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## Managing COPD Exacerbations in the Hospital and Home

By David Vines, MHS, RRT, FAARC and Sandra Adams, MD, MS

Chronic obstructive pulmonary disease (COPD) primarily results from inhalation of noxious gases which create an airflow limitation. This airflow limitation is not completely reversible. The severity of this disease is classified depending on the degree of airflow limitation that exists. The patients with moderate to severe limitations have a higher occurrence of COPD exacerbations. Acute COPD exacerbations are identified by an increase in the patient's dyspnea, cough, and production and/or purulence of their sputum. COPD exacerbations affect the patient's quality of life, morbidity, and mortality. They also place a large financial burden on the healthcare system. The treatment of an exacerbation involves the use of short-acting bronchodilators, oral or intravenous corticosteroids, antibiotics, oxygen therapy, noninvasive positive pressure ventilation, and secretion removal. Based on the patient's severity, history, and symptoms they may be treated in the home or hospital setting. The prevention of more exacerbations involves smoking cessation, vaccinations, long-acting bronchodilators, inhaled corticosteroids, patient education, and outpatient pulmonary rehabilitation. The article is a review of the current recommendations and evidence related to the care of COPD patients with acute exacerbations. To lessen the burden of this disease it is important for healthcare providers to understand these current recommendations and guidelines.

## Panel Discussion: Applying Comprehensive Chronic Care to Impact Acute Exacerbations of COPD

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COPD exacerbations represent a significant burden to both patients and healthcare providers. As with other medical conditions, preventive strategies can help avoid the need for acute care situations. An action plan that incorporates patient education, ready access to medications, and medical support can go far to prevent exacerbations, but there are challenges in implementing these measures. We have invited a panel of experts to discuss some of the advantages and barriers to the successful management of the patient with COPD.

# Managing COPD Exacerbations in the Hospital and Home

By David Vines, MHS, RRT, FAARC and Sandra Adams, MD, MS

Chronic obstructive pulmonary disease (COPD) is a preventable and treatable disease characterized by airflow limitation which is not completely reversible. This progressive limitation in airflow is caused by the inhalation of noxious gas (cigarette smoking, air pollution, so forth) that results in an abnormal inflammatory response. Chronic inflammation leads to damage of lung parenchyma, narrowing of airways, and airway remodeling. The severity of COPD has been classified into 4 stages which are best defined by changes in spirometry (Table 1).

Respiratory failure is identified by a partial pressure of arterial oxygen (PaO<sub>2</sub>) < 60 mm Hg with or without a partial pressure of carbon dioxide (PaCO<sub>2</sub>) > 50 mm Hg. At stage II (moderate COPD), the patient's symptoms become more apparent (increased dyspnea on exertion, cough, and sputum production). By stage III (severe COPD), symptoms begin to impact the patient's quality of life (QOL). At this stage, patients become more sedentary, experience chronic fatigue, and often develop repeated exacerbations of symptoms.<sup>1</sup>

## COPD Exacerbations

Acute COPD exacerbations are identified by an increase in the patient's dyspnea, cough, sputum production and purulence beyond the day-to-day variability.<sup>1-3</sup> COPD exacerbations are associated with significant morbidity, mortality, and cost which place a burden on the patient and healthcare system. QOL can be affected for months following an exacerbation. In a large prospective study of hospitalized pa-

tients with acute COPD exacerbation and hypercapnia, only 25% of the patients reported a good or better QOL 6 months after discharge. Of the 514 patients interviewed at 6 months, 54% required help with activity of daily living and 49% reported their health status as fair or poor.<sup>4</sup> Frequent exacerbations (≥ 3 per year) have been associated with worsening of health-related QOL in COPD patients with an FEV<sub>1</sub> 35-50% of predicted.<sup>5</sup> The mortality of hospitalized patients with COPD exacerbation and hypercapnia was 11%. Their 180-day mortality and 2-year mortality rates were 33% and 49% respectively.<sup>4</sup> The 1-year mortality rate associated with COPD exacerbations requiring treatment in the intensive care unit was higher (59%) in patients > 65 years of age.<sup>6</sup> Higher mortality rates have also been linked to the frequency of exacerbations and exacerbations requiring hospitalization. The risk of death was 4.3 times greater for exacerbations that required hospitalization than those that did not.<sup>7</sup> In 2002, the economic burden of COPD in the US was \$18 billion in direct costs and \$14.1 billion in indirect costs.<sup>1</sup> There is a direct relationship between increasing severity and increasing cost. In 2000, COPD exacerbations resulted in more than 725,000 hospitalizations and 1.5 million emergency department visits.<sup>8</sup> The physical and fi-

nancial burden of COPD and associated exacerbations place a greater emphasis on understanding the etiology, management, and prevention of this disorder. To lessen this burden, it is important for healthcare providers to understand current recommendations regarding management and prevention of COPD exacerbations.

