2 Epidemiology and Economic Consequences of COPD

Key Points
1. Tobacco smoke inhalation is the major risk factor for the development of COPD.
2. Secondhand, passive, or environmental tobacco smoke exposure may also have a potentially important role in the development of chronic lung disease.
3. Approximately one quarter of individuals with COPD are not smokers; nontobacco smoke risk factors for COPD development include indoor and outdoor air pollutants, workplace dust and fumes, childhood lower respiratory disorders including asthma, and pulmonary infections (tuberculosis and human immunodeficiency virus).
4. Chronic lower respiratory disease (COPD and asthma) is the third leading cause of death in the US.
5. In 2010, the total cost of COPD in the US was estimated to be $36 billion and is projected to rise to $49 billion in 2020.
6. The majority of COPD medical costs are related to healthcare visits (emergency department and hospitalizations) for exacerbations.
7. COPD impairs workers and is a significant contributor to sick and disability leave and employer healthcare costs.

2.1 Introduction

Studies of the epidemiology of COPD provide critical associations between environmental risk factors and the development of airflow limitation and other disease manifestations in vulnerable individuals. Obstructive lung disease does not develop in all individuals exposed to known potential risk factors which suggests that, in addition to environmental exposures, a genetic predisposition or susceptibility is required for the development of COPD. Because the hereditary factors (other than alpha 1 antitrypsin mutations) are poorly characterized, these epidemiologic associations provide the best current opportunity to prevent the development of COPD by identifying potentially avoidable exposures and decreasing their detrimental effects.

COPD may be the single most underdiagnosed and misdiagnosed chronic disorder with the greatest economic consequences (Mannino, 2002; Mannino, 2007; Diaz-Guzman, 2014). COPD is the third leading cause of death in the US and accounts for nearly $40 billion dollars in direct healthcare costs with approximately additional $4 billion dollars in indirect costs due to lost or impaired work (Ford, 2014). An analysis of the National Health and Nutrition Examination Survey 2007–2009 revealed COPD under-diagnosis (failure to diagnose COPD in individuals with respiratory symptoms
and airflow limitation measured by spirometry) of 82.9% (95% confidence interval (CI) 75.2, 88.6) and over-diagnosis (diagnosis of COPD in individuals who did not have airflow limitation) of 61.1% (95% CI, 49.0, 72.0) (Munson, 2013). Other studies suggest that the under-diagnosis of COPD ranges from 63.3–71.1% (Murphy, 2011; Mannino, 2000; Petty, 2000).

COPD exacerbations including emergency room visits and hospitalizations are the major factors contributing to direct medical costs of COPD (Darnell, 2013). Nearly three quarters of individuals diagnosed with COPD are under 65 years old and employers spend about $17,000 per year on employees with COPD which is three times more than for those who do not have COPD (Bunn, 2008).

Despite COPD’s significant economic costs and prevalence, research support for COPD basic science, translational, and clinical studies is severely underfunded. An analysis of National Institutes of Health research funding for 29 common conditions found that COPD was the most underfunded disorder based upon disease burden (Gillum, 2011).

