

REVIEW ARTICLE

Rising Costs of COPD and the Potential for Maintenance Therapy to Slow the Trend

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Background: Chronic obstructive pulmonary disease (COPD) affects an estimated 14% of adults in the United States between the ages of 40 and 79 years. This progressive disease is characterized by persistent airflow limitation. The management of patients with COPD is focused on reducing risk factors, relieving symptoms, and preventing exacerbations.

Objective: To examine the peer-reviewed literature on the impact of maintenance therapy on the direct treatment costs of patients with COPD in the United States.

Methods: PubMed was searched for articles written in English that were published between 2000 and 2013, using the search terms “COPD,” “economics,” “exacerbation,” “maintenance,” and related terms. Articles reporting the results of longitudinal studies of the costs associated with the management of patients with COPD, the costs associated with hospitalizations for acute exacerbations of COPD, and randomized clinical trials evaluating the effects of maintenance therapy on the incidence of COPD exacerbations were included in this review.

Results: The search identified a total of 277 articles, and 11 of these articles were deemed appropriate for inclusion in this review. The direct healthcare costs for patients with COPD increased by 38% between 1987 and 2007, and continued to increase by approximately 5% annually between 2006 and 2009. The costs associated with hospital admissions for patients with COPD accounted for the largest absolute increase (\$2289 per admission in constant 2007 US dollars). Recent estimates suggest that the aggregate costs associated with the treatment of acute exacerbations are between \$3.2 billion and \$3.8 billion, and that annual healthcare costs are 10-fold greater for patients with COPD associated with acute exacerbations than for patients with COPD but without exacerbations. The results of 2 large clinical trials of maintenance therapy, including a long-acting cholinergic antagonist or a long-acting beta-2 agonist, showed a 16% to 17% reduction in the incidence of exacerbations compared with placebo. Nevertheless, maintenance therapy remains underutilized, with only 30% to 35% of patients with COPD in private and public health insurance plans receiving prescriptions for maintenance therapy.

Conclusions: The treatment of acute exacerbations of COPD remains the major driver of increasing healthcare costs associated with this condition. The appropriate use of maintenance therapy has been shown to reduce the incidence of exacerbations and has the potential to reduce overall costs associated with the management of patients with COPD.

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The clinical and economic burden of chronic obstructive pulmonary disease (COPD) is significant and is increasing. COPD is now the third leading cause of death in the United States, after heart disease and cancer.¹ COPD reached this rank in 2008, more than a decade earlier than projected by the Global Burden of

Disease Study.² In the United States, mortality due to COPD is the only one among the 5 leading causes of death that showed an increasing rate between 2010 and 2011.³

In 2011, 6.3% of US adults (an estimated 15 million) contacted by the Behavioral Risk Factor Surveillance System (BRFSS) reported being told by their physician that they had COPD.⁴ This estimate is likely to be low. Spirometric testing performed for the National Health and Nutrition Examination Survey (NHANES; 2007-2010) indicated that an estimated 14% of US adults aged 40 to 79 years met the diagnostic criteria for COPD.⁵ The roughly 2-fold greater prevalence of COPD that is cited by NHANES is considered a better estimate than the BRFSS prevalence, because COPD is underdiagnosed in its earlier stages.⁶

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Along with the growing prevalence, the death rate for COPD is also rising.¹ Between the years 1980 and 2000, the overall death rate attributed to COPD increased by 67%, from 40.7 deaths to 66.9 deaths per 100,000 persons aged ≥ 25 years.⁶ Although the death rate for COPD has remained relatively constant through 2005, when it was 64.3 deaths per 100,000 persons aged ≥ 25 years, the absolute number of annual deaths continues to increase, as a result of the aging of the US population.⁷ Because the prevalence and severity of COPD increase with age, the impact on the healthcare system will likely continue to expand.⁸

COPD is a progressive disease and to date cannot be cured.⁹ Exacerbations of COPD, which are typically defined as an acute worsening of symptoms that results in a change in treatment and often hospitalization, are a major contributor to the high costs associated with the management of patients with COPD^{10,11} and are a significant risk factor for COPD-related mortality.¹² The use of inhaled long-acting bronchodilators has been shown to reduce the incidence of COPD exacerbations,¹³ but their use remains suboptimal.^{14,15}

The goal of this article is to summarize the current information about the prevalence and healthcare costs associated with COPD in the United States. In the remainder of this review we discuss the rising costs associated with COPD and expand on the evidence that maintenance therapy can improve outcomes and may reduce overall costs. In addition, obstacles that impede appropriate COPD management are also discussed.

