Chronic obstructive pulmonary disease (COPD) is defined as a process characterized by the presence of chronic bronchitis or emphysema that may lead to the development of airways obstruction. COPD may range from mild to severe. Health care providers must be involved in the primary prevention of COPD through campaigns to eliminate cigarette smoking and other risk factors and secondary prevention through early detection of airflow obstruction in asymptomatic individuals at risk. They must also implement effective care for those who become symptomatic, and develop rehabilitation programs to slow disease progression among those with more serious airway obstruction.

COPD affects approximately 11% of the US adult population; further, its incidence is increasing, with greater rates of change for women than for men. Cigarette smoking is the most important and best documented risk factor for COPD; air pollution exacerbates the disease and may be a risk factor for its development. There is substantial evidence that childhood infections are also a risk factor for COPD. Further, COPD is aggregated in families, and there is good evidence that those with a severe hereditary deficiency in alpha1-antitrypsin are more susceptible to COPD. Other risk factors include male sex, advanced age, airway hyperactivity, occupational exposure to dusts (particularly for cigarette smokers), and perhaps environmental exposures such as oxidant gases associated with low socioeconomic status. Secondary and tertiary risk factors include exposure to outdoor pollutants and intercurrent infection.

The clinical care of COPD includes avoidance of polluted air, regular influenza vaccinations, and rigorous programs for smoking cessation; augmentation therapy should be considered for those with severe alpha1-antitrypsin deficiency. Symptomatic measures may include the use of bronchodilators, sympathomimetics, anticholinergics, theophylline, and selective use of corticosteroids and antibiotics. Supportive therapy involves nutrition programs to combat progressive weight loss, and psychological treatment for depression and anxiety. It includes comprehensive rehabilitation, home ventilator care, and long-term oxygen therapy for hypoxemic patients. Lung transplantation is also now an option for advanced COPD. Providers should be actively involved in risk factor modification.

Education is essential for the development of new treatment programs for COPD patients. Some of the major targets for improved educational programs include the development of better smoking-cessation methods, dissemination of information on the benefits of early treatment, more widespread efforts to increase the use of influenza vaccinations, programs to enhance patient knowledge and self-care skills, and programs to disseminate information to health care providers. Patient education goals should be directed toward the development of better self-management programs for those with minimal illness, as well as those with more severe disability. Provider education programs should increase the following: (a) the number of physicians who know the risk factors for COPD and how to modify them; (b) the number of physicians who screen for airflow obstruction; and (c) the use of risk factor modification for those with secondary complications. These programs will require both public education campaigns and targeted continuing education programs. Further, these goals might be better achieved if prevention became consistently established in the medical school curriculum.

Health services research goals include the development of better outcome measures, expanded cost/effectiveness studies, and research on the relationship between dysfunction and psychological depression. In addition, it will be important to focus more attention on the high prevalence and the rising incidence of COPD among minority groups and women. Determinants of provider behavior including documentation of appropriate and inappropriate test use will also be important. Finally, more research is necessary to delineate the determinants of patient behaviors, such as cigarette smoking and noncompliance with medical regimens. Experimental evaluations of interventions to remedy these problems should also be undertaken.

Research Recommendations

Epidemiologic Research
- Define interaction of nonmodifiable and environmental risk factors.
- Define host factors in determining impact of cigarette smoke on the lung.
- Define role of maternal smoking (in utero) on later development of COPD.
- Better define role of airway hyperresponsiveness on development of COPD.
- Define role of childhood exposure to ozone and acid aerosols in the development of COPD.
- Better define risk associated with socioeconomic status and race.

Biomedical Research
- Develop improved chemical markers of lung injury.
- Further develop the component parts of the protease-antiprotease systems in relation to lung injury.

Reprint requests: Dr. Edelman, Robert Wood Johnson Medical School, 675 Hoes Lane, Piscataway, New Jersey 08854
• Explore other (than AAT deficiency) genetic causes (pre-dispositions) for development of COPD.

Therapeutic Research
• Define role of antiinflammatory agents in therapy.
• Define optimal methods for prevention of infection.
• Define optimal approach to bronchodilator therapy.
• Define role of respiratory and locomotor muscle conditioning.
• Develop improved methods for ventilatory support.
• Develop improved methods for lung transplantation.
• Develop improved methods for delivery of oxygen to patients.

Research Related to Health Care Delivery
• Develop instruments to assess quality of life in COPD patients and relate quality to function and therapeutic modalities.
• Conduct cost/effectiveness and cost/utility studies in relation to therapeutic modalities.
• Develop economic models of disease impact which evaluate true costs (ie, resource-based as well as charges).
• Define the impact of COPD on affect and develop methods to optimize the treatment of affective impairment in COPD.
• Better define the impact of COPD on minority groups, taking into account confounding variables such as socioeconomic status.
• Define the determinants of the behavior of professionals in discovering and caring for patients with COPD.
• Define the determinants of patient behavior regarding modification of risk factors and participation in therapy.

Nature of the Problem

Definition and Impact of COPD

In a recent review, COPD was defined as, "a process characterized by the presence of chronic bronchitis or emphysema that may lead to the development of airways obstruction; airways obstruction need not be present at all stages of the process; the airway obstruction may be partially reversible." This definition is based upon the following considerations. Most authors extend the term COPD to encompass chronic bronchitis and emphysema. Chronic bronchitis is defined symptomatically in terms of productive cough. Emphysema, on the other hand, is defined anatomically as airspace enlargement with destruction of acinar architecture. The lesion is most definitively identified by pathologic examination of the lungs after surgical excision or at autopsy; however, recent studies report accurate diagnosis of emphysema by means of computerized tomographic scanning. An important concept is that both chronic bronchitis and emphysema may exist without demonstrable airflow obstruction. In chronic bronchitis, the hypersecretory state leading to chronic productive cough may be quite distinct from and correlate poorly with the obstructive process. In emphysema, "early" or highly localized disease may be present without airflow obstruction.

Chronic bronchitis and emphysema often coexist, and airflow obstruction may accompany both disorders. There is often significant reversibility of airflow obstruction after inhalation of a beta-sympathomimetic agonist, and there may be airways hyperresponsiveness following inhalation of methacholine. These are the same features found in asthma. COPD presents along a spectrum, ranging from mild to severe. The ability to prevent or minimize symptoms and disability associated with COPD depends on when one intervenes.

Primary prevention of COPD is directed toward healthy individuals; secondary prevention targets those at risk for the condition; tertiary prevention emphasizes control of COPD among those already affected. Prevention and control of the symptoms associated with COPD requires education and research-based initiatives directed at each level of prevention. Issues in prevention will be described in this report. Before proceeding, however, it is important to review the pathology, clinical features, and epidemiology of the disease.