2.2 Epidemiology

2.2.1 Risk Factors for COPD Development

2.2.1.1 Tobacco Smoke

Although tobacco smoke inhalation is the major factor associated with the development of COPD globally, smoking is the predominant risk factor in the developed world and other factors dominate in the developing world currently. A large meta-analysis of 218 studies examining the relationship between smoking and COPD, chronic bronchitis, and emphysema revealed a relative risk (RR) of ever smoking and developing COPD of 2.89 (95% CI 2.63, 3.17), chronic bronchitis 2.69 (95% CI 2.50, 2.90), and emphysema 4.51 (95% CI 3.38, 6.02) (Forey, 2011). For current smokers, the RR increases to 3.51 (95% CI 3.08, 3.99) for COPD, to 3.41 (95% CI 3.13, 3.72) for chronic bronchitis, and to 4.87 (95% CI 2.83, 8.41) for emphysema. The risk for lung disease increased with the amount and the duration of smoking, and decreased with increasing age of starting to smoke and duration of smoking cessation (Forey, 2011). The effect is greater for cigarette smokers and less for pipe and cigar smokers. In addition, the age of smoking cessation significantly influences the effect of smoking on longevity (Jha, 2013). Quitting smoking by the age of 35 neutralizes most of the excess mortality due to smoking (Jha, 2013). Smoking cessation reduces the rate of lung function decline at all stages of COPD but has the greatest effect in early disease (Welte, 2014). Thus, the amount, duration, age of starting smoking, age of quitting smoking, duration of smoking abstinence, and type of tobacco product all contribute to the development of COPD.
2.2.1.2 Passive or Environmental Tobacco Smoke Exposure
The 2006 Surgeon General’s report concluded that secondhand, passive, or environmental tobacco smoke exposure is associated with multiple disorders including COPD, asthma, respiratory infections, cardiovascular disease, and cancer but the evidence was insufficient to establish a causal relationship (U.S. Department of Health and Human Services, 2006). Environmental tobacco smoke exposure includes 85% sidestream smoke from the burning tip of a cigarette and 15% mainstream smoke that is exhaled by an active smoker (Manuel, 1999). Sidestream smoke is unfiltered and contains smaller particles than mainstream smoke but both sources contain multiple toxic and carcinogenic agents (Reardon, 2007).

Passive smoke exposure in utero or during early childhood may adversely affect lung development and predispose to the subsequent development of COPD (Stocks, 2013), (discussed in Chapter 9, Natural History, Phenotypes, and Gender Differences in COPD.) Among nonsmoking adults over the age of 40 in China, over 78% had environmental tobacco smoke exposure and the odds of COPD among those with home or work environmental tobacco smoke exposure is 1.48 (95% CI, 1.18, 1.85) (Regional COPD Working Group, 2003; Yin, 2007). A meta-analysis of the effect of second hand smoke exposure and the development of COPD shows an increased odds ratio (OR) of 1.56 (95% CI 1.40, 1.74) (Eisner, 2010). Workers in environments where laws have been enacted prohibiting smoking experience less cough and phlegm production and their lung function improves after smoking has been banned from their workplace (Goodman, 2007; Menzies, 2006; Eagan, 2006).

2.2.1.3 Non-tobacco Smoke Factors
The attributable risk for the development of COPD due to tobacco smoke ranges from 9.7 to 97.9% but is generally less than 80%, which suggests that other exposures contribute to 20% or more of COPD cases (Eisner, 2010). Approximately one quarter of individuals with COPD in the US, UK, and Spain were never smokers (Salvi, 2009). Factors other than tobacco smoke that have been associated with the development of COPD include indoor and outdoor air pollutants, workplace dust and fumes, childhood lower respiratory infections, pulmonary tuberculosis, chronic asthma, intrauterine growth retardation, poor nutrition, and lower socioeconomic status (Salvi, 2009; Eisner, 2010; Diaz-Guzman, 2012). Depending upon the level of these exposures, between 25 and 45% of individuals with COPD may be never smokers (less than 100 cigarettes in their lifetime) (Salvi, 2009).

2.2.1.4 Occupational Exposures
Combined tobacco smoke and occupational exposures to dusts, gases, fumes, and smoke significantly increase the risk of developing COPD (Blanc, 2009; Salvi, 2009; Eisner, 2010; Doney, 2014; Omland, 2014). In the US, approximately 15% of cases of
COPD may be due to environmental exposures in the workplace when controlling for tobacco smoke exposure (Balmes, 2003; Blanc, 2007). Between 30–40% of farmers have COPD and lung disease is associated with ammonia and dust inhalation (Lamprecht, 2007; Eduard, 2009). Dust exposure, especially from silica, is associated with COPD among construction workers, miners, and foundry and concrete workers (Salvi, 2009). Other industries with increased risk of COPD include plastics, textile, rubber, leather, trucking (especially with diesel exhaust exposure), and food products (Salvi, 2009; Hnizdo, 2002; Weinmann, 2008).

