
# CHRONIC LOWER RESPIRATORY DISEASE

## A STATE AND NATIONAL PROBLEM

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# EXECUTIVE SUMMARY

## General Facts

- Chronic Lower Respiratory Disease (CLRD) is the fourth leading cause of death in the United States but the third leading cause of death in West Virginia. It is projected to be third nationwide by 2020.

- CLRD comprises three major diseases: chronic bronchitis, emphysema, and asthma.

- Approximately $42.7 billion is spent annually on direct and indirect health care costs due to CLRD.

- Tobacco smoking is the most important risk factor for chronic bronchitis and emphysema, accounting for about 80% of cases. Cigarette smokers are 10 times more likely to die from these diseases than nonsmokers. The remaining 20% of cases are attributable to environmental exposures and genetic factors. Asthma appears to have a strong genetic basis, with 30% to 50% of all cases due to an inherited predisposition.

- A direct association between secondhand smoke and lower respiratory disease has been documented by the Environmental Protection Agency.

- Smoking cessation in the single most effective way to reduce the risk of CLRD and its progression.

- Approximately 124,000 people die each year in the United States from CLRD. This estimate is considered low, however, because CLRD is often cited as a contributory, not underlying, cause of death on the death certificate.

- Lower respiratory disease deaths increased in the United States by 163% between 1965 and 1998. This trend reflects smoking patterns initiated 30 to 50 years ago.

## West Virginia Statistics

<u>Prevalence</u>

- According to the American Lung Association, in 2002 there were approximately 64,000 people with chronic bronchitis and 22,450 people with emphysema in the state.

- According to 2001 Behavioral Risk Factor Surveillance System data, 12% of adult West Virginians have received a diagnosis of asthma, compared with a national rate of 11%. Data from the Youth Tobacco Survey (YTS) show that 23% of middle school students and 21% of high school students have received an asthma diagnosis at some time in their lives.

Smoking

- In 2001, 28% of adult residents reported being current smokers, the 4th highest rate in the country. Nearly 25% reported being former smokers. This means that over one-half (53%) of all adults in West Virginia have put or are currently putting themselves at risk for CLRD.

- Sixteen percent (16%) of middle school students reported on the YTS that they currently smoke, i.e., have smoked cigarettes on one or more of the past 30 days. More than one in three (34%) high school students report current smoking.

- Seventy-three percent (73%) of middle school students and 83% of high school students report exposure to secondhand smoke.

Hospitalizations

- Using hospital discharge data, it was found that the rates of hospitalization for chronic bronchitis in West Virginia in 2000 were three times higher than rates nationwide. The rate of asthma hospitalization was somewhat lower in the state than in the nation as a whole.

- The rates of hospitalization for chronic bronchitis and emphysema have increased steadily since 1996 among both men and women.

- Total charges for COPD hospitalizations in 2000 amounted to $67,821,146, an increase of 32% from 1996. Medicare bears the brunt of CLRD costs (71%).

Mortality

- West Virginia's rate of CLRD mortality of 63.2 deaths per 100,000 population was the highest in the country in 2000. The state rate exceeds the national rate for both sexes and all age groups.

- West Virginia's rate of CLRD as a contributing cause of death in 2000 was also higher than the national rate for both sexes and all age groups.

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# I. CHRONIC LOWER RESPIRATORY DISEASE: A NATIONAL BURDEN

Chronic Lower Respiratory Disease (CLRD) is a serious illness affecting millions of people. Currently the fourth leading cause of death in the United States, CLRD has been the third leading cause of death in West Virginia since 2000 and is projected to move into third place nationwide by 2020 (1). While mortality rates for the top two leading causes of death in the state and nation, heart disease and cancer, respectively, are decreasing, deaths from CLRD continue to rise.

CLRD actually comprises three major diseases, i.e., chronic bronchitis, emphysema, and asthma, that are all characterized by shortness of breath caused by airway obstruction[1]. The obstruction is irreversible in chronic bronchitis and emphysema, reversible in asthma. Before 1999, CLRD was called Chronic Obstructive Pulmonary Disease (COPD). The International Classification of Diseases used by the World Health Organization (WHO) to code diseases and mortality was revised in 1999, with slight changes to the category between the 9th and 10th editions (2). While the two classifications are similar, in this document COPD is used to refer to chronic bronchitis and emphysema only (for compatibility with the majority of studies cited), and CLRD is used to refer to chronic bronchitis, emphysema, and asthma.

According to the National Center for Health Statistics (NCHS), over 16 million people in the United States have been diagnosed with COPD, and it is estimated that another 16 million cases are undiagnosed (3). COPD cost the nation more than $30 billion in 2000, $14.7 billion in direct health care costs and $15.7 billion in indirect costs (1). The American Lung Association (ALA) estimates that, in 1999, there were 24.7 million Americans who had been diagnosed with asthma at some time during their lives (4). In that same year, the direct health care costs for asthma were approximately $8.1 billion and indirect costs were $4.6 billion (4). All together, approximately $42.7 billion dollars are spent annually on chronic lower respiratory diseases in the United States.

***Lung Anatomy.*** The lungs work by drawing air into our bodies, allowing the oxygen to be absorbed into the blood and then removing and expelling carbon dioxide and other gases. Rib cage muscles and the diaphragm, in particular, contract when we inhale, which allows air to be sucked into the lungs. These muscles then relax, causing the air to be expired. During the process of inhalation, air travels through the nose and mouth, where mucus membranes warm and moisten the air and trap particles of foreign matter. The air continues down the throat into the trachea, or windpipe, which divides into the left and right bronchi leading into the lungs. Each bronchus then divides over and over into progressively narrower airways. The smallest airways

[1]The category of CLRD also includes bronchitis, not specified as acute or chronic, simple and mucopurulent chronic bronchitis, unspecified chronic bronchitis, other chronic obstructive pulmonary disease, and bronchiectasis; however, the incidence of and mortality from these conditions is quite small. This report focuses on the major components of the classification.

(bronchioles) end in the alveoli, some 300 million tiny air sacs arranged in clusters. During inhalation, the alveoli expand, deflating when the lungs relax. It is in the alveoli that the oxygen in the air is absorbed by tiny blood vessels surrounding the sacs and carried to the rest of the body. At the same time, carbon dioxide and other waste gases pass from the blood into the alveoli and are exhaled.

Lungs are designed to stay healthy by expelling inhaled toxins and particulate matter. The mucus in the airways traps foreign particles, which are then moved up the bronchi into the trachea by little hairs called cilia to be expelled by coughing. This process is aided by macrophages, specialized cells in airway tissues that ingest toxins as a part of the body's infection-fighting system. The introduction of greater-than-normal exposures to particulates and toxins in smoke, dust, or fumes damages this process, leading to the development of pulmonary inefficiency.

## Chronic Lower Respiratory Disease Components

Each of the illnesses collectively designated as chronic lower respiratory disease differs from the others in definition, but they often exist in some combination in the patient. The majority of COPD patients have both chronic bronchitis and emphysema in varying degrees, and their condition often presents with an asthmatic component. Chronic bronchitis and emphysema are progressive diseases, with the development of chronic bronchitis usually preceding emphysema, except in a few genetically determined cases.

### Chronic Bronchitis

Chronic bronchitis accounts for the majority of COPD diagnoses with an ALA estimate of 8.8 million new cases diagnosed annually (5), ranking it the ninth most prevalent chronic condition in the nation. According to the 1998 National Health Interview Survey (NHIS), in that year 4.6% of adults in the United States had received a diagnosis of chronic bronchitis[2], 2.9% of men and 6.1% of women (6). Over five percent (5.1%) of whites had received such a diagnosis, compared with 3.6% of African-Americans, 2.2% of persons of other races, and 2.7% of Hispanics. Income level was inversely associated with chronic bronchitis; 7.2% of individuals categorized as poor[3] had chronic bronchitis, while 5.6% of the near poor[4] and 4.1% of the not

[2]Had ever been told by a doctor or other health professional that they had chronic bronchitis.

[3]Below the poverty threshold as defined by the U.S. Census Bureau based on family income and size.

[4]100% to <200% of the poverty threshold.

poor[5] had been diagnosed with the disease. NCHS estimated that there were 1,907,292 seniors (age 65+) with chronic bronchitis in 1999 (7).

The Merck Manual of Geriatrics defines chronic bronchitis as ". . . a clinical diagnosis . . . characterized by a productive cough occurring most days of the month for at least three months of the year for two consecutive years" (8). In chronic bronchitis, there is persistent inflammation and eventual scarring of the bronchial tubes. The inflammation causes excessive production of mucus and swelling of the bronchial walls. Acute bronchitis is triggered by viral or bacterial infections; the chief cause of chronic bronchitis, however, is cigarette smoking (including exposure to secondhand smoke). Long-term exposure to other irritants such as dust, fumes, and other pollutants and frequent prior viral or bacterial lung infections are also triggers. While smokers are the most likely to develop chronic bronchitis, higher rates of the disease are also found among coal miners, grain handlers, metal workers, and others exposed to dust or irritating fumes (9).

Chronic bronchitis is often not treated properly until it has reached an advanced stage because sufferers do not realize its seriousness until their lungs have already been damaged. By this time, the lining of the bronchial tubes has thickened due to the persistent inflammation, excess mucus is constantly being produced, there is much coughing, airflow is increasingly hampered, and respiratory infections occur with more frequency due to the ideal breeding conditions of the bronchi. Chronic inflammation in the smaller, peripheral airways (those having a diameter of less than 2 mm) leads over time to scar tissue formation and additional fixed airway obstruction. In severe cases, the lung damage can produce pulmonary hypertension, leading to cor pulmonale, a failure of the right side of the heart due to increased workload on the right ventricle from the pulmonary hypertension. Overall, the 10-year mortality rate following a diagnosis of chronic bronchitis is >50% (10).

## Emphysema

The ALA estimated the nationwide lifetime prevalence of emphysema at 2.8 million persons in 1999 (11). NHIS data from 1998 indicate that 1.5% of U.S. adults reported having received a diagnosis of emphysema, 1.8% of males and 1.2% of females (6). The prevalence of emphysema increased with age, with 5.1% of respondents aged 75 and older reporting the disease. As with chronic bronchitis, whites (1.8%) were more likely to report an emphysema diagnosis than African-Americans (0.9%), other races (0.6%), or Hispanics (0.6%). Poor and near poor respondents were more likely to have emphysema than not poor respondents.

Emphysema is a pathological definition: abnormal permanent enlargement of the air spaces at the ends of the bronchioles, accompanied by the destruction of their walls (12). Most emphysema is caused by smoking; however, approximately 50,000 to 100,000 current U.S. cases,

[5] 200% of the poverty threshold or greater.

primarily among individuals of Northern European descent, are the result of an inherited condition known as alpha-1 antitrypsin (ATT) deficiency. ATT, a protein produced by the liver, can also be deactivated by cigarette smoke, causing an environmentally induced deficiency. Whatever the cause of the deficiency, the results are the same. ATT normally works to inhibit the enzyme elastase, which acts to destroy a protein called elastin. Elastin ("elastic") forms the underlying structure of the lungs and is the material that gives the air sacs, or alveoli, their vital ability to stretch and recoil after filling with air. As elastin is destroyed, alveoli walls can break down, forming large, permanent distended air sacs. Emphysema sufferers must then forcefully expel the air from their lungs, increasing the use of their respiratory muscles. This puts pressure on the airways from the outside, causing even more damage to both the airways and the alveoli. Eventually the exchange of oxygen and carbon dioxide is compromised, producing hypoxemia (oxygen deficiency) and hypercapnia (excess carbon dioxide).

Emphysema develops gradually. The initial symptom of emphysema is dyspnea, or shortness of breath; a cough might also be present, as chronic bronchitis often precedes emphysema. As the disease progresses, even a short walk can result in difficulty in breathing. The most common conditions leading to death from emphysema are respiratory acidosis (alterations in blood pH due to buildup of carbon dioxide), cor pulmonale, and massive collapse of the lungs due to pneumothorax (accumulation of air in the pleural cavity surrounding the lungs).

## Asthma

Data from the Behavioral Risk Factor Surveillance System (BRFSS)[6] are used to estimate the prevalence of adult asthma on the national and state level. In 2001, 11.2% of U.S. adults reported a lifetime prevalence of asthma;[7] of these, 67.8% said they still have asthma (13). The ALA used 1999 NHIS data to estimate a prevalence of diagnosed pediatric asthma of approximately 7.7 million children under the age of 18 (14).

Asthma, unlike chronic bronchitis and emphysema, is a reversible obstructive lung disease that is caused by hyperreactivity of the airways to various stimuli. During an asthma attack, the bronchi become inflamed and swollen. The muscles surrounding the airways tighten, causing the airways to narrow and making breathing difficult. With asthma, inhaling is not a problem, because breathing in causes the airways to expand and air can slide past the blockages. In exhaling, the airways restrict, and air is trapped in the lungs. Symptoms of an asthma attack include wheezing, coughing, dyspnea, rapid or labored breathing, and a tight feeling in the chest. Triggers are varied, e.g., cold weather, cigarette smoke, emotional stress, physical exertion,

[6]The BRFSS is a monthly telephone survey established by the Centers for Disease Prevention and Control CDC) that allows states to monitor health behaviors among their adult populations (18+). The BRFSS was begun in 1984 with 15 participating states, expanding to 54 states and territories in 2001. Asthma prevalence has been monitored in all states since 2000.