Methods

Although this article is not a systematic review, detailed searches of the medical literature were conducted. To assess the changing economic impact of COPD in the United States, and, in particular, the contribution of exacerbations to the total cost and the influence of the use of maintenance medication on exacerbations, we conducted several searches on PubMed. The searches were conducted to identify studies that reported on the economic impact of COPD, estimated at 2 or more time periods; pharmaco-economic studies of the costs of treatment of COPD exacerbations; and randomized, double-blind studies of the impact of maintenance therapy on COPD exacerbations.

The primary search terms were (“Pulmonary Disease, Chronic Obstructive/economics”[Majr] OR ((chronic obstructive [ti] OR COPD [ti])) AND (cost*[ti] OR economic*[ti])). The results for this search were further refined by combining results with additional search terms (eg, “AND exacerbation*”, “AND maintenance”). Only articles describing original research or meta-analyses that were written in English and were

KEY POINTS

- The prevalence and severity of COPD, a progressive and costly condition, increase with age; although this disease has no cure, appropriate management can improve patient outcomes, improve quality of life, and reduce overall costs.
- The treatment of acute exacerbations of COPD remains the major cost driver in this patient population, reaching between \$3.2 billion and \$3.8 billion in aggregate.
- The annual healthcare costs are 10-fold greater for patients with acute exacerbations of COPD than for patients with COPD without exacerbations.
- The results of 2 clinical trials of maintenance therapy showed a 16% to 17% reduction in the incidence of exacerbations compared with placebo.
- Maintenance therapy remains underutilized for COPD and is used by only 30% to 35% of patients in private and public health plans.
- Earlier diagnosis and the earlier initiation of treatment can improve patient outcomes and lessen the financial burden associated with this disease.

published in the year 2000 or later were considered for this review.

Results

Search Results

A total of 277 articles were identified by our search. Of these, 11 articles were selected for this review (Table), including 2 articles that presented longitudinal analyses of the changing COPD-related healthcare costs,^{16,17} and 7 articles that estimated the costs associated with the treatment of COPD exacerbations.¹⁶⁻²² In addition, 2 large, randomized, double-blind studies of the impact of maintenance therapy on the incidence of exacerbations were identified and included,^{23,24} as well as a recent meta-analysis of 35 clinical studies of maintenance therapy lasting at least 4 weeks.¹³ One recent comprehensive systematic review of pharmaco-economic studies of maintenance therapy related to COPD was also included.²⁵

The New Demographic for Patients with COPD

Smoking is a major risk factor for COPD. A meta-analysis that included 62 studies from 28 countries reported that the prevalence of COPD among smokers was 15.4% compared with 10.7% among nonsmokers.²⁶ In the United States, smoking is estimated to be responsible for more than 77% of all deaths from COPD.²⁷ There are currently 44 million smokers in the United States, ap-

Table Studies Reporting Cost and Efficacy of Treatment of COPD Exacerbations in the United States

