the subgroups and total sample is summarized in table 2.

TABLE 2

RACIAL DISTRIBUTION OF THE SAMPLE

Race	Subgroup			Total Sample
	I	II	III	
Black	3 (30.0)	4 (40.0)	4 (40.0)	11 (36.7)
White	7 (70.0)	6 (60.0)	6 (60.0)	19 (63.3)
Total	10 (100.0)	10 (100.0)	10 (100.0)	30 (100.0)

N=30

NOTE: The first value is the number in each group. The value in parentheses is the percentage of total.

The sample was surveyed in regard to their current marital status. Only one (3.3 percent) subject was widowed, three (10.0 percent) subjects were single, nine (30.0 percent) subjects were divorced, and seventeen (56.7 percent) subjects were married. The marital status of the subgroups and the total sample is presented in table 3.

TABLE 3

MARITAL STATUS OF THE SAMPLE

Marital Status	Subgroup			Total Sample
	I	II	III	
Divorced	3 (30.0)	2 (20.0)	4 (40.0)	9 (30.0)
Married	4 (40.0)	7 (70.0)	6 (60.0)	17 (56.7)
Single	2 (20.0)	1 (10.0)	0 (0.0)	3 (10.0)
Widowed	1 (10.0)	0 (0.0)	0 (0.0)	1 (3.3)
Total	10 (100.0)	10 (100.0)	10 (100.0)	30 (100.0)

N=30

NOTE: The first value is the number in each group. The value in parentheses is percentage of total.

Of the total sample two (6.6 percent) subjects reported living alone. Both subjects had a FEV_1 from 0.75 to 1.25 liters placing them in subgroup II. No subjects in subgroup I, FEV_1<0.75 liter resided alone. Eight (26.7 percent) subjects of the total sample lived with another individual outside of the family. Twenty (66.7 percent) subjects lived with one or more family members. Living arrangements of the subgroups and the total sample are summarized in table 4.

Educational preparation for two (6.7 percent) subjects of the total sample included some college. Four

TABLE 4

LIVING ARRANGEMENT OF THE SAMPLE

Marital Status	Subgroup			Total Sample
	I	II	III	
Family	7 (70.0)	7 (70.0)	6 (60.0)	20 (66.7)
Alone	0 (0.0)	2 (20.0)	0 (0.0)	2 (6.6)
Other	3 (30.0)	1 (10.0)	4 (40.0)	8 (26.7)
Total	10 (100.0)	10 (100.0)	10 (100.0)	30 (100.0)

N=30

Note: The first value is the number in each group. The value in parentheses is percentage of total.

(13.3 percent) subjects reported having graduated from college. Nine (30.0 percent) subjects possessed some or all of a high school education. Educational preparation for fifteen (50.0 percent) subjects was limited to grade school. Subgroup I contained the most college graduates (30.0 percent). Table 5 summarizes the education of the subgroups and the total sample.

Ten (33.3 percent) subjects of the total sample reported annual incomes between $10,000 and $30,000. Twenty (66.7 percent) subjects reported annual income levels between $5,000 and $10,000. Table 6 presents annual income levels of the subgroups and the total sample.

TABLE 5

EDUCATIONAL LEVEL OF THE SAMPLE

Educational Level	Subgroup			Total Sample
	I	II	III	
Grade school	5 (50.0)	6 (60.0)	4 (40.0)	15 (50.0)
High school	2 (20.0)	4 (40.0)	3 (30.0)	9 (30.0)
Some college	0 (0.0)	0 (0.0)	2 (20.0)	2 (6.7)
College graduate	3 (30.0)	0 (0.0)	1 (10.0)	4 (13.3)
Total	10 (100.0)	10 (100.0)	10 (100.0)	30 (100.0)

N=30

Note: The first value is the number in each group. The value in parentheses is percentage of total.

TABLE 6

ANNUAL INCOME LEVEL OF THE SAMPLE
(Income Level in Thousands of Dollars)

Annual Income Level	Subgroup			Total Sample
	I	II	III	
5-10	7 (70.0)	7 (70.0)	6 (60.0)	20 (66.7)
10-30	3 (30.0)	3 (30.0)	4 (40.0)	10 (33.3)
Total	10 (100.0)	10 (100.0)	10 (100.0)	30 (100.0)

N=30

NOTE: The first value is the number in each group. The value in parentheses is percentage of total.

The disability ratings of the subjects were compared according to the subjects' abilities to perform certain activities. Category A represents unlimited ability to work at the usual occupation. Category B represents limited ability to work at any occupation. Category C represents inability to work but ability to carry out ADL. Category D represents dependency on others to carry out ADL. The total sample contained two (6.7 percent) subjects with limited abilities to work at their usual occupations. Both subjects were in subgroup III with FEV_1>1.25 liters. Twelve (40 percent) subjects of the total sample said they were dependent on others to carry out ADL. Eighty percent of subgroup I with FEV_1<0.75 liter was composed of subjects with D disability ratings. Forty percent of subgroup II with FEV_1 from 0.75 to 1.25 liters was composed of subjects with D disability ratings. Subgroup III with FEV_1>1.25 liters contained no subjects with D disability ratings. Sixteen (53.3 percent) subjects of the total sample reported inability to work but ability to carry out ADL. No subject reported an unlimited ability to work at his usual occupation. The distributions of disability ratings of the subgroups and total sample are presented in table 7.

The age distribution of the total sample ranged from 40.0 to 65.0 years. The mean age of the total sample

TABLE 7

DISABILITY RATINGS OF THE SAMPLE

Disability Rating	Subgroup			Total Sample
	I	II	III	
B	0 (0.0)	0 (0.0)	2 (20.0)	2 (6.7)
C	2 (20.0)	6 (60.0)	8 (80.0)	16 (53.3)
D	8 (80.0)	4 (40.0)	0 (0.0)	12 (40.0)
Total	10 (100.0)	10 (100.0)	10 (100.0)	30 (100.0)

N=30

Note: The first value is the number in each group. The value in parentheses is percentage of total.

A--unlimited ability to work at usual occupation.
B--limited ability to work at any occupation.
C--inability to work but ability to carry out ADL.
D--dependent on others to carry out ADL.

was 55.9 years with a standard deviation of 5.8 years. The mean age in subgroup I was 54.6 years. The mean age in subgroup II was 57.7 years. The mean age in subgroup III was 55.4 years. These data are summarized in table 8.

The mean number of years since initial diagnosis of COPD of the total sample was 13.8 with a standard deviation of 7.6 years. The range of the total sample varied from 4.0 to 40.0 years. The ranges of each subgroup differed considerably as presented in table 9.

The mean FEV_1 of the total sample was 0.97 liter with a standard deviation of 0.37 liter. The range of the

TABLE 8

AGES OF THE SAMPLE
(Age in Years)

	Mean	Standard Deviation	Range	
			Minimum	Maximum
Subgroup I	54.6	7.6	40.0	65.0
Subgroup II	57.7	4.0	53.0	63.0
Subgroup III	55.4	5.5	48.0	64.0
Total Sample	55.9	5.8	40.0	65.0

N=30

TABLE 9

YEARS SINCE INITIAL DIAGNOSIS OF
COPD OF THE SAMPLE

	Mean	Standard Deviation	Range	
			Minimum	Maximum
Subgroup I	14.0	4.8	5.0	20.0
Subgroup II	14.2	8.1	4.0	30.0
Subgroup III	13.3	9.9	6.0	40.0
Total Sample	13.8	7.6	4.0	40.0

N=30

total sample varied from 0.40 to 1.55 liters. The means of the subgroups were as follows. Subgroup I was 0.55 liter. Subgroup II was 0.99 liter. Subgroup III was 1.38 liters. Table 10 summarizes these data.

