COPD Care in the 21st Century: A Public Health Priority

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Summary

COPD is an underdiagnosed, undertreated, and yet largely preventable disease. COPD affects millions of Americans on a daily basis, accounts for tens of thousands of deaths per year, and costs billions to the United States health-care system annually. Further, it impacts the quality of life for patients living with the disease. COPD care is fragmented in the United States, with a high level of responsibility placed on patients and their primary care physicians. Pulmonary specialists care for a minority of patients with COPD in the United States. Unfortunately, tobacco dependence, which is the leading cause of COPD, remains prevalent. Further, women and those with low socioeconomic status continue to share a relatively greater burden of disease. Exacerbations are experienced frequently by patients and contribute to high rates of emergency department visits and in-patient admissions and readmissions as well as high medical costs to the United States economy. Numerous strategies have been proposed to combat these high rates, including the use of discharge bundles, hospital at-home programs, telemedicine, and tele-rehabilitation, but no single best strategy has emerged. The COPD National Action Plan was introduced in 2017 as part of a multi-stakeholder endeavor to encourage collaboration among various patients, caregivers, physicians, researchers, and policymakers to optimize awareness, diagnosis, and treatment of this disease. It is time to make COPD care a public health priority. Key words: COPD; COPD exacerbation; economic burden; disparities; primary care physician; tobacco cessation; readmission; discharge bundle; telemedicine; tele-rehabilitation. [Respir Care 2018;63(5):591–600. © 2018 Daedalus Enterprises]

Introduction

COPD is currently the fourth leading cause of death in the United States.¹ Further, COPD is the cause of significant patient morbidity, affecting the daily lives of millions.¹⁻³ Patients struggle with not only the disease itself but also the added burden of obtaining care. There are significant barriers to delivering optimal care for the COPD patient population in the United States, which this review will highlight. Special emphasis will be placed on the high rate of underdiagnosis of COPD in the United States as well as the challenges that patients face in accessing specialty care and needed medications, which are further compounded by socioeconomic disparities.²⁻⁸ COPD is also associated with periodic exacerbations that result in a significant number of emergency department and in-patient visits. Several new interventions, including discharge bundles, telemedicine, and tele-rehabilitation, have been proposed to reduce readmission rates⁹⁻¹² and will be further examined in this review. Finally, we also outline here the proposed goals of the recently released COPD National Action Plan, which encourages the collaboration of all stakeholders, including patients, caregivers, physicians, researchers, and policymakers, to improve understanding of and treatment for COPD.¹³

Epidemiology

In 2015, COPD accounted for >3 million deaths worldwide, or 5% of all deaths.¹⁴ Compared with 1990, COPD accounted for 10% more deaths and had a 44% greater prevalence in 2015.¹⁴ The morbidity and mortality attributable to COPD both globally and nationally is probably even greater than reported due to underdiagnosis and undertreatment of COPD.^{2,3,15,16} An estimated 29 million Americans age 20–79 y (ie, 15% of this age group) are living with obstructive lung disease, but only 13 million, or 6.5%, of these adults are aware of their diagnosis.^{2,3}

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Further, those who are aware of their diagnosis do not know the specifics of their disease and its severity. In a national telephone survey administered to >1,000 patients with COPD, 79% knew their blood pressure but only 10% knew their FEV₁.¹⁵ COPD is also characterized by exacerbations that are a significant driver of morbidity, mortality, and cost. In a cohort of >50,000 adult Medicare Advantage patients, Dhamane et al⁹ found that roughly 44% of subjects had at least one COPD exacerbation over the prior 24-month period. COPD exacerbations accounted for 1.8 million emergency department visits in 2012 with an estimated 20% subsequently admitted to the hospital.¹⁰⁻¹²

Economic Burden

Impact on the United States Economy

COPD is a costly disease, and as its prevalence rises, associated costs will increase. In 2010, the total burden of COPD-attributable costs in the United States was an estimated \$36 billion, accounting for both direct medical costs as well as absenteeism costs.¹⁷ By the year 2020, it is projected that national medical costs for COPD will total \$49 billion.¹⁷ Exacerbations of COPD account for up to 75% of the total direct disease cost.^{9,11} Costs associated with in-patient hospitalization for patients with either COPD or bronchiectasis totaled \$18 billion in 2012 (see Fig. 1).¹⁰