Study	Study design	Key findings
<i>Trends in COPD-related healthcare costs</i>		
Blanchette et al, 2012 ¹⁶	Longitudinal, cross-sectional surveys	<ul style="list-style-type: none"> • Average direct per-patient medical costs for patients with COPD increased by 38% between 1987 and 2007, from \$11,807 to \$16,292 (2007 dollars) • In 2007, the largest cost was for inpatient admissions for COPD (\$13,840)
Dalal et al, 2011 ¹⁷	Longitudinal study of COPD-related health service utilization for patients with commercial insurance or Medicare Advantage	<ul style="list-style-type: none"> • From 2006 to 2009, total direct COPD-related healthcare costs increased by approximately 6% annually among commercially insured patients and by approximately 5% in Medicare Advantage beneficiaries
<i>Healthcare costs associated with acute COPD exacerbations</i>		
Wier et al, 2011 ¹⁸	Analysis of the Healthcare Cost and Utilization Project data	<ul style="list-style-type: none"> • In 2008, the aggregate cost for hospital admissions for acute COPD exacerbation was \$3.8 billion
Perera et al, 2012 ¹⁹	Analysis of the Healthcare Cost and Utilization Project data	<ul style="list-style-type: none"> • From 2006-2010, the aggregate cost for hospitalization for acute COPD exacerbation increased from \$2.96 billion to \$3.47 billion (2010 dollars)
Yu et al, 2011 ²⁰	Analysis of service claims and cost data from the Thomson Reuters MarketScan database	<ul style="list-style-type: none"> • In 2004-2008, the total COPD-related cost for patients with a severe exacerbation was \$7014 per quarter • Cost associated with COPD patients who had no exacerbations was \$658 per quarter (or \$2632 annually)
Pasquale et al, 2012 ²¹	Analysis of claims data from a large national healthcare company for a predominately Medicare population	<ul style="list-style-type: none"> • In 2007-2009, mean annual COPD-related healthcare cost was \$12,765 for patients with a severe exacerbation • The cost for moderate exacerbation was \$3356 • The cost for patients with no exacerbations was \$1425
Dalal et al, 2011 ²²	Analysis of hospital administrative data from the Premier Perspective Database	<ul style="list-style-type: none"> • Between 2005 and 2008 the mean cost of a COPD-related emergency room visit increased by 4.0%, to \$647 • In the same period the mean cost of simple hospital admissions for COPD increased by 5.9%, to \$7242 • Little change was seen in mean cost of complex hospital admission for COPD (\$20,757 in 2008)
<i>Maintenance therapy for preventing acute COPD exacerbation</i>		
Tashkin et al, 2008 ²³	4-year, randomized, double-blind, placebo-controlled study of inhaled tiotropium (18 µg daily) in COPD	<ul style="list-style-type: none"> • The relative risk for first exacerbation was 0.86 (95% CI, 0.81-0.91) in the group randomized to tiotropium compared with placebo • The risk of first hospitalization for an exacerbation was 0.86 (95% CI, 0.78-0.95) in patients receiving tiotropium compared with placebo
Calverley et al, 2007 ²⁴	3-year, randomized, double-blind, placebo-controlled study of inhaled salmeterol (50 µg twice daily) plus inhaled fluticasone propionate (500 µg twice daily), inhaled salmeterol alone, inhaled fluticasone propionate alone, or placebo	<ul style="list-style-type: none"> • The relative risk for exacerbation requiring hospitalization was 0.82 (95% CI, 0.69-0.96) in patients receiving salmeterol alone compared with placebo • Addition of fluticasone propionate to salmeterol was not different from salmeterol alone in reducing the risk for exacerbation requiring hospitalization (relative risk 1.02 [95% CI, 0.87-1.20] compared with salmeterol alone)
Puhan et al, 2009 ¹³	Meta-analysis of randomized trials of ≥4 weeks' duration to test the effect of inhaled drug regimens on COPD exacerbations	<ul style="list-style-type: none"> • 35 studies included 26,786 patients receiving placebo, inhaled long-acting beta-agonists, inhaled long-acting cholinergic antagonists, inhaled corticosteroids, or inhaled combination therapy with long-acting beta-agonists and inhaled corticosteroids • All regimens of inhaled therapy were equally effective compared with placebo at reducing the risk for exacerbation

Continued

Table Studies Reporting Cost and Efficacy of Treatment of COPD Exacerbations in the United States (Continued)

Study	Study design	Key findings
<i>Cost-effectiveness of maintenance therapy of COPD</i>		
Rutten-van Mólken, Goossens, 2012 ²⁵	Systematic literature review of economic evaluations of drug therapy for COPD	<ul style="list-style-type: none"> • Tiotropium, a long-acting cholinergic antagonist, reduced COPD-related healthcare costs in most, but not in all studies • Long-acting beta-2 agonists combined with inhaled corticosteroids improve outcomes, but with an increase in total COPD-related costs • The cost-effectiveness of COPD maintenance therapy is better in patients at high risk for exacerbation