COPD exacerbations may be associated with infections, air pollution, patient medication compliance issues and gastroesophageal reflux. Lung infections and air pollution are the most common causes of exacerbations.<sup>9</sup>

## The Role of Pathogens and Air Pollution

Infections can result from a bacterial or viral source. The most common bacterial organisms are *Haemophilus influenzae*, *Streptococcus pneumoniae*, and *Moraxella catarrhalis*. Patients with severe COPD have a greater risk of Gram negative organisms (*Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, etc).<sup>10</sup> Besides declining lung function, these opportunistic organisms may be associated with prior antibiotic use. Bacteria can affect COPD symptoms in several ways. They stimulate mucus production, some inhibit ciliary beat frequency, others cause epithelial damage, and inflammation is caused by endotoxin and cytokine release. These bacteria have been identified both when the patient is clinically stable and during exacerbations, although the bacterial load is often increased in the latter situation.<sup>4</sup> There is also an association between purulent sputum (i.e. green color) and a high bacterial load in acute COPD exacerbations resulting from bacterial infections.<sup>11</sup>

Table 1. Classification of COPD Severity

Stage	Severity	FEV <sub>1</sub> /FVC	Predicted value of FEV <sub>1</sub>
I	Mild	<0.70	≥80%
II	Moderate	<0.70	≥ 50% but < 80%
III	Severe	<0.70	≥ 30% but < 50%
IV	Very Severe	<0.70	< 30%, < 50% in case of chronic respiratory failure

Several viruses have been associated with COPD exacerbations, including rhinovirus, influenza virus, parainfluenza virus, respiratory syncytial virus, and adenovirus.<sup>4</sup> Of these, rhinoviruses have been the most commonly isolated viruses. Viruses can result in damage to the epithelium, loss of cilia, increased mucus production, and inflammation. Viral infections can also predispose COPD patients to secondary bacterial infections. It remains controversial as to whether COPD patients are more susceptible to viruses than healthy individuals.<sup>4</sup> COPD exacerbations from a viral source have been associated with an increased severity and a longer recovery time compared to other causes.<sup>12</sup>

Air pollution from diesel exhaust (sulphur dioxide, ozone, and nitrogen dioxide) has been associated with airway inflammation.<sup>4</sup> During times of the year when air pollution is increased, 6% to 9% of the hospital admissions in COPD patients may be associated to it.<sup>13</sup>

### Diagnosis and Classification

Patients who develop acute COPD exacerbations (increase in dyspnea, cough, and sputum production) can be managed in the hospital or at home. The GOLD guidelines recommend that the following criteria be used for hospital assessment or admission of COPD patients with acute exacerbations: increased intensity of symptoms, severe COPD, cyanosis, peripheral edema, failure to respond to initial medical treatment, significant comorbidities, frequent exacerbations, new arrhythmias, diagnostic uncertainty, older age, and insufficient home support.<sup>1</sup> These patients should be assessed for the severity of the exacerbation, which includes a review of their medical history, a physical examination, determination of blood gas levels, and a chest X-ray. Signs of increased severity include accessory muscle use, paradoxical breathing, central cyanosis, peripheral edema, hemodynamic instability, signs of right

**Table 2. Operational classification of acute COPD exacerbation severity. (Celli 2004)**  
COPD exacerbation patients classified as level 1 can be managed in the home, level 2 require hospitalization, and level 3 patients develop respiratory failure.

	Level I	Level II	Level III
<b>Clinical History</b>			
Co-morbid conditions <sup>#</sup>	+	+++	+++
History of frequent exacerbations	+	+++	+++
Severity of COPD	Mild/moderate	Moderate/severe	Severe
<b>Physical Findings</b>			
Hemodynamic evaluation	Stable	Stable	Stable/unstable
Use, accessory respiratory muscles, tachypnea	Not present	+++	+++
Persistent symptoms after initial therapy	No	+++	+++
<b>Diagnostic procedures</b>			
Oxygen saturation	Yes	Yes	Yes
Arterial blood gases	No	Yes	Yes
Chest radiograph	No	Yes	Yes
Blood tests <sup>##</sup>	No	Yes	Yes
Serum drug concentrations <sup>###</sup>	If applicable	If applicable	If applicable
Sputum Gram stain and culture	No	Yes	Yes
Electrocardiogram	No	Yes	Yes

+: Unlikely to be present, ++: likely to be present, +++: very likely to be present, #: the more common co-morbid conditions associated with poor prognosis in exacerbations are congestive heart failure, coronary artery disease, diabetes mellitus, renal and liver failure., ##: blood tests include cell blood count, serum electrolytes, renal and liver function. ### serum drug concentrations. consider if patients are using theophylline, warfarin, carbamazepine, digoxin. consider if patient has recently been on antibiotics.

heart failure, and a change in mental status. These signs should be compared to baseline findings to determine the degree of change. In severe COPD, the most important sign is a change in mental status (i.e. reduced alertness). Spirometry measurements are not accurate during exacerbations and thus are not recommended for assessing severity. Patients who do not respond to treatment during an exacerbation should be evaluated for conditions that mimic exacerbations (e.g., pulmonary embolism, pneumonia, congestive heart failure, pneumothorax, pleural effusion, and cardiac arrhythmias).<sup>1</sup> Celli and colleagues recommended an operational classification of severity based on clinical history and physical findings to determine if the patient can be managed in the home or should be hospitalized.<sup>3</sup> Exacerbated COPD patients classified as level 1 can be managed in the home; level 2 requires hospitalization, and level 3 patients develop respiratory failure. (Table 2)

### Pharmacological Treatment

Managing COPD exacerbations in both home and hospital settings requires the use of bronchodilators.