TABLE 10

FEV_1 OF THE SAMPLE
(FEV_1 in Liters)

	Mean	Standard Deviation	Range	
			Minimum	Maximum
Subgroup I	0.55	0.13	0.40	0.73
Subgroup II	0.99	0.11	0.76	1.13
Subgroup III	1.38	0.10	1.26	1.55
Total Sample	0.97	0.37	0.40	1.55

N=30

The mean $FEV_{1\ ABD}$ of the total sample was 1.11 liters with a standard deviation of 0.39 liter. The range of the total sample varied from 0.46 to 1.77 liters. The means of the subgroups were as follows. Subgroup I was 0.64 liter. Subgroup II was 1.13 liters. Subgroup III was 1.55 liters. These data are summarized in table 11.

The mean $PaCO_2$ of the total sample was 42.48 mm. Hg with a standard diviation of 9.00. The range of the total

TABLE 11

$FEV_{1\ ABD}$ OF THE SAMPLE
($FEV_{1\ ABD}$ in Liters)

	Mean	Standard Deviation	Range	
			Minimum	Maximum
Subgroup I	0.64	0.12	0.46	0.80
Subgroup II	1.13	0.11	0.88	1.29
Subgroup III	1.55	0.13	1.38	1.77
Total Sample	1.11	0.39	0.46	1.77

N=30

sample varied from 30.30 to 70.20. The means of the subgroups were as follows. Subgroup I was 49.64. Subgroup II was 40.41. Subgroup III was 37.40. Among the subgroups, the range of subgroup I was broadest, 32.40 to 70.20. These data are summarized in table 12.

The mean PaO_2 of the total sample was 63.80 mm. Hg with a standard deviation of 11.37. The range of the total sample varied from 40.60 to 84.60. The means of the subgroups were as follows. Subgroup I was 56.79. Subgroup II was 61.05. Subgroup III was 73.56. These data are summarized in table 13.

TABLE 12

$PaCO_2$ OF THE SAMPLE
($PaCO_2$ in mm. Hg)

	Mean	Standard Deviation	Range	
			Minimum	Maximum
Subgroup I	49.64	12.05	32.40	70.20
Subgroup II	40.41	3.75	36.60	46.50
Subgroup III	37.40	3.36	30.30	42.40
Total Sample	42.48	9.00	30.30	70.20

N=30

TABLE 13

PaO_2 OF THE SAMPLE
(PaO_2 in mm. Hg)

	Mean	Standard Deviation	Range	
			Minimum	Maximum
Subgroup I	56.79	9.79	40.60	67.40
Subgroup II	61.05	8.62	50.50	80.20
Subgroup III	73.56	8.78	58.86	84.60
Total Sample	63.80	11.37	40.60	84.60

N=30

The mean SaO_2 of the total sample was 87.62 percent with a standard deviation of 4.05. The range of the total sample varied from 78.10 to 94.00. The means of the subgroups were as follows. Subgroup I was 83.41. Subgroup II was 88.65. Subgroup III was 90.80. These data are summarized in table 14.

TABLE 14

SaO_2 OF THE SAMPLE
(SaO_2 in percent)

	Mean	Standard Deviation	Range	
			Minimum	Maximum
Subgroup I	83.41	3.77	78.10	87.30
Subgroup II	88.65	1.50	86.40	91.00
Subgroup III	90.80	2.05	88.60	94.00
Total Sample	87.62	4.05	78.10	94.00

N=30

The mean resting heart rate of the total sample was 93.7 beats per minute with a standard deviation of 7.0. The range of the total sample varied from 80.0 to 110.0. The means of the subgroups were as follows. Subgroup I was 99.4. Subgroup II was 91.6. Subgroup III was 90.2. Table 15 presents these data.

TABLE 15

RESTING HEART RATE OF THE SAMPLE
(Heart Rate in Beats per Minute)

	Mean	Standard Deviation	Range	
			Minimum	Maximum
Subgroup I	99.4	6.2	88.0	110.0
Subgroup II	91.6	5.5	84.0	104.0
Subgroup III	90.2	6.1	80.0	102.0
Total Sample	93.7	7.0	80.0	110.0

N=30

A complete summary of the demographic data according to subject and subgroup of the sample is presented in tables 26 through 28 (appendix G). Subjects are further identified by specific disease entities within the category of COPD. This information was obtained from medical records. Estimates of packs per day of cigarettes smoked times years and estimates of number of hospitalizations for exacerbations of COPD are presented for each subject. Table 29 (appendix H) presents FEV_1, $FEV_{1\ ABD}$, $PaCO_2$, PaO_2, SaO_2, resting heart rate, and total pulmonary distress score for each subject of the sample.

Analysis of Total Pulmonary Distress Scores of the Sample

The pulmonary distress syndrome questionnaire (appendix D) contains forty-seven items representing stressors in the life of the COPD patient. The items relate to ADL of the COPD patient, components of the medical regime of the COPD patient, symptomatology of COPD, and interpersonal relationships. Each subject was asked to respond to each item by assigning a numerical distress value from zero to five. Therefore, the total pulmonary distress score for a subject could theoretically range from zero, no distress, to 235, severe distress.

The total sample tested contained scores ranging from 56.0 to 192.0. The mean score for the total sample total was 118.7 with a standard deviation of 41.8. The range of subgroup I varied from 144.0 to 192.0 with a mean of 167.7. The range of subgroup II varied from 98.0 to 151.0 with a mean of 113.2. The range of subgroup III varied from 56.0 to 94.0 with a mean of 75.3. This data is summarized in table 16.

The data from the pulmonary distress syndrome questionnaire were analyzed by calculating the median and range of the distress scores for each of the forty-seven items. Items were then ranked in descending order of quantitated distress.

TABLE 16

TOTAL PULMONARY DISTRESS SCORES OF THE SAMPLE

	Mean	Standard Deviation	Range	
			Minimum	Maximum
Subgroup I	167.7	16.0	144.0	192.0
Subgroup II	113.2	20.3	98.0	151.0
Subgroup III	75.3	12.8	56.0	94.0
Total Sample	118.7	41.8	56.0	192.0

N=30

The three items that had medians of five, severe distress, involved performance of strenuous physical activity. These items included "fast walking one block on level ground" (item 13); "shortness of breath after climbing one flight of stairs" (item 15); and "performance of heavy work such as mopping the floor, gardening, and mowing the lawn" (item 16).

The four items that received a median distress score of four related to performance of strenuous physical activity and to the disabling symptomatology of COPD. These items included "fast walking thirty feet on level ground" (item 11); "adjusting to changes in the weather's humidity" (item 27); "shortness of breath, wheezing and

chest tightness during an episode of bronchospasm" (item 30); and "shortness of breath when stooping and leaning over to perform a task" (item 9).

Thirteen items received a median distress score of three. Sixteen items received a median distress score of two. Nine items received a median distress score of one. Distributed within each of these three categories of distress levels were stressors associated with the performance of ADL, disabling symptomatology of COPD, components of the medical regime, and the psychosocial aspects of a burdensome chronic illness.

Only two items received a median distress score of zero. These were "fear of dying when sleeping" (item 47) and "having a headache after taking a 'breathing treatment' with a bronchodilator" (item 25). Table 17 presents the sample's medians and ranges of distress scores for each item of the pulmonary distress syndrome questionnaire. Items are reported in descending order of quantitated distress.

