

#### 4. CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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The approach to developing quality indicators for the diagnosis and treatment of chronic obstructive pulmonary disease (COPD) was based primarily on an evaluation of English language review articles. In addition, targeted MEDLINE literature searches identified randomized controlled trials published between 1992 and 1996 on the prevention and treatment of COPD and its exacerbations. Selected articles were reviewed in areas where randomized trials have demonstrated benefit to therapy, and in areas where management controversy exists.

##### **IMPORTANCE**

COPD is estimated to affect at least 15 million Americans (Fromm, 1994), causing 75,000 deaths and 900,000 hospitalizations each year (Rosen, 1992). COPD is second only to arthritis as the leading cause of long-term disability and functional impairment (Heath, 1993), and it is the third most frequent diagnosis (after congestive heart failure and stroke) for patients receiving home care (ATS, 1995). The mortality rate ten years after diagnosis is greater than 50 percent (Ferguson, 1993). COPD is the fifth leading cause of death in the US (Ferguson, 1993) causing eight percent of all deaths (Heath, 1993). The death rate for COPD has risen by 22 percent in the last decade (Ferguson, 1993).

##### **Definitions**

COPD is characterized by the presence of airflow obstruction due to chronic bronchitis or emphysema. The airflow obstruction is generally progressive, may be accompanied by airway hyperreactivity, and may be partially reversible (ATS, 1995). Chronic bronchitis is defined clinically as a chronic productive cough for three months in each of two successive years in a patient in whom other causes of chronic cough have been excluded (ATS, 1995). Emphysema is defined anatomically as abnormal permanent enlargement of the airspaces distal to the terminal bronchioles, with accompanying destruction of their walls and no obvious

fibrosis. Destruction is defined as lack of uniformity in the pattern of respiratory airspace enlargement; the orderly appearance of the acinus and its components is disturbed and may be lost (ATS, 1995). Some diagnosticians include small airways disease in the definition of COPD (Angstman, 1992), noting that airways obstruction as gauged by forced expiratory volume at one second (FEV<sub>1</sub>) results from airway narrowing or collapse and/or loss of elastic recoil of the lungs. They also note that the small noncartilaginous conducting airways that show pathologic changes of inflammation, fibrosis, mucus production, and narrowing are the major site of airflow obstruction in COPD. Nonetheless, early small airways disease is not reliably detected by currently available tests (Angstman, 1992), and most investigators refer exclusively to emphysema and bronchitis in discussions of COPD (ATS, 1995).

#### **Prevention of COPD**

Smoking is the principal risk factor for development of COPD (Angstman, 1992), and it accounts for 80 to 90 percent of COPD deaths (Rosen, 1992). Other identified risk factors include air pollution (sulfur dioxide and other respiratory irritants) (Heath, 1993); certain occupational exposures (Angstman, 1992) such as airborne silica (Heath, 1993); alpha<sub>1</sub>-antitrypsin deficiency (Angstman, 1992); and history of childhood respiratory trouble (Angstman, 1992). Age and reduced lung function also seem to have an effect on development of COPD (Angstman, 1992). Of these risk factors, cigarette smoking is the most amenable to change, and smoking prevention and cessation are primary targets for preventive efforts.

#### *Smoking Cessation*

COPD is closely linked to smoking. There is a strong relationship between airway obstruction (reduced FEV<sub>1</sub>) and a high number of pack-years of smoking (Angstman, 1992). The relative risk of chronic bronchitis for smokers versus nonsmokers is 8.8 for men and 5.9 for women (Heath, 1993). In a British study of respiratory symptoms, 80 percent of male subjects who reported symptoms of chronic bronchitis were tobacco smokers (Heath, 1993). For these reasons, COPD prevention

is focused on smoking prevention and cessation. Indicators for smoking cessation are included in Chapter 5.

## **SCREENING**

There are no current recommendations in the reviewed literature for screening asymptomatic individuals for COPD.

## **DIAGNOSIS**

### **History**

Principal symptoms of COPD include dyspnea, chronic mucus production, decreased exercise and work tolerance, and cough (Nesse, 1992). COPD should be considered in patients with a history of smoking who present with these symptoms. Therefore, in a patient presenting with dyspnea, mucus production, or cough, a history of smoking should be elicited (Angstman, 1992) and documented in the record at the time of the presenting respiratory complaint (Indicator 1). History may provide evidence of other diseases, such as bronchiectasis, idiopathic pulmonary fibrosis, pulmonary sarcoidosis, pneumoconiosis, coccidiomycosis, and pulmonary tuberculosis (Angstman, 1992). Therefore, some information on other possible sources of exposure and occupational history should be elicited.

### **Physical Exam**

Certain elements in the physical exam may help to confirm a diagnosis of COPD. A lung exam may provide evidence of wheezing or airflow limitation, or evidence suggestive of other pulmonary conditions. Therefore, in patients presenting with dyspnea, cough, or wheezing in whom the diagnosis of COPD is made or considered, a lung examination should be documented on first presentation with a respiratory complaint (Indicator 2).