[7]Answered yes to the question "Has a doctor ever told you that you have asthma?"

chemical irritants, allergens, and even, in some cases, aspirin or aspirin products. Asthma attacks are treatable, and a person with asthma can return to normal breathing. Asthma must be managed, however, for it can be life threatening if not treated or controlled.

## Who Gets Chronic Lower Respiratory Disease?

### COPD

Older individuals are more likely to be diagnosed with COPD (it has been estimated that 10% of the population aged 55-85 have COPD [15]), and our aging population is one reason for the increasing morbidity and mortality from the disease. COPD is a progressive disease; according to Dr. Stephen Rennard, a pulmonary specialist and participant in the Global Initiative for Obstructive Lung Disease (GOLD) Workshop,[8] "Typically, it takes 30 to 40 years for COPD to develop fully enough to cause symptoms. Before that, it is present, but silent" (16). American seniors (aged 65+) made over five million visits to physicians and 545,000 visits to emergency rooms in 1999 due to COPD (7). Nonwhites and Hispanics are less likely than non-Hispanic whites to develop COPD; in fact, COPD is the only pulmonary illness that affects whites disproportionately compared with other races and ethnicities (2).

**Gender Differences.** While historically men of all ethnicities have been more likely to have COPD than women, this is changing. NCHS reports that women began experiencing more severe disease and more hospitalizations due to COPD starting in the mid-1990s; COPD deaths have also increased among women, while they have stabilized or decreased among men (1). Several European studies have suggested that these trends are the combined result of increased smoking among women and differences in female lung anatomy (17, 18). Although at birth and for a short period following birth, females have larger airways in relation to their lung size than do males, this soon changes. Subsequent lung development ceases earlier in females, and they retain smaller airways than males as they age. As a result, lung damage occurs more quickly and to a greater extent in females exposed to the same contaminants as males. Hyperresponsiveness is also more prevalent in women, contributing to more progressive loss of lung function (18).

### Asthma

Asthma, which often runs in families, usually has its onset in childhood or adolescence but may appear for the first time in adulthood. Asthma affects up to 10% of the U.S. population, with data from the Third National Health and Nutrition Examination Survey

[8]GOLD is a collaborative project of the U.S. National Heart, Lung, and Blood Institute (NHLBI) and the WHO.

(NHANES III) conducted from 1988 through 1994 suggesting that the prevalence of undiagnosed asthma[9] among adults could be as high as 11% (19). Among all ages, the disease has increased approximately 60% since 1982, while among children the increase has been about 55% (20). It is the leading cause of school absenteeism, contributing to approximately 14 million missed school days in 2002 (21); it also accounts for about 14.5 million missed work days for adults each year (21).

African-Americans are more likely than whites and other races to have asthma; among adults 12.4% of African-Americans and 10.9% of whites reported lifetime asthma in 2001 (13), while among children, the Child Trends DataBank reports that nearly 8% of African-American children had asthma in 2001, compared with 6% of non-Hispanic white and 4% of Hispanic children (22). Urban minority children are more likely to have asthma than non-urban children. An alarming study begun in 2001 by staff members at the Harlem Hospital Center found that 25.5% of 1,400 children under the age of 13 living in that section of New York had asthma (23). The Child Trends DataBank also reports that asthma is more common among children with public health insurance and those living in families in which at least one person received income from welfare/TANF in the previous year (23).

**Gender Differences.** During infancy and childhood, asthma is slightly more common among boys than among girls. According to the Child Trends DataBank, in 2001, 6% of boys under the age of 18 had asthma, compared with 5% of girls (22). Of childhood sufferers, only about one-quarter become symptom-free in adulthood; the ALA estimates that about 85% of females and 72% of males continue to suffer from asthma (4). Asthma prevalence among adults is higher among women than men, the reverse of childhood prevalence, and this gap increases among older Americans. In 2001, 8.3% of adult women reported having asthma, compared with 6.4% of adult men (24).

## What Causes Chronic Lower Respiratory Disease?

### COPD

Tobacco smoking is by far the most important risk factor for chronic bronchitis and emphysema, accounting for about 80% of all cases. The American Lung Association states that cigarette smokers are 10 times more likely to die of COPD than nonsmokers (5). Pipe and cigar smokers also have greater COPD morbidity and mortality than nonsmokers; however, their rates are lower than those for cigarette smokers (25). Other environmental exposures, i.e., occupational dusts and chemicals and indoor/outdoor air pollution, contribute to approximately 15% of COPD cases, with 5% due to genetic influences.

[9]Undiagnosed asthma was defined as a history of wheezing in the past year but without a doctor diagnosis of asthma or chronic bronchitis.

**Asthma**

Cigarette (or other tobacco) smoke aggravates existing asthma. Secondhand smoke exposure is particularly dangerous to children, and can contribute to the development of asthma in both adults and children. The lungs of asthmatic persons are hypersensitive to irritants; their airways react to stimuli that do not affect healthy lungs. Asthma has a strong genetic basis, with estimates of 30% to 50% of all cases due to an inherited predisposition for the disease (26). Occupational exposures are thought to contribute to another 10% of asthma cases (27). Asthma attacks can be triggered by such irritants as animal dander and hair, cockroaches, dust, house mites, smoke, pollen, molds, exercise, and cold weather.

### *Cigarette Smoke and CLRD*

*Cigarette Smoking.* Cigarette smoke affects the lungs in several ways. It increases mucus production in the airways (even contributing to an increase in the number of mucus glands), while at the same time stopping the cilia from working, allowing the buildup of mucus and the contaminants it contains. Over time this results in obstruction of the airways, causing chronic bronchitis. The smoke also attracts inflammatory cells into the lungs, which release elastase. Elastase breaks down elastin, normally protected by the inhibitor ATT; however, cigarette smoke attracts more cells and stimulates the release of more elastase than can be countered by the ATT. In addition, the smoke itself inactivates ATT, and it is the imbalance between elastase and ATT that leads to the development of emphysema.

However, not all smokers develop COPD, leading scientists to conclude that there is a varying susceptibility factor in the etiology of the disease (28). Approximately 15% to 20% of smokers have been found to lose lung function at a rate that can result in severe COPD; for these individuals, smoking cessation will slow down the progression of the disease but will not improve the existing symptoms. This overall (non-gender-specific) genetic predisposition to bronchial hyperresponsiveness is known as the "Dutch Hypothesis" (28).

*Passive Smoking.* Passive smoke, also known as secondhand smoke, is a mixture of mainstream smoke that is exhaled by a smoker and sidestream smoke that comes from the lighted cigarette, pipe, or cigar (and actually is higher in concentrations of toxins than exhaled smoke). It has been suggested that persons who are the most susceptible to the irritants in cigarette smoke would never smoke or quit very shortly after starting to smoke. The population of nonsmokers would, therefore, be somewhat more likely to include persons susceptible to the development of COPD than the population of smokers themselves (29).

Numerous studies have documented the direct association between lower respiratory difficulties and exposure to secondhand smoke. The Environmental Protection Agency (EPA) estimates that passive smoke causes between 150,000 and 300,000 lower respiratory illnesses in children under the age of 18 months each year, as well as worsening the condition of up to one million asthmatic children (30). The Harlem study cited previously found that asthmatic children are approximately 50% more likely to live with a smoker than children who do not have asthma (23).

The results of a Finnish study released in 2001 showed that people whose partners smoke were nearly five times more likely to develop adult asthma than those persons not exposed to secondhand smoke (31). In addition, nonsmokers who were exposed to passive smoke at work were found to be more than twice as likely to develop respiratory problems. Maritta Jaakkola, one of the lead investigators of the study, stated during a presentation at the 11th European Congress of Lung Disease and Respiratory Medicine, "Our results demonstrate conclusively that passive smoking plays a role in the development of adult asthma" (31).

An earlier (1994) Swiss study documented the association of secondhand smoke exposure with elevated risks of wheezing, bronchitis symptoms, chronic bronchitis symptoms, dyspnea, and physician-diagnosed asthma among nonsmokers (32). This association was not affected when controls were added for parental smoking or occupational exposure to other irritants.

In the United States, the Kaiser Permanente Division of Research conducted a large cross-sectional study using data from multiphasic health checkups of over 42,000 plan participants between 1979 and 1985 to examine the association between passive smoke exposure and selected demographic and lifestyle characteristics and self-reported health conditions (33). Any current passive smoke exposure was found to be associated with asthma in both men and women (odds ratio [OR] =1.22 [1.11,1.34] and 1.14 [1.06,1.23], respectively). Additionally, heavy exposure (defined as > 40 hours/week) was associated with chronic cough (OR =1.60 [1.22,2.10]) and emphysema in men (OR=3.02 [1.22,7.34] ). The relation between secondhand smoke and health conditions was found to be independent of all socioeconomic and lifestyle factors examined.

### *Occupational Exposures*

Exposure to vapors, gases, dust, or fumes on the job can also cause COPD and asthma independently of cigarette smoking and genetic factors and increase the risk and disease severity among smokers. These irritants can include mineral dusts (e.g., gold, coal, iron), organic dusts (e.g., grain, cotton, red cedar), and paint and chemical fumes. A study by the National Institute for Occupational Safety and Health (NIOSH) published in 2002 in the *American Journal of Epidemiology* suggested that nearly one in five cases (19.2%) of COPD were attributable to occupational exposures and that nearly one-third (31.1%) of the COPD cases among persons who never smoked were job-related (34). The NIOSH study found COPD to occur more frequently in certain industries, including rubber, plastic, and leather manufacturing, utilities, and office building services (laborers, cleaners, material handlers, and maintenance workers), even after

controlling for smoking and socioeconomic factors. By job, the researchers found freight, stock, and material handlers and members of the armed forces to be at the greatest risk.

The results of a large international study released in 2001 examined the relationship between occupational exposures and chronic bronchitis among 13,253 men and women aged 20 through 44 (young adults) in 14 industrialized countries (35). Even at the relatively young age of the workers studied, occupational exposure to vapors, gases, dust, or fumes was found to be associated with chronic bronchitis among smokers. An increased risk for chronic bronchitis was found among both smokers and nonsmokers who were agricultural, textile, paper, wood, chemical, or food processing workers, with the risk more pronounced among smokers. In a further study, a research group in New Zealand found that, among workers of all ages, ever working with vapors, gases, dust, or fumes was significantly associated with chronic bronchitis and airway obstruction (OR=3.13 [1.07,9.12]) (36).

The relationship between coal mining dust and obstructive lung disease has been long recognized and is well documented (37). A more in-depth examination of additional determinants of declining lung function among coal miners was performed by NIOSH in the late 1990s (38). The study, involving 264 underground coal miners whose health was followed for 11 years, examined occupational and non-occupational exposures, smoking, personal and family medical histories, and childhood living conditions. Certain jobs within the mining environment were found to be more conducive to lung function declines, i.e., roof bolting, exposure to explosive blasting, and exposure to water used for spraying (to control dust) that was stored in holding tanks. Non-mining factors that were also found to be associated with the development of obstructive lung disease were smoking, body mass, weight gain in adulthood, childhood pneumonia, and childhood exposure to both passive smoke in the home and smoke produced by wood and coal-burning stoves and fireplaces.

## Quality of Life with Chronic Lower Respiratory Disease

COPD is the third leading reason for at-home care, following congestive heart failure and stroke (39), and ranks second to coronary artery disease as a Social Security compensated disability (8). A 2001 survey conducted by the American Lung Association, "Confronting COPD in America," revealed that millions of Americans suffer from COPD so severely that the illness interferes with their daily activities (40). Over half (51%) of the COPD sufferers interviewed said their COPD limited their ability to work. Nearly half reported that they got short of breath while doing light housework (46%) or washing and dressing (44%). Nearly one-third (32%) got short of breath while talking, while 28% had difficulty breathing even when sitting down or lying still. Almost one-fourth (25%) reported that their COPD had made them an invalid; 8% were too breathless to leave home. "The survey confirms and quantifies what people living with COPD . . . know from first-hand experience: It can be a debilitating disease that robs people of their breath and their independence," said Dr. Norman Edelman, spokesperson for the ALA (40).

A study presented at the 1998 American Lung Association/American Thoracic Society International Conference indicated that COPD has a greater impact on the quality of life of

women compared with men (41). The study, conducted at the University of Illinois at Chicago, involved subjects with moderate to severe COPD. No gender differences were found in disease symptoms or the severity of the disease; however, women were more likely to report lower emotional functioning and a lower quality of life. "It may be that women's multiple roles make their lives so complex that the breathing problems caused by this chronic disease have a greater impact on them," observed Dr. Janet Larson, study lead author.

Researchers at the Institute for Health Policy Studies at the University of California used data from a three-year study of California adults to examine the impact of COPD on health status and work disability (42). Substantial reduction in quality of life, both in terms of employment limitations and self-reported diminished general health and mental health status, was found. Compared with adults who reported no chronic health conditions, persons with COPD or asthma were more likely to perceive themselves as having fair or poor general health (ORs=10.95 [6.31, 19.0] and 3.92 [2.31, 6.65], respectively). They also reported more depressive symptoms (ORs = 10.05 [5.29, 19.08] and 2.59 [1.33, 5.04], respectively). Subjects with COPD were found to be less likely to have current employment (OR= 0.41 [0.24, 0.71]), an association not found with asthma. When compared against subjects with other, non-respiratory chronic conditions, adults with COPD were still more likely to report diminished mental and physical health and less likely to be working; no difference, however, was found in these categories between those subjects with asthma and those with other chronic conditions.