Impact on Patients and Their Caregivers

COPD results in an estimated 16.4 million days of absenteeism, resulting in \$3.9 billion in indirect costs in 2010.¹⁷ Further, the daily symptom burden of COPD leads many to leave the workforce and become dependent on disability benefits.^{18,19} A 2015 Morbidity and Mortality Weekly Report by the Centers for Disease Control and Prevention found that 20.4% of those with COPD reported inability to work compared with 4.8% without the disease.¹⁸ Thornton Snider et al¹⁹ reported that Americans with COPD who were ≥50 y old were less likely to be employed than those without COPD or those with cancer, heart disease, diabetes, or hypertension. They were also more likely to collect Social Security Disability Insurance and Supplemental Security Income than those with the aforementioned chronic conditions as well as those who had suffered a stroke.¹⁹ As COPD progresses, patients become more debilitated and dependent on others for daily living and for management of their chronic condition. These informal caregivers, ranging from unpaid family members to friends, also incur indirect costs, with 7% of caregivers suffering an average of 1.7 lost days of work per year.

Inhalers remain the foundation of optimal medical management of patients with COPD²⁰; However, cost of

Fig. 1. Aggregate charges for in-patient stays for COPD or bronchiectasis among patients age ≥ 18 y, according to the Nationwide Inpatient Sample. Data from Reference 10.

these agents remains a significant burden to many patients.^{21,22} Castaldi et al²¹ found that 31% of Medicare beneficiaries who were ≥ 65 y old reported non-adherence to inhaler therapy secondary to cost. A nationwide analysis of Medicare Part D estimated that for just one inhaler, annual out-of-pocket costs exceeded \$900; for patients with more severe COPD who required 2 or 3 inhalers, the average annual out-of-pocket costs totaled \$1,600 to \$2,800.²²

Disparities

Age

The prevalence of COPD increases with age. As life expectancy increases and treatment advances, COPD prevalence is expected to grow.²³⁻²⁶ Further burdening the aging COPD population is their increased risk for multimorbidity; patients with COPD average 4–6 comorbidities, whereas age-matched controls without COPD average 2–3.²⁶ Common comorbid conditions in the COPD population include hypertension, hyperlipidemia, depression, cataracts, osteoporosis, and cancer.^{15,27,28} Mannino et al²⁹ found that as FEV₁ worsened in subjects with COPD who also had cardiovascular disease, hypertension, and/or diabetes, these subjects had higher significant hospitalization and nonsignificant mortality rates, compared with those without these comorbid conditions.

Gender

For the past few decades, prevalence of COPD in women has exceeded that in men, despite overall less lifetime

cigarette consumption (see Fig. 2). Since 2000, mortality in women has surpassed that in men.^{16,24,30} A 2016 National Center for Health Statistics report found that age-adjusted death rates from COPD have decreased for white and African-American men (2000–2014) but increased for African-American women and remained stagnant for white women during that same time period.³¹ Women may also experience greater lung function decline than men after controlling for the amount of tobacco exposure.³²⁻³⁴ Proposed factors include female-specific genetic predisposition to deleterious effects of inhaled tobacco, greater reported dyspnea burden, and a deleterious effect on health-related quality of life and increased airway hyperreactivity in women.³⁴⁻³⁶ Moreover, decreases in estrogen during menopause are thought to promote alveolar loss, possibly increasing women's susceptibility to COPD development.³⁷

Socioeconomic

Within COPD, there is an inverse relationship between prevalence and income level.^{16,30} COPD prevalence is 1.5–3 times higher in those with low socioeconomic status compared with those in higher socioeconomic groups.³⁸ Low-socioeconomic status patients account for an estimated two thirds of the COPD population despite comprising <20% of the general population.³⁸ In general, those who are economically disadvantaged tend to have higher smoking rates, more occupational exposure to inhalant toxins, and greater exposure to air pollution, leading to increased risk for COPD development.³⁸ Unfortunately, lower socioeconomic status has also been linked to poorer outcomes, including more severe disease, worse lung func-

Fig. 2. Prevalence of COPD among adults age ≥ 18 y in the United States from 1998 to 2009. Data from Reference 25.