### 2.2.1.5 Air Pollution

#### 2.2.1.5.1 Indoor

Exposure to biomass fuels (wood, dung, and coal) that are used in open fire stoves throughout the developing world is a significant risk for the development of lung disease, especially among nonsmoking women and children (Regalado, 2006; Rinne, 2006; Grigg, 2009). Worldwide, approximately 50% of all and 90% of rural households use biomass fuels for heating and cooking (Zeng, 2012). Biomass smoke exposure increases the odds for developing COPD by two to three fold (Sood, 2012). A systemic review of the association between solid fuels and COPD and chronic bronchitis demonstrated OR’s of 2.80 (95% CI 1.85, 4.0) and 2.32 (95% CI 1.92, 2.80), respectively (Kurmi, 2010). In addition, solid fuel smoke is associated with increased lung infections, especially among women and children, higher risk for asthma, interstitial lung disease, and lung cancer (Sood, 2012).

#### 2.2.1.5.2 Outdoor

Outdoor air pollution is associated with impaired development of lung function in childhood and adolescence which may reduce peak lung function or decrease the duration of the plateau phase of maximal lung function (see Chapter 9. Natural History, Phenotypes, and Gender Differences in COPD.) (Gauderman, 2004; Gauderman, 2007; Rojas-Martinez, 2007; Ko, 2012). The Study on the Influence of Air Pollution on Lung Function, Inflammation, and Aging (SALIA) showed that increasing exposure to aerosolized particulate matter was associated with reductions in FEV\textsubscript{1}, FVC, and FEV\textsubscript{1}/FVC and increased risk for COPD in 4,575 German women (Schikowski, 2005). The Swiss Study on Air Pollution and Lung Diseases in Adults demonstrated a reduction in the decline in lung function as air quality improved (Downs, 2007). In the UK, the lung function of postmen working in cities with worse air pollution is reduced compared to those working in areas with better air quality (Fairbairn, 1958; Holland, 1965). In addition, worse air pollution is associated with increased COPD exacerbations; for every 10 microgram/m\textsuperscript{3} increase in the annual mean particulate matter 10, (PM10 >100 microgram/m\textsuperscript{3}), the hospitalization rate for acute COPD exacerbations increases by 2.4% (Ko, 2007).
2.2.1.6 Sex
Women appear to be more susceptible to the development of smoking related COPD (Aryal, 2014). They develop greater airflow limitation at younger ages and with less tobacco smoke exposure, experience a faster rate of lung function decline than men, and have a higher risk of hospitalization for acute exacerbations of COPD (Aryal, 2014; Gan, 2006, Tam, 2013). Potential explanations for the gender differences in COPD manifestations include dysanapsis (airway size disproportionate to lung size; women’s airways are smaller than men’s even controlling for differences in lung size), elevated susceptibility to inflammation and mucus hypersecretion, differential effects of hormones, differences in pulmonary particle deposition, and greater and longer cigarette smoke inhalation by women compared with men (Tam, 2013).

2.2.1.7 Infections
Review of epidemiologic studies of tuberculosis (TB) and COPD demonstrate an increased risk of obstructive lung disease in individuals who previously had pulmonary tuberculosis with OR between 1.37 and 2.94 (Allwood, 2013; Ehrlich, 2011). The prevalence of COPD among individuals previously treated for tuberculosis ranges from 28–68% and increases with the time after tuberculosis treatment completion (Jordan, 2010). Prior tuberculosis infection is associated with accelerated lung function decline but it is unclear if the pathophysiology of this reduction is related to the processes that cause lung function decline in tobacco-related COPD (Hnizdo, 2000). Conversely, smoking doubles the risk of TB infection, active disease, and mortality (van Zyl-Smit, 2010).