A number of generalizations can be formulated based on the analysis of the item distress scores on the pulmonary distress syndrome questionnaire. On all items for which the patient could devise coping strategies to enhance adaptation, lower distress levels were reported. Two categories which ranked highest in distress were the performance of difficult

TABLE 17

THE SAMPLE'S MEDIANS AND RANGES OF DISTRESS SCORES FOR EACH ITEM OF THE PULMONARY DISTRESS SYNDROME QUESTIONNAIRE

	Item	Median	Range	
			Min.	Max.
13.	Fast walking one block on level ground	5	5	5
15.	Shortness of breath after climbing one flight of stairs	5	3	5
16.	Performance of heavy work such as mopping the floor, gardening, and mowing the lawn	5	3	5
11.	Fast walking 30 feet on level ground	4	3	5
27.	Adjusting to changes in the weather's humidity	4	3	5
30.	Shortness of breath, wheezing, and chest tightness during an episode of bronchospasm	4	3	5
9.	Shortness of breath when stooping and leaning over to perform a task	4	1	5
4.	Shortness of breath when taking a bath	3	1	5
12.	Slow walking one block on level ground	3	1	5
14.	Fatigue after climbing one flight of stairs	3	1	5
19.	Difficulty blowing all the air from your lungs after a deep breath	3	1	5
22.	Interference with a good night's sleep because of shortness of breath	3	1	5

TABLE 17--Continued

	Item	Median	Range	
			Min.	Max.
28.	Adjusting to changes in the weather's temperature	3	1	5
31.	Having a sudden hospitalization for a worsening in your condition that you had not planned	3	1	5
39.	Having a chronic illness which places a financial burden on you and your family	3	1	5
41.	Expressing anger toward another person	3	1	5
20.	Coughing up sputum in the presence of family and friends	3	0	5
32.	Finding that activities require more time to finish	3	0	5
45.	Thinking about your ability to breathe in the future	3	0	5
17.	Difficulty in coughing up sputum	3	2	4
29.	Experiencing repeated episodes of respiratory infections	2	1	5
1.	Feeling tired when you wake up in the morning	2	0	5
7.	Shortness of breath after eating a meal	2	0	5
10.	Slow walking 30 feet on level ground	2	0	5
33.	Spending a large amount of time in bed since the onset of your chronic illness	2	0	5
34.	Spending a large amount of time in one room	2	0	5

TABLE 17--Continued

	Item	Median	Range	
			Min.	Max.
35.	Having to give up hobbies and special interests because of a lack of energy	2	0	5
37.	Talking about your lung problem with friends	2	0	5
38.	Having to depend on others to perform chores for you	2	0	5
40.	Changes in sexual relations with your spouse since onset of your chronic illness	2	0	5
46.	Thinking about the irreversibility of your lung problem	2	0	5
2.	Shortness of breath while dressing	2	0	4
21.	Feeling dependent on your medicines to ease the work of breathing	2	0	4
24.	Feeling nervous after taking a "breathing treatment" with a bronchodilator	2	0	4
36.	Following a treatment program that keeps you from going out and visiting your friends	2	0	4
43.	Not understanding the illness causing your breathing problem	2	0	3
23.	Finding a comfortable position for sleep that will ease the work of breathing	1	0	5
5.	Feeling tired when taking a bath	1	0	4
18.	Difficulty taking a deep breath	1	0	4
26.	Having a bounding pulse after taking a "breathing treatment" with a bronchodilator	1	0	4

TABLE 17--Continued

Item	Median	Range	
		Min.	Max.
8. Having to eat less food at each meal	1	1	3
6. Fatigue after eating a meal	1	0	3
42. Expressing joy and happiness toward another person	1	0	3
44. Not knowing all the reasons for taking your medicines	1	0	3
3. Fatigue while dressing	1	0	2
47. Fear of dying when sleeping	0	0	4
25. Having a headache after taking a "breathing treatment" with a bronchodilator	0	0	1

N=30

physical activities and the ability to cope with the symptomatology of COPD. Items relating to shortness of breath ranked higher in distress than items about fatigue. Difficulty blowing all the air from the lungs ranked higher in distress than difficulty taking a deep breath. Expressing anger toward another person ranked higher in distress than expressing joy and happiness toward another person. In regard to weather, changes in humidity produced greater distress in the COPD patient than changes in temperature.

Statistical Correlation of Variables

The Spearman rho correlation method, a nonparametric measure of relationship, also known as rank-difference correlation (Siegel 1956), was calculated to determine the strength of the relationship between each of the physiologic variables which included number of years of diagnosis of COPD, age of the subject, FEV_1, $FEV_{1\ ABD}$, $PaCO_2$, SaO_2, and resting heart rate. The Spearman rank correlation method was also used to determine the strength of the relationship between the pulmonary distress score and each of the physiological variables which included number of years since initial diagnosis of COPD, age of subject, FEV_1, $FEV_{1\ ABD}$, $PaCO_2$, PaO_2, SaO_2, and resting heart rate. The level of significance of the tested relationships was established at 0.05. The Spearman rho correlation method is subject to less error than the product-moment formula when measurement of the variable has only the power of an ordinal scale and when the sample size is less than thirty (Williams 1968).

The first hypothesis formulated for this study was: there is no relationship between the total distress syndrome of the COPD patient with the resting heart rate. The Spearman rank correlation coefficient was 0.4765 with an associated probability of 0.0078. Therefore, the null hypothesis was rejected at the 0.05 level of significance. The

alternative hypothesis was accepted: there is a significant relationship between the total distress syndrome of the COPD patient with the resting heart rate. It was concluded that the pulmonary distress syndrome of the COPD patient increases as the resting heart rate increases.

The second hypothesis formulated for this study was: there is no relationship between the total distress syndrome of the COPD patient with the FEV_1. The Spearman rank correlation coefficient was -0.9784 with an associated probability of 0.0001. Therefore, the null hypothesis was rejected at the 0.05 level of significance. The alternative hypothesis was accepted: there is a significant relationship between the total distress syndrome of the COPD patient with the FEV_1. It was concluded that the pulmonary distress syndrome of the COPD patient increases as the FEV_1 decreases.

The third hypothesis formulated for this study was: there is no relationship between the total distress syndrome of the COPD patient with the $FEV_{1\ ABD}$. The Spearman rank correlation coefficient was -0.9608 with an associated probability of 0.0001. Therefore, the null hypothesis was rejected at the 0.05 level of significance. The alternative hypothesis was accepted: there is a significant relationship between the total distress syndrome of the COPD patient

with the $FEV_{1\ ABD}$. It was concluded that the total distress syndrome of the COPD patient increases as $FEV_{1\ ABD}$ decreases.

The fourth hypothesis formulated for this study stated: there is no relationship between the total distress syndrome of the COPD patient with the baseline $PaCO_2$. The Spearman rank correlation coefficient was 0.5242 with an associated probability of 0.0030. Therefore, the null hypothesis was rejected at the 0.05 level of significance. The alternative hypothesis was accepted: there is a significant relationship between the total distress syndrome of the COPD patient with the baseline $PaCO_2$. It was concluded that the total distress syndrome of the COPD patient increases as the $PaCO_2$ increases.

The fifth hypothesis formulated for this study stated: there is no relationship between the total distress syndrome of the COPD patient with the baseline PaO_2. The Spearman rank correlation coefficient was -0.6732 with an associated probability of 0.0001. Therefore, the null hypothesis was rejected at the 0.05 level of significance. The alternative hypothesis was accepted: there is a significant relationship between the total distress syndrome of the COPD patient with the baseline PaO_2. It was concluded

that the total distress syndrome of the COPD patient increases as the baseline PaO_2 decreases.

The sixth hypothesis formulated for this study stated: there is no relationship between the total distress syndrome of the COPD patient with the baseline SaO_2. The Spearman rank correlation coefficient was -0.7894 with an associated probability of 0.0001. Therefore, the null hypothesis was rejected at the 0.05 level of significance. The alternative hypothesis was accepted: there is a significant relationship between the total distress syndrome of the COPD patient with the baseline SaO_2. It was concluded that the total distress syndrome of the COPD patient increases as the baseline SaO_2 decreases.

Two statistically nonsignificant relationships were identified. First, there is no significant relationship between the total distress syndrome of the COPD patient with the years of age of the COPD patient. The Spearman rank correlation coefficient was -0.0830 with an associated probability of 0.6627. Second, there is no relationship between the total distress syndrome of the COPD patient with the number of years of diagnosis of COPD. The Spearman rank correlation coefficient was -0.0304 with an associated probability of 0.8732.

The correlation coefficients of the physiological variables with the total distress syndrome of the COPD patient varied as to the degree of correlation. The variables are listed by descending order of degree of correlation in table 18.