Short-acting inhaled beta-2 agonists are preferred during an exacerbation. If the patient does not respond quickly to the beta-2 agonist then an anticholinergic agent should be added.<sup>1,3</sup> With regard to the frequency of use of bronchodilators, current recommendations are “as needed” for treatment at home and every 2-4 hours if the patient is hospitalized. Long-acting beta-2 agonists or long-acting anticholinergics are not currently recommended during an acute exacerbation, but should be considered for maintenance therapy. Bronchodilator delivery via small-volume nebulizers (SVN) or metered-dose inhalers (MDI) with spacers are considered equivalent.<sup>14</sup> The addition of a spacer for use with MDIs should be considered and the patient’s appropriate use of the aerosol delivery device checked if treated at home.<sup>3</sup> The primary method of delivering short-acting bronchodilators in the hospital is through small volume nebulizers; because of both their suitability for patients who have difficulty breathing and their convenience of use.<sup>15</sup>

Glucocorticosteroids are recommended for the management of exacerbations in the hospital setting. They are recommended in the home setting

if the baseline forced expiratory volume in 1 second ( $FEV_1$ ) is  $< 50\%$  of predicted value. They have been shown to improve  $FEV_1$  and  $PaO_2$ .<sup>1</sup> Glucocorticosteroids may reduce length of hospital stays, treatment failures, rate of relapse, and  $FEV_1$ .<sup>16,17</sup> Oral prednisolone for 7-10 days at 30-40 mg is effective and safe.<sup>1</sup> Additional treatment increases the risk of hyperglycemia and muscle atrophy.

A systematic review and meta-analysis reported that antibiotic use reduced treatment failure by 46% and in-hospital mortality by 78%.<sup>17</sup> Treatment failures were defined as “unchanged” or “worsened symptoms within 21 days” or “need for additional antibiotics within 7 days of treatment.” The GOLD guidelines divide their recommendations for antibiotic use into 3 groups based on the severity of the exacerbation and risk factors for poor outcome (severe COPD,  $\geq 3$  exacerbations per year, presence of comorbid diseases, and antibiotic use in the last 3 months).<sup>1</sup> Group A patients have mild exacerbations and no risk factors for a poor outcome. If patients in Group A have an increase in all 3 cardinal symptoms (dyspnea, sputum volume, sputum purulence) or have purulent sputum plus 1 of the other 2 symptoms, then antibiotics are recommended. Antibiotics recommended for use with this group are beta-lactam/beta-lactamase inhibitors, macrolides, second or third generation cephalosporins. Group B patients have moderate exacerbations with risk factors for a poor outcome, so antibiotics are recommended. The presence of resistant organisms presents more of a concern. Antibiotics recommended for this group include those listed above with the addition of fluoroquinolones. Group C patients have severe exacerbations with risk factors for a *Pseudomonas* infection (previous isolation of *P. aeruginosa*, recent hospitalization, 4 courses of antibiotics in the last year). Antibiotics against *Pseudomonas* infections should be given to this group.

High-dose fluoroquinolones are recommended by the guidelines. The GOLD guidelines also recommend antibiotics for COPD patients with severe exacerbations requiring noninvasive or invasive mechanical ventilation.<sup>1</sup> Antibiotics given to COPD patients with acute exacerbations requiring mechanical ventilation resulted in significant reductions in hospital mortality and length of hospital stay compared to placebo.<sup>18</sup>

### Respiratory Treatment

The presence of cyanosis is a physical finding associated with hospital assessment or admission. In this setting, supplemental oxygen is provided to correct the patient’s hypoxemia. The recommended goal of oxygen therapy is to increase  $PaO_2$  to  $< 60$  mm Hg or  $SaO_2$  to  $> 90\%$ .<sup>1</sup> Supplemental oxygen is best provided with an air entrainment mask (Venturi mask) and should be started at 28% and titrated to achieve a  $SaO_2$  of 90% (Figure 1). Supplemental oxygen may also be provided by a nasal cannula, usually starting at 2 liters per minute (LPM). The fraction of inspired oxygen ( $FiO_2$ ) delivered will vary more with a nasal cannula than with an air entrainment mask. A humidified high flow nasal cannula may also be used instead of the air entrainment mask.

The percent of oxygen delivered with the high flow nasal cannula should be controlled by a blender started at 28% and titrated to achieve the  $SaO_2$  of



Figure 1. Comfort Flo® High Flow Nasal System and the ConchaTherm® Neptune® Heated Humidifier (Teleflex Medical)

90%. It is also recommended that arterial blood gases be obtained 30-60 minutes after initiation of oxygen to document the reversal of the hypoxemia, and more importantly, the pH and  $PaCO_2$  level.<sup>1</sup> Changes in oxygen therapy require monitoring of the patient and their pH because acute elevations in  $PaCO_2$  can occur in COPD patients with  $CO_2$  retention. Even if respiratory acidosis occurs, it is important to maintain the  $SaO_2$  at 90-92%. Respiratory acidosis may require the use of non-invasive positive pressure ventilation (NPPV) if pH falls below 7.35. If a high flow nasal cannula (Figure 1) is used as a step between standard oxygen therapy and NPPV, pH and  $PaCO_2$  level, accessory muscle use, and respiratory rate should be checked within 30 minutes. If these measures worsen, NPPV should be started without delay. More research is needed to clarify the role of the high flow nasal cannula in the management of COPD exacerbations.