CI indicates confidence interval; COPD, chronic obstructive pulmonary disease.

proximately 78% of whom smoke daily.²⁸ Together with the approximately 50 million former US smokers, approximately 94 million Americans are at an increased risk for COPD.²⁸

Women may be more susceptible to the adverse effects of smoking than men,²⁹ which may account for the increasing COPD-related mortality among women. The death rate from COPD among US women has increased steadily, nearly tripling between 1980 and 2000⁶; since 2000, more women than men have died of COPD.^{7,30} This influence of COPD in women has changed the demographic characteristics of COPD from a disease of elderly men to a condition with a 58% prevalence among women, with an average age <65 years.¹⁶

The younger age and the changing sex ratio of the COPD population, together with the expansion of Medicare Advantage, have sharply increased the likelihood that a patient with COPD will be enrolled in a private health plan in the United States. In 1987, the National Medical Expenditure Survey (NMES) showed that only 16.2% of patients with COPD had private insurance coverage.¹⁶ By 2007, that percentage had increased to 40.6% during a period of little overall growth in private health insurance coverage.¹⁶

Patients with COPD have an average of 3.7 to 9 chronic medical comorbidities, including lung disease (often lung cancer), that contribute to their utilization of healthcare at a rate twice that of age- and sex-matched patients without COPD.^{31,32} Many of these comorbidities are at least in part related to smoking.³² The 2007 Medical Expenditure Panel Survey (MEPS) showed that common comorbidities included hypertension (65% of patients), asthma (41%), diabetes (26%), coronary heart disease (20%), stroke (16%), and myocardial infarction (14%).¹⁶ Other often occurring conditions included peripheral arterial disease, obesity, osteoarthritis, osteoporosis/osteopenia, depression, and gastroesophageal reflux disease.^{33,34} Comorbidities associated with COPD can be worsened by deteriorating COPD; conversely, these co-

morbidities can contribute to a more rapid COPD decline.^{35,36} Therefore, the treatment plans for patients with COPD should also include appropriate attention to these comorbidities.

Increasing Costs of COPD

Of the 11 articles included in this article, 2 presented analyses of change in costs in US-based populations. Blanchette and colleagues compared 2 cross-sectional, population-based surveys and analyzed data for patients aged ≥40 years with COPD (1987 NMES³⁷; 2007 MEPS³⁸), and found that the average direct per-patient medical costs (primarily based on payments by health insurance or federal plans)—including COPD-related and non-COPD-related costs—increased by 38% between 1987 and 2007, from \$11,807 to \$16,292 (constant 2007 US dollars).¹⁶ The largest absolute increase was for inpatient admissions, which increased by \$2289 per admission. The prescription drug costs increased by 170% per patient, and the costs of emergency department services increased by 183% per visit.¹⁶

Dalal and colleagues compared the medical records of commercially insured and Medicare Advantage populations for the period from 2006 to 2009, and found that the direct COPD-related health service utilization (both medical and pharmacy claims) costs increased by approximately 6% annually in the commercially insured patients compared with an annual rate of 5% in the Medicare Advantage patients.¹⁷

Because the current prevalence of COPD is higher than it was projected 10 years ago, the overall costs associated with COPD are higher as well. Dalal and colleagues performed a retrospective claims-based analysis of commercially insured patients with COPD and estimated that in 2006, the direct COPD-associated medical and pharmacy costs were \$15.7 billion (in 2008 US dollars).³⁹ However, their estimate is likely low, because it does not reflect the impact of comorbidities on these costs. As mentioned earlier, the prevalence of comorbid-

ities among patients with COPD is high, and COPD often exacerbates other chronic conditions. Therefore, including the impact of COPD on coexisting conditions may better represent the actual cost of COPD. The study by Blanchette and colleagues estimated that the all-cause direct costs of patients with COPD in the United States were more than \$75 billion in 2007.¹⁶ Analysis of the distribution and allocation structure of the current costs of COPD may allow the identification of opportunities to reduce acute care costs via better management of the disease.