Pathology: The pathology of COPD is reviewed elsewhere and will not be fully repeated here. The major characteristics of abnormalities in the airways are hypertrophy and hyperplasia of submucosal glands; varying degrees of infiltration of the mucosa with inflammatory cells; varying degrees of smooth muscle hyperplasia; and frequent inflammatory changes in respiratory bronchioles. The respiratory airspace dilation with destruction, which characterizes emphysema, is considered to exist in 2 general patterns: in centriacinar emphysema, the process is largely limited to the respiratory bronchiole and adjacent alveoli in the center of the acinus; in panacinar emphysema, the process is present in all respiratory airspaces. Centriacinar emphysema is associated with prolonged inhalation of agents which are toxic to lung tissue, such as tobacco smoke, while panacinar emphysema is characteristically found in the hereditary form of emphysema associated with alpha-antitrypsin deficiency.

Clinical Features: The clinical diagnosis of COPD is based upon the presence of symptoms such as productive cough, wheezing, or dyspnea occurring in middle or older age, and the presence of predisposing risk factors such as cigarette smoking. There may be signs on physical examination which reflect airflow obstruction.

A reduction of forced expiratory volume in one second (FEV1) associated with a reduction of the ratio of this value to the forced vital capacity (FEV1/FVC) confirms the presence of airways obstruction. Since clinical signs and symptoms develop late in the course of the disease, measurement of flow rates (spirometry) is needed for early detection. Other laboratory tests may be useful. For example, evaluation of the FEV1, after administration of bronchodilators acutely or with treatment can show that there is an irreversible component of airflow obstruction. The finding that diffusing capacity is reduced and residual lung volume and total lung capacity are increased can buttress a suspicion that anatomic emphysema is present. Arterial blood gas measurement may show hypoxemia with eucapnia in mild or moderate disease; more severe hypoxemia and hypercapnia may be present with severe disease. In addition, hypoxemia may develop or worsen with exercise. Not all elements need be present for a diagnosis. For example, chronic bronchitis is manifested by a history of long-term sputum production. There need be no evidence of airflow obstruction or limitation of respiratory function.
Epidemiology: The magnitude of COPD is substantial and increasing. In the United States, the age-adjusted prevalence for men, as estimated from the National Health Interview Survey, was 11.0% in 1985 as compared to 8.4% in 1979. The comparable statistic for women was 11.9% in 1985 as compared to 8.8% in 1979. The increasing prevalence as well as differences between sexes can be largely accounted for by changing patterns of cigarette smoking, taking into account the substantial lag between onset of smoking and the manifestation of disease. Because there is a long asymptomatic period of disease, COPD may be underdiagnosed.

Similar trends exist for mortality from COPD. Data from the National Vital Statistics System indicate an age-adjusted death rate of 0.20% for men in 1985 as compared to 0.17% in 1979. The death rate due to COPD in women rose from 0.05% in 1979 to 0.08% in 1985. From age 40 and beyond, death rates increase rapidly with age. In 1985, COPD was the underlying cause in 3.6% of all deaths and a contributory cause in an additional 4.3%. Viewed from a broad perspective, these data are quite dramatic. In a 7-year period, death rates from COPD have increased approximately 16% in men and 73% in women, despite a decline in death rates from all causes, notably cardiovascular disease, and a plateauing in death rate from cancer other than that of the respiratory system.

The impact of COPD on society can be estimated from data on use of medical resources. Men increased their visits to doctors’ offices for COPD by approximately 15% from 1979 to 1985; women by approximately 8%. Feinleib and co-workers report a dramatic difference in self-assessment of health status: patients with COPD are twice as likely to rate their health as fair or poor, and to have experienced recent limitation in activities in comparison to the general population; many report more frequent visits to physicians (46% as compared to 29% of the general population). They also report approximately twice the number of short hospital stays, days of restricted activity, and days of being confined to bed as do subjects from the general population.

There is general agreement that most of the morbidity and mortality due to COPD can be attributed to cigarette smoking. The FEV₁, a commonly used measure of lung function, is predictive of future morbidity and mortality. When the level of FEV₁ reaches 35% to 40% of predicted normal, most individuals are limited for work and to some extent, for activities of daily living. As function deteriorates further, symptoms worsen and death often occurs from obstructive lung disease when the level of FEV₁ decreases below 25% of predicted level. Smokers have a more rapid decline in pulmonary function than do nonsmokers. When smokers stop smoking, they do not fully recover the function they have lost but may reduce their rate of loss to that of a nonsmoker. Thus, level of pulmonary function is an important predictor of morbidity and mortality.

Since not all smokers have similar rates of decline of pulmonary function for a given amount of smoking, one must consider additional risk factors that may put people on these different tracks. It is known that children tend to follow a set trend in the growth of their lung function. One hypothesis is that children who do not reach their predicted level of full lung function in early adult life are at greater risk of the effects of cigarette smoke. If this hypothesis is true, it becomes important to determine why some children exhibit these slower rates of growth and when this effect begins. Recent investigations have focused on the beginning stages of lung growth and have involved evaluation of both in utero as well as postnatal exposures to a variety of risk factors.

Other selected risk factors for obstructive airways diseases include recurrent respiratory infections in childhood, specific occupational exposures resulting in asthma-like syndromes (eg, from toluene diisocyanate, wood dusts, tea and coffee dusts, animal protein exposures, and solder fluxes), and chronic airways disease (eg, from welding fumes, cement dusts, and certain other occupational dusts). In addition, the severe form of hereditary alpha,-antitrypsin deficiency associated with the PiZZ genotype is associated, especially in smokers, with severe, early onset emphysema. The gene frequency of this phenotype is about 1/2,700 and is too rare to be responsible for much of the population burden of emphysema; however, it does serve as a paradigm of a genetic obstructive lung disease.

Primary Risk Factors for COPD

Considerable progress has been made in recent years toward the goal of distinguishing between genetic and environmental risk factors for COPD. Although the hereditary data are far from complete, one conclusion is inescapable: in the absence of cigarette smoking, severe deficiency of alpha,-antitrypsin, and bronchiectasis, COPD of sufficient severity to cause appreciable impairment of lung function is quite uncommon, at least in Western countries. This may not be true, however, in developing countries where COPD is seen with some frequency in nonsmokers as well as in smokers.

Smoking: Active smoking is known with certainty to be related causally to COPD. Not well understood yet is the importance of the composition of the smoke, the kind of cigarette, the way in which the individual puffs, and whether there is a clear dose-response relationship between amount smoked and the development of disease. The picture is less clear for passive smoking and maternal smoking. With the present state of knowledge, it is reasonable to conclude that children whose parents (especially mothers) smoke are likely to have increased rates of respiratory infections and respiratory symptoms and may have slightly reduced pulmonary function relative to their peers who have nonsmoking parents. It is not known whether these changes in pulmonary function result directly from environmental exposures in childhood or from in utero exposure from mothers who smoke while pregnant. Household exposure relates directly to the number of smokers in the household. How these exposures and effects translate into increased risk of COPD in adult life is not yet known.