NPPV is indicated in COPD patients with severe exacerbation when respiratory distress (dyspnea, increased accessory muscle use, paradoxical breathing, respiratory rate  $> 25$  breaths/min) and respiratory acidosis (pH  $< 7.35$  and  $PaCO_2 > 45$  mm Hg) are present.<sup>1,3</sup> A recent metaanalysis on the management of acute exacerbations of COPD reported that the use of NPPV reduced the risk of intubation by 65%, the length of hospital stay by 1.9 days, and hospital mortality by 55%.<sup>17</sup> These patients must be screened for the following contraindications: respiratory arrest, cardiovascular instability (hypotension, arrhythmias, myocardial infarction), change in mental status, uncooperative patient, high risk of aspiration, copious secretion, recent gastroesophageal or facial surgery, burns, extreme obesity, craniofacial trauma, and fixed nasopharyngeal abnormalities.<sup>1,3,19</sup> If the indications are present and contraindications absent, then choosing an interface and ventilator initiation are

the next steps in treatment. An oronasal or full face mask are frequently used as the interface in COPD patients with acute exacerbations and respiratory acidosis (Figure 2). The mask should be appropriately sized and fitted to the patient. The size of the mask is based on the length from the bridge of the nose to under the lower lip. Connect the mask to the noninvasive ventilator and start with low settings (expiratory positive airway pressure: 5 cm H<sub>2</sub>O; inspiratory positive airway pressure: 10 cm H<sub>2</sub>O). Allow the patient to hold the mask on their face while the straps are adjusted to secure the mask and prevent leaks. Caution should be taken not to overtighten the mask since this can cause a decrease in tolerance and skin breakdown. After the mask is secured and the patient is comfortable, inspiratory pressure can be slowly increased until the respiratory rate decreases or spontaneous tidal volume returns to normal. Adding heat and humidity may improve patient compliance and prevent nasal and oral dryness. Predictors of success include minimization of air leaks, lower severity of illness, decreasing respiratory rate and heart rate, and improvement in gas exchange within 1 hour of initiation.<sup>19</sup>

Invasive mechanical ventilation is indicated if patients cannot tolerate NPPV, severe respiratory distress continues, respiratory rate is > 35 breaths/min, pH is < 7.25, life-threatening hypoxemia develops, respiratory arrest occurs, worsening of mental status occurs, or a cardiovascular complication develops.<sup>1,3</sup>

The use of heliox therapy may have a role in the management of severe COPD exacerbations. A retrospective analysis of 81 COPD patients with acute exacerbations and respiratory acidosis revealed that heliox may reduce intubation rate, mortality rate, and length of stay in the intensive care unit and hospital.<sup>20</sup> These findings need to be confirmed in a randomized controlled trial. In hypercapnic COPD patients with



Figure 2. BiPap®Vision® Ventilatory Support System (Philips/Respironics) and the ConchaTherm® Neptune® Heated Humidifier (Teleflex Medical)

acute exacerbations requiring noninvasive or invasive mechanical ventilation, heliox has been shown to reduce intrinsic positive end-expiratory pressure (airtrapping),<sup>21</sup> work of breathing,<sup>21,22</sup> dyspnea and PaCO<sub>2</sub><sup>23</sup> compared to air. These findings suggest that heliox may be beneficial in COPD patients requiring high levels of inspiratory pressure or pressure support to maintain adequate ventilation during noninvasive ventilation. The addition of heliox in this group of patients may further reduce the rate of intubation compared to noninvasive ventilation alone. A randomized controlled trial of COPD exacerbation patients requiring noninvasive positive pressure ventilation compared 78:22 heliox to air and found that the hospital length of stay was shorter and cost lower in the heliox group.<sup>24</sup> Although intubation rate was lower in the heliox group (13%) versus the air group (20%), it did not reach significance. Further research is needed to clearly identify the role of heliox in managing patients with severe COPD exacerbations.

The GOLD guidelines recommend bronchial hygiene or secretion removal by manual or mechanical chest percussion and postural drainage if the patient has greater than 25 mL of sputum/day or lobar atelectasis.<sup>1</sup> An evidence based review concluded that chest physiotherapy (CPT) was ineffective and could be detrimental to COPD patients with

acute exacerbations.<sup>25</sup> A small randomized controlled trial in patients with acute exacerbation of chronic bronchitis compared CPT and postural drainage, oscillating positive expiratory pressure, and expiration with the glottis open in the lateral position.<sup>26</sup> All patients tolerated all 3 treatments well without desaturation, and all treatments significantly increased sputum production. For the first hour after treatment, sputum production was significantly higher with oscillating positive expiratory pressure, and expiration with the glottis open in the lateral position.<sup>26</sup> If tolerated, oscillating positive expiratory pressure or expiration with the glottis open in the lateral position may be beneficial if the patient has greater than 25 mL of sputum/day.