A comparison of 1987 to 2007 cumulative expenditures for patients with COPD and the cumulative number of patients reveals nearly identical distributions, with only 20% of patients with COPD accounting for 74% of the total expenditures.¹⁶ This observation suggests that the nature of the underlying problem has not changed in those 20 years. Specifically, hospitalization costs have remained the greatest proportion of direct medical costs (85%) associated with COPD, and most of the total cost increase in that period is attributable to hospitalizations, largely resulting from COPD exacerbations.¹⁶

Of the articles identified by our search, 7 described the costs associated with hospitalizations for acute exacerbations of COPD in the United States. For example, Wier and colleagues analyzed data from the Healthcare Cost and Utilization Project for patients aged ≥ 40 years who were hospitalized with COPD in 2008.¹⁸ They estimated that the aggregate cost for hospital stays with COPD exacerbation as the primary diagnosis was \$3.8 billion.¹⁸ A similar study using the same database reported that the aggregate costs for hospitalizations for acute COPD exacerbations increased from \$2.96 billion in 2006 to \$3.47 billion in 2010 (constant 2010 US dollars).¹⁹

Yu and colleagues conducted a retrospective analysis of the Thomson Reuters MarketScan administrative database and reported that the total COPD-related costs for patients with a severe exacerbation were \$7014 per 90 days (or \$28,056 annually) compared with \$658 per 90 days in patients with no exacerbations.²⁰ More than 90% of the costs in patients with severe exacerbations were for inpatient expenses.²⁰ In a predominantly Medicare population, Pasquale and colleagues reported that the annual COPD-related healthcare costs were much higher in patients with a severe exacerbation (\$12,765) than in patients with moderate exacerbations (\$3356) or no exacerbations (\$1425).²¹

In addition, 1 single article discussed the changes in emergency department or inpatient costs over time, showing that between 2005 and 2008, the inflation-adjusted mean costs for a COPD emergency department visit and for a simple COPD-related hospital admission increased by 4% and 5.9%, respectively.²² The researchers reported

no change in the costs associated with COPD-related complex admissions during the same period.²²

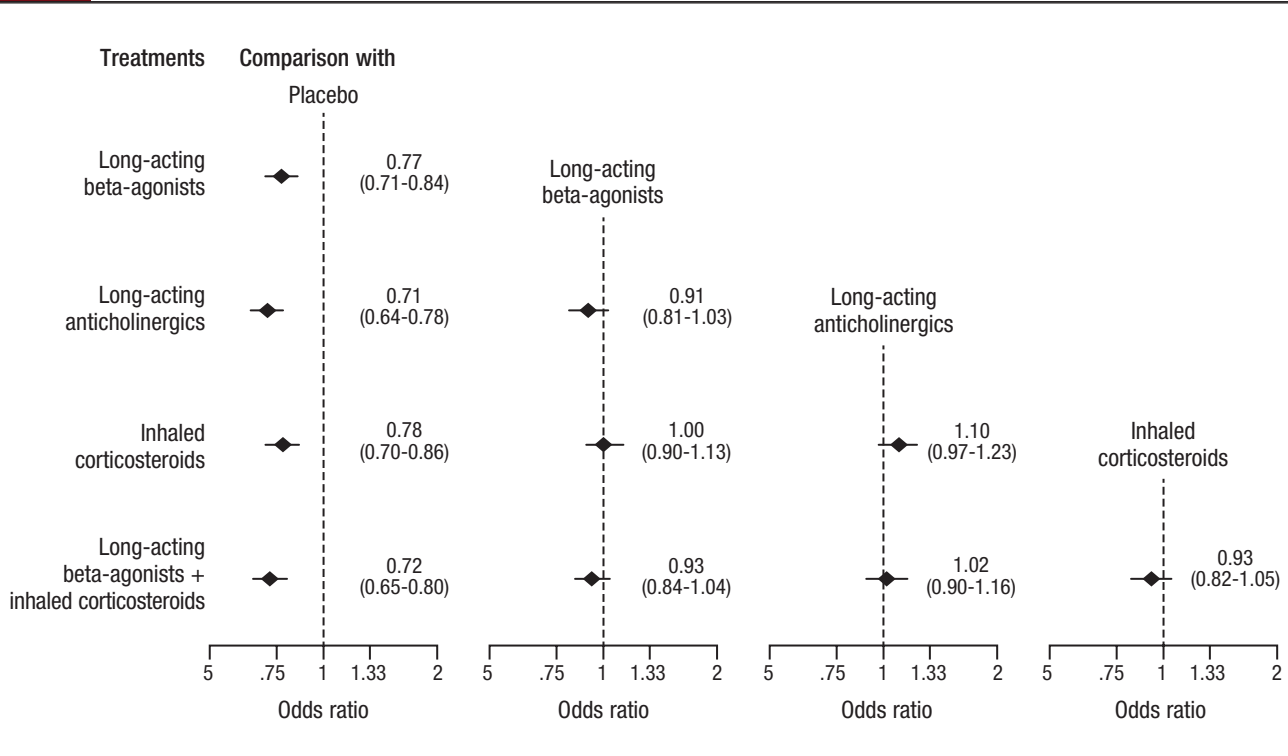
The Impact of Suboptimal COPD Management on Costs