The ALA National Asthma Survey revealed that asthma patients make a wide range of adjustments in their lifestyle to accommodate their disease (43). The families of asthmatic patients were found to be affected by the disease almost as profoundly as the sufferer. Nearly three-quarters (73%) of parents of asthmatic children and 61% of adult asthma respondents reported that preparing for asthma attacks is always a consideration when planning family activities. Some patients even reported that they took care not to laugh or cry too hard so as not to trigger an attack. The severity of the disease was found to be greater among African-American and Hispanic patients and families, with more parents reporting their children had problems in sports, exercise, and missing school. Adult African-Americans and Hispanics were more likely to miss time from work or school.

## Diagnosis of Chronic Lower Respiratory Disease

### COPD

While early diagnosis cannot reverse the damage already done to an individual's lungs by COPD, it can result in interventions that can slow down the progression and improve symptoms. A diagnosis of COPD should be suspected when there is a history of exposures to risk factors accompanied by some airflow limitation, with or without other symptoms. The GOLD Workshop report recommends that all patients who have a chronic cough and sputum production, along with risk factor exposures, should be tested for airflow limitation, even if shortness of breath is not occurring (44).

Lung function is most commonly assessed by spirometry, a test that measures how much and how quickly air is expelled from the lungs after the patient takes a deep breath. The patient breathes out forcefully into a device called a spirometer. Two measures, the total amount of air than can be expelled following taking the breath (forced vital capacity [FVC]) and the amount of air that can be expelled in one second (forced expiratory volume in one second [$FEV_1$]), are normally used for assessment. The ratio of $FEV_1$ to FVC ($FEV_1$/FVC) is indicative of the degree of a patient's airflow obstruction. If obstruction exists, the air will not be expelled as quickly, and the percentage will be lower. Normally, 75% to 85% of the air in a person's lungs can be expelled in the first second, but this depends upon the individual's age, gender, height, and race. The expected percentage is higher among persons who are younger, tall, male, and white. A number smaller than 85% of the expected percentage is considered low, or abnormal.

The severity of COPD is classified by $FEV_1$/FVC values. A person is considered at risk for COPD if he or she has a normal spirometry reading but has chronic symptoms, i.e., cough and sputum production. Stage I (mild), Stage II (moderate), or Stage III (severe) COPD diagnoses are based on $FEV_1$/FVC values as a percentage of predicted values for the individual. Arterial blood gas levels, typically abnormal in patients with moderate and severe COPD, are used to diagnose hypoxemia and concomitant hypercapnia as the disease progresses.

**Asthma**

The consideration of an asthma diagnosis begins with the presentation of common asthma symptoms such as wheezing, shortness of breath, rapid or difficult breathing, and/or a tight feeling in the chest. Maximum chest expansion when inhaling, hunched shoulders, and contracting neck muscles are examples of other signs of narrowed airways. A family history of atopy (the genetic tendency to develop allergic diseases, including asthma) is another indicator. The conclusive diagnosis is made through spirometry. Breathing is evaluated before and after the administration of an asthma medication, often albuterol. As noted, reversible airflow limitation is associated with asthma, as opposed to COPD.

***Underdiagnosis of CLRD***

A recent study using data collected during NHANES III and published in the August 2001 issue of the *American Journal of Respiratory and Critical Care Medicine* found that undiagnosed airflow obstruction is common in the United States (45). Twelve percent (12.0%) of respondents were found to have undiagnosed airflow obstruction that impaired their health and functional status, while only 3.1% and 2.7% had doctor-diagnosed COPD and asthma, respectively.

Canadian researchers found that many primary care physicians in North America[10] do not diagnose COPD, even when the patient presents with a chronic cough, dyspnea, and/or wheezing

[10] Ninety-six American and 96 Canadian physicians were surveyed, using a hypothetical case presentation and a structured interview.

(46). In addition, they found physicians more likely to make the diagnosis of COPD in men than in women, 58% vs. 42%. This study confirmed an earlier report that spirometry is underused by primary care doctors, both for the assessment of COPD and that of asthma. In the absence of spirometry, the researchers also found that asthma was given more frequently to women than men as a provisional diagnosis (in approximately the reverse ratio as COPD, i.e., 58% vs. 42%).

## Treatment of Chronic Lower Respiratory Disease

### COPD

**Smoking Cessation.** The advice from the multinational GOLD Workshop is unequivocal: "Smoking cessation is the single most effective – and cost-effective – way to reduce the risk of COPD and stop its progression" (44). Secondhand smoke should also be avoided, as well as occupational exposures and other indoor and outdoor pollutants.

The Lung Health Study Group studied 3,926 smokers with mild-to-moderate airway obstruction who were separated into a smoking cessation group or a nonintervention group. Their lung function was measured annually for five years. Subjects who quit smoking experienced an improvement in their $FEV_1$ in the year after they quit, and the subsequent rate of decline in $FEV_1$ among sustained quitters was half that of participants who continued to smoke, comparable with that of never-smokers (47). The benefits the quitters derived were independent of advanced age, poor baseline lung function, airway hyperresponsiveness, or amount previously smoked.

A 30-year follow-up study of middle-aged Finnish men examined the effects of permanent and intermittent smoking cessation on decline in pulmonary function (48). The results indicated that both sustained and intermittent quitters showed improvement in the rate of decline of lung function as measured by spirometry at five intervals during the study period. Danish researchers investigated the relationship between smoking cessation and reduction and COPD-related hospital admissions over a 14-year period ending in 1998 (49). Heavy smokers (defined as smoking 15 or more cigarettes a day) who reduced their cigarette consumption by at least 50% were compared with smokers who quit and continuous heavy smokers. Quitting smoking was associated with a significant reduction in the risk of hospital admission (RR=0.57; CI 0.33 to 0.99). Those who only reduced their consumption, however, did not have a significantly lower risk than continuous heavy smokers (RR=0.93; CI 0.73-1.18).

**Rehabilitation.** According to the GOLD Workshop, the "principal goals of pulmonary rehabilitation are to reduce symptoms, improve quality of life, and increase physical and emotional participation in everyday activities" (44). Evidence shows that COPD patients at all stages of the disease can benefit from exercise programs in terms of exercise tolerance and decreased dyspnea and feelings of fatigue (50). Results published in 1999 in the *European Respiratory Journal* reported that these benefits were sustained even after a single pulmonary rehabilitation program. A well-developed rehabilitation program should include exercise training, education, and nutrition counseling.

**Medications.** To date, no medications for COPD exist that modify the long-term decline in lung function. Drug therapy, however, can be helpful in alleviating symptoms and complications. Bronchodilators, which can be administered as inhalers, pills, or liquids, are the most commonly used medications in treating COPD symptoms. There are two main classes of bronchodilators, beta$_2$-agonists, which relax the muscles around the airways, and anticholinergics, which block the chemical produced by our bodies that normally causes the airways to contract and also decrease mucus secretions. These are often administered together for maximum effectiveness. In mild COPD, short-acting bronchodilators are used to treat symptoms when needed. Regular treatment with one or more long-acting bronchodilators is usually recommended for moderate and severe COPD.

In moderate and severe disease, inhaled corticosteroids, which reduce inflammation, swelling, and mucus production, may be of benefit to some sufferers and are routinely recommended. Inhaled corticosteroids are used as controller medications, rather than for quick relief. Systemic corticosteroid use has been shown to be beneficial in treating acute COPD exacerbations (51), i.e., shortened hospitalization and earlier improved $FEV_1$. Chronic use of steroids, however, can result in a heightened risk of adverse effects, including osteopenia, cataracts, hyperglycemia, secondary infection, cardiovascular disease, and behavioral changes (51, 8).

Antibiotics are an important component of COPD treatment when infectious exacerbations occur, but are not recommended for long-term use. Influenza and pneumococcal vaccines can also be beneficial in reducing mortality in COPD patients; one study showed influenza vaccines reduced illness and death by approximately 50% (44). It is not recommended that cough medicines be taken regularly as cough has been shown to have a significant protective role for the COPD patient (44).

**Oxygen Therapy.** Long-term oxygen therapy is usually introduced in Stage III, or severe, COPD, or when there is evidence of congestive heart failure or pulmonary hypertension (44). A British study demonstrated that the administration of oxygen (versus no supplemental oxygen) for at least 15 hours per day resulted in a survival advantage of five years and had a beneficial impact on well-being and appetite (52). A United States study of hypoxemic COPD patients showed that continuous oxygen therapy (defined as 17.7 hours per day or more) was more beneficial to their long-term survival than fewer hours, such as receiving nocturnal oxygen only (53).

**Surgery.** For severe emphysema sufferers, two surgical procedures have been developed that can provide improvement in their symptoms and prevent complications. A bullectomy is the surgical removal of a bulla, a large, distended air space in the lung that is greater than one centimeter in diameter. Bullae, which form as the result of tissue damage and do not contribute to the exchange of oxygen and carbon dioxide, compress the healthy aveoli around them, limiting their ability to function. Bullae may also rupture, causing pneumothorax. When a bulla is removed, the healthy air sacs can expand and the muscles used to breathe are able to function

better, resulting in improved respiration. There is usually only one large bulla removed during the procedure.

Lung volume reduction surgery (LVRS) is performed on patients who have smaller, nonfunctioning air sacs distributed more widely through the lung. In this procedure, badly diseased tissue is removed, approximately 30% to 40% of one or both lungs (54). LVRS improves lung function by increasing the space in the chest cavity, allowing the patient's diaphragm to better function while pumping air into and out of the lungs, and by restoring elastic recoil in the aveoli. After bilateral LVRS, 20% to 40% increases in FVC and $FVC_1$ have been reported (54). A study conducted by the Washington University School of Medicine found the benefits of LVRS to last as long as five years in patients with severe emphysema (55).

Lung transplantation is a complicated and expensive procedure that is normally the last resort for emphysema sufferers. Transplantation involves the removal of one or both diseased lungs from a patient and the replacement of the lungs with healthy organs from a donor. Currently, single-lung transplants are preferred for most emphysema patients due to the limited supply of donor lungs (54). According to the United Network for Organ Sharing (UNOS), there were 956 lung transplants performed in the United States in 2000, with nearly four thousand patients on waiting lists (56). Post-operative complications can include infection, organ rejection, kidney damage, hypertension, osteoporosis, and lymphoma. UNOS statistics from 1995 point to a 51% survival rate for patients three years post-transplant (56).

### Asthma

Bronchodilators are commonly used to treat asthma and can offer rapid relief during an attack, primarily through the use of short-acting $beta_2$-agonists such as albuterol. Persons with persistent asthma, however, normally use long-term control medications to prevent symptoms from occurring in the first place. Inhaled corticosteroids, which have fewer side effects than systemic steroids, are generally prescribed on a daily basis to reduce inflammation in the airways at all levels of asthma severity except in mild intermittent cases. For patients with moderate to severe asthma, treatment is generally more effective when inhaled corticosteroids are combined with inhaled long-acting $beta_2$-agonists or other long-term control bronchodilators.

The most effective way to control asthma is to avoid the triggers that precipitate an attack. Triggers can vary for each individual and include such diverse exposures as cockroaches, dust mites, soot, pesticides, animal hair and dander, molds, fungus, pollens, cold air, or feathers. Cigarette smoking must be avoided, as well as secondhand smoke.

## Chronic Lower Respiratory Disease Mortality

### COPD

Even as mortality rates for other leading causes of death are declining,

COPD deaths increased by 163% in the United States between 1965 and 1998 (57). This disturbing trend reflects cigarette smoking patterns that were initiated 30 to 50 years ago. The increase in smoking among women that occurred following World War II is now being seen in chronic bronchitis and emphysema mortality statistics. Hospitalizations for women with COPD surpassed those among men in the mid-1990s and the number of deaths from COPD among women was higher than that among men for the first time in 2000 (59,936 vs. 59,118) (57). Just as cigarette smoking has increased among women, it has also increased among minority populations. While in 1998 COPD ranked ninth as a cause of death among Hispanics and eighth among African-Americans, compared to fourth among whites, this is expected to change as the rates of smoking in these groups increase, according to CDC statistics (58). The strongest predictors of COPD mortality are older age and decreased $FEV_1$. Overall, the median survival rate for patients who have lost two-thirds of their lung function is 10 years (59).

Mannino et al. analyzed mortality trends in deaths from obstructive lung disease from 1979 through 1993 using data from the NCHS multiple-cause mortality files (60). Their findings reflect any listing of obstructive lung disease on the death certificate, either as underlying or contributory cause. COPD-related mortality rates among white males increased 16.9% over the 15-year study period, while those among black males increased 29.3% and those among males of other races increased 53.5%. The increases among women were markedly higher: 126.3% among white females, 158.4% among black females, and 91.7% among females of other races.