### **Spirometry**

Spirometry is important for detecting the presence of an obstructive defect and for establishing lack of reversibility, which distinguishes COPD from asthma. This distinction has important implications for treatment (Indicator 3). An obstructive ventilatory

impairment is seen on spirometry in COPD, indicated by a low FEV<sub>1</sub> to FVC (forced vital capacity) ratio. Typically the FEV<sub>1</sub> is reduced, and the FVC is normal or increased; however, in end-stage COPD it may be found that the FVC is decreased, leading to false normalization of the FEV<sub>1</sub>:FVC ratio (Angstman, 1992). Thus the FEV<sub>1</sub> to FVC ratio is most useful in evaluation of mild disease. With disease progression FEV<sub>1</sub> worsens (Angstman, 1992), and an FEV<sub>1</sub> reading that is lower than predicted and declines more rapidly than expected over time (i.e., by more than 25 ml/yr) is an additional spirometric indicator of COPD (Jacobs, 1994). In COPD, impairment persists despite medical therapy, distinguishing COPD from asthma (Angstman, 1992). Although airway obstruction may reverse partially with bronchodilators, it does not do so completely (Angstman, 1992).

#### **Indicators of Oxygenation: Complete Blood Count, Hemoglobin, Arterial Blood Gas**

Oxygen treatment has been shown to improve morbidity and mortality in hypoxemic patients with COPD (Nocturnal Oxygen Therapy Trial Group 1980; The Medical Research Council Working Party, 1981; Anthonisen, 1983). For example, nocturnal treatment with oxygen for sleep desaturation in COPD patients with daytime normoxemia (PaO<sub>2</sub> > 60 mm Hg) slowed or reversed the progression of pulmonary hypertension (Fletcher et al., 1992). Long-term oxygen treatment in a group of COPD patients with hypoxemia (PaO<sub>2</sub> < 55 mm Hg) led to significantly increased survival compared with a control group (Corrado et al., 1994). Therefore, experts agree that detection of hypoxemia in patients with COPD is important.

An arterial blood gas (ABG) has been recommended for detection of hypoxemia in the following instances: 1) if there is evidence of cor pulmonale, cyanosis, erythrocytosis, or if FEV<sub>1</sub> is less than one liter (Angstman, 1992); or, 2) if there are ongoing symptoms of COPD. ABG results may suggest the need for long-term therapy and allow for better evaluation of the severity of respiratory deterioration during an acute exacerbation (Hagedorn, 1992) (Indicators 4 and 5).

### **Chest Radiograph**

A chest x-ray should be considered part of the diagnostic evaluation for COPD. Although not itself diagnostic for COPD, a chest x-ray may exclude other causes of chronic airway obstruction (Angstman, 1992). Performing a chest x-ray may guide COPD therapy, as it can detect other lung conditions that, as with COPD, present as cough or dyspnea. Such conditions, not all of which produce obstructive defects, include sarcoidosis, coccidiomycosis, pulmonary tuberculosis, pneumoconiosis, pulmonary fibrosis, or lung nodules indicative of primary or metastatic cancer. Because smoking places patients at increased risk for lung cancer, which may present with dyspnea or cough, detection of an obstructive defect on spirometry does not guarantee that new symptoms result solely from COPD. The possibility of alternative or coexisting pathology has led to recommendations that a standard baseline posterior-anterior chest radiograph be obtained in the diagnostic evaluation of COPD (Listello, 1992). However, we have found no evidence to gauge the frequency with which this test identifies other pathology.

## **TREATMENT**

### **Smoking Cessation**

Smoking cessation is the primary therapy for chronic bronchitis in smokers (Griffith, 1993). It has also been called the most challenging intervention for both the patient and physician (Listello, 1992). Various forms of therapy are available, including group sessions, behavioral modification, hypnosis, and pharmacotherapy (Listello, 1992). Abstinence from smoking reduces the symptoms that define chronic bronchitis (cough, sputum production, wheezing, and dyspnea). Improvement with smoking cessation varies by age, smoking history, bronchial hyperreactivity, and degree of fixed airflow obstruction. Smoking cessation decreases the rate of decline in pulmonary function typically seen with sustained smoking (Griffith, 1993). Although the FEV<sub>1</sub> does not revert to normal on smoking cessation, the rate of decline falls back from 50-60 cc/yr to the normal rate of 20 cc/yr. The health benefits of smoking cessation include improved life expectancy;

decreased risk of cancer (lung, larynx, oral cavity, esophagus, pancreas, bladder); reduced risk of myocardial infarction; improved outcome after myocardial infarction; reduced risk of cerebrovascular and peripheral vascular disease; reduced respiratory symptoms (cough, sputum, wheezing, dyspnea); decreased mortality from respiratory infections; decreased rate of pulmonary decline; improved healing of duodenal ulcers; and, where pertinent, improved fetal birth weight (Griffith, 1993). Therefore, counseling or referral for smoking cessation should be documented on the chart for all smokers within three months of diagnosis or initiation of therapy for COPD (Indicator 6).

#### **Inhaled Bronchodilators: Anticholinergics**

High levels of safety and efficacy have made inhaled ipratropium a standard first-line drug for the treatment of patients with COPD. Bronchodilation begins about 15 minutes after use, and the duration of action is three to five hours (Nesse, 1992). Although some maintain that the drug's slow onset of action not only mandates regular use but clearly indicates inappropriate use for episodic bronchospasm (Nesse 1992), others state that onset is comparable to that seen with beta-agonists, with a longer duration of action (Griffith, 1993). The margin of safety for ipratropium is extremely large, and tachyphylaxis has not been reported. In addition, the bronchodilating effects of ipratropium in patients with chronic bronchitis are comparable or superior to those of beta-adrenergic agents in patients with chronic bronchitis (Griffith, 1993). Ipratropium has the additional theoretical advantage of producing an anticholinergic-mediated reduction of secretions (Heath, 1993), making this the bronchodilator of choice for initial treatment of chronic bronchitis (Griffith, 1993) and emphysema (Indicator 7). The most common side effects are cough and throat irritation (Griffith, 1993). As with other inhaled agents, individual patient response may dictate a higher dose, up to four puffs four times a day (Nesse, 1992).