### Prevention and Long-term Management

The prevention of more exacerbations involves smoking cessation, vaccinations, long-acting bronchodilators, inhaled corticosteroids, patient education, and outpatient pulmonary rehabilitation. The Lung Health Study reported twice the decline in FEV<sub>1</sub> for smokers compared with sustained quitters over an 11-year period.<sup>27</sup> After 14.5 years, the all-cause mortality was 18% less in the smoking cessation group compared with those that continued to smoke.<sup>28</sup> Patients should be educated on the hazards of smoking and given help to quit. Influenza and pneumococcal vaccinations are recommended for COPD patients. Both vaccinations have been shown to reduce or prevent respiratory tract infections.<sup>29-31</sup> Long-acting beta-2 agonists, long-acting anticholinergics, and inhaled corticosteroids have been shown to reduce the frequency of acute exacerbations in patients with moderate-to-severe COPD.<sup>32</sup> Patient education and appropriate use of aerosol delivery devices are important to assure that the medication is being delivered properly. After the patient has recovered from the

exacerbation, pulmonary rehabilitation has been shown to be effective in improving dyspnea and health-related QOL, and in reducing health-care utilization.<sup>33</sup>

## Conclusion

COPD exacerbations place a burden on patients and the healthcare system. Short-acting bronchodilators, oral or intravenous corticosteroids, and antibiotics are used both in the outpatient and hospital setting to treat acute COPD exacerbations. In more severe exacerbations, oxygen therapy and, if needed, NPPV are initiated in the hospital setting. The goal is to return the patient back to their health status prior to the exacerbation. Once the patient has recovered, preventive measures are recommended. More research is needed in this area to optimize the chronic care of these patients.

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**Sandra Adams** MD, MS (See page 11 for biographical information.)

# Applying Comprehensive Chronic Care to Impact Acute Exacerbations of COPD.

## Roundtable Discussion

### Moderator:

**Sandra Adams, MD,**

Associate Professor of Medicine,  
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### Panelists:

**Sidney Braman, MD,**

Professor of Medicine,  
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**Nicola Hanania, MD**

Associate Professor of Medicine,  
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**Susan Blonshine, RRT**

President/CEO TechEd Consultants

The management of COPD represents a huge burden to health-care resources. Attention is often allocated to acute disease treatment as opposed to the prevention of complications.<sup>1</sup> As an example, COPD management is often tailored to treating acute exacerbations of COPD (AECOPD), while minimal effort is expended to educate patients or health-care systems about preventing exacerbations. This may lead to inappropriate resource utilization. Therefore, a multidisciplinary organized approach to preventative COPD management is needed.

The Chronic Care Model (CCM) has been proposed as a solution to prevent complications and improve outcomes in patients with chronic diseases.<sup>2</sup> This model identifies essential elements that encourage high-quality chronic diseases care.<sup>1-4</sup> These elements

involve the community and health system and include self-management support, delivery system design, decision support, and clinical information systems. The model fosters productive interactions between informed patients who actively participate in their care and experienced providers, resulting in higher quality and possibly more cost-effective patient care. Systematic reviews and clinical studies have demonstrated that implementing the CCM components in patients with chronic diseases such as asthma, congestive heart failure, depression, and diabetes is associated with significantly improved outcomes.<sup>5,6</sup> A systematic review of studies that implemented the chronic care model in patients with COPD demonstrated that those who received interventions with two or more CCM components had fewer unscheduled/emergency center visits, fewer hospitalizations, and reduced hospital length of stay compared with the control groups.<sup>7</sup> Therefore, I would like to welcome everyone to this roundtable discussion about the potential benefits and barriers of implementing the chronic care model in patients with COPD.

*Which components of a chronic care model have the highest potential to shift COPD care from management to prevention of acute exacerbations?*

**Blonshine:** Self-management strategies and delivery system design may prove beneficial. In one study, a significant potential for decreased hospi-

tal admissions with an integrated care pathway was identified.<sup>8</sup> The system requires a flexible shared-care arrangement with hospitals and primary care that can be supplemented with information technologies. Last year, Dr. Roca from the University of Barcelona presented research from the CHRONIC project which supports the shared-care model with information technologies.<sup>9</sup> The University of Michigan Center for Managing Chronic Disease opened in 2007 to conduct research on how people may control the effects of their chronic illness by putting them at the center of their own disease control. When patient education, service delivery, and payment systems focus on patients' and families' efforts to manage disease effectively, disease control increases, health care costs go down, and family well-being is improved.<sup>10</sup>