tion, more physical function limitations, greater risk for COPD exacerbations, and less health-care access.^{38–40} COPD patients with lower income who were also unemployed and/or without a high school degree have higher rates of emergency department visits and hospitalization rates for COPD exacerbation.⁴¹

Race

Whereas whites have the highest COPD prevalence and mortality, mortality rates for African-Americans are increasing more rapidly.^{16,30} Further, African-Americans experience more COPD exacerbations requiring hospitalizations than whites as well as worse quality of life associated with COPD exacerbation.⁴² Increased susceptibility to the detrimental effects of tobacco smoke has been suggested as a cause for observed differences.^{32,33} If so, possible contributing factors include lower lung volumes in African-Americans and different inflammatory responses to tobacco smoke.^{32,33}

Out-Patient Management

Role of the Primary Care Physician

Primary care physicians play a prominent role in COPD diagnosis and management.⁴³ According to Perez et al,⁴ 80% of COPD care and management is performed by primary care health professionals. Croft et al⁵ found that 3.7 million adults in the United States do not have access to a pulmonologist within a 1-h driving distance, resulting in primary care physicians, and more recently nurse practitioners and physician

assistants, being primarily responsible for diagnosis and subsequent management of the majority of patients with COPD (Fig. 3).⁶ However, patients exclusively managed by primary care physicians are less likely to receive treatment adherent to Global Initiative for Chronic Obstructive Pulmonary Disease (GOLD) guidelines compared with patients managed solely by a pulmonologist or co-managed by their primary care physician and pulmonologist.^{7,8}

In 1998, the National Heart, Lung, and Blood Institute (National Institutes of Health) and the World Health Organization created the GOLD guidelines to not only increase COPD awareness but to somewhat standardize diagnosis and treatment for this chronic disease.²⁰ However, despite this better standardization of diagnosis and management, there are significant barriers that health-care professionals in the primary care setting face, including lack of patient-reported dyspnea, time constraints due to management of multiple comorbid conditions, lack of accessibility to spirometry for accepted standard diagnosis, unfamiliarity with pulmonary function test interpretation, and unawareness of the GOLD guidelines.^{4,6} These barriers are thought to contribute to underdiagnosis and undertreatment of COPD.⁶

Preventive Health: Tobacco Cessation

Primary care providers play a pivotal role in COPD prevention, especially with tobacco cessation assistance, as tobacco abuse is the leading environmental risk factor for COPD and accounts for 80% of COPD deaths.^{2,20} From 2005 to 2015, the Centers for Disease Control found a 27.7% decline in current cigarette smoking in United States adults, regardless of gender, socioeconomic status, and

Fig. 3. Locations of 12,392 pulmonologists and quintiles of county estimates of the 15.7 million adults ≥ 18 y old with diagnosed COPD. From Reference 5, with permission.

Fig. 4. United States adults who were current cigarette smokers according to the National Health Interview Survey. Data from Reference 45.

region ($P < .05$).⁴⁴ Despite this positive improvement, 36.5 million, or 15.1%, of the United States adult population was still smoking in 2015 (see Fig. 4).⁴⁴

The United States Preventive Services Task Force recommends that all clinicians ask patients about tobacco abuse, advise them to abstain from tobacco, and provide them with behavioral and FDA-approved pharmacologic interventions for patients who do use tobacco.⁴⁵ A com-

monly used model is the 5 As (*ask* about tobacco use, *advise* users to quit, *assess* willingness to quit, *assist* in quitting, and *arrange* follow-up).⁴⁵ Based on the 2005–2009, National Ambulatory Medical Care Survey and the National Health Interview Survey, 66.6% of patients underwent tobacco use screening at their primary care visits; however, of those identified as current tobacco users, only 26.9% actually experienced tobacco counseling, and 8.3% ended up being prescribed tobacco cessation medication.⁴⁶ Time constraints, lack of significant reimbursement for treatment, lack of institutional support for screening and treatment, and lack of knowledge by primary care physicians were thought to be significant barriers.⁴⁶