As disturbing as the statistics on COPD mortality are, it is generally agreed that they are greatly underreported. Several studies have documented that only a small portion of men and women with an official COPD diagnosis had COPD listed as the underlying cause of death on their death certificates (57). If cited, COPD is more frequently listed as a contributory rather than underlying cause of death, but often it is not listed at all. To quote Dr. Robert A. Wise, Professor of Pulmonary and Critical Medicine at Johns Hopkins School of Medicine, " . . . COPD statistics reflect only the tip of the COPD mortality iceberg" (57).

## Asthma

Deaths from asthma are far less frequent than those from chronic bronchitis and emphysema but have increased over the past two decades (61). Mortality rates differ significantly by gender and ethnicity and are highest among African-American men living in inner cities (61). While asthma mortality primarily affects adults over the age of 45, males have a higher death rate than females during the first 25 years of life, and African-American children between the ages of 1 and 4 have a mortality rate that is almost 10 times higher than white children (62). In general, persons in greatest risk of dying from asthma are those with severe, unstable disease who are not being objectively monitored.

The ALA Epidemiology and Statistics Unit used NCHS final mortality statistics from 1979 through 1998 and 1999-2000[11] to examine trends in deaths from asthma (63). Between 1979 and 1998, the overall asthma mortality rate increased from 0.9 deaths per 100,000 population to 1.4 deaths. Among whites, there was an increase from 0.8 to 1.1; among African-Americans the increase was from 1.9 to 3.7. In 2000, the rate among whites was 1.3, compared with 3.9 for African-Americans.

## The Economic Cost of Chronic Lower Respiratory Disease

According to data from the 1999 Medical Expenditure Panel Survey (MEPS), an estimated $34 billion was spent in that year by U.S. households on direct medical costs for COPD and asthma, i.e., outpatient and office-based medical provider visits, hospital inpatient stays, emergency room visits, prescribed medications, and home health care (64). Oxygen alone is responsible for about three billion dollars in costs each year (65). Together, COPD and asthma ranked fourth in expenditures by condition, following heart conditions, trauma-related disorders, and mental disorders. Using the 2000 census population, this translates to an annual cost of almost $120 per person living in the United States. It is projected that these costs will increase by 90% by the year 2020 (66).

The NHLBI estimated both direct medical and indirect costs of COPD in 2000 at $30.4 billion, $14.7 billion in direct costs and $15.7 in indirect costs (1). NHLBI further breaks down direct costs into hospital costs ($9.0 billion) and other costs ($5.7 billion). Indirect costs are divided into morbidity ($6.5 billion) and mortality ($9.2 billion).

Hilleman et al. reported in *Chest* in 2000 on the retrospective pharmoeconomic analysis they performed on COPD patients using costs for drugs (estimated through 1999 PC-Price Check data [67]), oxygen therapy, laboratory tests, diagnostic tests, procedures, clinic visits, emergency department visits, and hospitalizations identified through patient medical and billing records (68). As expected, patients with Stage III COPD had the highest cost ($10,812 per patient per year), followed by Stage II patients ($5,037) and Stage I patients ($1,681). Hospitalization costs were the largest proportion of costs at all stages. Oxygen therapy was the second highest cost ($2,012) among Stage III patients.

Although COPD is associated with advancing age, 70% of COPD patients in 1995 were under the age of 65, or of working age; they were responsible for 67% of total COPD office visits and 43% of hospitalizations (69). Population-based data from NHANES III were used to determine the relationship between COPD and labor force participation in the United States. Of the 12,436 participants aged 18 to 64 in NHANES III, 1,073 (8.6%) reported having COPD.

[11] Because of coding differences between ICD-9 and ICD-10, rates of asthma mortality before and after 1999 are not directly comparable (coding changes resulted in slightly fewer deaths being classified as due to asthma after 1999).

Overall, these individuals were 3.9% (95% CI 1.3% to 6.4%) less likely to be in the labor force than those without COPD. The more severe the COPD, the less likely an individual was to be working: mild, moderate, and severe COPD were associated with a 3.4%, 3.9%, and 14.4% reduction in the labor force participation rate, respectively, compared with persons without the disease. In 1994 dollars, this resulted in an average annual work loss cost of approximately $9.9 billion.

Workplace exposures to irritants, including secondhand smoke, can result in occupational COPD and asthma. Leigh et al. reviewed several national data sets from 1996 to estimate mortality and direct and indirect costs of occupational COPD and asthma (70). The authors used a population attributable risk (PAR) of 15% to assess mortality. Direct costs included payments to hospitals, physicians, pharmaceutical companies, nursing homes, and medical supplies (including oxygen), as well as expenses for medical and insurance administration. Indirect costs included lost wages, lost fringe benefits, and lost home production. Assuming a 15% PAR, there were 15,032 occupational COPD deaths and 805 occupational asthma deaths in 1996. Direct and indirect costs for occupational COPD were estimated $2.84 billion and $2.14 billion, respectively. Direct and indirect costs for occupational asthma were calculated at $1.17 billion and $404 million, respectively. (The higher indirect costs for COPD are the result of the higher death rate among COPD sufferers.)

# II. CHRONIC LOWER RESPIRATORY DISEASE: THE WEST VIRGINIA PROBLEM

Chronic lower respiratory disease is more prevalent and causes more deaths among West Virginians than their counterparts nationwide for several reasons. West Virginia residents have the highest median age among all the states in addition to high rates of smoking among both adults and adolescents. To compound this already high-risk situation, the American Lung Association's 2003 "State of the Air" report indicated that "one in four West Virginians breathes air so smoggy that it fails federal quality standards and worsens such diseases as asthma, chronic bronchitis and emphysema" (71). Cabell, Hancock, Kanawha, Ohio, and Wood counties each received an "F" for having unhealthy levels of toxic air pollution. The ALA estimates that approximately 465,000 West Virginians live in these counties, including about 77,000 people aged 65 and older (72).

## Chronic Lower Respiratory Disease Prevalence

### COPD

The only data available on the prevalence of chronic bronchitis and emphysema in West Virginia at the time of this study were provided by the ALA. These estimates are probably conservative, as they are based on national NHIS estimates applied to the state population. Because of West Virginia's high rate of cigarette smoking and older population, these estimates should be considered lower than the actual prevalences of both these conditions. That said, the ALA estimated that in 2002 there were 64,000 persons over the age of 18 with chronic bronchitis (73). This figure was unchanged from the estimate in 2001. The ALA's 2002 estimate of 22,450 adult West Virginians with emphysema was a 7% increase over the previous year.

### Asthma

More extensive data are available on asthma prevalence in West Virginia through the Behavioral Risk Factor Surveillance System[12] and the West Virginia Youth Tobacco Survey

[12] See page 4 for a description of the BRFSS.

(WVYTS)[13,14] (24). Table 1 presents BRFSS data on the prevalence of lifetime[15] and current[16] asthma among adults in West Virginia in 2001. The overall prevalence of lifetime asthma was 12.5%, compared with a U.S. rate of 11.1%. West Virginia ranked 6th in that year among the 54 states and territories that participated in the BRFSS. The state's overall prevalence of current asthma was 9.3%, significantly higher than the U.S. rate of 7.2%. West Virginia ranked 5th in current asthma among BRFSS participants in 2001.

The Youth Tobacco Survey is a standardized survey administered to a sample of middle (6th, 7th, and 8th grades) and high school (9th, 10th, 11th, and 12th grades) students in public schools in 27 states in 2000 and 21 states in 2002. The WVYTS included questions on asthma for the first time in 2002; these results are presented in Table 2. The prevalence of lifetime asthma was found to be 23.2% among middle school students and 21.1% among high school students, with no significant differences found between boys and girls. Both middle school and high school students were asked if they had suffered an attack of asthma during the previous year, an indication of ill-controlled asthma. Ten percent (10.3%) of middle school students and 8.8% of high school students answered yes to this question, with no significant differences between the sexes. Current asthma data are available only for high school students; 12.4% of these students reported that they still had asthma (66% of high school students with lifetime asthma). Again, there were no significant differences between boys and girls. Middle school students were significantly more likely to be currently taking prescription medication for their asthma than high school students, 10.5% vs. 7.3%, respectively.

[13]The WVYTS is conducted jointly by the West Virginia Department of Education, Office of Healthy Schools; the West Virginia Department of Health and Human Resources, Office of Epidemiology and Health Promotion; and the Office on Smoking and Health at the CDC. For more information on the survey, the reader is referred to *2002 West Virginia Youth Tobacco Survey*, published in 2003 and available through the West Virginia Tobacco Prevention Program at (304) 558-1743.

[14]A comprehensive analysis of the state's burden of asthma among both adults and adolescents is found in *The Impact of Asthma in West Virginia*, published by the West Virginia Bureau for Public Health in 2003 and available through the West Virginia Asthma Education and Prevention Program at (304) 558-0644..

[15]Answered "yes" to the question "Have you ever been told by a doctor that you have asthma?"

[16]Answered "yes" to the subsequent question "Do you still have asthma?"

| Table 1. Prevalence of Lifetime and Current Asthma among Adults by Selected Demographics<br>2001 West Virginia Behavioral Risk Factor Surveillance System | | | | | |
|---|---|---|---|---|---|
| | Lifetime Asthma | | | Current Asthma | |
| Demographic | Prevalence (%) | (95% CI) | | Prevalence (%) | (95% CI) |
| Total | 12.5 | (11.2, 13.8) | | 9.3 | (8.2, 10.4) |
| Sex | | | | | |
| Male | 10.8 | (8.9, 12.8) | | 7.4 | (5.7, 9.0) |
| Female | 13.9 | (12.2, 15.7) | | 11.0 | (9.4, 12.6) |
| Age | | | | | |
| 18-24 | 18.9 | (13.5, 24.3) | | 12.9 | (8.3, 17.5) |
| 25-34 | 11.6 | (8.7, 14.5) | | 7.9 | (5.5, 10.3) |
| 35-44 | 11.7 | (9.1, 14.3) | | 8.8 | (6.5, 11.1) |
| 45-54 | 12.9 | (10.3, 15.5) | | 10.4 | (8.0, 12.8) |
| 55-64 | 10.3 | (7.4, 13.2) | | 8.1 | (5.5, 10.7) |
| 65+ | 11.2 | (8.8, 13.4) | | 8.6 | (6.6, 10.6) |
| Educational Level | | | | | |
| <12 Years | 15.5 | (12.6, 18.4) | | 12.8 | (10.1, 15.5) |
| 12 Years | 12.6 | (10.8, 14.4) | | 9.4 | (7.8, 11.0) |
| 13-15 Years | 12.0 | (9.6, 14.4) | | 8.4 | (6.3, 10.5) |
| 16+ Years | 9.5 | (7.0, 12.0) | | 6.3 | (4.2, 8.4) |
| Household Income | | | | | |
| <$15,000 | 17.6 | (14.2, 21.0) | | 14.2 | (11.1, 17.3) |
| $15,000-$24,999 | 14.8 | (12.2, 17.4) | | 10.6 | (8.3, 12.9) |
| $25,000-$49,999 | 10.4 | (8.4, 12.4) | | 7.4 | (5.7, 9.1) |
| $50,000+ | 8.3 | (6.1, 10.5) | | 5.9 | (4.0, 7.8) |

| Table 2. Asthma-Related Prevalences among West Virginia Students<br>2002 West Virginia Youth Tobacco Survey | | | | |
|---|---|---|---|---|
| | Middle Schools | | High Schools | |
| | % | (95% CI) | % | (95% CI) |
| Lifetime Asthma | | | | |
| Total | 23.2 | (22.0, 24.4) | 21.1 | (18.1, 24.1) |
| Males | 24.2 | (22.5, 25.8) | 21.4 | (17.8, 25.0) |
| Females | 22.0 | (20.5, 23.5) | 21.0 | (17.5, 24.5) |
| Current Asthma | | | | |
| Total | NA | -- | 12.4 | (9.5, 15.3) |
| Males | NA | -- | 11.7 | (8.4, 15.0) |
| Females | NA | -- | 13.2 | (10.0, 16.4) |
| Asthma Attack in Past Year | | | | |
| Total | 10.3 | (9.7, 10.9) | 8.8 | (6.9, 10.7) |
| Males | 10.6 | (9.7, 11.4) | 7.8 | (5.4, 10.3) |
| Females | 10.0 | (9.0, 11.0) | 9.8 | (7.9, 11.8) |
| Currently Taking Prescription Medicine for Asthma | | | | |
| Total | 10.5 | (9.8, 11.2) | 7.3 | (5.1, 9.5) |
| Males | 10.5 | (9.5, 11.5) | 8.2 | (5.4, 10.9) |
| Females | 10.3 | (9.1, 11.6) | 6.5 | (4.4, 8.6) |

## Cigarette Smoking Prevalence

As discussed earlier (see page 6), cigarette smoking is the most important risk factor for the development of chronic bronchitis and emphysema and a major trigger for asthma attacks. The prevalence of cigarette smoking among West Virginians, both adults and youth, is high and corresponds with the high rates of CLRD prevalence, mortality, and hospitalization in the state.

**Adult Smoking.** In 2001, 28.2% of West Virginia adults self-reported being current cigarette smokers, the 4$^{th}$ highest rate among the 54 BRFSS participants in that year. Little difference was noted between the sexes; 28.9% of men and 27.6% of women reported current smoking. As shown in Table 3, smoking prevalence decreases with age, educational level, and household income.