**Braman:** There are several components of a comprehensive chronic care model that have potential to prevent the acute exacerbations of COPD. The first I would mention is in the realm of decision support. I believe it is essential to establish treatment algorithms based on well-recognized evidence-based guidelines such as the GOLD and ATS/ERS guidelines. There is growing evidence that proper pharmacologic treatment for COPD can prevent exacerbations as well as improve other aspects of this disease. For example, prospective, randomized controlled trials have demonstrated that inhaled long-acting beta agonists given twice a day and anticholinergics given once a day have been shown to

reduce exacerbation rates. In addition, a combination therapy with a long acting beta agonist and an inhaled corticosteroid may have a significant impact on exacerbation rates and reduce the use of oral corticosteroids for COPD exacerbations. Reducing the use of systemic corticosteroids is especially important in the older patient with COPD as these agents have significant side effects such as diabetes mellitus and osteoporosis. In recent years, long-acting bronchodilators and inhaled corticosteroids were used predominantly for symptom control. Current evidence from well designed clinical research studies supports their use for prevention of exacerbations of COPD, an important finding because research has also shown that quality of life diminishes significantly in patients with recurrent exacerbations. If medications were prescribed for COPD using appropriate evidence-based protocols and if these protocols were modified for use in the primary care community, exacerbation rates for COPD would likely diminish. If this occurred, patient outcomes would improve and healthcare utilization for COPD would diminish.

It has been shown that treating an exacerbation of COPD with antibiotics can prevent progression of the exacerbation and escalation of care such as hospitalization. Hence educating patients on the signs and symptoms of an exacerbation and the need for early treatment with antibiotics (and possibly corticosteroids) can prevent more serious consequences. Educational efforts such as smoking cessation and exercise programs are other educational measures that should be stressed to improve outcomes for the COPD patient.

**Hanania:** All the components of the chronic care models for COPD are important and complement one another. However, I believe that self-management is very important because many patients with COPD do not understand

## I believe it is essential to establish treatment algorithms based on well-recognized evidence-based guidelines such as the

their disease and thus are less likely to adhere to management. Therefore, promoting self-management and education of patients will improve treatment compliance and adherence to preventative and management strategies. This will help in preventing exacerbations. In addition, altering the delivery system design towards a non-physician team approach will help to improve patient access and greater efficiency of care.

*What are the benefits and potential risks of implementing an action plan for patients with COPD?*

**Blonshine:** Action plans assist patients in early identification of symptoms, allowing for interventions and changes in the treatment plan to prevent hospitalizations. Historically, action plans have been successfully used in asthma care, and more recently in COPD. When physicians provide criteria for decision making or draw up written plans, patient symptoms decrease and quality of life improves. Watson and colleagues evaluated self-management plans in COPD over 10 years ago.<sup>11</sup> In this early study, there were significant behavior changes in the intervention group compared with controls. Although lung function did not change, the intervention group initiated treatment in response to de-

teriorating symptoms at a significantly higher rate than the control group. An economic benefit to action plans may also exist. COPD patients from 7 respiratory centers with a previous hospitalization in the year preceding enrollment were randomized to usual care and self-management education.<sup>12</sup> The intervention group received standardized COPD education and supervision by a case manager. Cost was calculated as prevention of hospitalization versus cost of the program and related to case load. The cost savings in the Canadian healthcare system were not realized at 14 patients per year, but were significant at a higher caseload of 50 patients (\$2,149.00). Cost savings were also realized in the Living Well with COPD program with an intervention over 2 months.<sup>13</sup>

**Braman:** Patients who are more knowledgeable about their disease feel more empowered to control outcomes. Depression and anxiety are extremely common in COPD and measures to lessen the stress of COPD are important. Having an action plan gives a patient confidence in managing his or her condition and leads to proper use of medical facilities such as emergency departments and walk-in clinics. The potential risk of an action plan is that the patient may continue to follow it despite worsening, and this may delay transfer to a hospital until the disease has advanced to a dangerous level. With appropriate education I think this latter disadvantage can be avoided in most instances.

**Hanania:** As it is in asthma there are advantages and disadvantages for using an action plan in COPD management. Perhaps the most important advantage is the ease of use of such a plan, especially if it is written and simplified for patients who are often elderly and have memory problems. A written action plan will keep the patient more organized with the care of their COPD. An



ideal action plan would list the current medications, their indications, their mode of use, and potential side effects. As well, it would list what medications the patient should use in the event of an exacerbation, such as an antibiotic, a steroid, or both. Action plans in asthma have been based on the use of PEFR as well as symptoms, but this is not the case in COPD. A COPD action plan has to be based on symptoms alone as the use of PEFR for detecting exacerbation is of minimal benefit. As for the potential problems of an action plan, COPD is not a homogenous disease and patients may have different phenotypes. An action plan for one patient may not work for others. Therefore, depending on an action plan alone may be risky, especially in those with poor perception of airway obstruction.