Air Pollution: Air pollution is a complex mixture of gases, particles, and water vapor that results from the burning of fossil fuels or other combustible materials (biomass) and the interaction with climate and other factors in the environment. Over the past 40 years, several major population-based studies incorporating monitoring of ambient air pollutants, together with assessment of respiratory morbidity, have identified adverse health outcomes ranging from excess
total mortality to increased respiratory morbidity in adults and increased symptoms in children.10-12 These epidemiologic studies are concordant with data from animal and clinical chamber exposure studies in selected human volunteers.6,13

Because of improved local control technologies, direct impacts of primary pollutants from stationary sources (power plants and large industrial complexes) have decreased over the last 20 years in the developed countries. Notably, this is not true in Eastern Europe and in the developing countries where these primary pollutants still produce excessively high levels of exposure. Also, long-range transport pollutants (ozone and H2SO4) have been increasing in many parts of North America. Hospital admissions for respiratory diseases have been associated with SO2, O3, and sulfate concentrations and temperature, all potential surrogates for long-range transport pollutants.14 Asthmatic subjects appear to be a more susceptible part of the population, particularly with respect to SO2 and H2SO4. Still unresolved is the question of the relative difference in effects of short-term high peak exposures vs long-term low level exposures. In addition, there remains the question of the relationship between increased respiratory symptoms and lower respiratory illnesses resulting from these exposures and whether the subsequent development of COPD is related.

Childhood Infections: There is a strong association linking childhood respiratory infections and chronic mucus hypersecretion.15-18 Some viral infections seem to be more likely to lead to long-term respiratory symptoms than others. Present evidence suggests that severe childhood respiratory infections may be associated with an accelerated rate of decline of lung function in adult life and increased susceptibility to clinically significant COPD.19 It is important to emphasize that for childhood respiratory infections, as for air pollution, the role played by these factors in increased risk for COPD may be different in developed than in developing countries.

Hereditary Factors: Ample evidence exists that there is familial aggregation of lung function level and/or susceptibility to COPD.20-23 although the full role of hereditary factors in the development of COPD is yet to be understood. Except in cystic fibrosis, the only host or genetic factor known unequivocally to be causally related to COPD is the genetically determined alpha-antitrypsin deficiency, specifically the severe deficiency associated with the PiZZ phenotype which occurs with a frequency of approximately 1 in 2,700 in the US population.24,25

Sex: Virtually all population-based studies in the developed world demonstrate a higher prevalence and mortality from COPD in men than in women.26-33 In many developing countries, however, the differences between the sexes are not as striking. Differences between the sexes and the age at which different cohorts have taken up smoking likely explain much of the difference in COPD frequency in the developed world. Whether greater exposure to childhood risk factors explains some of the lack of differences in the developing world is unknown. Recent physiologic studies suggest differences in rates of lung and airways maturation between the sexes. Whether these differences interact with environmental risk factors is an ongoing research question.

Age: Whether the increasing prevalence of respiratory symptoms in clinical COPD and the accelerated rate of decline of lung function that occurs with age reflect the cumulative exposure and response of lifetime exposure to respiratory irritants or more host-related phenomena related to the loss of elastic recoil of lung tissue and stiffening of the chest wall has not been fully elucidated. The fastest growing rate of COPD mortality in the United States is in adults over the age of 65. This may represent the effect of lifetime smoking in individuals who have given up smoking, whereas formerly they would have died of cardiovascular diseases related to continued smoking. On the other hand, the whole field of normal lung aging has been only minimally explored, and more work is required to sort out normal from abnormal aging.

Airways Hyperresponsiveness: Evidence in support of the notion, first proposed by Dutch researchers more than 20 years ago, that bronchial hyperresponsiveness may be a risk factor for COPD has been accumulating over the past few years.34 It is reasonably clear that bronchial hyperresponsiveness is associated in some way with an accelerated decline in lung function. However, it is difficult to sort out the question of causality because bronchial hyperresponsiveness may follow rather than precede the onset of smoking or other environmental results, and may be more a result of smoking-related airways disease than a true risk factor.

Occupation: It is well established that occupational exposure to dust will result in prolonged mucus hypersecretion and chronic chronic bronchitis.35 More recently, evidence has accumulated that occupational exposure to a variety of dusts, and possibly other occupational exposures, can affect lung function and cause a decrease in FEV1/FVC and an accelerated rate of decline in FEV1.36-39 The contribution of occupational dust exposures to the development of COPD appears to be additive to that of cigarette smoking. Some cigarette smokers may be unduly susceptible to the effects of dusts and other occupational exposures; others can develop clinically significant COPD with occupational exposures to dusts in the absence of cigarette smoking.39-42 Overall, however, the contribution of occupational exposures to COPD is outweighed in developed countries by the contribution of cigarette smoking. Nevertheless, conceptually and when seeing individual patients, it is important to consider the contribution that occupational exposures may have made to any individual with COPD.

Socioeconomic Status: It has been difficult in North America to demonstrate a clear relationship between socioeconomic status and living conditions and both respiratory symptoms and decline in lung function. In less-developed countries, however, there is still evidence that risk for COPD is inversely related to socioeconomic status. It is not clear, however, whether this is a reflection of exposure to indoor and outdoor air pollutants or to crowding, nutrition, and other factors which are related to socioeconomic status.7

Secondary and Tertiary Risk Factors for COPD

Secondary factors are those which exacerbate or complicate already-existing disease. For COPD, these are primarily cigarette smoking, environmental exposure to particulates and irritating gases, and infection. Continued smoking is associated with an abnormally rapid decline in pulmonary function. Poor quality ambient air may exacerbate symptoms
in some patients with COPD. Pollutants most likely to affect COPD patients are ozone, acid aerosols, and particulates. The principal indoor pollutant is cigarette smoke. Patients with hyperresponsive indoor airways are sensitive to a variety of nonspecific irritants, and in some cases, to specific allergens.

Intercurrent infection plays a clear role in the exacerbation of COPD. The most important agents are the common respiratory viruses, the influenza virus, and bacterial agents such as *Streptococcus pneumoniae*, *Hemophilus influenzae*, and *Legionella pneumophila*.

Tertiary factors are those elements of disease which can be modified by therapeutic measures. The major factor in COPD is reversible airflow obstruction, which is due to increased bronchomotor tone and bronchial hyperreactivity. Inflammation of airways and narrowing of airways due to mucus is also commonly present. In more severely impaired patients, hypoxemia, loss of mass of skeletal muscles, (including those used for breathing), and respiratory failure frequently supervene. Important psychosocial problems occur in this group as well.

**Clinical Care of COPD**

The prevention of COPD and its sequelae require attention to tertiary, secondary, and primary risk factors.