Former smoking is also a risk factor for chronic lower respiratory diseases. The prevalence of former smokers in 2001 was 24.7% (no rank available). Thirty percent (30.4%) of men and 19.6% of women reported having smoked at one time in their lives, a statistically significant difference. The percentage of former smokers increases with age, but no pattern is evident for education or income.

Table 3. Prevalence of Current/Former Cigarette Smoking among Adults by Selected Demographics
2001 West Virginia Behavioral Risk Factor Surveillance System

| | Current Smoking* | | | Former Smoking | |
|---|---|---|---|---|---|
| Demographic | Prevalence (%) | (95% CI) | | Prevalence (%) | (95% CI) |
| Total | 28.2 | (26.4, 30.0) | | 24.7 | (23.1, 26.4) |
| Sex | | | | | |
| Male | 28.9 | (26.1, 31.8) | | 30.4 | (27.7, 33.3) |
| Female | 27.6 | (25.3, 29.9) | | 19.6 | (17.7, 21.6) |
| Age | | | | | |
| 18-24 | 41.1 | (33.9, 48.7) | | 11.0 | (7.1, 16.7) |
| 25-34 | 35.0 | (30.5, 39.8) | | 15.1 | (11.9, 18.9) |
| 35-44 | 35.4 | (31.4, 39.7) | | 18.3 | (15.2, 22.0) |
| 45-54 | 28.1 | (24.5, 32.0) | | 27.2 | (23.5, 31.2) |
| 55-64 | 23.7 | (19.6, 28.3) | | 37.0 | (32.1, 42.1) |
| 65+ | 11.2 | (8.9, 14.0) | | 36.7 | (33.0, 40.5) |
| Educational Level | | | | | |
| <12 Years | 33.6 | (29.4, 38.1) | | 27.1 | (23.4, 31.2) |
| 12 Years | 30.7 | (27.9, 33.6) | | 24.6 | (22.1, 27.3) |
| 13-15 Years | 28.0 | (24.3, 32.0) | | 25.1 | (21.7, 28.9) |
| 16+ Years | 15.9 | (12.8, 19.6) | | 21.7 | (18.2, 25.7) |
| Household Income | | | | | |
| <$15,000 | 35.4 | (30.8, 40.3) | | 21.5 | (17.8, 25.7) |
| $15,000-$24,999 | 33.5 | (29.6, 37.6) | | 28.1 | (24.6, 32.0) |
| $25,000-$49,999 | 27.3 | (23.9, 32.2) | | 24.6 | (20.5, 29.1) |
| $50,000+ | 19.3 | (14.9, 24.9) | | 24.4 | (19.4, 30.2) |

*Have smoked at least 100 cigarettes in their lives and still smoke.

When the percentages of current smokers and former smokers are combined, it is apparent why this behavior and CLRD constitute such a serious problem in West Virginia. In 2001, 52.9% of all West Virginia adults smoked or had smoked. Nearly six out of every 10 men (59.3%) and 47.2% of all women were either current or former smokers.

**Youth Smoking.** Data on youth smoking were obtained from the 2002 WVYTS. Two categories of cigarette smoking self-reported by students are presented in Table 4: current smokers and frequent smokers.

Sixteen percent (16.3%) of middle school students reported being current smokers, i.e., had smoked cigarettes on one or more of the past 30 days. Among high school students, 33.7% of students reported current smoking. Five percent (5.4%) of middle school students and 18.7% of high school students were frequent smokers, i.e., had smoked cigarettes on 20+ days of the past 30 days. No significant differences were found in either category between male and female students.

The overwhelming majority of high school students[17] strongly agreed that tobacco use increases a person's chances of getting lung cancer or other serious diseases, with females significantly more likely to strongly agree than males. Over half of all current smokers in both the middle schools and high schools had attempted to quit at some time during the past 12 months. Fifty-seven percent (56.7%) of current smokers in middle schools had tried to quit, as had 57.9% of current smokers in high school, with no significant differences between the sexes in either category.

Research shows that secondhand smoke is directly associated with lower respiratory diseases (see page 7). The students surveyed by the WVYTS were asked about their exposure to someone else's cigarette smoke. Seventy-three percent (73.2%) of middle school students and 82.9% of high school students reported having been in the same room or in a car with someone who was smoking within the past seven days. Interestingly, middle school girls were significantly more likely to have had secondhand smoke exposure than were the boys; no significant difference was found among high school students.

[17] Middle school students were not asked this question.

| Table 4. Prevalence of Current and Frequent Cigarette Smoking, Quit Attempts, and Exposure to Secondhand Smoke among Middle and High School Students 2002 West Virginia Youth Tobacco Survey | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Middle Schools | | | | High Schools | | |
| | Males % (95% CI) | Females % (95% CI) | Total % (95% CI) | | Males % (95% CI) | Females % (95% CI) | Total % (95% CI) |
| Current Smoking | 15.8 (13.8, 17.8) | 16.6 (14.3, 18.9) | 16.3 (14.3, 18.3) | | 33.3 (29.4, 37.2) | 34.1 (29.4, 38.8) | 33.7 (30.6, 36.8) |
| Frequent Smoking | 5.4 (4.2, 6.6) | 5.3 (4.2, 6.4) | 5.4 (4.5, 6.3) | | 19.6 (16.0, 23.2) | 17.9 (13.7, 22.1) | 18.7 (15.4, 22.0) |
| Strongly Agree that Using Tobacco Increases Chances of Getting a Serious Disease | NA | NA | NA | | 73.6 (69.2, 78.0) | 85.1 (81.5, 88.7) | 79.1 (75.5, 82.7) |
| Current Smokers Who Have Attempted to Quit | 54.4 (49.6, 59.4) | 59.0 (55.9, 62.1) | 56.7 (54.3, 59.1) | | 55.9 (48.5, 63.3) | 60.1 (54.0, 66.2) | 57.9 (53.4, 62.4) |
| Exposure to Secondhand Smoke | 70.6 (67.9, 73.3) | 75.9 (74.0, 77.8) | 73.2 (71.0, 75.4) | | 81.2 (77.7, 84.7) | 84.7 (81.9, 87.5) | 82.9 (80.4, 85.4) |

## Chronic Lower Respiratory Disease Hospitalizations

**West Virginia and United States, 2000.** Hospitalization data provide important information on the burden of specific conditions on a population, both in terms of human suffering and financial cost. Data were obtained from the West Virginia Health Care Authority (WVHCA)[18] (74) to estimate COPD and asthma inpatient hospitalizations among state residents and related costs during 2000. United States data presented for comparison purposes were obtained from the 2000 National Hospital Discharge Survey (75). All data are presented for COPD or asthma as a first-listed diagnosis only.

Table 5 compares the rate of hospital discharges and average length of stay (ALOS) for patients with a first-listed diagnosis of either chronic bronchitis or asthma for the United States and West Virginia for 2000 (data on emphysema were not available for comparison with the

[18]The WVHCA collects inpatient data from all nonfederal licensed hospitals in the state, as well as Medicare data on West Virginia residents hospitalized in out-of-state hospitals.

U.S.). The rates of hospitalization due to chronic bronchitis were markedly higher for West Virginians than their national counterparts for both sexes and among all age groups. The overall rate of 54.2 discharges per 10,000 population was over three times the U.S. rate of 17.6. The ALOS for a chronic bronchitis hospitalization in West Virginia was similar to that in the U.S. as a whole.

The rates of asthma hospitalizations in 2000 were lower in the state than in the nation. The state's total rate of 12.9 was about 23% lower than the U.S. rate of 16.7. The ALOS for an asthma hospitalization in West Virginia was slightly higher than that in the U.S., 3.5 days compared with 3.0 days.

Table 5. Rate of Hospital Discharges and Average Length of Stay (ALOS) for First-Listed Diagnoses of Chronic Bronchitis and Asthma by Gender and Age West Virginia and United States, 2000

| Diagnosis | Rate of Discharge* | | ALOS | |
|---|---|---|---|---|
| | WV | US | WV | US |
| Chronic Bronchitis | | | | |
| Total | 54.2 | 17.6 | 5.2 | 5.2 |
| Male | 46.3 | 15.6 | 5.0 | 5.2 |
| Female | 61.7 | 19.5 | 5.4 | 5.2 |
| <15 | ** | ** | ** | ** |
| 15-44 | 6.1 | 1.4 | 4.0 | 4.6 |
| 45-64 | 67.3 | 23.7 | 4.8 | 5.1 |
| 65+ | 226.8 | 94.3 | 5.5 | 5.2 |
| Asthma | | | | |
| Total | 12.9 | 16.7 | 3.5 | 3.0 |
| Male | 9.4 | 14.5 | 2.9 | 2.6 |
| Female | 16.3 | 18.8 | 3.8 | 3.4 |
| <15 | 24.2 | 33.6 | 2.3 | 2.2 |
| 15-44 | 8.1 | 9.1 | 3.2 | 2.9 |
| 45-64 | 11.5 | 13.7 | 4.2 | 3.9 |
| 65+ | 14.9 | 19.6 | 5.2 | 4.9 |

*Rate per 10,000 population
**Number too small to meet standard of reliability

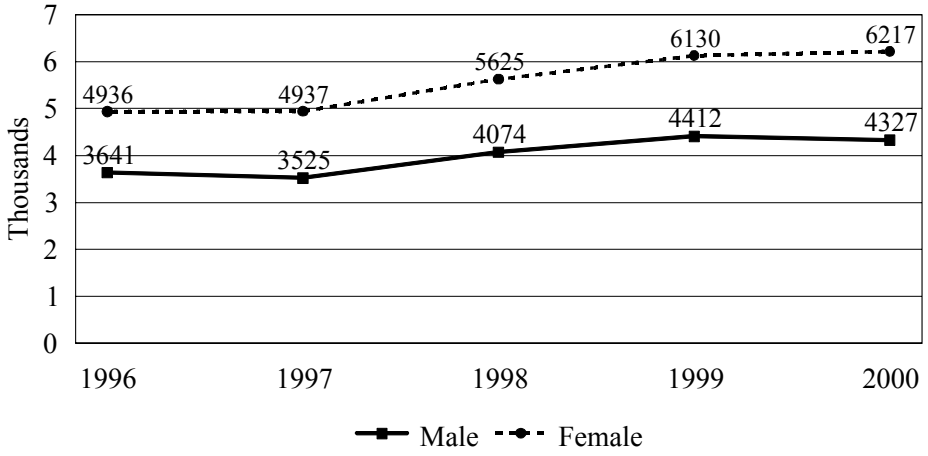
**West Virginia, 1996-2000.** Looking strictly at West Virginia data, in 2000 there were 10,544 hospital discharges having COPD as the first-listed diagnosis,[19] 6,217 among men and 4,327 among women (Figure 1). From 1996 to 2000, total COPD hospitalizations increased 23%, with increases seen among both sexes. While the number of hospitalizations has increased, the

[19]Hospital discharges were still coded according to ICD-9 in 2000. Data for this section were obtained for the diagnosis related group (DRG) 88, COPD and Allied Conditions. DRG 88 includes chronic bronchitis, emphysema, and chronic asthma; it does not include acute bronchitis or acute asthma.

average length of stay for a patient with a COPD diagnosis has decreased by approximately a half day over the past five years (Figure 2). In 1996, the ALOS for a COPD diagnosis was 5.3 days, compared with an ALOS of 4.9 in 2000.

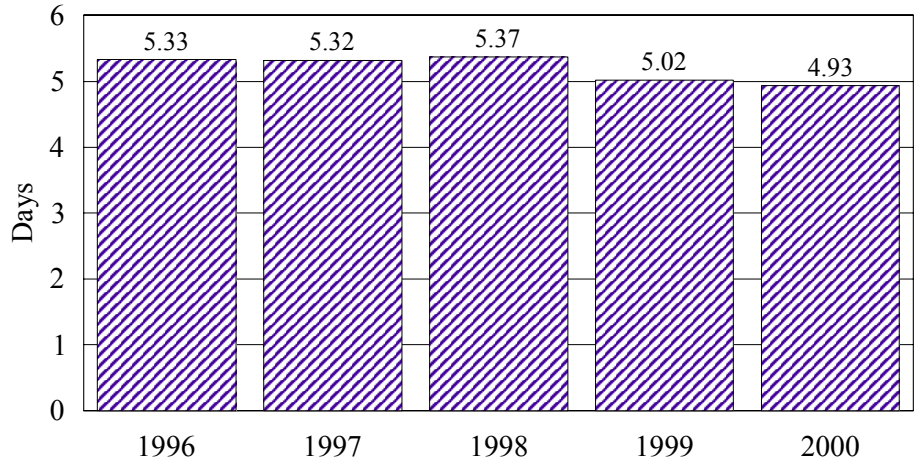
Rates of COPD hospitalization varied greatly around the state in 2000. Figure 3 illustrates these differences by county. The rates (hospitalizations per 10,000 population) ranged from a high of 159.0 in Lewis County to a low of 11.4 in Morgan County, with the highest rates clustered in the southern and central portions of the state. The state average in that year was 52.7. Individual county rates are found in Appendix A.