#### **Inhaled Bronchodilators: Beta-2 Selective Agonists**

Efficacy of selective beta-agonists as bronchodilators has been unequivocally demonstrated in chronic bronchitis (Griffith, 1993). Inhaled therapy is the preferred method of administration (Griffith,

1993). No evidence clearly favors any one inhaled agonist over another (Nesse, 1992). Relatively recently it was recommended that these agents be given as two puffs four times a day, or up to six puffs or more at a time (Nesse, 1992). However, a British study found that continuous inhaled beta-agonist therapy was no more effective than "as-needed" treatment (Heath, 1993). In addition, side effects are more troublesome than those of ipratropium, and include tremor, tachycardia and increased cardiac output, though these are less problematic with inhaled than with oral therapy (Nesse, 1992; Griffith, 1993). In the asthmatic population, regular use may cause tachyphylaxis and may even increase mortality (Griffith, 1993). Although combination therapy continues to be advocated for maximal effect in acute exacerbations (Heath, 1993), the combination of ipratropium and a beta-agonist has not been found to achieve greater bronchodilation than a maximal dose of either agent alone. For this reason, routine use of ipratropium is recommended first (Griffith, 1993). Selective beta-agonists are still regarded as useful in several circumstances: 1) as needed for exacerbations of bronchospasm; 2) as an alternative first-line bronchodilator for patients who do not tolerate or do not respond to ipratropium; and 3) routinely in combination with ipratropium (both in relatively low doses) for patients who do not tolerate maximal doses of either agent (Griffith, 1993).

#### **Instructions on Bronchodilator Usage**

A metered dose inhaler (MDI) is as effective as a nebulizer for most patients (Griffith, 1993), if it is used correctly or with a spacer device. A spacer device (e.g., a simple extension tube or a proprietary device such as InspirEase) improves delivery by optimizing inhaled particle size, allowing large particles to settle out. This prevents the need for coordination of breathing and inhaler use, which is an important consideration in the elderly (Griffith, 1993). Some recommend using a spacer device for virtually all patients (Nesse, 1992). In the absence of a spacer, the factor that most limits efficacy of inhaled bronchodilators is inadequate dosage resulting from inefficient use; proper delivery requires an alert cooperative patient who has been

adequately educated in the technique, with follow-up (Nesse, 1992). Sixty-two percent of adult outpatients with COPD use the metered dose inhaler incorrectly (Hofford, 1992). Following a single instruction in correct use, 77 to 80 percent demonstrate the correct technique for using the inhaler (Hofford, 1992). Additional verbal instruction, followed by a time during which the patient practices proper use of the inhaler, further improves patient performance (Hofford, 1992) (Indicator 8).

### **Theophylline**

Treatment with theophylline is controversial for the following reasons: 1) a low toxic-to-therapeutic index, 2) wide variation in rates of absorption and metabolism, resulting in significantly different serum levels even in the same person over time, and 3) a large number of pharmaceutical and other factors (such as age, smoking or smoking cessation, diet, coexisting medical conditions) that influence the serum level (Nesse, 1992). The risk of life-threatening complications with theophylline therapy has been estimated at 0.5 percent per year (Nesse 1992). Severe side effects such as cardiac arrhythmias and seizures can occur even with "therapeutic" serum levels. One study found that theophylline added little benefit to otherwise maximal therapy, with several adverse side effects (Griffith, 1993). Although theophylline produces only moderate bronchodilation, efficacy in relief of dyspnea and improvement in arterial oxygen pressure, ventilation, and functional level have been significant even without discernible alteration in pulmonary function tests. This may be due to factors such as improvement in diaphragmatic muscle activity, reduced vascular and pulmonary bronchiolar resistance, and protection against episodic bronchospasm (Nesse, 1992).

A serum theophylline level of ten to 13 mg/mL provides at least 90 percent of the bronchodilatory benefit of higher serum levels and reduces the likelihood of toxic side effects (Nesse, 1992). Typically, serum levels of theophylline are checked two to five days after a significant change in dose, and should be measured whenever symptoms suggest toxicity (Nesse, 1992). Patients should be educated to

recognize and report to their physicians any early signs of toxicity such as nausea and tachycardia (Nesse, 1992) (Indicators 9 and 10).

### **Oral Corticosteroids**

Corticosteroid use remains controversial for COPD. Although airway inflammation is also part of the pathophysiology of COPD, the inflammation is characterized by neutrophil excess and not by the lymphocyte traffic and eosinophilic infiltration characteristic of asthma. As a consequence, the airway inflammation of COPD and the clinical course of COPD do not appear to be amenable to corticosteroid treatment in the majority of patients (Chapman, 1996). Only about ten percent of patients with COPD will benefit from either systemic or inhaled steroid therapy according to one recent meta-analysis (Chapman, 1996). Those patients most likely to benefit from steroid therapy show significant (i.e., greater than 15 percent) improvement in flow rates after bronchodilation (Jacobs, 1994). A meta-analysis has concluded that steroids are useful in patients with severe but stable COPD who remain symptomatic with maximum bronchodilation. Therefore, oral corticosteroid therapy should be reserved for patients in whom primary bronchodilator therapy fails to provide adequate control of symptoms and in whom steroids are beneficial.