**Principles of Control of COPD**

The clinical management of patients with established COPD and tertiary preventative techniques have recently been reviewed.\(^3\) Except when patients are suffering from acute respiratory failure or some other acute medical incident, the management of patients with COPD can be carried out in the ambulatory medical setting. However, given the importance of acute events as causes of death, it is essential that these patients have ready access to the hospital when they become acutely ill.

**Specific Measures: Smoking Cessation.** Although there is some debate (see Smoking Committee Report), the rate of decline of lung function, measured as decrease in FEV\(_1\), per year, is greater in smokers than nonsmokers, especially in smokers with COPD.\(^4\)\(^-\)\(^6\) Every effort should be made to help persons with COPD stop smoking at all stages and levels of disease. There may be a small improvement in lung function following smoking cessation, especially if function loss is mild. Of greater importance is that the rate of decline of FEV\(_1\) reverts in most exsmokers to that of nonsmokers, thus delaying the development of dyspnea during activities of daily living.

Many strategies have been tried to accomplish smoking cessation: hypnotism, behavior modification techniques, group sessions, and nicotine gum. No single technique has been demonstrated to be unequivocally superior, although results from hypnotism have been less encouraging. However, the importance of health care professionals as the initiators of a smoking-cessation effort cannot be overemphasized. Even a 1- to 2-min delivery of advice to quit smoking has an important impact; about 5% of patients stop smoking simply in response to such advice.\(^6\) A more detailed discussion of smoking interventions is provided in the task force section of this report.

**The Environment.** Although the role of urban air pollution in the pathogenesis of COPD is not entirely clear, it makes sense to limit exposure, as far as possible, to particulates and irritant gases. There is evidence that high levels of air pollution result in exacerbation of COPD. Persons with severe COPD should monitor public announcements of air quality and should stay indoors when air quality is poor.

**Vaccination.** Influenza causes greater morbidity and mortality in persons with COPD than it does in the general population. COPD patients, therefore, should receive influenza vaccine annually. Although there is some question as to its efficacy in COPD,\(^4\)\(^-\)\(^6\) pneumococcal vaccine should be given. Revaccination is not indicated for most patients; however, it is recommended for high-risk populations.

**Augmentation Therapy for Severe Alpha\(_1\)-Antitrypsin Deficiency.** Severe deficiency of the serum protein alpha\(_1\)-antitrypsin (AAT) (defined as serum values <15% of normal) is associated with the development in early or midlife of pulmonary emphysema. Most severely AAT-deficient individuals are homozygous for the Z allele and their phenotype is designated PZZ, or simply PZ. Such individuals probably make up fewer than 2% of persons with COPD. Persons who are heterozygous for 1 of the deficient alleles have serum AAT levels that are intermediate between severe deficiency and normal; they do not have increased susceptibility to COPD.\(^4\)

Augmentation therapy with purified human AAT in severe AAT deficiency is based on the concept that a deficient protein is being restored to protective levels (estimated from epidemiologic data to be a serum AAT level >35% of normal). It is presumed, but not proven, that augmentation therapy will halt the progression of emphysema. Since emphysema is a permanent structural change, augmentation therapy cannot improve lung structure or function. AAT-deficient persons with normal lung function should be followed, not treated; augmentation therapy should be considered when lung function is abnormal and especially if serial studies show deterioration.\(^4\) The AAT is given as a weekly intravenous infusion; the cost of AAT for 1 year of augmentation therapy in a 70 kg patient is more than $15,000 for the product alone. This condition should be suspected when there is unexplained and early (20s and 30s) onset of dyspnea on exertion and airflow obstruction in both smokers and nonsmokers.

**Symptomatic Measures: Symptomatic therapy is directed against the relief of reversible airflow obstruction due to bronchial inflammation, luminal secretions, and smooth muscle spasm. Symptomatic therapy will be addressed under the subheadings of bronchodilator therapy, corticosteroids, antibiotics, and mobilization of airways secretions.**

**Bronchodilator Drugs.** Although most of the airways obstruction in subjects with COPD is fixed and irreversible, there is a high prevalence of partial acute reversibility to inhaled isoproterenol. The amount of reversibility of FEV\(_1\), averages 15% of the baseline value, with about one third of patients showing responses of 62% or greater.\(^6\) COPD patients with the greatest bronchodilator responses have the lowest annual decline in FEV\(_1\), and the greatest 5-year survival. The hypothesis that regular bronchodilator therapy may slow deterioration of lung function is currently under investigation in a large clinical trial, the National Heart, Lung, and Blood Institute Lung Health Study.\(^4\)

**Sympathomimetics.** The beta\(_2\)-adrenergic agonists, given as
an aerosol from a metered dose inhaler (MDI), are considered to be generally safe and frequently useful. Recent data raise the possibility of a deleterious effect with the regular use of long-acting beta₂-agonists.⁴⁶

Anticholinergics. The quaternary ammonium anticholinergic compound, ipratropium bromide, is poorly absorbed and is available in a MDI; it is effective for 4 to 6 h and has few side effects. Ipratropium has a statistically greater bronchodilating effect in COPD than do the beta₂-agonists, although in absolute terms, the difference is not great.³⁰

Theophylline. The mode of action of theophylline is poorly understood but appears to be different from that of either the sympathomimetics or the anticholinergics. Theophylline decreases smooth muscle spasm, enhances mucociliary clearance, improves right ventricular function, and decreases pulmonary vascular resistance and arterial pressure. Its role in improving diaphragmatic function and in improving dyspnea on exercise is controversial. Slow-release anhydrous theophylline preparations are well absorbed following oral ingestion and might improve patient compliance. Theophylline is often used in combination with an inhaled beta₂-agonist or ipratropium.¹¹⁻¹³ Recently, the question has been raised as to whether the risk/benefit ratio for the use of theophylline is favorable in patients with COPD.¹⁴

Corticosteroids. Corticosteroid therapy is beneficial in about 15% of patients with COPD. A 25% or greater response of the FEV₁ is the best predictor of responsiveness. A short trial of high dose oral corticosteroids should be considered in patients with an acute exacerbation of their disease, with rapid tapering as the exacerbation subsides. The efficacy of inhaled corticosteroid aerosol is not proven, but to minimize toxicity of oral corticosteroids in patients with severe chronic disease, a trial of inhaled corticosteroids may be instituted. If necessary, aerosol corticosteroids can be combined with daily or every other day oral prednisone therapy. Daily prednisone therapy, especially in high doses, should be employed only in the sickest patients who fail to respond to other treatment strategies; oral corticosteroids should be given over long periods of time only if they have been shown objectively to be effective.²⁰⁻²⁷ Patients on long-term corticosteroid therapy must be monitored for the many side effects of this therapy.