Figure 1. Total Discharges for COPD by Sex
West Virginia Inpatient Records, 1996-2000




Source: West Virginia Health Care Authority

Figure 2. Average Length of Stay for COPD Diagnosis
West Virginia Inpatient Records, 1996-2000




Source: West Virginia Health Care Authority

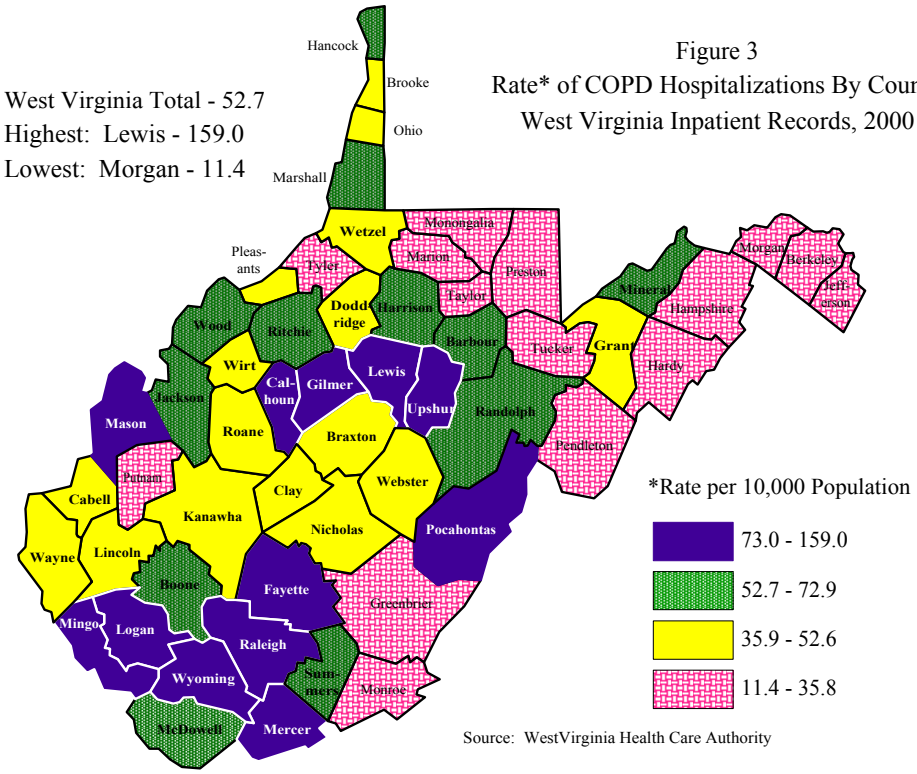
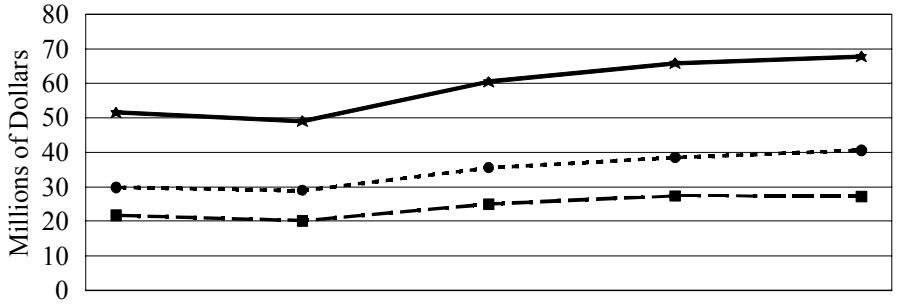



Figure 3
Rate* of COPD Hospitalizations By County
West Virginia Inpatient Records, 2000

Total charges for COPD hospitalizations according to WVHCA inpatient records are presented in Figure 4. Overall charges increased 31.7% from 1996 to 2000, from $51,487,381 to $67,821,146. Charges among female COPD patients increased at a greater rate than those among male patients, 36.1% over the five-year period.

Figure 4. Charges for COPD Hospitalizations by Sex
West Virginia Inpatient Records, 1996-2000



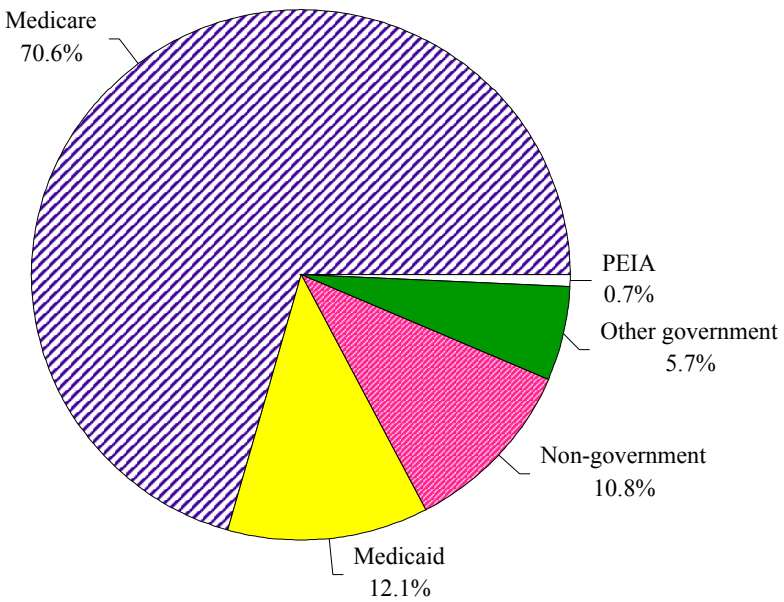

| | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|
| ★ Total | 51487381 | 49063934 | 60414501 | 65851348 | 67821146 |
| ■ Male | 21642536 | 20149479 | 24930152 | 27378820 | 27208370 |
| ● Female | 29844845 | 28914455 | 35484349 | 38472528 | 40612776 |

Table 6 presents the breakdown of total charges for COPD hospitalizations in 2000 by payer, as well as average charge, number of COPD-related discharges, and ALOS by payer. The bulk of the charges, $47,895,310 or over 70%, were billed to Medicare, not surprising since COPD develops over many years and primarily affects older persons. The next largest share of the costs were billed to Medicaid. Figure 5 illustrates the distribution of charges for COPD hospitalizations, showing the heavy burden on Medicare.

Table 6. Selected Data on COPD Hospitalizations by Payer
West Virginia Inpatient Records, 2000

| Payer | Discharges | Total Charges ($) | Average Charge ($) | Inpatient Days | ALOS |
|---|---|---|---|---|---|
| Medicare | 7,200 | 47,895,310 | 6,652 | 37,359 | 5.19 |
| Medicaid | 1,312 | 8,197,850 | 6,248 | 5,806 | 4.43 |
| Other Govt. | 639 | 3,888,478 | 6,085 | 2,878 | 4.50 |
| PEIA | 94 | 485,804 | 5,168 | 392 | 4.17 |
| All Other | 1,299 | 7,353,704 | 5,661 | 5,589 | 4.30 |

Figure 5. Distribution of Total Charges* for COPD Hospitalizations
By Payer, West Virginia Inpatient Records, 2000

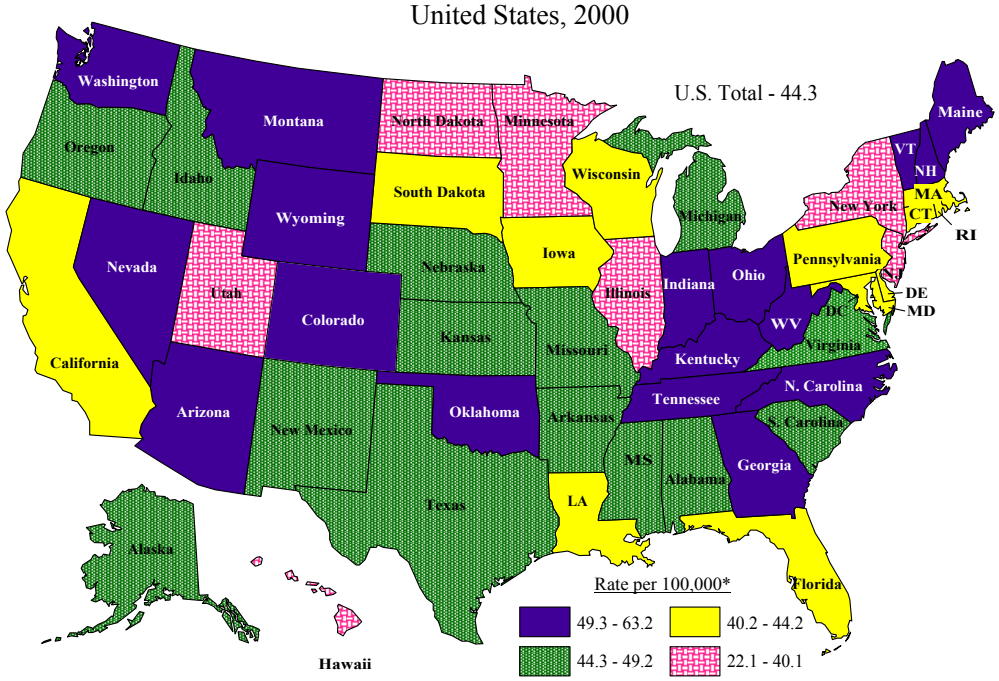



*$67,821,146

## Chronic Lower Respiratory Disease Mortality

Since 2000, chronic lower respiratory disease has been the third leading cause of death in West Virginia. Only two other states, Nevada and Wyoming, currently share this distinction; CLRD is the fourth leading cause of death in all other states and the District of Columbia. In 2000, West Virginia's age-adjusted[20] CLRD mortality rate of 63.2 deaths per 100,000 population was the highest in the country; the national rate was 44.3 (Figure 6) (76). In that year, West Virginians comprised only 0.64% of the U.S. population but made up 1.1% of the nation's total CLRD deaths. See Appendix B for individual state rates.

Figure 6
Chronic Lower Respiratory Disease Mortality
United States, 2000



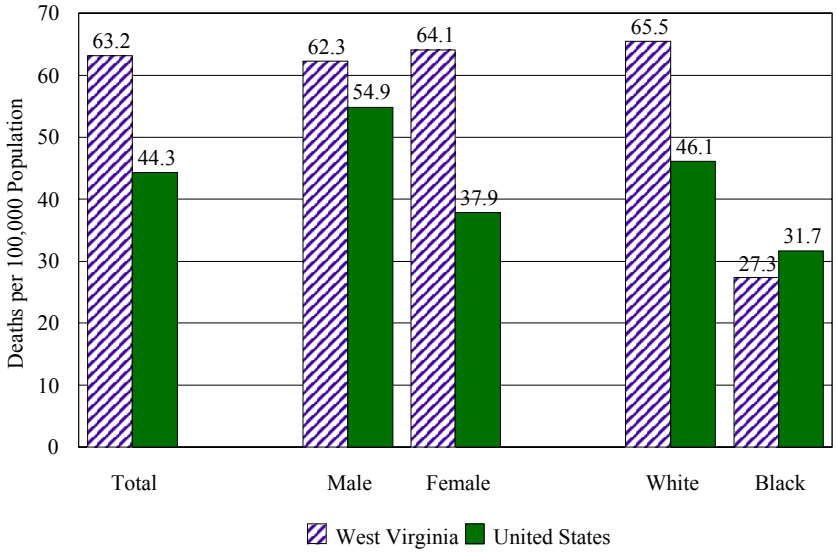

*Age-adjusted to the 2000 U.S. standard million

When examined by sex and race, in 2000 West Virginia residents had higher mortality rates due to CLRD in every group except African-Americans (Figure 7). While the overall state rate was 20% higher than the national rate, this difference was largely due to deaths among women. The state rate of 64.1 deaths per 100,000 population for women was 69% higher than that among women as a whole in the U.S. White residents had a mortality rate that was 42% higher than their counterparts nationwide. African-American residents, on the other hand, had a mortality rate that was 14% lower than the comparable national rate.

[20] Adjusted to the 2000 U.S. standard million.

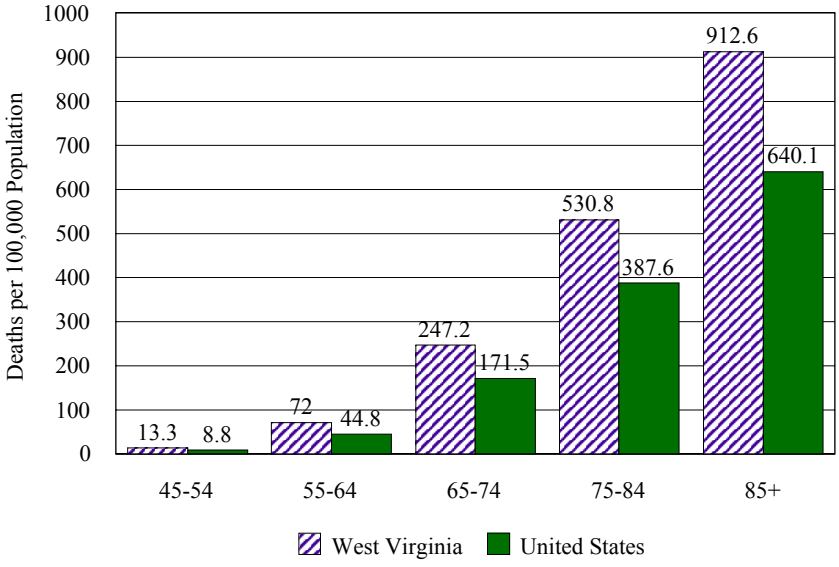
Analysis of mortality rates by age group showed that in 2000 West Virginians were more likely than their peers nationally to die from CLRD at all ages (Figure 8). The differences between West Virginia and U.S. rates ranged from a state rate 37% higher among persons aged 75-84 to a rate 61% higher among West Virginians aged 55-64.