TABLE 18

CORRELATIONS OF THE PHYSIOLOGICAL VARIABLES WITH THE TOTAL DISTRESS SCORES OF THE SAMPLE

Physiological Variables	Total Distress Score	
	r_s	Significance Level
FEV_1	-0.9784	0.0001
$FEV_{1\ ABD}$	-0.9608	0.0001
SaO_2	-0.7894	0.0001
PaO_2	-0.6732	0.0001
$PaCO_2$	0.5242	0.0030
Heart rate	0.4765	0.0078
Age	-0.0830	0.6627*
Years since initial COPD diagnosis	-0.0304	0.8732*

N=30

$p \leq 0.05$

*Nonsignificant relationship

The relationships between physiological variables of the sample included thirteen statistically significant correlations. The correlations of FEV_1 with $FEV_{1\ ABD}$, total distress score of the COPD patient, SaO_2, PaO_2, $PaCO_2$, and resting heart rate were found to be statistically significant at the 0.05 level. The correlations of FEV_1 with the years since initial diagnosis of COPD and age of subject were not found to be statistically significant. Table 19 summarizes these data.

The correlations of $FEV_{1\ ABD}$ with FEV_1, total distress score of the COPD patient, SaO_2, PaO_2, $PaCO_2$, and resting heart rate were found to be statistically significant at the 0.05 level.

The correlations of $FEV_{1\ ABD}$ with age of subject and years since initial COPD diagnosis were not found to be statistically significant. Table 20 summarizes these data.

The correlations of $PaCO_2$ with SaO_2, FEV_1, total distress score, $FEV_{1\ ABD}$, resting heart rate, and PaO_2 were found to be statistically significant at the 0.05 level. The correlations of $PaCO_2$ with the age of the subject and the years since initial COPD diagnosis were not found to be statistically significant. Table 21 summarizes these data.

The correlations of PaO_2 with SaO_2, total distress score, FEV_1, $FEV_{1\ ABD}$, and $PaCO_2$ were found to be statistically significant at the 0.05 level. The correlations

TABLE 19

CORRELATIONS OF FEV_1 WITH PHYSIOLOGICAL VARIABLES AND THE TOTAL DISTRESS SCORES OF THE SAMPLE

Physiological Variables	FEV_1	
	r_s	Significance Level
$FEV_{1\ ABD}$	0.9785	0.0001
Total distress score	-0.9784	0.0001
SaO_2	0.7619	0.0001
PaO_2	0.6652	0.0001
$PaCO_2$	-0.5243	0.0029
Heart rate	-0.4716	0.0085
Years since initial COPD diagnosis	-0.0472	0.8045*
Age	0.0403	0.8327*

N=30

$p \leq 0.05$

*Nonsignificant relationship

of PaO_2 with resting heart rate, age of subject, and years since initial COPD diagnosis were not found to be statistically significant. Table 22 summarizes these data.

The correlations of SaO_2 with PaO_2, total distress score, FEV_1, $FEV_{1\ ABD}$, and $PaCO_2$ were found to be statistically significant at the 0.05 level. The correlations of SaO_2 with resting heart rate, years since initial COPD

TABLE 20

CORRELATIONS OF $FEV_{1\ ABD}$ WITH PHYSIOLOGICAL VARIABLES AND THE TOTAL DISTRESS SCORES OF THE SAMPLE

Physiological Variables	$FEV_{1\ ABD}$	
	r_s	Significance Level
FEV_1	0.9785	0.0001
Total distress score	-0.9608	0.0001
SaO_2	0.7337	0.0001
PaO_2	0.5905	0.0006
$PaCO_2$	-0.5032	0.0046
Heart rate	-0.4701	0.0088
Age	0.0580	0.7607*
Years since initial COPD diagnosis	-0.0295	0.8771*

N=30

$p \leq 0.05$

*Nonsignificant relationship

diagnosis, and age of subject were not found to be statistically significant. These data are summarized in table 23.

The correlations of resting heart rate with the total distress score, $PaCO_2$, FEV_1, and $FEV_{1\ ABD}$ were found to be statistically significant at the 0.05 level. The correlations of resting heart rate with SaO_2, PaO_2, age of subject and years since initial COPD diagnosis were not

TABLE 21

CORRELATIONS OF $PaCO_2$ WITH THE PHYSIOLOGICAL VARIABLES AND TOTAL DISTRESS SCORES OF THE SAMPLE

Physiological Variables	$PaCO_2$	
	r_s	Significance Level
SaO_2	-0.5814	0.0008
FEV_1	-0.5243	0.0029
Total distress score	0.5242	0.0030
$FEV_{1\ ABD}$	-0.5032	0.0046
Heart rate	0.4760	0.0078
PaO_2	-0.4248	0.0193
Age	-0.1808	0.3391*
Years since initial COPD diagnosis	0.0898	0.6370*

N=30

$p \leq 0.05$

*Nonsignificant relationship

found to be statistically significant. These data are summarized in table 24.

Multiple Linear Regression Analysis

Multiple linear regression analysis was used to predict the total distress score from the combined physiological variables. The multiple linear regression equation

TABLE 22

CORRELATIONS OF PaO_2 WITH THE PHYSIOLOGICAL VARIABLES AND TOTAL DISTRESS SCORES OF THE SAMPLE

Physiological Variables	PaO_2	
	r_s	Significance Level
SaO_2	0.8360	0.0001
Total distress score	-0.6732	0.0001
FEV_1	0.6652	0.0001
$FEV_{1\ ABD}$	0.5905	0.0006
$PaCO_2$	-0.4248	0.0193
Heart rate	-0.1052	0.5800*
Age	-0.0438	0.8183*
Years since initial COPD diagnosis	0.0236	0.9016*

N=30

$p \leq 0.05$

*Nonsignificant relationship

derived from this analysis specified the form of the relationship of the dependent variable with the independent variables. In this study the total pulmonary distress score was designated as the dependent variable. The multiple regression equation was:

TABLE 23

CORRELATIONS OF SaO_2 WITH THE PHYSIOLOGICAL VARIABLES AND TOTAL DISTRESS SCORES OF THE SAMPLE

Physiological Variables	SaO_2	
	r_s	Significance Level
PaO_2	0.8360	0.0001
Total distress score	-0.7894	0.0001
FEV_1	0.7619	0.0001
$FEV_{1\ ABD}$	0.7337	0.0001
$PaCO_2$	-0.5814	0.0008
Heart rate	-0.3015	0.1054*
Years since initial COPD diagnosis	0.0926	0.6267*
Age	0.0083	0.9654*

N=30

$p \leq 0.05$

*Nonsignificant relationship

Predicted total pulmonary distress score =
322.75 + 0.1907 resting heart rate - 91.7480 FEV_1 - 8.8513 $FEV_{1\ ABD}$ - 0.1195 $PaCO_2$ + 0.0533 PaO_2 - 1.3828 SaO_2

Analysis revealed that 96.3 percent of the variation in the dependent variable, the total pulmonary distress score, was accounted for by its relationship to the physiological variables including resting heart rate, FEV_1, $FEV_{1\ ABD}$, $PaCO_2$, PaO_2, and SaO_2.

TABLE 24

CORRELATIONS OF RESTING HEART RATE WITH THE PHYSIOLOGICAL VARIABLES AND TOTAL DISTRESS SCORES OF THE SAMPLE

Physiological Variables	Resting Heart Rate	
	r_s	Significance Level
Total distress score	0.4765	0.0078
$PaCO_2$	0.4760	0.0078
FEV_1	-0.4716	0.0085
$FEV_{1\ ABD}$	-0.4701	0.0088
SaO_2	-0.3015	0.1054*
PaO_2	-0.1052	0.5800*
Age	-0.1065	0.5755*
Years since initial COPD diagnosis	-0.0419	0.8259*

N=30

$p \leq 0.05$

*Nonsignificant relationship

The seventh hypothesis formulated for this study stated: there is no relationship between the total distress score of the COPD patient with the combined physiological variables including resting heart rate, FEV_1, $FEV_{1\ ABD}$, baseline $PaCO_2$, baseline PaO_2, and baseline SaO_2. The multiple correlation coefficient computed was 0.981 with an associated probability of 0.0001. This was a highly

significant relationship at the 0.05 level of significance. Therefore, the null hypothesis was rejected. The alternative hypothesis was accepted: there is a significant relationship between the total distress score of the COPD patient with the combined physiological variables including resting heart rate, FEV_1, $FEV_{1\ ABD}$, baseline $PaCO_2$, baseline PaO_2, and baseline SaO_2.