### **Inhaled Corticosteroids**

In many or most patients who respond to systemic corticosteroids, substitution of inhaled for oral steroids is not adequate (Jacobs, 1994; Griffith, 1993). However, results of studies have shown that some patients with chronic bronchitis do respond favorably to inhaled steroids (Griffith, 1993). Such patients can only be identified by therapeutic trial. Advent of more powerful inhaled steroids may improve the likelihood of response in steroid responsive patients, though this remains to be documented. In light of favorable studies, some have recommended inhalation therapy with beclomethasone dipropionate, four to six puffs four times a day, while attempting to taper or discontinue oral prednisone; however, others have questioned whether adequate evidence supports this (Nesse, 1992).

## **Antibiotics**

Recommendations for antibiotic use in chronic bronchitis are mixed. The role of prophylactic antibiotic therapy on both a seasonal and continuous basis has been studied repeatedly, without a clear consensus as to its effectiveness (Heath, 1993). Some note that a subgroup of chronic bronchitis patients with frequent exacerbations have shown fewer exacerbations while taking prophylactic antibiotic therapy (Griffith, 1993).

## **Vaccination**

*Hemophilus influenzae*: Vaccination against *H. influenzae* is believed to reduce the number of episodes of bronchitic exacerbation (Griffith, 1993). Nonetheless, data regarding this benefit are sparse.

*Influenza*: No data from controlled trials demonstrate a decrease in disease from use of influenza virus vaccine in patients who have chronic bronchitis exclusively (Griffith, 1993). However, one nursing home study found that those residents who received influenza vaccine had a significant reduction in lower respiratory tract disease, hospitalization, and mortality compared with those who had not been vaccinated (Griffith, 1993). Another rationale for vaccine use is potential reduction in postviral bacterial colonization of the tracheobronchial tree (Griffith, 1993). Although efficacy has not been conclusively demonstrated, it is believed that the risk-benefit ratio for influenza vaccine favors its use in chronic bronchitis (Griffith, 1993).

*Pneumovax*: Pneumococcal pneumonia probably occurs in patients with chronic airflow obstruction more often than in the general population, but does not appear to predispose patients to excessive pneumococcal bacteremia or increased mortality (Griffith, 1993). There are no data suggesting that the vaccine is beneficial for prevention of pneumonia or bronchitic exacerbations in this population. It has not been subjected to large-scale trials to demonstrate reduced morbidity or mortality in a COPD population, and small trials have been inconclusive (Jacobs, 1994). However, most specialists advocate its use (Chapman, 1996), believing the risk-benefit ratio to be favorable (Heath, 1993; Chapman, 1996).

Quality indicators for vaccinations are included in Volume III of this series (see "Chapter 19: Preventive Care").

### **Exercise Rehabilitation**

Exercise rehabilitation addresses diverse factors that may contribute to dyspnea such as abnormal pulmonary mechanics, respiratory muscle fatigue, poor nutritional status, misperception of dyspnea, and even smoking cessation. Specific exercise techniques include general exercise conditioning, targeted respiratory muscle training, breathing retraining, and techniques in energy conservation (Griffith, 1993). These interventions also allow symptom monitoring by a respiratory therapist who can provide support and education for the symptomatic patient (Heath, 1993). Some maintain that exercise rehabilitation may be beneficial for patients with chronic airflow obstruction who, in spite of aggressive medical management, continue to have significant dyspnea (Griffith, 1993). However, rehabilitation techniques do not affect pulmonary function per se (Griffith, 1993) and, although they can improve exercise tolerance (Griffith, 1993), they have not been proved to alter disease progression (Heath, 1993).

### **Supplemental Oxygen**

Supplemental oxygen has been shown to improve survival and quality of life in hypoxemic patients with chronic obstructive lung disease (Nocturnal Oxygen Therapy Trial Group, 1980; The Medical Research Council Working Party, 1981; Anthonisen, 1983; Griffith, 1993; O'Donohue, 1996). Long-term oxygen therapy may increase lifespan by six to seven years in patients who have COPD with hypoxemia and cor pulmonale. Survival and subjective improvement increase when patients use oxygen for 19 to 24 hours per day (Listello et al., 1992). Overnight oxygen improves mortality compared with no oxygen in chronically hypoxic COPD patients (Chapman, 1996), and continuous oxygen improves survival compared with overnight oxygen (Chapman, 1996). Benefits include improved survival; improved neuropsychiatric function; amelioration of polycythemia, pulmonary hypertension, and cor pulmonale; and enhanced exercise performance (Jacobs 1994; O'Donohue, 1996).

In 1993, there were approximately 616,000 people in the U.S. receiving home oxygen at a cost of \$1.4 billion (O'Donohue, 1996). The indications for continuous long-term oxygen therapy for patients with hypoxemia at rest developed by the Health Care Financing Administration (HCFA) are generally accepted by third party payers throughout the U.S. These include  $\text{PaO}_2 \leq 55$  mm Hg,  $\text{SaO}_2 \leq 88$  percent, or  $\text{PaO}_2$  56 to 59 mm Hg or  $\text{SaO}_2 \leq 89$  percent in cases with edema caused by heart failure, with evidence of cor pulmonale, or with elevated hematocrit ( $> 56$  percent).