Figure 7. CLRD Mortality Rates* by Sex and Race**
West Virginia and United States, 2000




*Age-adjusted to the 2000 U.S. standard million.
** Number of other races too small to meet standard of reliability.

Figure 8. CLRD Mortality Rates* by Age Group**
West Virginia and United States, 2000



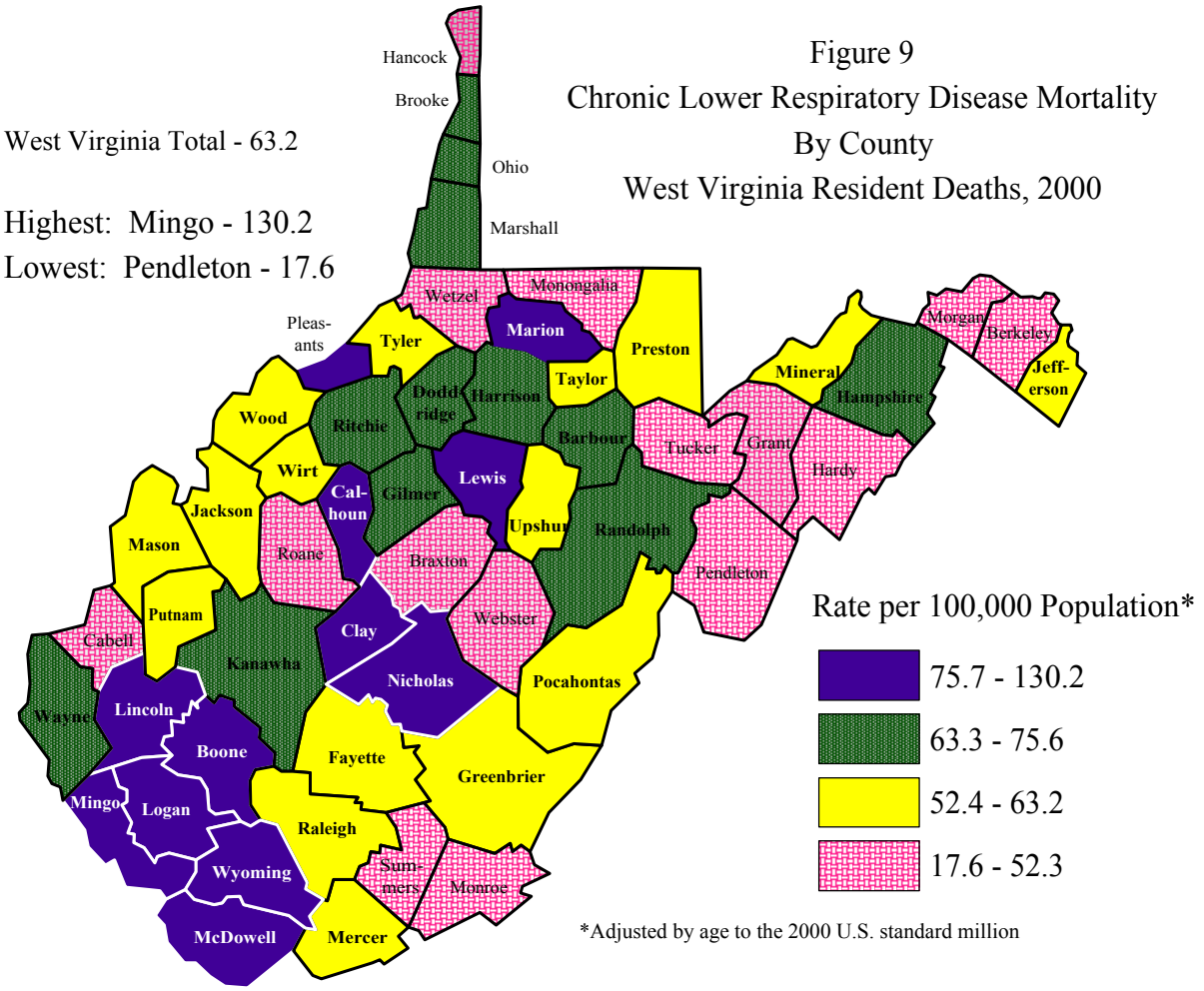

*Age-adjusted to the 2000 U.S. standard million.
**Number of deaths among younger age groups too small to meet standard of reliability.

The highest rates of CLRD mortality in 2000 were primarily clustered among the southern and central counties of West Virginia, as Figure 9 illustrates. Rates ranged from a high of 130.2 deaths per 100,000 population in Mingo County to a low of 17.6 in Pendleton County. A complete list of county rates can be found in Appendix C.

Figure 9
Chronic Lower Respiratory Disease Mortality
By County
West Virginia Resident Deaths, 2000

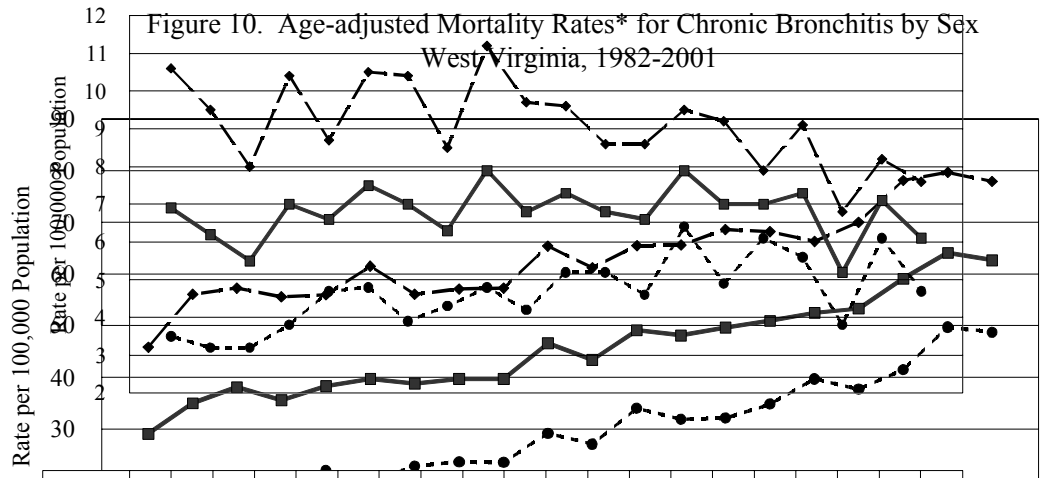
West Virginia Total - 63.2

Highest: Mingo - 130.2
Lowest: Pendleton - 17.6




*Adjusted by age to the 2000 U.S. standard million

Figure 11. Age-adjusted Mortality Rates* for Emphysema by Sex
West Virginia, 1982-2001




| | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | 6.9 | 6.2 | 5.5 | 7 | 6.6 | 7.5 | 7 | 6.3 | 7.9 | 6.8 | 7.3 | 6.8 | 6.6 | 7.9 | 7 | 7 | 7.3 | 5.2 | 7.1 | 6.1 |
| Male | 10.6 | 9.5 | 8 | 10.4 | 8.7 | 10.5 | 10.4 | 8.5 | 11.2 | 9.7 | 9.6 | 8.6 | 8.6 | 9.5 | 9.2 | 7.9 | 9.1 | 6.8 | 8.2 | 7.6 |
| Female | 3.5 | 3.2 | 3.2 | 3.8 | 4.7 | 4.8 | 3.9 | 4.3 | 4.8 | 4.2 | 5.2 | 5.2 | 4.6 | 6.4 | 4.9 | 6.1 | 5.6 | 3.8 | 6.1 | 4.7 |

| | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total* | 29.1 | 35 | 38.1 | 36.6 | 38.3 | 39.7 | 38.8 | 39.7 | 39.7 | 42.6 | 43.5 | 43.5 | 49.1 | 48.1 | 49.6 | 50.9 | 52.5 | 53.3 | 59.1 | 64.1 | 62.7 |
| Male | 45.8 | 56.1 | 57.3 | 55.6 | 56 | 61.5 | 56.1 | 57.1 | 57.3 | 65.4 | 61.2 | 65.5 | 65.6 | 68.6 | 68.2 | 66.3 | 70 | 78.1 | 79.7 | 77.9 | |
| Female | 13.7 | 15.4 | 20.4 | 17.1 | 21.9 | 19.6 | 22.8 | 23.6 | 23.5 | 29.2 | 27.1 | 34 | 31.9 | 32.1 | 34.8 | 39.7 | 37.7 | 41.5 | 49.7 | 48.7 | |

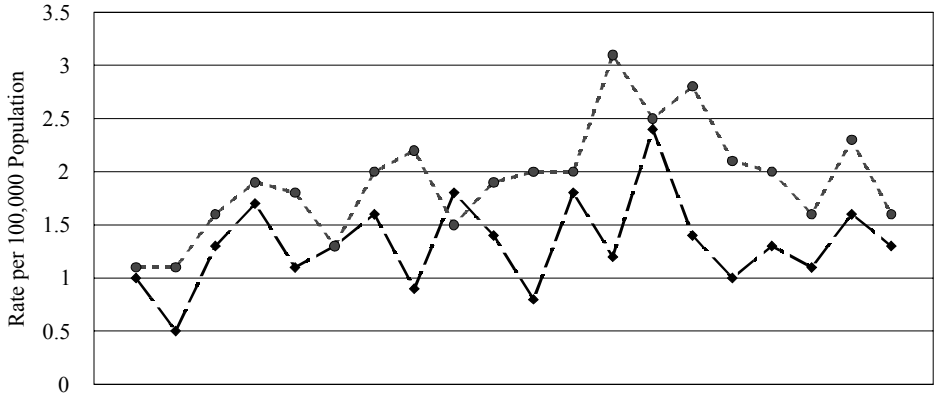
*Rates are deaths per 100,000 population, adjusted by age to the 2000 U.S. standard million.

**Chronic Bronchitis.** From 1982 through 2001, West Virginia's overall age-adjusted mortality rate for chronic bronchitis increased 116%, from 29.1 deaths per 100,000 population in 1982 to 62.7 in 2001 (Figure 10). While the rate among men rose 70% (45.8 to 77.9), that among the state's women increased a staggering 256% (13.7 to 48.7), an annual average increase of 6.9%.

**Emphysema.** The overall age-adjusted mortality rate for emphysema decreased 12% between 1982 and 2001, from 6.9 deaths per 100,000 population to 6.1 (Figure 11). This decrease, however, was due entirely to the decline in deaths among men, from a rate of 10.6 in 1982 to 7.6 in 2001. Emphysema mortality rates among West Virginia's women increased 34% over the time period, from 3.5 in 1982 to 4.7 in 2001, with rates as high as 6.1 in 1997 and 2000.

**Asthma.** The overall death rate for asthma fluctuated between a low of 0.8 in 1983 and a high of 2.5 recorded in 1995 (Figure 12). With a few exceptions, the mortality rate among females was slightly higher than that among males over the 20-year period. Asthma deaths among females peaked in 1994 with a rate of 3.1.

Figure 12. Age-adjusted Mortality Rates* for Asthma by Sex
West Virginia, 1982-2001




| | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | 1.1 | 0.8 | 1.5 | 1.8 | 1.5 | 1.3 | 1.8 | 1.5 | 1.6 | 1.7 | 1.4 | 1.9 | 2.2 | 2.5 | 2.1 | 1.6 | 1.7 | 1.4 | 1.9 | 1.4 |
| Male | 1 | 0.5 | 1.3 | 1.7 | 1.1 | 1.3 | 1.6 | 0.9 | 1.8 | 1.4 | 0.8 | 1.8 | 1.2 | 2.4 | 1.4 | 1 | 1.3 | 1.1 | 1.6 | 1.3 |
| Female | 1.1 | 1.1 | 1.6 | 1.9 | 1.8 | 1.3 | 2 | 2.2 | 1.5 | 1.9 | 2 | 2 | 3.1 | 2.5 | 2.8 | 2.1 | 2 | 1.6 | 2.3 | 1.6 |

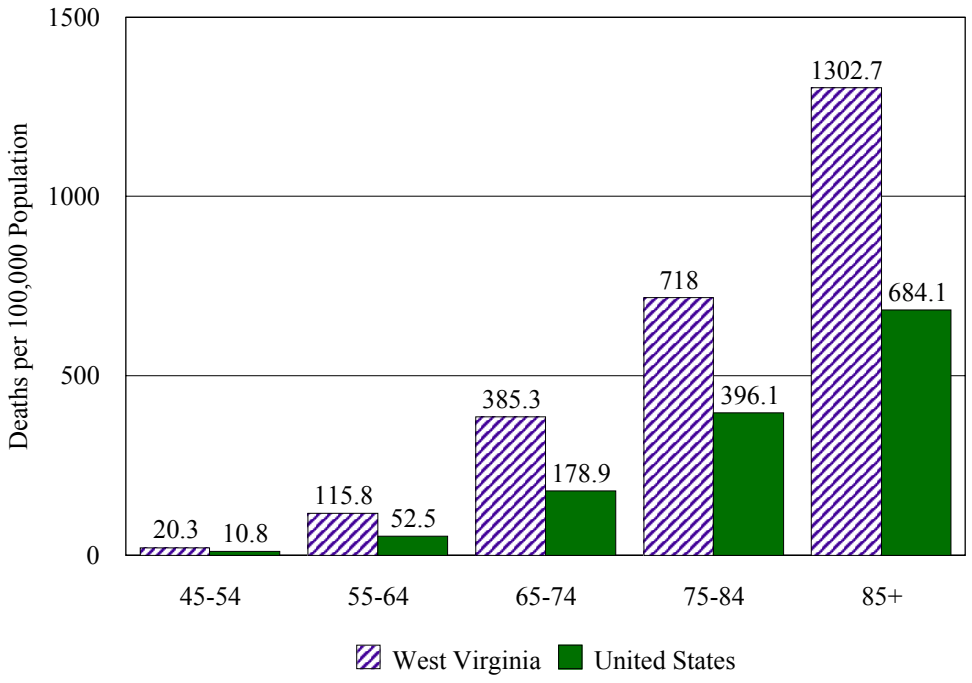
*Rates are deaths per 100,000 population, adjusted by age to the 2000 U.S. standard million.