Human immunodeficiency virus (HIV) infection is another risk factor for COPD, especially emphysema (Raynaud, 2011; Gingo, 2013). Early reports associated HIV infection with air trapping, reduced diffusing capacity, and CT scan evidence of emphysema (Diaz, 1992; Diaz, 2000). When controlling for smoking, HIV infected individuals older than 50 years have an 11% higher incidence of COPD than those who are not infected and, among those less than 50 years old, the incidence is 25% greater (Crothers, 2011). HIV infected injection drug users are 3.4 fold more likely to have obstructive lung disease than non-infected users (Drummond, 2012). Smoking further increases the risk of COPD among HIV infected individuals (Crothers, 2005).

2.2.2 Prevalence

2.2.2.1
The measurement of COPD prevalence is extremely dependent upon the criteria used to define COPD, use of spirometry, and the threshold for airflow limitation. Many epidemiologic studies utilize a clinical definition of COPD asking participants if they have ever been told by a healthcare provider that they have COPD, chronic bronchitis,
or emphysema. In the absence of physiologic measurement, the clinical diagnosis of COPD may be inaccurate in 25% of patients (Murray, 2011). Even when spirometry is used, the measured prevalence will depend upon whether pre-bronchodilator or post-bronchodilator values are used to determine the presence of airflow limitation. The threshold for the definition of airflow limitation significantly alters the measured prevalence of airflow limitation (discussed in Chapter 4, Pulmonary Function Testing: Presence and Severity of Airflow Limitation/Obstruction). Even studies that used very standardized and uniform methodologies such as the Burden of Obstructive Lung Disease (BOLD) and the Latin American Project for the Investigation of Obstructive Lung Disease (PLATINO) found dramatic variability in COPD prevalence across countries and regions (Buist, 2007; Menezes, 2005). Therefore, when reviewing studies of COPD epidemiology, one should be careful to assess study methodology and disease definitions.

Because tobacco smoke inhalation is the predominant cause of COPD, the prevalence of COPD corresponds closely with smoking rates but with a lag of several decades. In the US, smoking rates for men peaked in the 1950s and 1960s and COPD prevalence and mortality rates have stabilized or begun to decline (http://www.tobaccoatlas.org/products/male_tobacco_use/prevalence/; http://www.cdc.gov/copd/data.htm). For women, smoking rates peaked in the 1970s and 1980s and the prevalence and mortality rates of COPD in women more than doubled from 1980 to 2000 and have stabilized from 1999 to 2010 (http://www.tobaccoatlas.org/products/female_tobacco_use/prevalence/; http://www.cdc.gov/copd/data.htm). Thus, where cigarette smoke inhalation is the predominant cause of COPD, the prevalence of COPD lags smoking rates by several decades.

2.2.2.2 United States

2.2.2.2.1 Prevalence

Based upon the National Health Interview Survey, 5.1% of US adults over the age of 18 had COPD in 2007–2009 and the prevalence of COPD was greater in women, 6.1%, than in men, 4.1% (Akinbami, 2011). The overall prevalence of COPD was stable from 1998 through 2009. COPD prevalence increased with age and was higher in women than in men throughout most age groups.

The Third National Health and Nutrition Examination Survey (NHANES III) estimated that the prevalence of COPD was 6.8–8.5% within the general US population (Mannino, 2000). COPD prevalence was estimated to be greater in current (12.5%) and former (9.4%) smokers than in never smokers (5.8%) (Mannino, 2000). In 2011, 6.8% of US adults older than 25 years reported that a caregiver had told them that they had COPD (Ford, 2013). The age adjusted prevalence was higher in American Indian/Alaska natives, 11.0%, than in non-Hispanic whites, 6.9%, non-Hispanic blacks, 5.7%, Hispanics, 4.1%, and Asian/Pacific Islanders, 2.5%. COPD prevalence was also
greater in women, 7.3%, than in men, 5.7% (Ford, 2013). Geographically, COPD prevalence was greatest in the states bordering the Ohio and Mississippi Rivers (Ford, 2013).