The observed value of the total pulmonary distress score for each subject correlated closely with the predicted value from the multiple linear regression techniques. Table 25 contains observed and predicted values of the total pulmonary distress score of each subject of the sample.

TABLE 25

OBSERVED VALUES AND PREDICTED VALUES OF THE TOTAL DISTRESS SCORES OF THE SAMPLE USING MULTIPLE LINEAR REGRESSION ANALYSIS

Observation	FEV_1 of Subject	Observed Value	Predicted Value	Residual
1	0.40	190	184.1	5.9
2	0.43	173	176.2	-3.2
3	0.44	192	182.1	9.7
4	0.46	176	183.3	-7.3
5	0.49	170	171.8	-1.8
6	0.51	163	166.7	-3.7
7	0.56	163	161.6	1.4
8	0.71	159	154.8	4.2
9	0.72	144	150.6	-6.6

TABLE 25--Continued

Observation	FEV_1 of Subject	Observed Value	Predicted Value	Residual
10	0.73	147	146.8	0.2
11	0.76	151	136.5	14.5
12	0.88	151	127.8	23.2
13	0.94	98	117.2	-19.2
14	0.99	106	117.8	-11.8
15	1.00	111	114.1	-3.1
16	1.00	105	114.7	-9.7
17	1.04	108	109.1	-1.1
18	1.04	99	108.7	-9.7
19	1.12	102	104.7	-2.7
20	1.13	101	101.3	-0.3
21	1.26	94	86.5	7.5
22	1.27	85	81.5	3.5
23	1.29	88	84.6	3.4
24	1.32	85	79.6	5.4
25	1.36	77	75.7	1.3
26	1.40	74	74.8	-0.8
27	1.43	68	67.8	0.2
28	1.46	67	69.0	-2.0
29	1.50	59	58.3	0.7
30	1.55	56	54.2	1.8

N=30

Summary

This chapter discussed the analysis and treatment of data collected from a sample of thirty COPD patients

in two hospitals in a Southwest metropolis. Data were collected from medical records and patient interviews. The characteristics of the sample were summarized by frequency distributions. The mean, standard deviation, and range were calculated for each of the physiological variables. The sum of the pulmonary distress scores obtained from the pulmonary distress syndrome questionnaire was computed for each subject. The median value and the range values were reported for each item. Items were ranked in descending order of quantitated distress. The Spearman rank correlation coefficient was computed to determine the significance of relationships between the designated variables of this study. Multiple linear regression analysis was used to relate the dependent variable, the total pulmonary distress score of the subject, to the independent variables. Statistically significant relationships were obtained for all seven hypotheses formulated for this study. Therefore, the seven null hypotheses were rejected and the alternative hypotheses were accepted.

CHAPTER V

SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

A quantitative-descriptive research study was conducted for the purposes of:

1. Assessing the distress level of events in the daily life of the COPD patient
2. Determining the relationship of the total distress syndrome of the COPD patient with the resting heart rate
3. Determining the relationship of the total distress syndrome of the COPD patient with the FEV_1
4. Determining the relationship of the total distress syndrome of the COPD patient with the $FEV_{1\ ABD}$
5. Determining the relationship of the total distress syndrome of the COPD patient with the baseline $PaCO_2$
6. Determining the relationship of the total distress syndrome of the COPD patient with the baseline PaO_2

7. Determining the relationship of the total distress syndrome of the COPD patient with the baseline

8. Determining the relationship of the total distress syndrome of the COPD patient with the combined physiological variables including resting heart rate, FEV_1, $FEV_{1\ ABD}$, baseline $PaCO_2$, baseline PaO_2, and baseline SaO_2

This investigation was undertaken in two hospitals in a Southwest metropolis. The sample for this study was composed of thirty male COPD patients divided into three subgroups according to FEV_1. Data were collected from medical records and from patient interviews. Values for the pulmonary distress syndrome were obtained from a forty-seven item questionnaire developed to rank the distress levels of events in the daily life of the COPD patient. The total pulmonary distress score was computed for each subject. Items were ranked in descending order of quantitated distress. Median and range values were reported for each item.

The Spearman rank correlation coefficient was computed to determine the significance of relationships between the total pulmonary distress score and each of the physiological variables including resting heart rate, FEV_1,

$FEV_{1\ ABD}$, baseline $PaCO_2$, baseline PaO_2, and baseline SaO_2. The strength of the relationship between each pair of physiological variables was also analyzed by the Spearman rank correlation method. Multiple linear regression analysis was used to relate the total distress score to the combined physiological variables.

Statistically significant relationships were obtained for all seven hypotheses formulated for this study. Therefore, the seven null hypotheses were rejected and the alternative hypotheses were accepted. Analysis also indicated that there were thirteen statistically significant relationshps between the physiological variables. It was concluded that the total pulmonary distress syndrome of the COPD patient varies inversely with the FEV_1, $FEV_{1\ ABD}$, baseline PaO_2, and baseline SaO_2. The total pulmonary distress syndrome varies directly with the baseline $PaCO_2$ and resting heart rate.

Conclusions

On the basis of the data obtained from this investigation, the following conclusions are warranted. The conclusion can be drawn that stress theory is applicable to the assessment component of the nursing process. The COPD patient's perceived distress of events in daily living were quantitated and correlated with the degree of his

physiological impairment. The clinically important features of COPD significantly correlated with the patient's prognosis, as documented by serial studies (Renzetti, McClement, and Litt 1966; Jones, Burrows, and Fletcher 1967; Burrows and Earle 1969; Bousky et al. 1973; and Diener and Burrows 1975), were shown to be significantly correlated with the patient's pulmonary distress syndrome.

Significant relationships were also identified between the physiological indices of impairment in COPD. When combined, the physiological variables were successful in predicting levels of pulmonary distress of the COPD patient by multiple linear regression analysis. This is the prediction of an expected patient outcome that the nurse would encounter in the clinical setting. This information contributes to the knowledge base from which the nurse operates to assess the COPD patient, diagnose problems, design a plan of care, implement the plan, and evaluate the effects.

Implications

This study was concerned with the relationship of selected physiological variables with the total distress syndrome of the COPD patient. The findings demonstrate there are significant relationships between each of the physiological variables and the total distress syndrome of

the COPD patient have implications for nursing education, nursing practice, and nursing reserach.

In regard to nursing education, it is recommended that the nursing student utilize stress theory as a perspective for comprehending the nature of man in health and disease and the nature of the nursing process in relation to these phenomena. Comprehensive and systematic tools should be utilized in the collection of patient data during the assessment process. The nursing student should be made aware of the stressors in the life of the COPD patient including the ADL, disabling symptomatology, components of the medical regime, and psychosocial factors. The significance of ABG analysis and pulmonary function test analysis should be emphasized. The nursing student should recognize the relation of these physiological variables to the total pulmonary distress syndrome of the COPD patient.

In regard to continuing education, health care agencies providing episodic and/or distributive care to COPD patients should have an ongoing inservice program to maintain the competency of nurses in delivering optimum care. Such a program should include content focusing on the relationship of physiological indices of impairment to the pulmonary distress syndrome of the patient. Agency protocol for the assessment of the patient should contain

systematic and comprehensive tools designed to include data on stressors and on the coping ability of the COPD patient. Interventions should be based on this data base. In addition, inservice education of critical care nurses should focus on the interpretation and application of ABG and pulmonary function test analysis to the care of the COPD patient in acute respiratory failure.