Indications for use of intermittent oxygen, during sleep or at rest, are somewhat less widely accepted. Indications for oxygen with exercise by HCFA's standards are  $\text{PaO}_2 \leq 55$  mm Hg, or  $\text{SaO}_2 \leq 88$  percent documented during exercise. Indications for nocturnal oxygen only, according to HCFA, are  $\text{PaO}_2 \leq 55$  mm Hg or  $\text{SaO}_2 \leq 88$  percent during sleep; a decrease in  $\text{PaO}_2$  of greater than 10 mm Hg; or a decrease in  $\text{SaO}_2$  greater than five percent with signs or symptoms of hypoxemia (defined as impaired cognition, restlessness, or insomnia) (O'Donohue, 1996). These recommendations agree closely with most published recommendations (Heath, 1993; Ferguson, 1993; Listello 1992; Chapman, 1996). Measurement should be made at times of clinical stability. If patients require oxygen therapy on discharge from the hospital, oxygen saturation should be retested one to three months after recovery from the acute illness (Chapman, 1996; O'Donohue, 1996).

HCFA requires retesting 61 to 90 days after discharge with oxygen only if the initial  $\text{PaO}_2 \geq 56$  mm Hg, or if  $\text{SaO}_2 \geq 89$  percent (O'Donohue, 1996). Oxygen should be given at a rate sufficient to produce oxygen saturation consistently greater than 90 percent (Indicators 11, 19, and 20).

### **Bullectomy**

Bullectomy has been suggested for improving airflow and gas exchange and reducing dyspnea in selected patients with bullae larger than one-third of the hemithorax and associated with lung compression. Laser bullectomy techniques have been described. Risks and benefits have not been clearly established (Ferguson, 1993).

### **Treatment of Acute Exacerbations of COPD**

The American Thoracic Society's Standards for the Diagnosis and Care of Patients with Chronic Obstructive Pulmonary Disease recommend that emergency evaluation of acute exacerbation of COPD include elements of history, physical exam, and laboratory evaluation (ATS, 1995). Attention should be paid to factors with documented prognostic value, particularly those that identify patients at high risk of relapse after outpatient medical management. In one study, these factors were found to include medical visits for dyspnea within the previous week; number of doses of bronchodilator therapy given in the evaluation setting; use of home oxygen; previous relapse rate; administration of aminophylline; and use of corticosteroids and antibiotics at the time of discharge from the medical setting (ATS, 1995).

According to recommendations of the American Thoracic Society and others, a history should include information on:

- *Outpatient medications* (ATS, 1995) - to assess use of home O<sub>2</sub> (which influences risk), use of theophylline (which signifies need for theophylline testing), and use of beta-blockers (which may exacerbate bronchospasm);
- *Recent medical visits and hospitalizations for COPD exacerbations* - to assess risk;
- *The presence of other symptoms* (such as fever or new cough that might signify presence of pneumonia or other infection) - to direct the evaluation and management of risk for continued respiratory compromise and, therefore, need for hospitalization; and,
- *Comorbid medical conditions* (ATS, 1995) - which also guide the risk stratification of the patient.

A physical examination should include:

- *Documentation of vital signs* (ATS, 1995) - to indicate hemodynamic stability, evaluate tachypnea (and correlate respiratory rate with pCO<sub>2</sub> from ABG), and to assess for presence of fever suggestive of coexisting infection;
- *A lung and chest exam* (ATS 1995) - to document the presence of airflow restriction or wheezing, which may guide severity

assessment. Crackles or egophony suggestive of consolidation will guide risk stratification, while the absence of lung sounds bilaterally may signify poor prognosis. The absence of lung sounds unilaterally may indicate the need for evaluation of pneumothorax.

- *Documentation of the presence or absence of paradoxical abdominal muscle use or accessory muscle use* (ATS, 1995) - which will indicate severity of breathing difficulty and influence severity assessment (Indicator 12).

According to American Thoracic Society 1995 standards, laboratory evaluation and other tests should include:

- *ABG* - to evaluate oxygenation status and ventilatory status;
- *EKG* - to assess for cor pulmonale and to rule out concomitant ischemia or arrhythmia that could exacerbate shortness of breath (Indicator 13);
- *Theophylline level* - if outpatient theophylline is prescribed (Indicator 14); and,
- *Chest x-ray* - to be documented within the past year, including a lateral view within the past year.

Acute treatment in the medical setting should begin with bronchodilator therapy, including beta-2 agonists and/or ipratropium by inhalation using a MDI with or without spacer or jet nebulizer (Indicator 15). The role of antibiotics remains under debate, although antibiotics are usually given. In one study, clinical deterioration was ten percent in patients treated with antibiotics, compared with 19 percent in patients who received placebo; and clear improvement occurred in 68 percent of patients treated with antibiotics versus 55 percent in the placebo group (Anthonisen et al., 1987). The advantage of antibiotic therapy was most pronounced in patients with increased dyspnea, increased sputum volume, and purulent sputum, and did not occur in subjects with only one of the three. Nonetheless, determination of who requires antibiotics and how antibiotics should be selected remain subjects of debate (Verghese, 1994).

Corticosteroids and theophylline are commonly given in acute exacerbations of COPD. However, the utility of steroids in the acute

setting remains a topic of debate, with some studies showing improvement and others not (Rosen, 1992). With respect to aminophylline, one meta-analysis of 13 controlled aminophylline studies found no evidence to support its use in the acute setting (Littenberg, 1988). However, a subsequent double-blind placebo-controlled randomized trial found that aminophylline, in doses producing levels just below the level commonly accepted as therapeutic, reduced the hospital admission rate among patients with asthma or COPD exacerbations by a factor of three (Wrenn et al., 1991). Oxygen should be administered if hypoxemia is present (oxygen saturation < 88 percent on ABG or pulse oximetry, and/or PO<sub>2</sub> < 55 mm Hg on ABG) (Indicator 16).