Antibiotics. It is unclear in many exacerbations of COPD whether the development of purulent sputum is due to bacterial infection or has some other basis (such as the direct effect of cigarette smoking or exposure for several days to heavily polluted air). Nevertheless, most clinicians prescribe antibiotics for these exacerbations. Controlled trials in general show that antibiotic-treated exacerbations are generally briefer and may have fewer consequences than do placebo-treated exacerbations.³⁰ However, it is also clear that although the acute morbidity is reduced, treatment has no effect on the natural history of the disease. Commonly employed oral antibiotics to manage a COPD exacerbation include ampicillin, tetracycline, doxycycline, trimethoprim-sulfamethoxazole, or a newer cephalosporin such as cefaclor.

Thinning and Mobilization of Secretions. Viscid secretion in peripheral airways in an important mechanism of airways obstruction in COPD. Unfortunately, our ability to effect thinning of secretions or to help patients mobilize their secretions is limited. The national mucolytic study has offered some evidence that iodinated glycerol may decrease mucus-related symptoms.⁵⁸ It is reasonable to advise patients to drink enough fluids to maintain hydration. The techniques of chest physiotherapy (controlled coughing, chest percussion) have not been shown to be useful unless the patient produces large (>30 ml) amounts of sputum daily.⁶⁰

Supportive Measures: Rehabilitation. A carefully integrated rehabilitation program, which helps the patient accommodate to physiologic limitations while providing realistic expectations for improvement, is important in managing patients with severe COPD. These programs typically will include an exercise regimen that is directed toward improving exercise tolerance and ability to perform daily activities. In addition, components of education and psychosocial support are provided.⁴¹ The exercise components are designed to improve respiratory and general skeletal muscle function with resultant decreased ventilatory and cardiovascular requirements for exercise.⁴²⁻⁴⁵

Long-term Oxygen Therapy. Two studies have firmly established a role for long-term oxygen therapy in the management of severe COPD.⁴⁶⁻⁴⁸ Long-term oxygen therapy for 24 h per day prolongs life in hypoxemic COPD patients; the mortality rate falls to a value that is similar to that of an age-and FEV₁-matched group of minimally hypoxemic COPD patients. Oxygen therapy of 12 h per day is worthwhile but is less effective than 24 h per day therapy. Additional benefits of continuous oxygen therapy are a fall in hematocrit value toward normal levels, modest neuropsychologic improvement, and some amelioration of pulmonary hemodynamic abnormalities and improvement in cor pulmonale. Long-term oxygen therapy should be prescribed for COPD patients whose resting room air PaO₂ is 55 mm Hg or less, as well as for those with a resting PaO₂ between 56 and 59 mm Hg if they have evidence of tissue hypoxia such as secondary polycythemia (a hematocrit value of 55 percent or greater) or cor pulmonale. The use of oxygen therapy in patients with hypoxemia only during sleep or exercise remains to be defined.⁴⁶⁻⁴⁷

Home Ventilator Care. The greatly expanded skill of pulmonologists and other care givers has resulted in the salvaging of an increased number of COPD patients who have required mechanical ventilation in order to survive a bout of respiratory failure. A small proportion of these persons cannot be weaned from a mechanical ventilator. At least 1 report suggests that two-thirds of ventilator-bound patients can be managed in their homes.⁶⁰

Nutrition. Some patients with advanced COPD experience major, slowly progressive weight loss. Weight loss is accompanied by evidence of somatic depletion with a significant reduction in triceps skinfold thickness. However, there is no evidence of protein malnutrition; patients have normal serum albumin and transferrin levels, as well as normal lymphocyte counts. The consequences of weight loss in COPD patients remain conjectural. However, recent evidence suggests nutritional depletion is associated with increased mortality in COPD patients.⁶⁰ Malnutrition and weight loss can reduce respiratory muscle strength and endurance, apparently due to both a reduction in respiratory muscle mass as well as reduced strength of the remaining muscle fibers.⁶⁰ Major caloric and protein deprivation may occur in hospitalized COPD patients who are in respiratory
failure and on mechanical ventilators. Several controlled studies demonstrated improvement in such patients following nutritional repletion. However, long-term maintenance of weight gain has been difficult to establish.

**Psychosocial Aspects of Severe COPD.** Like all serious chronic illnesses that are slow and insidious in onset, COPD has a profound effect on patients, their families, and other care givers. The constant threat of dyspnea and the reality of increased dependency can lead to loss of self-esteem, somatic preoccupation, anxiety, irritability, and depression. Depression may magnify the distress from physical symptoms in COPD, including a worsening of dyspnea. Management requires a willingness by the health care provider to deal with the psychosocial, as well as the somatic elements of the illness. Encouragement of the patient, education in self-care, the setting of realistic achievable goals, counselling of family members, and group interaction of patient and family members with groups of similar patients and their families are all useful. Participation in comprehensive pulmonary rehabilitation programs may be particularly effective in providing these elements in a cohesive manner. Pharmacologic treatment may be used to supplement these measures. However, psychoactive drugs frequently have side effects, such as sedation, which require special caution when used in the patient with COPD.

**Lung Transplantation.** With the advent of cyclosporin as an immunosuppressive agent, lung transplantation has become a potential treatment alternative for selected patients with end-stage COPD. Patients have generally been under age 50 years, and many have had severe alpha-antitrypsin deficiency as the cause of their emphysema. Although there have been some complications with double lung transplantation, there has been an increase in the use of single lung transplantation for patients with nonseptic obstructive disease. Continuing follow-up studies will be required in order to finally evaluate the benefits of single lung, double lung, and heart-lung transplantation; at present, the procedures appear to be promising for selected patients.

**Issues in Education**

The previous section provided a brief overview of the clinical care of established COPD patients. Since there is no cure for COPD, reducing the impact of these diseases requires preventive efforts. The remainder of the report will focus on primary and secondary preventive strategies. Improved preventive efforts require education directed toward patients, the general public, and health care providers.

**Barriers to Effective Prevention**

Success in the control of COPD begins with prevention. If this step fails, the next goal is early intervention, when airflow obstruction is still preventable or reversible. Although prevention and early intervention are desirable, they have proven difficult to achieve. Barriers to achieving these goals include the following:

1. **Inability to Achieve Smoking Cessation:** Although many established smokers have stopped smoking, over 50 million Americans (29% of the adult population) continue to smoke. As many as 50% of smokers try to quit in any year and most attempts are unsuccessful.

2. **Limited Awareness of Benefits of Early Treatment and Risk Factor Modification:** The earlier COPD is identified and treated, the more likely it is that functional impairment will be avoided. However, most COPD patients do not seek treatment until they become dyspneic. At this time, changes resulting in airflow obstruction are typically widespread and not reversible.

3. **Limited Use of Immunization for Influenza:** It has been estimated that as few as 20% of high-risk patients receive immunization against influenza. Retrospective studies have shown that immunization will prevent illness in 20% to 45% of those vaccinated. Additional studies have shown that those not completely protected tend to experience milder symptoms and are less likely to require hospitalization. Mortality is also decreased. It has been estimated that as many as 10,000 patients die from influenza in a nonepidemic year, and as many as 30,000 after a major epidemic. If the number of "at risk" persons immunized increased to 80%, these deaths, hospitalizations, and related costs to the health care system should substantially decrease.