Since COPD has become the nation's fastest growing health care problem, universities should design a continuing education course offering specialized knowledge and skills in the health care management of the COPD patient. Course content could include the theory of stress as it relates to the COPD patient and utilization of the nursing process in management of patient care.

In regard to the practice of nursing, the clinical nurse should recognize the relationship of physiological indices of impairment of the COPD patient with the patient's total pulmonary distress syndrome. She should be knowledgable in the interpretation of ABG analysis and pulmonary function test analysis. This information should be applied to the care of the patient. During the assessment phase of the nursing process, the COPD patient should be involved in the identification of stressors that impair his ability to cope. Such data should be collected via a comprehensive

and systematic assessment tool. The combined pathophysiological status of the patient with the assessment of the patient's ability to function provides the nurse with a knowledge base for the diagnosing of patient problems, planning of care, intervention, and evaluation. The clinical nurse should develop competency in the identification of problems in the clinical setting related to the delivery of health care to the patient. This information should be communicated to nurse researchers for the consideration of designing nursing studies to explore these problems.

Research undertaken by nurses has the potential of shaping the direction of nursing in the future. It is suggested that nurse reserachers focus their efforts on studies described under "recommendations."

Recommendations

The following recommendations are suggested as a result of this study:

1. That variations of this study be replicated
2. That further investigation be made into means of measuring distress levels of the COPD patient
3. That exploratory studies be conducted to identify stressors specific to patients with other particular disease entities

4. That a quantitative-descriptive study be conducted to examine the relationship of selected physiological variables with the distress syndrome of patients diagnosed with a chronic disease entity such as chronic renal failure, diabetes mellitus, coronary artery disease, hypertension, or a neuromuscular disorder

5. That a study be conducted to determine the relation of the psychosocial assets of the COPD patient with the total pulmonary distress syndrome

6. That a study be conducted to determine if there are significant differences in the total pulmonary distress syndrome among "pink puffers," "blue bloaters," and indeterminate COPD patients

7. That a study be conducted to determine the relationship between the COPD patient's compliance to the medical regimen and the total pulmonary distress syndrome

8. That a longitudinal study be conducted to determine the relation of the total distress syndrome with the rate of survival of the COPD patient

APPENDIXES

APPENDIX A

TEXAS WOMAN'S UNIVERSITY
COLLEGE OF NURSING
DENTON, TEXAS

DALLAS CENTER
1810 Inwood Road
Dallas, Texas 75235

HOUSTON CENTER
1130 M.D. Anderson Blvd.
Houston, Texas 77025

AGENCY PERMISSION FOR CONDUCTING STUDY*

THE Veterans Administration Hospital

GRANTS TO Priscilla Pillet

a student enrolled in a program of nursing leading to a Master's Degree at Texas Woman's University, the privilege of its facilities in order to study the following problem:

The problem of this study will be to examine the relationship of selected physiological variables with the total distress syndrome of the COPD patient.

The conditions mutually agreed upon are as follows:

1. The agency (may) (~~may not~~) be identified in the final report.
2. The names of consultative or administrative personnel in the agency (~~may~~) (may not) be identified in the final report.
3. The agency (wants) (~~does not want~~) a conference with the student when the report is completed.
4. The agency is (willing) (~~unwilling~~) to allow the completed report to be circulated through interlibrary loan.
5. Other: _____

Date 21 February 78

Walter Peak
Signature of Agency Personnel

Priscilla Pillet
Signature of student

Gretchen M. Gross
Signature of Faculty Advisor

*Fill out and sign three copies to be distributed as follows: Original - Student; first copy - agency; second copy - T.W.U. College of Nursing.

TEXAS WOMAN'S UNIVERSITY
COLLEGE OF NURSING
DENTON, TEXAS

DALLAS CENTER
1810 Inwood Road
Dallas, Texas 75235

HOUSTON CENTER
1130 M.D. Anderson Blvd.
Houston, Texas 77025

AGENCY PERMISSION FOR CONDUCTING STUDY*

THE Parkland Memorial Hospital

GRANTS TO Priscilla Pillet

a student enrolled in a program of nursing leading to a Master's Degree at Texas Woman's University, the privilege of its facilities in order to study the following problem:

The problem of this study will be to examine the relationship of selected physiological variables with the total distress syndrome of the COPD patient.

The conditions mutually agreed upon are as follows:

1. The agency (may) (~~may not~~) be identified in the final report.
2. The names of consultative or administrative personnel in the agency (may) (~~may not~~) be identified in the final report.
3. The agency (~~wants~~) (does not want) a conference with the student when the report is completed.
4. The agency is (willing) (~~unwilling~~) to allow the completed report to be circulated through interlibrary loan.
5. Other: Names like copy of analysis of data

Date September 12, 1977

Signature of Agency Personnel

Priscilla Pillet
Signature of student

Geraldine M. Hoosen
Signature of Faculty Advisor

Phone: 331-1220

*Fill out and sign three copies to be distributed as follows: Original -- Student; first copy -- agency; second copy -- T.W.U. College of Nursing.

APPENDIX B

TEXAS WOMAN'S UNIVERSITY

Human Research Committee

Name of Investigator: Priscilla Pillet Center: Dallas

Address: 2905 W. Pentagon Pkwy., #205 Date: 10/27/77

Dallas, Texas 75233

Dear Ms. Pillet:

Your study entitled Chronic Obstructive Pulmonary Disease: A Comparison of Total Distress Syndrome with Selected Physiological Parameters has been reviewed by a committee of the Human Research Review Committee and it appears to meet our requirements in regard to protection of the individual's rights.

Please be reminded that both the University and the Department of Health, Education and Welfare regulations require that written consents must be obtained from all human subjects in your studies. These forms must be kept on file by you.

Furthermore, should your project change, another review by the Committee is required, according to DHEW regulations.

Sincerely,

Gendolin M. Gonce

Chairman, Human Research Review Committee at Dallas.

APPENDIX C

DEMOGRAPHIC DATA

Date:_____ Age:_____ Race:_____

Marital status: Single___ Married___ Divorced___
Widowed___

Educational level:

Grade school level_____

High school level _____

Some college _____

College graduate _____

Annual income: up to $5,000____ $10,000 to $30,000____

$5,000 to $10,000____ over $30,000____

Living with family____ With other ____ Alone____

Total number of hospitalizations for COPD____

Number of years since first diagnosed with COPD____

Smoking: PPD____ x years____

Disability rating:

A___Unlimited ability to work at usual occupation

B___Limited ability to work at any occupation

C___Inability to work but ability to carry out ADL

D___Dependent on others to carry out ADL

APPENDIX D

PULMONARY DISTRESS SYNDROME QUESTIONNAIRE

Key: 0 = No distress
5 = Severe distress

1.	Feeling tired when you wake up in the morning	0	1	2	3	4	5
2.	Shortness of breath while dressing	0	1	2	3	4	5
3.	Fatigue while dressing	0	1	2	3	4	5
4.	Shortness of breath when taking a bath	0	1	2	3	4	5
5.	Feeling tired when taking a bath	0	1	2	3	4	5
6.	Fatigue after eating a meal	0	1	2	3	4	5
7.	Shortness of breath after eating a meal	0	1	2	3	4	5
8.	Having to eat less food at each meal	0	1	2	3	4	5
9.	Shortness of breath when stooping and leaning over to perform a task	0	1	2	3	4	5
10.	Slow walking 30 feet on level ground	0	1	2	3	4	5
11.	Fast walking 30 feet on level ground	0	1	2	3	4	5
12.	Slow walking one block on level ground	0	1	2	3	4	5
13.	Fast walking one block on level ground	0	1	2	3	4	5
14.	Fatigue after climbing one flight of stairs	0	1	2	3	4	5
15.	Shortness of breath after climbing one flight of stairs	0	1	2	3	4	5