### Gender Distribution

Over the past decade several dramatic changes in the gender distribution of COPD have occurred in the US (Ohar, 2011). For the first time in 2000, more women than men died from COPD in the US (Arias, 2003). Female smokers are 13 times more likely to die from COPD than nonsmoking women whereas male smokers are 12 times more likely to die from COPD than nonsmoking men (U.S. Department of Health and Human Services, 2014). Women are twice as likely to be diagnosed with chronic bronchitis as men; in 2011, 56.7 women per 1,000 population were diagnosed with chronic bronchitis compared with 29.6 per 1,000 population among men (http://www.lung.org/lung-disease/copd/resources/facts-figures/COPD-Fact-Sheet.html). Also, in 2011, the prevalence of diagnosed emphysema was greater in women than in men, 21.4 per 1,000 compared to 19.0 per 1,000. (http://www.lung.org/lung-disease/copd/resources/facts-figures/COPD-Fact-Sheet.html).

### Healthcare Utilization and Occupational Consequences

In the 2011 Behavioral Risk Factor Surveillance System survey, 6.3% of US had a self-reported caregiver diagnosis of COPD (Centers for Disease Control and Prevention, 2012). Of those with COPD, 76.0% had undergone pulmonary function testing, 64.2% felt their quality of life was impaired by breathlessness, and 55.6% were taking at least one breathing medication. In the year before the survey, 43.2% had seen a physician and 17.7% had been seen in an emergency room or hospitalized for respiratory-related symptoms. In 2010, there were 495 physician office visits, 72 emergency department visits, and 34 hospitalizations with a primary diagnosis of COPD per 10,000 US population (Ford, 2013).

Analysis of data from the National Health and Wellness Survey of over 20,000 employed US adults between 40 and 64 years old revealed that 5.5% self reported a diagnosis of COPD (DiBonaventura, 2012). Those with COPD reported greater presenteeism (the percentage of impairment while at work due to health in the past 7 days), and overall work and daily activity impairment.

### Mortality

In 2007, nearly 60,000 men (63.5 per 100,000 population) and nearly 65,000 women (46.8 per 100,000 population) died from COPD. The death rates from COPD declined for men but did not change for women from 1999 through 2007. Lower respiratory disease (COPD and asthma) was the third leading cause of death in the US in 2008 (Minino, 2010). COPD was the primary cause of approximately one in every 20 deaths in the US in 2005 (CDC, 2008).
2.3 Economics

2.3.1 Direct Costs

Direct costs are the expenses incurred by the healthcare system, community, and patients and their families due to illness. The total US costs related to COPD and its comorbidities in 2010 are estimated to be $36 billion with $32.1 billion due to direct medical expenditures and $3.9 billion in indirect or absenteeism costs (Ford, 2014). By 2020 the national direct medical costs of COPD are predicted to rise to $49 billion (Ford, 2014). COPD exacerbations and their management account for 45–75% of direct costs (Toy, 2010). A summary of the costs of COPD in 2006 estimated the per-patient direct costs to be $2,700–$5,900 annually with excess costs ranging from $6,100 to $6,600 annually (Foster, 2006). In 2008, hospitalization costs for COPD exacerbations were estimated to range from $7,242 for an uncomplicated admission to $44,909 for a complex admission requiring mechanical ventilation and critical care (Dalal, 2011). Medicare beneficiaries with COPD have annual healthcare costs $20,500 greater than those without COPD (Menzin, 2008). Overall healthcare costs are greater for those with COPD compared to individuals who do not have COPD.