A patient should be hospitalized if the acute exacerbation is characterized by increased dyspnea, cough, or sputum production plus any of several factors that indicate a more severe course or more marked clinical compromise. These factors indicate heightened risk of respiratory failure or inability of the patient to care for him- or herself at home. Although these factors have not been subjected to formal testing for prognostic utility, most physicians would acknowledge these factors as clinical indicators of severity or risk. Among the recommended factors indicating heightened risk and meriting hospitalization (ATS, 1995) those that can be operationalized as quality measures include: documentation of a serious co-morbid condition (documented ischemia; documented pneumonia); altered cognition; worsening hypoxemia (saturation below baseline and below 88 percent; or PaO<sub>2</sub> below baseline and below 55 mm Hg); or new or worsening hypercarbia (pCO<sub>2</sub> at least 5 mm Hg above baseline, and above 60 mm Hg)(Indicator 17).

A patient with acute COPD exacerbation and increasing respiratory compromise should be monitored in a setting equipped with medical personnel, and pulse oximetry and telemetry capabilities so that, in the event of respiratory failure, intubation will be possible. Conditions indicating severe respiratory compromise are accepted to include (Indicator 18):

- Severe dyspnea (breathing rate > 35 or accessory muscle use) despite initial bronchodilator treatment (ATS, 1995);

- Confusion or lethargy;
- Respiratory muscle fatigue as assessed subjectively, by paradoxical diaphragmatic motion, or by normalization of pH on ABG (pH < 7.42) despite continued tachypnea (breathing rate > 33) (ATS, 1995);
- Persistent or worsening hypoxemia despite supplemental oxygen (pO<sub>2</sub> < 60 with FiO<sub>2</sub> > 40 percent);
- Severe or worsening respiratory acidosis (pH < 7.3).

#### **FOLLOW-UP**

Recommendations for follow-up include many elements described previously, such as regular counseling regarding smoking cessation and yearly influenza vaccination. Some authorities recommend periodic testing of oxygen saturation at every four to six months and at least yearly follow-up of FEV<sub>1</sub> to estimate rate of decline (Veterans Health Administration Clinical Practice Guideline, 1997); however, frequent testing of oxygen saturation may not be necessary in patients with stable mild COPD. Moreover, frequent testing of FEV<sub>1</sub> is useful only if it modifies management. Therefore, although these measures may be appropriate in many cases, no indicators will be generated for follow-up.

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**RECOMMENDED QUALITY INDICATORS FOR COPD**

The following indicators apply to men and women age 18 and older.

Indicator	Quality of Evidence	Literature	Benefits	Comments
<b>Diagnosis</b>				
1. A smoking history should be documented on the same day in patients who present with a new complaint of any of the following: <ul style="list-style-type: none"> <li>• chronic cough (&gt; 3 weeks duration);</li> <li>• shortness of breath; or</li> <li>• dyspnea on exertion.</li> </ul>	III	Angstman, 1992; Subramanian, 1994	Improve management of symptoms. Decrease progression of COPD.	This influences likelihood of COPD diagnosis, thus directing initial therapy. Additionally, smoking cessation counseling or referral can be initiated. If smoking cessation is effective, progression of COPD will be reduced.
2. A lung exam should be documented on the same day in patients who present with a new complaint of any of the following: <ul style="list-style-type: none"> <li>• chronic cough (&gt; 3 weeks duration);</li> <li>• shortness of breath; or</li> <li>• dyspnea on exertion.</li> </ul>	III	Angstman, 1992	Decrease symptoms through treatment of underlying condition.	By identifying physical findings that may redirect the diagnostic evaluation (which allows diagnosis of other conditions or supports diagnosis of obstructive lung disease), one may initiate the appropriate therapy and minimize inappropriate use of medications.
3. COPD patients on bronchodilator therapy <sup>1</sup> should have spirometry performed with and without bronchodilation within 3 months of initiation of therapy, unless spirometry was performed in the previous 12 months.	III	Angstman, 1992; Listello, 1992	Decrease symptoms by targeting appropriate treatment.	By confirming an obstructive defect and distinguishing COPD from asthma with spirometry, one can initiate the appropriate therapy, minimize inappropriate use of medications, and more properly assess future improvement or exacerbations.

Indicator	Quality of Evidence	Literature	Benefits	Comments
<p>4. COPD patients on bronchodilator therapy should have one of the following tests within 6 months before or after initiation of therapy:</p> <ul style="list-style-type: none"> <li>• Hemoglobin;</li> <li>• Hematocrit;</li> <li>• CBC;</li> <li>• ABG; or</li> <li>• Pulse oximetry.</li> </ul>	III	Angstman, 1992; Listello, 1992; Hagedorn, 1992	Improve survival.	Results may indicate long-term therapy and allow better evaluation of the severity of respiratory deterioration during an acute exacerbation. Detection of hypoxemia allows initiation of oxygen therapy, which has been shown to have mortality benefit in hypoxemic COPD patients.
<p>5. COPD patients should have an ABG performed within 3 months of any of the following findings, unless hypoxemia (PaO<sub>2</sub> &lt; 55) has been previously documented or the patient is already on chronic O<sub>2</sub> therapy:</p> <ol style="list-style-type: none"> <li>a. laboratory detection of erythrocytosis (Hct &gt;55);</li> <li>b. notation of cyanosis or cor pulmonale in the medical record; and</li> <li>c. detection of FEV<sub>1</sub> &lt; 1 liter on spirometric evaluation.</li> </ol>	III	Angstman, 1992; Listello, 1992	Improve survival.	New factors suggesting hypoxemia should be followed by testing for hypoxemia, since oxygen treatment of this condition improves mortality.
<b>Treatment</b>				
<p>6. Newly diagnosed COPD patients should be counseled or referred for smoking cessation within 3 months before or after of the new diagnosis of COPD.</p>	III	Griffith, 1993; Heath, 1993; Listello, 1992; Chapman, 1993	Improve survival. Decrease progression of symptoms.	Smoking cessation decreases the decline in pulmonary function typically seen with sustained smoking.
<p>7. All patients receiving pharmacologic treatment for COPD symptoms (including daily theophylline or non-PRN beta-agonists) should also be receiving ipratropium, unless intolerance is documented.</p>	III	Griffith, 1993	Decrease shortness of breath. Limit side effects from treatment.	Ipratropium is the first choice agent because it has a higher margin of safety, fewer side effects, and bronchodilator efficacy comparable with that of beta-agonists.