16.	Performance of heavy work such as mopping the floor, gardening, and mowing the lawn	0	1	2	3	4	5
17.	Difficulty in coughing up sputum	0	1	2	3	4	5
18.	Difficulty taking a deep breath	0	1	2	3	4	5
19.	Difficulty blowing all the air from your lungs after a deep breath	0	1	2	3	4	5
20.	Coughing up sputum in the presence of family and friends	0	1	2	3	4	5
21.	Feeling dependent on your medicines to ease the work of breathing	0	1	2	3	4	5
22.	Interference with a good night's sleep because of shortness of breath	0	1	2	3	4	5
23.	Finding a comfortable position for sleep that will ease the work of breathing	0	1	2	3	4	5
24.	Feeling nervous after taking a "breathing treatment" with a bronchodilator	0	1	2	3	4	5
25.	Having a headache after taking a "breathing treatment" with a bronchodilator	0	1	2	3	4	5
26.	Having a bounding pulse after taking a "breathing treatment" with a bronchodilator	0	1	2	3	4	5
27.	Adjusting to changes in the weather's humidity	0	1	2	3	4	5
28.	Adjusting to changes in the weather's temperature	0	1	2	3	4	5
29.	Experiencing repeated episodes of respiratory infections	0	1	2	3	4	5

30.	Shortness of breath, wheezing, and chest tightness during an episode of bronchospasm	0	1	2	3	4	5
31.	Having a sudden hospitalization for a worsening in your condition that you had not planned	0	1	2	3	4	5
32.	Finding that activities require more time to finish	0	1	2	3	4	5
33.	Spending a large amount of time in bed since the onset of your chronic illness	0	1	2	3	4	5
34.	Spending a large amount of time in one room	0	1	2	3	4	5
35.	Having to give up hobbies and special interests because of a lack of energy	0	1	2	3	4	5
36.	Following a treatment program that keeps you from going out and visiting friends	0	1	2	3	4	5
37.	Talking about your lung problem with friends	0	1	2	3	4	5
38.	Having to depend on others to perform chores for you	0	1	2	3	4	5
39.	Having a chronic illness which places a financial burden on you and your family	0	1	2	3	4	5
40.	Changes in sexual relations with your spouse since the onset of your chronic illness	0	1	2	3	4	5
41.	Expressing anger toward another person	0	1	2	3	4	5
42.	Expressing joy and happiness toward another person	0	1	2	3	4	5
43.	Not understanding the illness causing your breathing problem	0	1	2	3	4	5

44.	Not knowing all the reasons for taking your medicines	0	1	2	3	4	5
45.	Thinking about your ability to breathe in the future	0	1	2	3	4	5
46.	Thinking about the irreversibility of your lung problem	0	1	2	3	4	5
47.	Fear of dying when sleeping	0	1	2	3	4	5

APPENDIX E

TEXAS WOMAN'S UNIVERSITY
COLLEGE OF NURSING
DALLAS CENTER

Faculty Advisor: Geraldine M. Goosen

Student: Priscilla Pillet
2905 W. Pentagon Pkwy., #205
Dallas, Texas 75233
331-1220

I am a T.W.U. graduate student specializing in nursing of pulmonary patients. I would appreciate your time and effort in examining the following assessment tool designed to measure distress levels of COPD patients associated with events in their daily life. The Likert-type scale for each item ranges from zero, no distress, to five, severe distress. The subject will respond to each item by selecting the numeral that represents his distress level for that particular event.

Please examine the content of the assessment tool for clarity and conciseness. Identify any items you consider inappropriate or ambiguous. Feel free to suggest areas of content not included on this tool.

PULMONARY DISTRESS SYNDROME QUESTIONNAIRE

Key: 0 = No distress
5 = Severe distress

1.	Feeling tired when you wake up in the morning	0	1	2	3	4	5
2.	Shortness of breath when taking a bath	0	1	2	3	4	5
3.	Fatigue after eating a meal	0	1	2	3	4	5
4.	Stooping and leaning over to perform a task	0	1	2	3	4	5
5.	Climbing one flight of stairs	0	1	2	3	4	5
6.	Finding that activities require more time to finish	0	1	2	3	4	5
7.	Feeling tired when taking a bath	0	1	2	3	4	5
8.	Interference with a good night's sleep because of shortness of breath	0	1	2	3	4	5
9.	Walking ten feet on level ground	0	1	2	3	4	5
10.	Spending a large amount of time in bed since the onset of your chronic illness	0	1	2	3	4	5
11.	Shortness of breath after eating a meal	0	1	2	3	4	5
12.	Finding a comfortable position for sleep that will ease the work of breathing	0	1	2	3	4	5
13.	Having to give up hobbies and special interests because of a lack of energy	0	1	2	3	4	5
14.	Spending a large amount of time in one room	0	1	2	3	4	5

15.	Having to eat less food at each meal	0	1	2	3	4	5
16.	Not understanding the illness causing your breathing problem	0	1	2	3	4	5
17.	Difficulty in coughing sputum up	0	1	2	3	4	5
18.	Difficulty taking a deep breath	0	1	2	3	4	5
19.	Difficulty blowing all the air from your lungs after a deep breath	0	1	2	3	4	5
20.	Feeling nervous after taking a "breathing treatment" with a bronchodilator	0	1	2	3	4	5
21.	Adjusting to changes in the weather's humidity	0	1	2	3	4	5
22.	Adjusting to changes in the weather's temperature	0	1	2	3	4	5
23.	Having a sudden hospitalization for a worsening in your condition that you had not planned	0	1	2	3	4	5
24.	Having a headache after taking a "breathing treatment" with a bronchodilator	0	1	2	3	4	5
25.	Feeling dependent on your medicines to ease the work of breathing	0	1	2	3	4	5
26.	Not knowing all the reasons for taking your medicines	0	1	2	3	4	5
27.	Having a bounding pulse after taking a "breathing treatment" with a bronchodilator	0	1	2	3	4	5
28.	Thinking about your ability to breathe in the future	0	1	2	3	4	5
29.	Thinking about the irreversibility of your lung problem	0	1	2	3	4	5

30.	Following a treatment program that keeps you from going out and visiting friends	0	1	2	3	4	5
31.	Talking about your lung problem with friends	0	1	2	3	4	5
32.	Having to depend on others to perform chores for you	0	1	2	3	4	5
33.	Coughing up sputum in the presence of family and friends	0	1	2	3	4	5
34.	Expressing anger toward another person	0	1	2	3	4	5
35.	Having a chronic illness which places a financial burden on you and your family	0	1	2	3	4	5
36.	Changes in sexual relations with your spouse since the onset of your chronic illness	0	1	2	3	4	5
37.	Expressing joy and happiness toward another person	0	1	2	3	4	5

COMMENTS:

DELETIONS:

ADDITIONS:

Thank you for your time and cooperation. Your responses will not be identified.

APPENDIX F

TEXAS WOMAN'S UNIVERSITY

(Form B--Oral presentation to subject)

Consent to Act as a Subject for Research and Investigation:

I have received an oral description of this study, including a fair explanation of the procedures and their purpose, any associated discomforts or risks, and a description of the possible benefits. An offer has been made to me to answer all questions about the study. I understand that my name will not be used in any release of the data and that I am free to withdraw at any time.

_____ _____
Signature Date

_____ _____
Witness Date

Certification by Person Explaining the Study:

This is to certify that I have fully informed and explained to the above named person a description of the listed elements of informed consent.