Among 8554 patients with COPD, mean annual COPD related healthcare costs were $4069 overall but $6381 for patients with two or more exacerbations and mean all cause healthcare costs were $18,976 overall and $23,901 for those with two or more exacerbations (Pasquale, 2012). Higher costs occurred among those with more severe exacerbations, comorbid cardiovascular disease, diabetes, and supplemental oxygen use. A review of 58,589 patients with COPD in the United Kingdom showed that the annual cost of COPD care was 1,523, 2,405, and 3,396 pounds (approximately, $2303, $3637, and $5135, US dollars, respectively) for patients with 0, 1, and 2 or more exacerbations (Punekar, 2014).

Hospitalization costs for COPD increase with the severity of the exacerbation. Analysis of administrative data from 602 hospitals in 2008 revealed that hospitalizations requiring intensive care and intubation cost $44909 whereas ward hospitalization cost $7242; complex hospitalizations requiring either intubation or intensive care accounted for only 5.8% of COPD hospitalizations but 20.9% of hospitalization costs (Dalal, 2011). Other factors that may increase the cost of COPD hospitalizations include hospital acquired pneumonia, chronic renal failure, and anemia (Ornek, 2012).

Severity of disease measured by airflow obstruction correlates very positively with the cost of COPD-related healthcare costs (de Miguel diez, 2008). Analysis of direct healthcare costs due to COPD among 160 patients with COPD in Taiwan showed that annual costs increased with airflow obstruction severity, 38,203, 149,031, and 288,825 new Taiwan dollars (approximately $1193, $4657, and $9026 US dollars, respectively for individuals with mild (FEV1% predicted >50%), moderate (FEV1% predicted <30% and <50%), and severe (FEV1% predicted <30%) disease and the greatest contributor to cost was hospitalization (Chiang, 2008). A Swedish review confirmed the strong
positive correlation between COPD severity and costs but suggested that over the past decade, costs have decreased for those with more severe disease and increased for individuals with more mild to moderate COPD (Jansson, 2013).

Comorbid conditions increase the healthcare cost for individuals with COPD (de Miguel diez, 2008; Dalal, 2011; Perera, 2012; Nielsen, 2011). Acute coronary syndrome, congestive heart failure, cerebrovascular disease, bronchogenic cancer, cardiac dysrhythmias, pulmonary vascular disease, and weight loss are associated with greater costs and mortality (Perera, 2012). Patients with COPD and cardiovascular disease have more ED visits (OR 1.47), more respiratory-related hospitalizations (OR 1.95), and any hospitalization or ED visit (OR 1.62). The annual total healthcare costs were nearly three-fold greater for those with COPD and cardiovascular disease compared with COPD alone, $22,755 and $8036 (2008 US dollars), respectively (Dalal, 2011).

### 2.3.2 Indirect Costs

Indirect costs are the economic output losses caused by illness. COPD is estimated to cause 16.4 million days of lost work annually (Ford, 2014). Estimated mean annual number of sick leave or disability days taken by employed individuals with COPD due to respiratory symptoms range from 1.3 to 19.4 days with estimated costs of $893-$2,234 per person (Patel, 2014). The type or amount of work performed by approximately 13–18% of individuals with COPD is limited and over one third experience reductions in their general activities (Patel, 2014). The number of days with diminished activity ranges from 27–63 days and employed individuals with COPD utilize between 1.3 and 19.4 days of sick or disability leave and may be bed bound for 13–32 days yearly (Patel, 2014). The annual indirect costs of COPD ranged from $1,521–3,348 per person in 2012 US dollars and comprised 27–61% of the total costs related to COPD (Patel, 2014).