Pulmonary Rehabilitation

Pulmonary rehabilitation is a highly recommended but underutilized intervention for COPD patients with persistent symptoms despite optimal medical therapy.^{20,47} At least 4 weeks of exercise training with patient education improves dyspnea, fatigue, and functional exercise capacity as well as reducing readmission rates and overall health-care utilization.^{48–50} However, the survey by Barr et al⁴⁷ found that only 19% of primary care physicians and 54% of pulmonologists regularly refer their patients to pulmo-

nary rehabilitation despite the majority of these physicians understanding that their moderate-to-severe COPD patients would benefit. Specific barriers include cost, poor insurance coverage, lack of perceived benefit by patients, and unavailability, with 23% of primary care physicians and 8% of pulmonologists reporting no available programs to them.^{47,51} For patients in rural areas, transportation to such programs also represents a real problem.

In an effort to combat these barriers, home tele-rehabilitation initiatives have been developed with promising results.^{49,52} Holland et al⁵² created a home-based pulmonary rehabilitation program, during which subjects were visited by a physical therapist at their home at week 1 and taught exercise techniques using readily available household equipment. Subjects were then followed up by telephone weekly for a total of 8 weeks. This tele-rehabilitation program was not inferior to the standard out-patient pulmonary rehabilitation program with regard to short-term quality of life and exercise capacity improvements at 8-week follow-up.

In a randomized trial in Canada, Maltais et al⁴⁹ found that a self-monitored, home-based rehabilitation with weekly telephone calls with an exercise trainer was not inferior to the traditional out-patient rehabilitation program at 1 y. Researchers in the United Kingdom randomized subjects upon hospital discharge for a COPD exacerbation to a home-based exercise and educational program with biweekly telephone follow-up compared with usual care; they found that participants in the intervention arm had a nonsignificant decrease in 30-d readmission rate compared with the usual care arm.⁵³

Curbing Readmission Rates

Since the turn of the 21st century, total emergency department visit and hospitalization rates have increased for COPD, with exacerbations accounting for 62.5% of admission reasons.^{10,54} Both emergency department visits and readmissions for COPD exacerbations account for the majority of COPD-related costs.^{9,11} Although the GOLD committee has issued recommendations for management of COPD exacerbations, adherence varies.^{20,55,56} There have been recent efforts by health-care systems to better adhere to expert-level recommendations and to better coordinate management, as the 30-d readmission rate currently exceeds 20%.^{57,58} Furthermore, in 2014, the Center for Medicare Services added exacerbations of COPD to the Hospital Readmission Reduction Program, which is a government effort to reduce Medicare payments to Inpatient Prospective Payment System hospitals with excessive 30-day all-cause readmission rates.⁵⁷

Recurrent exacerbations account for 27.6% of all readmissions based on a 2006–2010 review of Inpatient Prospective Payment System hospitals receiving Medicare fee-

for-service beneficiaries.⁵⁷ Patients discharged home without home care after their index COPD exacerbation admission are also more likely to be readmitted for COPD than those discharged to post-acute care, which includes short-term rehabilitation facilities as well as home care services (31.1% vs 18.8%, $P < .001$).⁵⁷ Other readmission risk factors include longer lengths of stay during the index admission and a greater number of comorbidities and specific comorbidities, including heart failure, obstructive sleep apnea, vertebral fractures, anemia, anxiety, depression, and electrolyte and acid/base disorders.^{57,59} To curb COPD's high readmission rates, various solutions have been proposed, including in-patient electronic order sets, discharge bundles, hospital at-home programs, telemedicine, and tele-rehabilitation. However, at this time, no single intervention has emerged as a generalizable model to consistently reduce 30-d readmission rates. This is probably related to the complex set of comorbidities and social factors that contribute to readmissions beyond COPD itself.

Electronic Order Sets

Implementation of an in-patient electronic order set for exacerbation management has been shown to increase prescriber adherence to recommended medications and an overall stay reduction but had no effect on 30-d readmission rates.⁶⁰ When Sonstein et al⁶¹ implemented an electronic order set, they also found greater provider adherence to GOLD medication recommendations but no effect on stay or readmission rate.