4. **Lack of Patient Knowledge, Skills, or Motivation to Follow Management Regimens:** COPD patients may lack the skills required to carry out their management regimen or to perform activities in an energy-efficient manner. The sensation of shortness of breath may lead to severe anxiety, avoiding activities that provoke dyspnea, and preoccupation with bodily complaints. These actions further compound the problems experienced.

5. **Lack of Knowledge by Health Care Providers:** Many COPD patients are cared for by health care professionals who are not specialists in pulmonary medicine. The state of the art in management of COPD has changed appreciably in the past decade. Application of current knowledge would be facilitated if physicians, nurses, and other health care professionals had easy access to educational materials which succinctly summarize these advances and present easy to follow strategies for improving the functional ability of COPD patients.

Educational strategies to resolve problems created by these barriers include initiatives directed toward education of the public, patient and family, and health care providers.

**Public Education**

Beyond patient education, general public education is also required. Strategies should include the following:

1. A clear, consistent, and repeated nonsmoking message should be delivered. A meta analysis of 39 controlled smoking cessation trials indicated that it was social reinforcement and support—by increasing the number of contacts, the types of contacts, and the number of people making the contacts—and not a specific intervention or delivery system that produced results. Likewise, it appeared that it was withdrawal of reinforcement that contributed to relapse. The conclusion drawn from this is that smoking cessation messages would be most productive if given clearly, repeatedly, and consistently through every feasible delivery system (eg, personalized advice, print materials, the mass media, and a smoke-free home, school, and work environment).

2. The development of smoking prevention and cessation programs should target adolescents and young adults with
higher smoking rates (eg, minorities and those with less education)\textsuperscript{46}

(3) The public should be educated about the need for influenza immunization, who should receive immunization, and the anticipated benefits. The classic annual approach of encouraging physicians to immunize high-risk patients has been minimally successful.\textsuperscript{32} More individuals whom the Centers for Disease Control recommends should receive immunization might do so if the benefits were better known. Programs are needed to educate the public about who should receive immunization and about the several benefits of immunization (eg, prevention, modification of symptoms, less virus shedding, and therefore, less risk to others).

Patient and Family Education

Once COPD becomes established, patient and family education is necessary. Strategies should include first, developing self-management programs targeted toward COPD patients with minimal disability. Most COPD patients are not aware of the benefits of early intervention. Educational programs should be developed which draw attention to changes which occur early in the disease, methods of detecting when pulmonary function is deteriorating more rapidly than normal for one's age, and the potential benefits of early intervention.

Second, self-management programs for COPD patients with moderate/severe disability should be developed. Pulmonary rehabilitation programs can help COPD patients and their families develop skills in self-care. In addition, support groups organized as part of these programs can extend and expand these benefits. However, not all COPD patients have access to such programs. State-of-the-art educational materials are needed to use in patient and family teaching. These materials could incorporate current knowledge about medication use, bronchodilator administration, methods to conserve energy, methods to improve exercise tolerance, and other self-management skills. Self-help booklets are currently available which have been developed by the American Lung Association.\textsuperscript{46} The efficacy of self-management in COPD has not been proven. However, results of clinical research evaluating asthma self-management in children have shown that several programs have resulted in improved management, use of health care services, and illness adjustment.\textsuperscript{46} Research on self-management in adults is limited at this time, and it will be necessary to demonstrate that what works for children also works for adults. It seems possible that the same outcomes could be achieved through teaching self-management skills to patients with COPD, although there have been no systematic evaluations.

Health Care Professional Education

Concise materials about current management approaches in COPD should be developed. Emphasis should be on recognition of disease, cooperative management strategies between patient, family, social environment, and medical team, and psychosocial aspects of care and support. These strategies should include developing concise educational materials to update physicians, nurses, and other health care professionals about current management strategies for COPD. Nurses and respiratory therapists are a rich resource for patient education; they have frequent contact with COPD patients and could provide needed teaching. Provision of this teaching would be facilitated if appropriate up-to-date teaching materials were available for use by practitioners, educators, and students.

Strategies for Physician Education

COPD is a common medical illness causing significant morbidity and mortality and often complicating the management and outcome of other medical, surgical, and psychologic illness. In view of the broad health care impact of COPD, an objective of clinical medical education should be to provide all physicians with a minimal level of competency related to the recognition and prevention of COPD. Barriers to the implementation of preventive services relate to the following: (1) knowledge of benefit; (2) skills; (3) organization (guidelines intervention: cues for physician to intervene and follow-up of intervention); (4) adequate return to physician; (5) perceived demand for preventive services; (6) perceived effectiveness of intervention; (7) perception of prevention as part of professional role; (8) confidence in providing preventive services; and (9) commitment.\textsuperscript{57}

The pulmonary specialist serves as the consultant and educational resource to the medical and lay community regarding respiratory health. Some evidence suggests that primary care physicians are aware of the importance of screening but do not have skills and experiences required to modify the risk factors.\textsuperscript{57} In general, it is the responsibility of the pulmonary specialist to disseminate the principles of prevention of lung disease to primary physicians and the lay public. The modifiable risk factors of COPD must be clearly delineated; smoking control programs are a necessity.

Research

There are significant gaps in our current state of knowledge. Areas requiring more research include epidemiologic research; basic biomedical research; health services research; and behavioral/educational research.

Epidemiologic Research (Research on Control of Risk Factors)

The primary determinants of COPD can be divided into those in which intervention cannot play a role (eg, age, sex, genetic predisposition) and those in which planned control can have a significant impact on the risk of disease (eg, environmental factors—smoking, occupational dust exposure, avoidance of acute respiratory illnesses). Since not all subjects who smoke or have occupational exposures to dust develop disease, the interaction of nonmodifiable and environmental risk factors is a necessary arena for research. Although some factors cannot be modified or controlled, the interaction of these factors with other putative factors may have a significant impact on the risk of disease.

Little is needed to further confirm the direct effect of cigarette smoking as a risk factor for the development of COPD. If any issue remains unresolved, it is why everyone who smokes does not develop the disease. Also unclear is whether passive smoking, both direct and indirect (in utero), plays an important role in setting the stage for the development of COPD in later life. This will require studies of lung maturation and development and how these processes are affected by passive exposure.
Similarly, the role of atopy and airways responsiveness and the development of subsequent COPD need further clarification. Subjects with a history of atopy are at greater risk of having airways responsiveness; however, whether the causal pathway goes on to the development of COPD is not known.

Increased airways resistance and responsiveness have been found in subjects exposed to ozone and acid aerosols (H₂SO₄, HNO₃) in recent controlled laboratory exposures.⁸¹ ⁹⁰ Animal studies suggest these agents produce inflammatory changes in small airways. Concern has been raised about the role of these agents in producing respiratory effects in chronically exposed children, and if so, whether these children will become more susceptible to COPD in later life. These issues require further study.