### 2.3.3 Effect of Treatment

Prescription and adherence with respiratory medications correlate inversely with healthcare utilization for individuals with COPD. Yearly hospitalizations and emergency department visits decreased by 2.5% and 1.8%, respectively, for every 5% increase in proportion of days covered (a measure of the percentage of days during which an individual filed claims for respiratory medications; it is an indirect epidemiologic measure of medication adherence) whereas outpatient visits only increased by 0.2% (Toy, 2011). A retrospective analysis of over 55,000 patients with COPD showed that medication adherence increased with less frequent dosing interval of respiratory medications; the proportion of days covered was 43.3%, 37.0%, 30.2%, and 23.0% for once, twice, thrice, and four times daily regimens (Toy, 2011). The annual cost
of care for 1000 patients with COPD decreased by $300,000 for every 5% increase in adherence (Toy, 2011). In a retrospective review of 33,816 Medicare beneficiaries with COPD, medication adherence measured by medication continuity or proportion of days covered was associated with lower hospitalization rates (RR, 0.88) and less Medicare cost (-$3764) (Simoni-Wastila, 2012). In addition, patients with a proportion of days covered greater than 80% had less hospitalizations (RR 0.90) and lower cost (-$2185) than those with less than 80% of days covered (Simoni-Wastila, 2012). An analysis of maintenance medication use versus no maintenance medication use among 6322 Medicare beneficiaries demonstrated that the users had fewer hospitalizations (OR 0.70, 95% CI, 0.61–0.79), rehospitalizations (OR 0.74, 95% CI 0.63–0.87) and lower Medicare costs (-$3916, 95% CI, -$4977, -$2854) (Stuart, 2010).

Integrated disease management programs for COPD that incorporate two or more interdisciplinary healthcare providers and two or more treatment components reduce respiratory-related hospitalizations and length of stay and improve respiratory quality of life and exercise capacity (Kruis, 2013). A VHA COPD disease management program produced an average cost savings of $593 per patient mainly by reducing ED visits and hospitalizations (Dewan, 2011). However, another VHA study of a comprehensive COPD care management program was prematurely stopped due to excess mortality in the intervention group (Fan, 2012).

Pulmonary rehabilitation is associated with reduced direct healthcare costs and an analysis of 592 pulmonary rehabilitation participants revealed an annual $344 (Canadian; approximately $291 US) per person decrease in overall healthcare costs (Golmohammadi, 2004). Hospital at home also reduces COPD related healthcare costs (Nicholson, 2001; Puig-Junoy, 2007; Steinel, 2003). A Spanish program found that among 180 patients presenting to the ED with a COPD exacerbation, home care by a specialized respiratory nurse reduced the average direct healthcare cost per patient by euro 810 (95% CI, euro 418–1,169) (approximately $955, US dollars) compared with hospitalization (Puig-Junoy, 2007). In-home healthcare by a pulmonary specialty team reduces hospitalizations, ED visits, and skilled nursing facility utilization, and decreases overall costs by $13,000 per patient annually (Steinel, 2003).

### 2.4 Conclusion

Epidemiology studies have demonstrated strong associations between tobacco smoke inhalation and the development of COPD. However, in the US and developed world, only 70–80% of individuals with COPD have a history of smoking. Other factors contributing to the development of COPD include indoor and outdoor air pollutants, workplace dust and fumes, childhood lower respiratory disorders including asthma, and pulmonary infections (tuberculosis and human immunodeficiency virus).

Although COPD prevalence is about 5–10% of the adult US population, these estimates may significantly underestimate COPD and up to three quarters of individuals...
with evidence of airflow obstruction may not have a diagnosis. Further, clinical diagnosis of COPD based only upon respiratory symptoms is often incorrect.

The economic costs of COPD due to direct medical care and indirect effects due to work impairment or total disability are approaching $40 billion annually in the US and may reach $50 billion by 2020. Appropriate COPD management with medications and nonpharmacologic measures can reduce the cost of COPD.

2.5 Summary Points

1. Tobacco smoke inhalation is the major cause of COPD in the US but nearly one fifth of COPD cases are due to other exposures such as indoor and outdoor air pollutants, workplace dust and fumes, childhood lower respiratory disorders, and pulmonary infections.
2. COPD is under- and mis-diagnosed making accurate measurement of COPD prevalence difficult. Current estimates of COPD prevalence in the US are 5–10%.
3. COPD is a significant contributor to direct and indirect medical care and its cost is estimated to increase by nearly 50% by 2020.

References


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