Indicator	Quality of Evidence	Literature	Benefits	Comments
8. Patients newly prescribed inhaled bronchodilators should be concurrently offered either a spacer device or instructions in proper use of a MDI.	III	Griffith, 1993; Listello, 1992	Reduce shortness of breath.	Inefficient use limits efficacy of inhaled bronchodilators. Proper delivery requires a patient who has been adequately educated in the technique.
9. COPD patients should have a theophylline level checked within 1 week of either initiation or increase of theophylline dose.	III	Nesse, 1992	Reduce adverse medication effects.	Testing the theophylline level determines whether a new or increased dose provides appropriate serum levels, and whether a reduced dose has brought serum levels from toxic to low therapeutic range. (Note: Recommendation is to recheck in 3 to 5 days of change in dose.)
10. In patients receiving theophylline, both of the following should occur when serum theophylline level exceeds 20 µg/ml: a. The dose should be modified within 1 day of the measurement; and b. Retesting of level should be performed within one week, unless theophylline was stopped.	III	Nesse, 1992; Listello, 1992	Prevent theophylline toxicity.	Retesting the theophylline level determines whether a modified dose provides serum levels that are neither toxic nor subtherapeutic.
11. COPD patients should be offered home oxygen if their baseline room air oxygen saturation is <88% at rest (not during an exacerbation).	I	Listello, 1992; Chapman, 1996; Jacobs, 1994	Improve survival. Improve neuro-psychiatric function. Enhance exercise performance.	Survival increases with supplemental oxygen saturation >90%, and there is subjective improvement when patients use oxygen for 19-24 hours. Long-term oxygen therapy may increase lifespan by 6 to 7 years in patients with COPD with hypoxemia and cor pulmonale.

Indicator	Quality of Evidence	Literature	Benefits	Comments
<b>Treatment: Management of Acute Exacerbations</b>				
<p>12. The following items should be documented in the medical record at the time of a COPD exacerbation<sup>2</sup>:</p> <ul style="list-style-type: none"> <li>a. Outpatient COPD medications;</li> <li>b. Information on prior hospitalizations, urgent care, or ED visits for COPD (e.g., time of most recent visit or number per year);</li> <li>c. Presence or absence of new cough;</li> <li>d. Vital signs, including respiratory rate, pulse, temperature, and blood pressure; and</li> <li>e. A physical examination of the chest</li> </ul>	III	American Thoracic Society, 1995	Reduce shortness of breath. Reduce theophylline toxicity. Assess severity.	<p>Assessing the patient's medications helps identify other risk factors for adverse outcomes (comorbid illness). It identifies use of theophylline, indicating need to test theophylline level; identifies agents that may increase or decrease clearance of theophylline, affecting serum levels; and identifies agents such as beta blockers which may worsen bronchospasm. Frequent recent ED visits and hospitalizations are a marker for more severe illness and assist in severity assessment.</p> <p>New productive cough in a dyspneic patient with a COPD exacerbation may signify a comorbid respiratory illness requiring treatment for resolution of symptoms (such as pneumonia). This will also guide severity adjustment, which will influence decision to hospitalize, as a worsening of a concurrent pneumonia may have serious consequences in a COPD patient. Vital signs guide therapy by evaluating severity of illness and identifying comorbid conditions.</p> <p>A silent chest may predict more severe airway obstruction. A physical examination helps guide therapy by evaluating severity.</p>
	III	American Thoracic Society, 1995		
	III	American Thoracic Society, 1995	Reduce shortness of breath. Provide possible survival benefit.	
	III	American Thoracic Society, 1995	Improve symptoms. Prevent mortality due to respiratory failure.	
<p>13. Patients admitted to the hospital for an exacerbation of COPD who have a history of coronary disease<sup>3</sup> should have an EKG performed within 24 hours of admission.</p>	III	American Thoracic Society, 1995	Prevent mortality due to primary or secondary cardiac conditions.	EKG may identify concurrent ischemia (contributing to shortness of breath) and cardiac conditions associated with pulmonary disease (e.g., Multifocal Atrial Tachycardia), which may guide treatment.