Discharge Bundles

Other efforts to combat high readmission rates have focused on implementation of discharge bundles, although with variable results. A United Kingdom research group implemented a COPD discharge care bundle, in which all patients admitted to the respiratory ward for exacerbations were provided with tobacco cessation and COPD education information, assessed for pulmonary rehabilitation appropriateness and proper inhaler technique, and scheduled with a pulmonary specialist within 1 month of discharge. Their efforts led to a nonsignificant decline in 30-d readmission rates.⁶²

A group of Ohio researchers implemented its own variation of a discharge care bundle that focused heavily on inhaler technique, clear discharge instructions with COPD education, and timely follow-up.⁶³ Despite not including tobacco cessation, vaccinations, and pulmonary rehabilitation referrals, this group found a significant decline in 30-d readmission rate (22.7% before COPD bundle, 14.7% after COPD bundle).⁶³ However, Jennings et al⁶⁴ found no difference in 30- and 90-d emergency room visit and readmission rates after implementation of a discharge bun-

dle 24 h before discharge, which included smoking cessation; COPD education with a focus on inhaler technique; screening for and potential management of gastroesophageal reflux disease, anxiety, and depression; and telephone follow-up at 48 h.

Conversely, Alshabanat et al⁶⁵ implemented a comprehensive care management program, in which respiratory therapists, nurses, and nurse practitioners followed patients with COPD for 90 d post-discharge with home and/or telephone support, focusing on clinical assessment, medication and inhaler technique review, COPD education, and multidisciplinary support. This program was piloted at 5 Vancouver hospitals and resulted in a significant reduction in COPD and all-cause readmissions and in stay for COPD-related readmissions.⁶⁵ Lawlor et al⁶⁶ coupled early discharge with a discharge bundle program in which subjects with COPD exacerbation were discharged to home within 4 d of admission or earlier and received education regarding COPD, inhaler technique, and home physical therapy exercises and were provided with smoking cessation counseling and rapid access to a pulmonary clinic if they felt they were experiencing a recurrent exacerbation; this program led to a significant reduction in emergency department visits and 6- and 12-month readmission rates when comparing the same subjects pre- and post-implementation.⁶⁶

Hospital at Home

For a select group of patients experiencing an exacerbation, some evidence suggests that discharge directly to home from the emergency department with appropriate medications and regular at-home respiratory nurse follow-up is associated with a significantly reduced readmission rate and nonsignificant reduction in mortality rate, compared with similar patients who received in-patient care.⁶⁷ Although this concept has shown some promising results, a Cochrane review of 8 studies that explored this intervention only found about 25% of their study population appropriate for this type of care, as the majority of patients met various exclusion criteria, including impaired consciousness, chest radiograph or electrocardiogram abnormalities, pH < 7.35, poor lung function, and/or severe comorbidities.⁶⁷

Telemedicine

Telemedicine has garnered significant attention in the past decade. By monitoring patients' symptoms and vital signs via various technological means, including web-based visits, telephone visits, and/or electronic diaries monitored by health-care personnel, it is proposed that COPD exacerbations can be detected earlier with the end goal of reducing emergency department visits and hospitalization

rates.⁶⁸ However, telemedicine remains controversial due to conflicting results in the setting of non-standardization of techniques.⁶⁹

Trappenburg et al⁷⁰ found that an electronic diary for daily symptom reporting paired with medication compliance and COPD education questions led to a significant reduction in the rate of hospital admissions and COPD exacerbations. A randomized, controlled trial by Bourbeau et al⁷¹ found that subjects with COPD who underwent a weekly COPD education program for 2 months with monthly telephone follow-up experienced decreased hospital admissions for COPD exacerbations and a reduction in all-cause admissions at 12 months, compared with subjects receiving usual care. An Italian randomized controlled trial found that subjects with COPD who were dependent on either long-term oxygen therapy or home mechanical ventilation and who were provided with continuous pulse oximeter monitoring and 24-h access to a nurse-centered tele-assistance hotline had fewer exacerbations, emergency department visits, and admissions.⁷²

Although Cordova et al⁷³ found daily peak flow and dyspnea to improve in subjects with COPD who entered daily COPD-related symptoms via a smartphone application, there was no reduction in readmission rates or stay. Pinnock et al⁷⁴ also found no significant decrease in COPD readmission rate or stay for subjects with COPD who answered a daily symptom questionnaire on a touchscreen and provided oxygen saturation data. Ringbaek et al⁶⁸ found that video consultation with patients with COPD and respiratory nurses led to fewer out-patient visits but not COPD-related or all-cause hospitalization rates.