Several recent studies suggest that occupational dust exposures result in COPD in some fraction of the exposed subjects.⁸⁰ ⁹¹ Occupational asthma has been characterized as a disease in which the specific agent, whether it be a sensitizer or irritant, can be identified. Unfortunately, in this setting, elimination from exposure only reverses the disease for a minority of patients. Thus, the onset of occupational asthma offers an opportunity to study the immunologic state of the host (potentially) before exposure begins and during the course of developing the disease. Obviously, tied to any such study must be industrial hygiene control methods to reduce exposure to a minimum. However, once sensitized, it may not be possible to reduce exposure sufficiently to protect the sensitized worker.

Although differences in socioeconomic status (SES) do not appear to be an important risk factor in the developed world at this time, experience suggests that in the past, SES was a surrogate for multiple environmental factors such as nutrition, smoke exposure, and crowding; these are potential risk factors that need to be explored in the developing world today.

Biomedical Research

Chemical Markers of Lung Injury: Over the last 23 years, scientists have developed evidence that neutrophil elastase causes at least some of the emphysema in smokers or in alpha,-antitrypsin deficient patients.⁸⁵ ⁹⁴ Several companies have developed elastase inhibitors;⁹⁵ however, current concepts of how a clinical trial of efficacy would have to be carried out dictate that these clinical trials would be enormously expensive. It is possible that chemical markers of lung injury may reduce the expense of a clinical trial enough to make it financially feasible. Two critical areas deserve serious attention: existing putative chemical indicators must be validated or discarded, and new indicators should be developed.

Expanding the Protease-Inhibitor Deficiency Hypothesis: Over the last 25 years, investigators studied various aspects of the protease-inhibitor deficiency hypothesis of emphysema.⁸⁴ ⁹⁴ This theory contends that neutrophil elastase causes emphysema if it is not inhibited by alpha,-antitrypsin. The dominance of this theory may have too-narrowly-focused research in this area. It is important to stimulate new ideas about the pathogenesis of emphysema. Several areas may be worth further research. Several groups have determined that alveolar macrophages provide the enzymes which digest lung elastin and cause emphysema.⁹⁶ ⁹⁷ Other groups have shown that proteoglycans are reduced in lungs with emphysema.⁹⁸ ⁹⁹ Expanding current research to include other specific areas of lung destruction and tissue destructive mechanisms, as well as mechanisms of repair, may be fruitful.

Exploring Genetic Clues to Emphysema: Not all smokers develop emphysema. In addition, there are family clusters of patients with emphysema that are not due to alpha,-antitrypsin deficiency. New genetic, cell biologic, and chemical methods have been developed to determine genetic loci in cystic fibrosis⁹⁶ and phenylketonuria. Efforts should be made to identify kindreds with emphysema and to encourage them to participate in research designed to determine why they have a familial propensity to develop emphysema.

Therapeutic Research

There is a wide variety of issues in therapy that require further clarification and development. These issues include the following: mechanisms of pulmonary vasoconstriction and control of pulmonary vasoconstriction; the role of acute and chronic airways inflammation in COPD and the efficacy of anti-inflammatory agents in its treatment; the role of oxygen therapy during sleep; the role of bronchodilators; the mechanism of apparent airways hyperresponsiveness and its control; the role of infection and optimal methods for prevention of infection; the role of locomotor and respiratory muscle conditioning in improving function; development of improved methods for ventilatory support; and improvement of methods for single lung transplantation.

Research Related to Health Care Delivery

Health Services Research: Health services research focuses on problems related to the quality, delivery, and costs of health services. Some important efforts in health services research involve the definition and measurement of health outcomes. These outcomes are described as health-related quality of life (HRQOL). Evaluating health outcomes typically involves 2 components. One component is mortality which is estimated through standard life table techniques. The other aspect is quality of life and is typically assessed using questionnaires. Traditional medical measures, such as pulmonary function tests, are often regarded as mediators of these outcomes.

There has been relatively little work evaluating HRQOL in COPD patients. Some of the approaches have used measures specific to lung disease, such as the dyspnea index⁹⁵ and the chronic respiratory disease questionnaire.¹⁰⁴ The nocturnal oxygen therapy trial (NOTT) used a general quality of life measure and demonstrated systematic relationships between degree of disease severity and quality of life outcomes.¹⁰⁵ This measure was also used in a clinical trial evaluating the cost effectiveness of home care for COPD patients.¹⁰⁶ A related approach known as the quality of well-being scale has also been used in several trials with COPD patients. This measure provides a generalized assessment of health status that can be used in cost effectiveness evaluations.¹⁰⁷ ¹⁰⁸ There has been little research that attempts to link measures of pulmonary function or disease severity to measures of health status or patient outcome.

There appears to be a major trend toward the use of health outcome measures in both clinical and policy re-
search. The Agency for Health Policy and Research, a federal organization, has recently been created to conduct health outcomes research. The Health Care Financing Administration has also emphasized the importance of measured health outcomes in the evaluation of treatments. Oregon has proposed a system of reimbursement under Medicaid as a function of improved health outcomes. The expansion and validation of health-related quality of life measures in the evaluation of treatments should be an important direction for future research.

Cost/Efficiency Studies: The terms "cost/utility," "cost/efficacy," and "cost/benefit" are used inconsistently in the medical literature.116 Better understanding of the potential limitations and philosophic underpinnings of each approach will aid the progress and acceptance of health services research. To date, there have been relatively few cost/efficiency studies dealing with COPD patients. Summer and colleagues115 have evaluated the cost/effectiveness of aerosol bronchodilators, while several investigators have assessed home care.106,114 Other studies have considered the costs of oxygen therapy117 and the benefits of oxygen-saving devices.118 Finally, several studies have investigated the cost/effectiveness of pulmonary rehabilitation programs.117,118

The greatest deficiency in current cost/effectiveness research is the failure to account for all program costs. These must include costs incurred at times distal to the treatment and costs associated with treatments outside the usual arena of care. For example, economists often value resource other than those consumed in the act of delivering health care. The purpose of treatment is not only to reduce costs to the health care system, but also to reduce costs to society as a whole. If a program reduces visits to a physician, the analysts must consider other costs that might be incurred, including costs of alternative providers. In addition, simple reduction in utilization may result in greater costs in the future. Refusing to pay for preventive care may reduce current costs but increase future costs. Such costs must also be part of the analysis.

A related issue is the difference between costs and charges. For many programs, charges and costs differ dramatically. For example, oxygen is relatively cheap when purchased in bulk; however, the charge for oxygen therapy is very high, often because the treatment is labor intensive. Analyses must take into consideration resource-based costs as well as customary charges. To date, few studies have considered these issues. Increased governmental and public awareness of the limitation of societal resources for health care should lead to a greater number of sophisticated cost/effectiveness studies and cost/utility studies in the years to come.