COPD is a progressive disease, and although it cannot be cured, appropriate management can slow its progression, reduce the frequency and severity of exacerbations, and improve symptoms and a patient's quality of life.^{9,40} Despite the existence of several evidence-based guidelines for the diagnosis and treatment of COPD,⁹ the diagnosis and management of COPD remains suboptimal.¹⁵ This "clinical inertia," which includes physician-, patient-, and system-related factors,¹⁵ may contribute to increased morbidity, which in turn contributes to rising COPD-related costs.

The diagnosis of COPD is usually based on clinical signs or symptoms and is often made at a late stage, when the disease is overt. Only 32% of patients with COPD have spirometry performed within 2 years before or 6 months after their diagnosis.⁴¹ As a result, COPD is diagnosed later than it would be if spirometry was routinely done, and the opportunities for earlier, and less expensive, interventions are lost. One study showed that 76% of patients with COPD were categorized as having either moderate or severe disease at first diagnosis.⁴² Before their diagnosis, patients with COPD use 50% to 60% more inpatient and emergency services than matched controls without COPD, and their average incremental annual costs are at least \$2627 more than those without COPD.⁴³ Those increased costs are most frequently incurred in the month before COPD diagnosis.⁴³ The investigators speculated that some of these additional costs might have been avoided by earlier diagnosis and earlier initiation of treatment, but no evidence was presented.⁴³

As noted, after delayed diagnosis, opportunities for early intervention are lost. A recent large survey of patients with COPD from 19 health plans (including private plans and private plans offering Medicare Advantage) showed that 66% of patients in commercial plans were not prescribed any maintenance pharmacotherapy, and 7% of patients were given only short-acting beta-agonists.⁴⁴ Patients with Medicare Advantage coverage managed by private health plans fared not much better, with 71% prescribed no maintenance prescriptions and approximately 5% prescribed short-acting beta-agonists only.⁴⁴ "High complexity" patients (ie, using comorbidities and procedures as markers for advanced COPD) were similarly undertreated despite their higher risk, with 59% and 69% of the patients in commercial and Medicare plans, respectively, receiving no maintenance therapy at all.⁴⁴ In addition to the suboptimal use of

Figure Meta-Analysis of the Effect of Inhaled Pharmacologic Maintenance Therapy in Patients with Stable COPD on the Risk of Exacerbation



NOTE: These forest plots show the odds ratios (95% CI) indicating the odds of having at least 1 exacerbation in patients receiving a treatment from the row compared with the treatment from the corresponding column. CI indicates confidence interval; COPD, chronic obstructive pulmonary disease. Reprinted with permission from Puhan MA, et al. *BMC Med.* 2009;7:2.