Casas et al⁷⁵ combined discharge bundles with telemedicine. Subjects hospitalized for COPD exacerbation were randomized to usual care versus an integrated care intervention that included assessment of disease severity, comorbidities, social needs, and self-management before discharge. Participants were also provided an individualized care plan that was shared between a specialized nurse case manager and subjects' primary care physicians and a web-based call center managed by the specialized nurse accessible to both subjects and primary care physicians over a 12-month follow-up period.⁷⁵ After 12 months, the integrated care arm had a significantly decreased readmission rate for COPD exacerbations (1.5 ± 2.6 in the integrated arm vs 2.1 ± 3.1 , $P = .033$).⁷⁵ This same integrated care model was then applied to COPD out-patients.⁷⁶ Over a 6-y follow-up period, the integrated care arm had a significant reduction in emergency department visits but no difference in admission rates. Importantly, however, 80% of the admissions for the integrated care group were scheduled via the subjects' primary care physician and in-patient team, whereas 100% of the usual care group admissions were unscheduled and thus via the emergency department.⁷⁶

Future Directions: COPD National Action Plan

The Department of Health and Human Services, National Institutes of Health, and Centers for Disease Control and Prevention released the COPD National Action Plan in 2017 to foster greater awareness to COPD, as it remains a largely preventable disease that continues to burden millions of Americans, many of whom are not diagnosed, with both disability and death and remains an economic strain on the health-care system.¹³ The plan was a collaborative effort of not only government agencies but also a range of COPD stakeholders, including patients and their caregivers, health-care providers, and nonprofit organizations. Five broad goals were announced, with each goal pertaining to a key stakeholder in the disease.

The goals are as follows: (1) raise public awareness of COPD, its symptoms, and its causes by focusing on educating patients and their caregivers; (2) improve training for health-care professionals in diagnosis, prevention, and treatment of COPD, and promote collaboration among all health-care professionals to create a national standardized, patient-centered treatment and prevention algorithm; (3) encourage data sharing to improve analysis of COPD-related public health data and prioritize dissemination of the results; (4) focus research efforts on identifying COPD earlier and preventing its progression, on understanding different COPD clinical phenotypes, and on developing personalized medicine as well as continuing research efforts to optimize COPD treatment; and (5) create an organization with both federal and non-federal partners that focuses on implementing the COPD National Action Plan's goals, generates funding, and implements public health prevention strategies.¹³

The COPD National Action Plan is a call to all those affected by COPD, whether they are patients, family members, researchers, physicians, or public policy officials, to focus on this largely preventable, national disease growing in prevalence and incidence. It acknowledges the importance of research and data collaboration; however, it also places strong emphasis on the role of public health campaigns and empowerment of patients and their families. However, it is important to remember that by itself, it is only a plan. Implementation will require the engagement of all stakeholders to fulfill its goals.

Summary

Despite being a largely preventable disease, the global and national burden of COPD remains high. The collaboration highlighted by the COPD National Action Plan is a great step forward in acknowledging that COPD can only be effectively prevented and treated if all stakeholders are invested. However, continued collaboration at the ground level is needed, as many patients continue to be burdened

by daily symptoms and barriers to diagnosis and optimal management. Future endeavors will need to focus on the coordination of primary care physicians, pulmonologists, nurses, and respiratory therapists in both the out-patient and in-patient settings to ensure patients receive optimal treatment and education and frequent monitoring for early signs of an exacerbation.

Greater emphasis must be placed on educating primary care health-care professionals on the signs and symptoms of COPD to aid earlier diagnosis and on GOLD standard treatment recommendations. Public health education programs need to be widely publicized so that undiagnosed patients receive treatment earlier. For both the in-patient and out-patient settings, there must be stronger efforts on tobacco cessation screening and treatment strategies to curb morbidity and mortality rates. The various new strategies to combat high COPD exacerbation readmission rates, such as discharge bundles, telemedicine, and tele-rehabilitation, have shown some promise. However, there must be continued application of these interventions to larger patient populations to determine whether their effects are generalizable, sustainable, and economically feasible.

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