*What are the main barriers to the successful comprehensive care of COPD in clinical practice?*

**Blonshine:** The majority of patients with mild-to-moderate COPD are seen in the primary care setting. In a study of 784 practicing primary care physicians by Foster et al, 55% of the physicians were aware of COPD guidelines, but only 25% used them to guide decision making. Education regarding COPD assessment and treatment needs to be tailored to the primary care setting.<sup>14</sup> Dr. Noreen M. Clark, director of the Center for Managing Chronic Disease at the University of Michigan in Ann Arbor wrote that the “U.S. health care system spends trillions of dollars each year treating patients with chronic disease, but 99 percent of the time no one other than the patient and their loved ones manage a chronic disease.” Research at the center shows that when doctors talk to chronically ill patients and guide them in managing their conditions day to day, they need fewer doctor and emergency room visits. The research also demonstrates that counseling patients adds no

## Education regarding COPD assessment and treatment needs to be tailored to the primary care setting.

extra time to each doctor visit. Typically, at a routine visit most chronically ill patients get prescriptions, procedures and treatments, but they do not get one-on-one counseling or advice from the physician who knows their medical history best.<sup>10, 15</sup>

**Braman:** I believe there are several barriers. The first is that many patients with COPD are not identified. The use of spirometry when there are symptoms of chronic cough, sputum expectoration and shortness of breath should be encouraged in the primary care community. Secondly, even when patients are identified as having COPD, about 50% of them are not treated with prescription medications. This problem may be alleviated by encouraging the use of appropriate treatment algorithms. There are many concerns in the patient community about the use of these medications being detrimental and having significant side effects. Proper education can alleviate these concerns. Lastly, of course, the medications are expensive and many patients do not have the means to buy them. Unfortunately this has proven to be a significant barrier to comprehensive care of the COPD patient.

**Hanania:** I agree with the others; there are many barriers to COPD care. To categorize them:

**Physician/Healthcare Professional Barriers:** Many physicians lack knowledge on the appropriate management of COPD patients and either are not aware of or do not implement treatment guidelines. In addition, many do not spend time educating patients about their disease and how to implement self-management strategies. Many physicians continue to have a nihilistic attitude towards COPD and believe it is not a treatable disease.

**Healthcare System Barriers:** Many patients with COPD do not have appropriate access to medical care and may not have insurance coverage. Thus, their treatment is restricted to acute care and ER visits and not on preventative ambulatory care. And as Dr. Braman noted, the cost of COPD medications is prohibitively expensive.

**Patient Barriers:** Many patients with COPD deny having problems, continue to smoke, and are reluctant to follow medical advice. Many use their medications when needed and fail to use maintenance medications as prescribed, even when taught self-management strategies. Many patients do not know how to use their inhalers and thus receive sub-optimal pharmacologic treatment.

*What strategies might be helpful to address and overcome these barriers?*

**Blonshine:** A paradigm shift in the management of chronic disease and reimbursement strategies is required. The healthcare reimbursement system will need to change to provide adequate coverage for disease prevention and education. The system needs to reward physicians and other healthcare providers for developing and providing patients with a comprehensive self-management plan and the one-on-one counseling to implement and monitor the plan. This is a fundamental change in the healthcare

system.<sup>10-15</sup> Additionally, implementation of education programs effective in improving care in the primary care setting and utilization of self-management plans for COPD patients are primary strategies.

**Braman:** The chronic care model has many components that can address the barriers to good care. The use of evidence-based protocols for physicians is a good example. Patient education and action plans are other useful tools. Delivery system designs can be modified to provide clinical managers who can assist patients with their needs and offer useful support to primary care providers. A central information system should be established to monitor COPD patients. These systems can alert clinicians to the need for influenza vaccination, pneumococcal vaccination, and to poor patient adherence to medication regimens. This will call for more intense intervention.

**Hanania:** To overcome physician/health professional barriers, continuing education is important. Disseminating the COPD guidelines and encouraging the implementation of these guidelines should be attempted. This can be in the form of CME or other educational activities. Emphasizing the role of early detection and the use of spirometry in primary care are very important measures. A few things that need to be done to overcome the healthcare system deficits include improving access to care for patients with COPD and coverage for their medications, implementing performance improvement measures for health professionals who treat COPD patients, increasing the number of pulmonary rehabilitation programs, and reimbursing such programs. To overcome patient barriers, education in self-management is of paramount importance. Discussing and implementing smoking cessation programs should be done in primary care offices. The pa-

## Multiple systems can be involved but the cardiovascular, musculoskeletal and psychiatric complications are the most important to

tients should be encouraged to discuss their disease and any comorbidities with their physician at each visit.

*What comorbidities are the most important to address in patients with COPD to improve outcomes and reduce AE-COPD?*

**Blonshine:** Comorbidities such as cardiovascular disease and lung cancer are the leading causes of mortality in mild-to-moderate COPD. This may be related to the inflammatory pathway.<sup>16</sup> Pneumonia also leads to a more sudden onset of symptoms, more severe illness, longer length of stay, and higher rates of ICU admission and death. Unfortunately, it is possible that interventions which are effective to reduce the risk of exacerbations, such as salmeterol and fluticasone, may actually increase the risk of pneumonia. From a management perspective, it is important to recognize and distinguish a COPD exacerbation from pneumonia. Patients with COPD also have musculoskeletal dysfunction. There can be multiple reasons, including inactivity, use of systemic glucocorticoids, malnutrition, and possibly systemic inflammation and oxidative

stress. COPD contributes to exercise limitation, so enrolling in a pulmonary rehabilitation program is a known preventive strategy. According to Chatila and colleagues, the evidence of COPD and comorbidities has increased, but research remains in the early stages.<sup>17</sup> It is not yet understood whether non-pulmonary interventions that reduce the systemic inflammatory burden, improve anemia, prevent osteoporosis, and improve nutrition will alter the natural history of COPD. More studies are needed to understand the influence of various COPD treatment strategies on the comorbidities

**Braman:** COPD is associated with several comorbidities. Clinical depression is a comorbidity of COPD that I believe is under addressed, and depressed patients may delay seeking medical care.