COPD medications, other aspects of treatment guidelines were similarly underutilized. For example, fewer than 20% of the population had received a current influenza vaccination, and more than 80% of current smokers had not received any smoking cessation intervention.⁴⁴ Smoking cessation is the most effective method of slowing the progression of COPD.⁹

Maintenance therapy with long-acting bronchodilators has been shown in 2 large, randomized, double-blind studies to significantly reduce the incidence of exacerbations and related hospitalization. In the Understanding Potential Long-term Impacts on Function with Tiotropium (UPLIFT) trial, tiotropium (18 µg daily) reduced the relative risk of exacerbation by 14% compared with placebo during the 4-year study.²³ A similar reduction in the risk of hospitalization was also observed. In the Towards a Revolution in COPD Health (TORCH) trial, the rate of exacerbations requiring hospitalization was reduced by 18% in the group treated with salmeterol (50 µg twice daily) alone compared with placebo.²⁴ The addition of fluticasone propionate (500 µg twice daily) to the treat-

ment regimen had no further benefit (ie, risk reduction of 17% compared with placebo).²⁴

A recent meta-analysis by Puhan and colleagues supports this concept that inhaled maintenance therapy reduces the incidence of exacerbations in patients with stable COPD.¹³ In their meta-analysis, Puhan and colleagues reviewed 35 studies of inhaled maintenance therapies with durations of ≥4 weeks and concluded that, compared with placebo, long-acting beta-agonists (LABAs), long-acting anticholinergics, inhaled corticosteroids, or the combination of LABAs plus inhaled corticosteroids significantly reduced the odds of having at least 1 exacerbation (Figure). The authors concluded that each of these pharmacotherapies was equally effective in their ability to reduce the risk of exacerbation.¹³ In addition, a recent systematic review of long-acting bronchodilators reported that in more than 70% of the 51 studies included in that review, a minimally important difference (defined as the smallest change perceived as important by patients) in health-related quality of life was reported.⁴⁵

The results of the TORCH and the UPLIFT trials changed the emphasis of pharmacotherapy from the palliation of symptoms to the prevention of exacerbations.⁴⁶ Exacerbations of COPD contribute to disease progression and to loss of lung function, and mortality increases directly with severe exacerbation frequency, particularly if hospital admission is required. Patients who are hospitalized for 1 exacerbation annually have a significantly elevated mortality risk (hazard ratio [HR], 2.94; 95% confidence interval [CI], 1.82-4.72), and patients with ≥ 3 exacerbations in 5 years have a much higher mortality risk (HR, 4.31; 95% CI, 2.7-6.88) compared with patients with COPD who do not have exacerbations.¹²

The high cost of exacerbations suggests that their incidence rate is the primary element affecting treatment cost-effectiveness in COPD^{10,11}; therefore, a reduction in the number of exacerbations is key to COPD management as well as for lowering overall costs. In a 9-year study of Medicare beneficiaries with COPD, the use of maintenance medication was significantly associated with a lower risk for hospitalization (odds ratio [OR], 0.70; 95% CI, 0.61-0.79) and rehospitalization (OR, 0.74; 95% CI, 0.63-0.87) compared with the cohort not using maintenance therapy.⁴⁷ Of note, the group using maintenance therapy incurred significantly lower annual Medicare expenses ($-\$3916$; 95% CI, $-\$4977$ to $-\$2854$). This was a retrospective study, and the 2 observation groups had many significant differences in baseline disease severity and other characteristics.⁴⁷ Therefore, these results cannot be used to support the concept that adding maintenance therapy for nonusers would have reduced costs.

However, although summary analyses of clinical studies of inhaled pharmacologic maintenance therapy in COPD have concluded that the incidence of exacerbations is reduced by this therapy,¹³ estimates of the cost-effectiveness of maintenance therapy show considerable variation, including cost increases and decreases, and dependent on the patient population, the country being studied, the length of observation, and the pharmacoeconomic models used.²⁵ A recent systematic review of maintenance therapy concluded that the cost-benefit is likely greatest in patients with a high risk for exacerbations.²⁵ Furthermore, in other diseases, it has been difficult to demonstrate cost reduction after the implementation of prophylactic therapy.⁴⁸

Obstacles to COPD Maintenance Therapy

The reduction of COPD exacerbation frequency may not occur unless maintenance pharmacotherapy is more consistently adopted.¹⁵ In the period from 1987 to 2007, despite the advent of new and effective maintenance therapies, the average number of COPD medications per patient did not change.¹⁶ Drug costs have continued to

increase and are sometimes seen as easy targets for cost reductions. However, prescribed drugs account for only 2.3% of the annual direct expenditures associated with COPD,¹⁶ and efforts to reduce this cost may have unintended consequences. For example, in British Columbia, efforts to reduce pharmacy costs by increasing the cost-sharing of prescription drugs for COPD led to the desired decrease in payer drug costs, but they also led to an increase in the net health plan expenditures caused by increased hospitalizations associated with lower adherence rates.⁴⁹