Cost/effectiveness studies will be important for establishing the value of preventive programs.116 Models are now available for comparing alternative uses of health care resources ranging from smoking prevention programs through the tertiary care of COPD patients. Refinement of these analyses is encouraged.

Affective Issues: One potentially preventable cause of morbidity in COPD patients is depression. The prevalence of depression has been shown to be high among the COPD patients in several different investigations.108,130-133 Although depression is common for patients in a variety of disease categories, some evidence suggests that COPD patients experience more depression than do other medical patients at the same level of disability.108,135

The reason for depression in COPD patients is not well established. Some argue that depression results from functional limitations, while others114 argue that hypoxia causes neurochemical changes in biogenetic amines within the central nervous system, ultimately resulting in depressed affect. More research is needed in order to clarify these issues. For example, it must be established whether depression experienced by COPD patients is qualitatively different than that experienced by equally dysfunctional patients in other disease categories. Further, it will be important to learn whether treatments for depression improve function and quality of life for COPD patients.

Minority Issues: As previously noted, cigarette smoking is the major cause of COPD. Each year, COPD is estimated to account for approximately 57,000 deaths. Evidence from the National Health Interview Survey in 1987 suggested that 31.7% of men and 26.8% of women smoke cigarettes. However, minority groups use cigarettes at higher rates. For example, 40% of Hispanic men and 26% of Hispanic women were estimated to be cigarette smokers between the years 1982 and 1984. Similarly, black men use cigarettes significantly more often (41%) than do white men (31%). Recent evidence on cigarette smoking by Southeast Asian men suggests that as many as 55% smoke cigarettes. Further, between 42% and 70% of American Indians and Alaskan natives are estimated to use cigarettes.138 Research to identify the best educational and preventive approaches for minority communities is clearly indicated. To further complicate the issue, health services for the poor are becoming increasingly difficult to finance. The 37 million uninsured and the growing number of underinsured Americans disproportionately represent ethnic minority groups. Evaluative studies are required in order to estimate the number of potential COPD patients in these groups and the potential impact of service restrictions.

Determinants of Professional Behavior: It was once typically assumed that the amount of health service consumed was a reflection of the need for the service. Thus, it would be expected that in demographically equivalent communities, the use of specific health care services would be approximately equal. However, Wennberg139 has shown this not to be the case. Within New England communities with demographically equivalent populations, the variation in the use of some services is substantial. For example, women in some communities are 9 times more likely to have a hysterectomy than are women with the same characteristics in a bordering community. Men with the same symptoms are 12 times more likely to have prostate operations in some communities than in others.104,107 There is little evidence to suggest that patients in communities with more intensive service use achieve better health outcomes.

There has been a growing interest in studies of small area variation, with new studies describing the relationship between practice variation and medical outcome. To date, however, few studies have addressed practice variation in relation to COPD. Future studies might address variations in the use of medications, pulmonary function testing, and rehabilitation. These studies should relate practice variation to outcomes of care.
Determinants of Patient Behavior

Smoking in COPD: More than 25 years ago, the Surgeon General released the first report on smoking and health. Over the last quarter century, the case against the use of cigarettes has become increasingly strong. In 1989, the Surgeon General released a new report entitled, "Reducing the Health Consequences of Smoking: 25 Years of Progress." As the new report suggests, the evidence on the detrimental effects of cigarette use is truly overwhelming. Nevertheless, the prevalence of smoking was still 29% in 1987, and techniques to reduce tobacco use in this group remain marginally effective and largely unsatisfactory. The need for research in this area remains urgent and is discussed elsewhere in this report.

Compliance Behavior: Despite major advances in medical diagnosis and the use of medical therapeutics, patients frequently do not receive the optimal benefit from contemporary medical care because they fail to follow treatment recommendations. Nearly all encounters between physicians and patients end with advice. The patients are told to stop smoking, use their medications in a specific way, exercise, and so on. Noncompliance or nonadherence is failure to follow this advice. Published studies suggest that rates of noncompliance range between 15% and 93%, with rates toward the higher end for those with diagnosed chronic diseases. Attempts to predict noncompliant behavior on the basis of psychological or demographic characteristics have been largely unsuccessful. In addition, there have been curious relationships between compliance and outcome. For example, Epstein reviewed the literature and discovered that compliance is associated with better health outcomes whether or not patients are receiving active drugs or placebo.

There have been relatively few studies on compliance behavior among patients with COPD. In one recent review, only a handful of studies was identified. Among the published studies, some findings specific to COPD patients emerged. For example, several studies identified overcompliance with medications such as corticosteroids that provide symptomatic relief. To date, commentaries on compliance with lung disease treatment exceed empirical studies. Some recent attention has been devoted to the advantages of transtracheal oxygen therapy. One study, for example, demonstrated that transtracheal oxygen can increase the number of patients who use therapy 24 h per day. Using the results of the NOTT trial, this increased compliance might be translated into estimates of greater life expectancy. Other studies have demonstrated that simple counseling interventions by pharmacists might increase compliance with medications commonly used by COPD patients.

There appears to have been relatively little research investigating the potential of increasing patient compliance among those with COPD. Physicians have little training in identifying the determinants of noncompliance and in assessing the magnitude of the problem. More research is necessary in order to identify counseling methods for enhancing compliance among COPD patients.

Conclusions

Chronic obstructive pulmonary disease is a major cause of death and disability in the United States. The most important risk factor for COPD is cigarette smoking. Thus, COPD is largely a preventable condition. Other risk factors may include air pollution, childhood infections, heredity, advanced age, airway hyperresponsiveness, and occupational exposures. Some risk factors, including male sex and socioeconomic status, may gain their influence through associations with cigarette smoking or living conditions. More attention to primary, secondary, and tertiary prevention of COPD is required.

In order to reduce the burden of illness associated with COPD, greater efforts in smoking prevention and smoking cessation are required. Other measures include reductions in air pollution, influenza vaccination programs, and augmentation therapy for those with severe alpha-1-antitrypsin deficiencies. Once persons are afflicted with COPD, high quality medical care is essential. Improved efforts in the prevention and management of COPD will require education directed toward patients, the general public, and health care providers. Considerably more research in education and prevention is necessary; this includes epidemiologic research to clarify the risk factors for dysfunction, biomedical research to substantiate information on the chemical markers of lung injury, expansion of the protease-inhibitor hypothesis, and evaluation of genetic predisposition toward the disease. Health services research will be required in order to create improved measures of health outcome, evaluate the cost-effectiveness of treatment programs, and improve the efficiency and effectiveness of both preventive and tertiary treatment programs. More research is necessary on cigarette use, access to care, and occupational exposures among members of underrepresented minority groups. Finally, it will be necessary to conduct more research to identify methods to help the general public adhere to preventive measures and to help COPD patients adhere to prescribed therapies.

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