**CLRD-Related Mortality.** The National Center for Health Statistics releases annual multiple-cause-of-death tapes that include decedent's age, sex, race, and state of residence; the underlying (primary) cause of death, and up to 19 contributing causes of death. This section examines multiple-cause-of-death data for West Virginia and the United States for 2000.

The age-adjusted rate for West Virginia for deaths with CLRD listed as a contributing cause was 91.3 (deaths per 100,000 population), compared with 45.9 for the United States as a whole. Excess West Virginia deaths were found among both males, with a state rate of 137.8 compared with 51.6 nationally, and females, 63.4 compared with 40.4. Although the mortality rate for CLRD as the underlying cause of death was lower among African-Americans in the state than their counterparts nationally in 2000 (see page 30), the reverse was found when examining CLRD as a contributory cause (79.7 vs. 27.3). The rate among white state residents was 92.5, compared with a rate of 55.9 among whites in the U.S. as a whole.

West Virginians of all ages were more likely to have CLRD listed as a contributing cause on their death certificates than their peers elsewhere (Figure 13). In terms of percentage differences between rates, the largest differences between state and national rates were found among 55-64 year olds (120.6% higher among West Virginians) and 65-74 year olds (115.4% higher).

Figure 13. Rates* of CLRD as a Contributing Cause of Death by Age
West Virginia and United States, 2000




*Rates are deaths per 100,000 population, adjusted by age to the 2000 U.S. standard million.

**APPENDIX A**
**RATES OF COPD HOSPITALIZATION BY COUNTY**
**WEST VIRGINIA INPATIENT RECORDS, 2000**

| County | 2000 Census | Discharges | Rate per 10,000 | Rank |
|---|---|---|---|---|
| Barbour | 15,557 | 97 | 62.4 | 20 |
| Berkeley | 75,905 | 155 | 20.4 | 53 |
| Boone | 25,535 | 167 | 65.4 | 17 |
| Braxton | 14,702 | 75 | 51.0 | 27 |
| Brooke | 25,477 | 116 | 45.6 | 31 |
| Cabell | 96,784 | 368 | 38.0 | 39 |
| Calhoun | 7,582 | 69 | 91.0 | 6 |
| Clay | 10,330 | 54 | 52.3 | 25 |
| Doddridge | 7,403 | 29 | 39.2 | 37 |
| Fayette | 47,579 | 535 | 112.4 | 3 |
| Gilmer | 7,160 | 96 | 134.1 | 2 |
| Grant | 11,229 | 50 | 44.3 | 32 |
| Greenbrier | 34,453 | 105 | 30.5 | 46 |
| Hampshire | 20,203 | 38 | 18.8 | 54 |
| Hancock | 32,667 | 180 | 55.1 | 24 |
| Hardy | 12,669 | 44 | 34.7 | 41 |
| Harrison | 68,652 | 475 | 69.2 | 15 |
| Jackson | 28,000 | 199 | 71.1 | 13 |
| Jefferson | 42,190 | 91 | 21.6 | 51 |
| Kanawha | 200,073 | 808 | 40.4 | 36 |
| Lewis | 16,919 | 269 | 159.0 | 1 |
| Lincoln | 22,018 | 85 | 38.4 | 38 |
| Logan | 37,710 | 286 | 75.8 | 10 |
| McDowell | 27,329 | 192 | 70.3 | 14 |
| Marion | 56,598 | 190 | 33.6 | 43 |
| Marshall | 35,519 | 217 | 61.1 | 21 |
| Mason | 25,957 | 218 | 84.0 | 8 |
| Mercer | 62,980 | 460 | 73.0 | 12 |
| Mineral | 27,078 | 151 | 55.8 | 23 |
| Mingo | 28,253 | 316 | 111.8 | 4 |
| Monongalia | 81,866 | 198 | 24.2 | 48 |
| Monroe | 14,583 | 35 | 24.0 | 49 |
| Morgan | 14,943 | 17 | 11.4 | 55 |
| Nicholas | 26,562 | 117 | 44.0 | 33 |
| Ohio | 47,427 | 242 | 51.0 | 26 |
| Pendleton | 8,196 | 24 | 29.3 | 47 |
| Pleasants | 7,514 | 27 | 35.9 | 40 |
| Pocahontas | 9,131 | 78 | 85.4 | 7 |
| Preston | 29,334 | 70 | 23.9 | 50 |
| Putnam | 51,589 | 166 | 32.2 | 44 |
| Raleigh | 79,220 | 596 | 75.2 | 11 |
| Randolph | 28,262 | 189 | 66.9 | 16 |
| Ritchie | 10,343 | 66 | 63.8 | 18 |
| Roane | 15,446 | 71 | 46.0 | 30 |
| Summers | 12,999 | 79 | 60.8 | 22 |
| Taylor | 16,089 | 33 | 20.5 | 52 |
| Tucker | 7,321 | 23 | 31.4 | 45 |
| Tyler | 9,592 | 33 | 34.4 | 42 |
| Upshur | 23,404 | 182 | 77.8 | 9 |
| Wayne | 42,903 | 209 | 48.7 | 28 |
| Webster | 9,719 | 40 | 41.2 | 35 |
| Wetzel | 17,693 | 75 | 42.4 | 34 |
| Wirt | 5,873 | 28 | 47.7 | 29 |
| Wood | 87,986 | 550 | 62.5 | 19 |
| Wyoming | 25,708 | 238 | 92.6 | 5 |
| WV Total | 1,808,344 | 9,521 | 52.7 | |

**Appendix B**
**Chronic Lower Respiratory Disease Rates* by State**
**United States, 2000**

| State | Rate per 100,000 Population | Rank |
|---|---|---|
| Alabama | 46.0 | 27 |
| Alaska | 46.9 | 25 |
| Arizona | 51.6 | 12 |
| Arkansas | 49.2 | 18 |
| California | 43.2 | 35 |
| Colorado | 53.6 | 8 |
| Connecticut | 40.2 | 42 |
| Delaware | 45.3 | 30 |
| Florida | 41.3 | 39 |
| Georgia | 49.9 | 15 |
| Hawaii | 22.1 | 50 |
| Idaho | 49.1 | 20 |
| Illinois | 39.5 | 44 |
| Indiana | 51.7 | 11 |
| Iowa | 43.3 | 34 |
| Kansas | 49.2 | 18 |
| Kentucky | 55.3 | 5 |
| Louisiana | 42.4 | 36 |
| Maine | 55.0 | 6 |
| Maryland | 40.8 | 41 |
| Massachusette | 42.1 | 37 |
| Michigan | 44.7 | 32 |
| Minnesota | 39.2 | 45 |
| Mississippi | 47.5 | 22 |
| Missouri | 47.4 | 24 |
| Montana | 53.9 | 7 |
| Nebraska | 45.4 | 29 |
| Nevada | 63.1 | 2 |
| New Hampshire | 50.8 | 13 |
| New Jersey | 34.0 | 49 |
| New Mexico | 48.5 | 21 |
| New York | 34.6 | 47 |
| North Carolina | 49.3 | 16 |
| North Dakota | 38.9 | 46 |
| Ohio | 50.6 | 14 |
| Oklahoma | 55.4 | 4 |
| Oregon | 47.5 | 22 |
| Pennsylvania | 40.9 | 40 |
| Rhode Island | 40.1 | 43 |
| South Carolina | 46.5 | 26 |
| South Dakota | 44.2 | 33 |
| Tennessee | 53.3 | 9 |
| Texas | 45.1 | 31 |
| Utah | 34.5 | 48 |
| Vermont | 52.9 | 10 |
| Virginia | 45.6 | 28 |
| Washington | 49.3 | 16 |
| West Virginia | 63.2 | 1 |
| Wisconsin | 41.6 | 38 |
| Wyoming | 63.1 | 2 |
| U.S. Rate | 44.3 | |

Source: USDHHS, NCHS

*Age adjusted to the 2000 U.S. standard million.

## APPENDIX C
## Chronic Lower Respiratory Disease By County
## West Virginia Resident Deaths, 2000

| County | Number of Deaths | Crude Rate per 100,000 Population | Adjusted Rate* per 100,000 Population | Rank |
|---|---|---|---|---|
| Barbour | 14 | 90.0 | 72.5 | 14 |
| Berkeley | 33 | 43.5 | 50.9 | 43 |
| Boone | 23 | 90.1 | 88.4 | 6 |
| Braxton | 5 | 34.0 | 30.4 | 54 |
| Brooke | 25 | 98.2 | 70.4 | 17 |
| Cabell | 59 | 61.0 | 50.0 | 46 |
| Calhoun | 8 | 105.5 | 81.1 | 10 |
| Clay | 10 | 96.8 | 86.3 | 7 |
| Doddridge | 6 | 81.0 | 74.3 | 13 |
| Fayette | 37 | 77.8 | 61.4 | 27 |
| Gilmer | 6 | 83.8 | 65.4 | 22 |
| Grant | 7 | 62.0 | 52.2 | 42 |
| Greenbrier | 29 | 84.2 | 60.7 | 29 |
| Hampshire | 16 | 79.2 | 70.8 | 15 |
| Hancock | 19 | 58.2 | 40.9 | 52 |
| Hardy | 6 | 47.4 | 42.0 | 51 |
| Harrison | 58 | 84.5 | 64.4 | 24 |
| Jackson | 18 | 64.3 | 54.3 | 37 |
| Jefferson | 22 | 52.1 | 61.3 | 28 |
| Kanawha | 176 | 88.0 | 68.4 | 19 |
| Lewis | 17 | 100.5 | 78.1 | 11 |
| Lincoln | 21 | 95.0 | 92.7 | 4 |
| Logan | 34 | 90.2 | 85.0 | 8 |
| McDowell | 35 | 128.1 | 102.8 | 3 |
| Marion | 62 | 109.5 | 75.7 | 12 |
| Marshall | 28 | 78.8 | 64.4 | 23 |
| Mason | 17 | 65.5 | 55.4 | 34 |
| Mercer | 48 | 76.2 | 57.3 | 31 |
| Mineral | 20 | 73.9 | 62.6 | 25 |
| Mingo | 35 | 123.9 | 130.2 | 1 |
| Monongalia | 32 | 39.1 | 45.9 | 49 |
| Monroe | 6 | 41.1 | 34.3 | 53 |
| Morgan | 10 | 66.9 | 52.3 | 41 |
| Nicholas | 25 | 94.1 | 83.1 | 9 |
| Ohio | 46 | 97.0 | 67.8 | 21 |
| Pendleton | 2 | 24.4 | 17.6 | 55 |
| Pleasants | 8 | 106.5 | 91.6 | 5 |
| Pocahontas | 7 | 76.7 | 54.9 | 35 |
| Preston | 19 | 64.8 | 55.9 | 33 |
| Putnam | 25 | 48.5 | 53.3 | 39 |
| Raleigh | 51 | 64.4 | 54.3 | 36 |
| Randolph | 24 | 84.9 | 68.3 | 20 |
| Ritchie | 9 | 87.0 | 70.5 | 16 |
| Roane | 8 | 51.8 | 44.2 | 50 |
| Summers | 10 | 76.9 | 50.1 | 45 |
| Taylor | 11 | 68.4 | 56.6 | 32 |
| Tucker | 5 | 68.3 | 46.7 | 48 |
| Tyler | 7 | 73.0 | 59.3 | 30 |
| Upshur | 17 | 72.6 | 61.6 | 26 |
| Wayne | 32 | 74.6 | 69.2 | 18 |
| Webster | 6 | 61.7 | 50.9 | 44 |
| Wetzel | 11 | 62.2 | 49.3 | 47 |
| Wirt | 3 | 51.1 | 54.0 | 38 |
| Wood | 57 | 64.8 | 52.9 | 40 |
| Wyoming | 28 | 108.9 | 108.8 | 2 |
| WV Total | 1,353 | 74.8 | 63.2 | |

*Age adjusted to the 2000 U.S. standard million.

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