**Hanania:** The pathophysiology of COPD has multiple components including a systemic component which is manifested by the presence of several comorbidities. It is not clear whether these comorbidities originate secondary to systemic effects of cigarette smoke exposure or secondary to systemic inflammation originating from the lung. Regardless of their origin, the impact of these comorbidities is quite tremendous and their presence increases the morbidity and mortality of COPD. Multiple systems can be involved but the cardiovascular, musculoskeletal and psychiatric complications are the most important to address in patients with COPD. A careful and comprehensive approach to COPD should include screening, diagnosis and treating these morbidities. Patients with COPD are at increased risk of cardiac complications and the risk increases with the severity of the disease. More than a third of patients with COPD die from cardiovascular causes. Osteoporosis is also a very common comorbidity which is present in a large number of patients regardless of

their pharmacologic therapy. Therefore early detection and implementation of strategies that will diminish the progressive bone loss are very important. In addition, many patients with severe COPD have cachexia which correlates with mortality from this disease. However, nutritional counseling and supplementation, while important, have not been shown to be of significant benefit. The exact effect of management of these co-morbidities on the course of COPD and on COPD exacerbation is not well studied.

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## Questions

- At which of the following stages of COPD will the patient's symptoms become more apparent?
  - Stage I (mild)
  - Stage II (moderate)
  - Stage III (severe)
  - Stage IV (very severe)
- According to a recent study, the risk of death was approximately \_\_\_\_\_ times greater for COPD exacerbations requiring hospitalization than those that did not.
  - Two
  - Three
  - Four
  - Five
- Acute COPD exacerbations are identified by an increase in the patient's:
  - Dyspnea
  - Cough
  - Sputum production
  - All of the above
- What is/are the causes of COPD exacerbation?
  - Lung infections
  - Patient medication compliance
  - Air pollution
  - All of the above
- Patient with moderate COPD has the following signs and symptoms: tachypnea, accessory muscle use, increased shortness of breath, and cyanosis. This patient is a candidate for treatment at home.
  - True
  - False
- Which of the following inhaled bronchodilators would you recommend for use during a COPD exacerbation?
  - Short-acting beta-2 agonist
  - Long-acting beta-2 agonist
  - Long-acting anticholinergics
  - All of the above
- What is the recommended dose of oral prednisolone in the management of COPD exacerbation?
  - 10 mg for 7 to 10 days
  - 20 mg for 7 to 10 days
  - 40 mg for 7 to 10 days
  - 80 mg for 7 to 10 days
- Antibiotics are indicated in which of the following COPD patients with an exacerbation?
  - The patient requires noninvasive or invasive mechanical ventilation.
  - The patient has purulent sputum and increased dyspnea.
  - The patient has increased dyspnea and sputum production.
  - A and B
- A recent metaanalysis reported that the use of NPPV in managing COPD patients with acute exacerbation reduced the risk of intubation by \_\_\_\_\_, the length of hospital stay by \_\_\_\_\_ days, and hospital mortality by \_\_\_\_\_.
  - 65%; 1.9; 55%
  - 55%; 2.9; 65%
  - 75%; 1.9; 45%
  - 45%; 2.9; 75%
- According to the GOLD guidelines, secretion removal therapy is indicated if the patient has greater than \_\_\_\_\_ mL of sputum per day.
  - 10
  - 15
  - 20
  - 25
- Besides inhaled long acting bronchodilators and inhaled corticosteroids, which of the following is/are useful in preventing COPD exacerbations?
  - Smoking cessation
  - Influenza and pneumococcal vaccinations
  - Patient education
  - All of the above
- What is the principal obstacle to the successful comprehensive care model in clinical practice?
  - Physicians' lack of knowledge of the appropriate management of COPD patients
  - Lack of access to medical treatment and lack of insurance
  - Patients' unwillingness to quit smoking
  - All of the above

This program has been approved for 2.0 contact hours of continuing education (CRCE) by the American Association for Respiratory Care (AARC). AARC is accredited as an approver of continuing education in respiratory care.

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### Objectives

Upon completion of the course, the reader was able to:

- To discuss the morbidity, mortality, and cost associated with COPD exacerbations  
Strongly Agree   Strongly Disagree  
1   2   3   4   5   6
- To distinguish between which patients should be managed at home or hospitalized  
Strongly Agree   Strongly Disagree  
1   2   3   4   5   6
- To list the current recommendations regarding management of acute COPD exacerbations  
Strongly Agree   Strongly Disagree  
1   2   3   4   5   6
- To list current recommendations regarding prevention of COPD exacerbations  
Strongly Agree   Strongly Disagree  
1   2   3   4   5   6
- Please indicate your agreement with the following statement. "The content of this course was presented without bias of any product or drug."  
Strongly Agree   Strongly Disagree  
1   2   3   4   5   6

## Answers

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| 7 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 15 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 16 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

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