The proper management of COPD critically depends on the effective delivery of inhaled medications to the lungs. Despite the apparent simplicity of handheld inhaler devices, including pressurized metered-dose inhalers and dry powder inhalers, misuse is common and may negatively influence inhaled drug administration.⁵⁰ In practice, effective inhaler use depends on a number of factors, such as manual dexterity, cognitive function, and hand strength, that are sometimes impaired in the COPD population.⁵⁰

In a meta-analysis by Brocklebank and colleagues, 77% of patients using a metered-dose inhaler made ≥ 1 error during administration.⁵¹ The correct use of metered-dose inhalers is reported to decline with advancing age,⁵² which is important in the aging patient population with COPD. This disease may also negatively influence the ability to properly use a dry powder inhaler because of the need to consistently provide adequate inspiratory airflow to disperse and deliver the drug properly.^{53,54}

The use of a nebulizer to administer inhaled medications may improve drug delivery in patients who are unable to effectively use handheld inhalers. Nebulizers are well received by patients with COPD,⁵⁵⁻⁵⁷ because they require only tidal breathing,⁵⁸ which facilitates adherence.⁵⁹ The use of nebulized medication administration may benefit patients with COPD and muscle wasting and weakness, a common systemic effect of COPD that can make operating an inhaler difficult,^{50,60,61} or patients with borderline or mild cognitive impairment.⁶² In the United States, nebulized formulations of LABAs (ie, formoterol and arformoterol) and corticosteroids (ie, budesonide) for maintenance therapy of COPD are currently available.^{9,63} Patients with COPD who are unable to properly use metered-dose inhaler-, or dry-powder inhaler-delivered maintenance medications, may be best served by nebulized formulations of maintenance medications.

Conclusion

In the past decade, pharmacotherapeutic advances in the management of COPD have brought the possibility of improving patient outcomes while lowering expenditures, largely through reducing the rate of exacerbations

with the optimal use of maintenance medications. Extending the benefits of maintenance therapy to all patients with COPD must take into account the specific characteristics and capabilities of each patient and the need to administer the appropriate drug most effectively.⁶⁴ Closer attention to the needs and abilities of patients with COPD to handle specific therapies can improve patient outcomes and reduce overall costs for patients and for payers. ■

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STAKEHOLDER PERSPECTIVE

Chronic Obstructive Pulmonary Disease Remains a Growing Population Health Concern

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PURCHASERS/PAYERS: Chronic obstructive pulmonary disease (COPD) remains a growing population health issue from a clinical effectiveness perspective and from an economic efficiency perspective, given our lifestyles and the aging US population. In their current review, Blanchette and colleagues highlight key outcome drivers to address when considering health plan design elements or coverage frameworks to improve and sustain health status goals. For example, employer-sponsored plans should focus on plan designs that align with their business goals of productivity and reduced absenteeism, while providing benefit designs that are attractive for their employees, including patients with chronic conditions, such as COPD.

Aligning health plan coverage through care management that optimizes maintenance therapies remains an elusive goal, yet this presents a significant opportunity to enhance patient outcomes and improve the plan's financial performance. Blanchette and colleagues provide in-

sight on how to address this challenge, which now needs to be followed up with action.

PATIENTS: The growth in high-deductible plans creates a potential economic barrier for patients with a chronic disease (such as COPD), who require long-term therapy. The underutilization of maintenance therapy by patients and the lack of incentives to change this behavior are barriers to be overcome, as well as plan-imposed barriers.

Finding the appropriate balance between meeting the treatment needs of patients and aligning plan designs to create opportunities to reward health status improvement remains a challenge. Building on the health reform focus on disease prevention, the challenge is how best to engage patients in the care of their chronic condition, and how best to inform healthcare providers about the optimal strategies that will have a positive impact on their patients to reinforce successes without penalty from using poor plan design. ■