_____ _____
Signature Date

_____
Position

_____ _____
Witness Date

APPENDIX G

DEMOGRAPHIC DATA LEGEND

Race: W--white
B--black

Marital status: M--married
D--divorced
s--single
W--widow

Disability rating:

A--unlimited ability to work at usual occupation
B--limited ability to work at any occupation
C--inability to work but ability to carry out ADL
D--dependent on others to carry out ADL

TABLE 26

DEMOGRAPHIC DATA OF SUBGROUP FEV_1<0.75 L

Subject FEV_1 and Diagnosis	Age	Race	Marital Status	Educational Level	Annual Income $	Living Situation	Disability Rating	Number years Dx COPD	No. Hospital Admissions for COPD	PPD Cigarettes Smoked x Years
0.40 Emphysema: alpha$_1$-antitrypsin deficiency	48	W	M	college graduate	10,000-30,000	family	D	10	10	2 x 25
0.43 Chronic bronchitis emphysema	60	B	D	grade school	5,000-10,000	Other	D	20	>10	2 x 25
0.44 Asthmatic bronchitis	65	W	W	grade school	5,000-10,000	family	D	15	10	3 x 25
0.46 Emphysema	62	B	M	grade school	5,000-10,000	family	D	18	>10	2 x 40
0.49 Chronic bronchitis	56	W	M	high school	5,000-10,000	family	D	15	>10	2 x 35
0.51 Chronic bronchitis emphysema	54	W	S	college graduate	10,000-30,000	family	D	12	>10	2 x 30
0.56 Chronic bronchitis emphysema	60	B	S	college graduate	10,000-30,000	family	D	20	>10	2 x 40
0.71 Chronic bronchitis emphysema	50	W	M	grade school	5,000-10,000	family	D	15	10	3 x 35

TABLE 26--Continued

Subject FEV_1 and Diagnosis	Age	Race	Marital Status	Educational Level	Annual Income $	Living Situation	Disability Rating	Number years Dx COPD	No. Hospital Admissions for COPD	PPD Cigarettes Smoked x Years
0.72 Emphysema: alpha$_1$-antitrypsin deficiency	40	W	D	high school	5,000-10,000	other	C	5	5-10	2 x 20
0.73 Chronic bronchitis emphysema	51	W	D	grade school	5,000-10,000	other	C	10	5-10	3 x 35

TABLE 27

DEMOGRAPHIC DATA OF SUBGROUP FEV_1 0.75-1.25 L

Subject FEV_1 and Diagnosis	Age	Race	Marital Status	Educational Level	Annual Income $	Living Situation	Disability Rating	Number years Dx COPD	No. Hospital Admissions for COPD	PPD Cigarettes Smoked x Years
0.76 Bullous emphysema alpha$_1$-antitrypsin deficiency	54	W	M	high school	10,000-30,000	family	C	15	5	1 x 20
0.88 Asthmatic bronchitis emphysema	54	W	M	grade school	5,000-10,000	family	D	10	>10	1 x 30
0.94 Asthmatic bronchitis	63	W	D	grade school	10,000-30,000	alone	C	30	5	2-3 x 30
0.99 Emphysema	63	W	M	grade school	10,000-30,000	family	D	15	< 5	3 x 40
1.00 Emphysema	58	B	D	grade school	5,000-10,000	alone	C	15	5-10	1 x 40
1.00 Chronic bronchitis emphysema	60	B	M	high school	5,000-10,000	family	D	25	5	2 x 40
1.04 Chronic bronchitis emphysema	54	W	S	high school	5,000-10,000	other	D	5	5	3 x 35
1.04 Asthmatic bronchitis	53	B	M	high school	5,000-10,000	family	C	13	< 5	non-smoker

TABLE 27--Continued

Subject FEV_1 and Diagnosis	Age	Race	Marital Status	Educational Level	Annual Income $	Living Situation	Disability Rating	Number years Dx COPD	No. Hospital Admissions for COPD	PPD Cigarettes Smoked x Years
1.12 Emphysema	56	W	M	grade school	5,000-10,000	family	C	4	< 5	1 x 20
1.13 Chronic bronchitis	62	B	M	grade school	5,000-10,000	family	C	10	5-10	2 x 30

TABLE 28

DEMOGRAPHIC DATA OF SUBGROUP FEV_1>1.25 l

Subject FEV_1 and Diagnosis	Age	Race	Marital Status	Educational Level	Annual Income $	Living Situation	Disability Rating	Number years DX COPD	No. Hospital Admissions for COPD	PPD Cigarettes Smoked x Years
1.26 Chronic bronchitis emphysema	50	B	D	some college	10,000-30,000	alone	C	6	5	2 x 25
1.27 Asthmatic bronchitis	48	W	M	high school	10,000-30,000	family	B	12	5	non-smoker
1.29 Chronic bronchitis	49	B	M	grade school	5,000-10,000	family	C	8	4	2 x 20
1.32 Chronic bronchitis	59	B	M	high school	5,000-10,000	family	C	15	5	1 x 35
1.36 Emphysema	57	W	D	college graduate	10,000-30,000	other	C	7	3	2 x 40
1.40 Chronic bronchitis	58	W	D	grade school	5,000-10,000	other	C	12	2	2 x 35
1.43 Chronic bronchitis	57	W	M	some college	10,000-30,000	family	C	8	2	1 x 20
1.46 Chronic bronchitis emphysema	64	B	M	grade school	5,000-10,000	family	C	10	5	1 x 40

TABLE 28--Continued

Subject FEV_1 and Diagnosis		Age	Race	Marital Status	Educational Level	Annual Income $	Living Situation	Disability Rating	Number years Dx COPD	No. Hospital Admissions for COPD	PPD Cigarettes Smoked x Years
1.50	Asthmatic bronchitis	51	W	M	high school	5,000-10,000	family	B	40	5	non-smoker
1.55	Chronic bronchitis	61	W	D	grade school	5,000-10,000	other	C	15	5	2 x 30

APPENDIX H

TABLE 29

PHYSIOLOGICAL VARIABLES AND TOTAL PULMONARY DISTRESS SCORES OF THE SAMPLE

FEV_1	$FEV_{1\ ABD}$	$PaCO_2$	PaO_2	SaO_2	HR*	PDS≠
0.40	0.60	70.2	40.6	78.6	96 CP≠	190
0.43	0.54	51.8	61.2	85.4	98 CP	173
0.44	0.46	45.8	52.4	81.4	100	192
0.46	0.52	32.4	45.8	78.1	88	176
0.49	0.61	52.0	64.2	85.6	108 CP	170
0.51	0.60	48.3	66.1	87.3	100 CP	163
0.56	0.70	40.3	64.2	87.1	96	163
0.71	0.76	68.8	45.8	78.8	98 CP	159
0.72	0.80	47.2	60.2	85.0	110 CP	144
0.73	0.78	39.6	67.4	86.8	100	147
0.76	0.88	36.6	60.1	91.0	96	151
0.88	1.03	39.2	52.1	87.0	90 CP	151
0.94	1.12	46.5	62.6	89.9	90 CP?	98
0.99	1.13	44.1	50.5	86.4	94	106
1.00	1.15	38.3	59.0	88.8	92	111
1.00	1.17	40.2	57.2	87.5	88 CP	105
1.04	1.22	39.0	58.7	88.2	84 CP	108
1.04	1.20	37.4	60.0	89.3	88	99
1.12	1.14	36.8	70.1	88.0	90	102
1.13	1.29	46.0	80.2	90.4	104 CP	101
1.26	1.40	37.4	80.0	90.3	88	94
1.27	1.38	35.8	83.3	93.6	88	85
1.29	1.40	30.3	65.1	90.0	90	88

TABLE 29--Continued

FEV_1	$FEV_{1\ ABD}$	$PaCO_2$	PaO_2	SaO_2	HR*	PDS≠
1.32	1.77	38.2	58.8	88.6	92 CP≠	85
1.36	1.50	37.6	69.0	89.8	84	77
1.40	1.61	40.5	70.8	89.4	102 CP	74
1.43	1.60	36.2	73.1	90.0	80	68
1.46	1.65	35.4	68.0	88.9	96 CP	67
1.50	1.63	40.2	82.9	93.4	90	59
1.55	1.51	42.4	84.6	94.0	92	56

* Heart rate
≠ Pulmonary distress score
≠ Cor pulmonale

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