Indicator	Quality of Evidence	Literature	Benefits	Comments
14. A theophylline level should be obtained for patients on theophylline who meet any of the following conditions: a. Present with an exacerbation of COPD; and b. Are hospitalized with an exacerbation of COPD.	III	American Thoracic Society, 1995	Reduce shortness of breath. Reduce theophylline toxicity	Measurement of theophylline level in a patient taking theophylline allows subtherapeutic and toxic levels to be identified. Treatment can be modified to improve symptoms or reduce toxicity from theophylline.
15. COPD patients who present with an exacerbation should be offered inhaled bronchodilator therapy <sup>4</sup> if their respiratory rate is >24.	III	American Thoracic Society, 1995.	Reduce shortness of breath.	Bronchodilators are the principal treatment for COPD. They reverse the airflow obstruction, leading to improved ventilation and oxygenation, and reduction in shortness of breath.
16. Patients presenting with COPD exacerbation should have oxygen administered if the oxygen saturation is < 88% or PO <sub>2</sub> is < 55 mm Hg.	III	American Thoracic Society, 1995; Fromm, 1994.	Reduce shortness of breath. Reduce complications of hypoxemia.	Oxygen should be administered to all hypoxemic patients. Inadequate oxygen leads to adverse consequences to organs including the heart and brain, and can lead to death.
17. Patients presenting with COPD exacerbation should be offered admission to the hospital if any of the following conditions are documented in the medical record on the date of presentation: • Acute Ischemia <sup>5</sup> ; • Pneumonia; or • Significant hypoxemia (saturation < 88%, or PaO <sub>2</sub> < 55 mm Hg on room air in patients not on home oxygen).	III	American Thoracic Society, 1995.	Reduce shortness of breath. Reduce mortality.	Expert consensus identifies indications for hospital admission that consider the severity of the underlying respiratory dysfunction, progression of symptoms, response to outpatient therapies, existence of comorbid conditions, and availability of adequate home care. More severe respiratory dysfunction, progression of symptoms, or comorbid conditions imply greater risk and reduced safety of outpatient management.

Indicator	Quality of Evidence	Literature	Benefits	Comments
<p>18. Patients hospitalized with a COPD exacerbation should be admitted to a monitored setting (that includes access to pulse oximetry and telemetry) while any of the following are present:</p> <ul style="list-style-type: none"> <li>• Severe dyspnea (breathing rate &gt; 35 with accessory muscle use) despite initial therapeutic measures;</li> <li>• Confusion or lethargy;</li> <li>• Persistent or worsening hypoxemia despite supplemental oxygen (pO<sub>2</sub> &lt; 60 with FiO<sub>2</sub> &gt; 40%); or</li> <li>• Severe respiratory acidosis (pH &lt; 7.3).</li> </ul>	III		Reduce mortality.	Patients with factors indicating definite or possible near-term need for intubation require admission to an ICU or other monitored setting. A monitored setting is required for close observation of the patients' progress and allows prompt intubation -- and prevention of death from respiratory complications.
<p>19. COPD patients hospitalized for an exacerbation should be discharged on home oxygen if the last documented oxygen saturation prior to discharge is &lt;88%.</p>	III	The Medical Research Council Working Party, 1981; Nocturnal Oxygen Therapy Trial Group 1980; Anthonisen, 1983; Griffith, 1993; Chapman, 1996; O'Donohue, 1996.	Improve survival. Improve neuro-psychiatric function. Enhance exercise performance.	Survival increases with supplemental oxygen to maintain saturation >90%, and there is subjective improvement when patients use oxygen for 19-24 hours. Overnight oxygen vs. improves no oxygen improves mortality in chronically hypoxic COPD patients. Continuous oxygen vs. overnight oxygen improves survival. Long-term oxygen therapy may increase lifespan 6 to 7 years in COPD patients with hypoxemia and cor pulmonale. Class I data shows mortality benefit in patients who are chronically hypoxemic; extrapolation of the data to the population who are hypoxemic on discharge (who may or may not be chronically hypoxemic) is class III.
<p>20. Patients with a diagnosis of COPD who present with a COPD exacerbation and whose last documented oxygen saturation during the exacerbation visit is &lt; 88% should either be hospitalized or discharged on home oxygen treatment.</p>	III	The Medical Research Council Working Party, 1981; Nocturnal Oxygen Therapy Trial Group, 1980; Anthonisen, 1983; Griffith, 1993; Chapman, 1996; O'Donohue, 1996.	Improved survival. Improve neuro-psychiatric function. Enhance exercise performance.	Benefits of oxygen therapy in hypoxemic patients include improved survival; improved neuropsychiatric function; amelioration of polycythemia, pulmonary hypertension, and cor pulmonale; and enhanced exercise performance. Class I data shows mortality benefit in patients who are chronically hypoxemic. Extrapolation of the data to the population who are hypoxemic in the acute setting (who are not known to be chronically hypoxemic) is class III.

Definitions and Examples

<sup>1</sup> Bronchodilator therapy: inhaled beta-agonists and/or ipratropium and/or theophylline.

<sup>2</sup> COPD exacerbation: subjective worsening of dyspnea or cough leading patient to seek medical help.

<sup>3</sup> Coronary disease: CAD, prior MI, angina, or history of angioplasty or CABG.

<sup>4</sup> Inhaled bronchodilator therapy: beta-agonists and/or ipratropium.

<sup>5</sup> Acute ischemia: (a) Physicians note of acute myocardial ischemia, accelerated angina, or unstable angina during the exacerbation, or (b) ST elevation in 2 separate leads of more than 2 mm on the day of presentation.

Quality of Evidence Codes

I RCT

II-1 Nonrandomized controlled trials

II-2 Cohort or case analysis

II-3 Multiple time series

III Opinions or descriptive studies