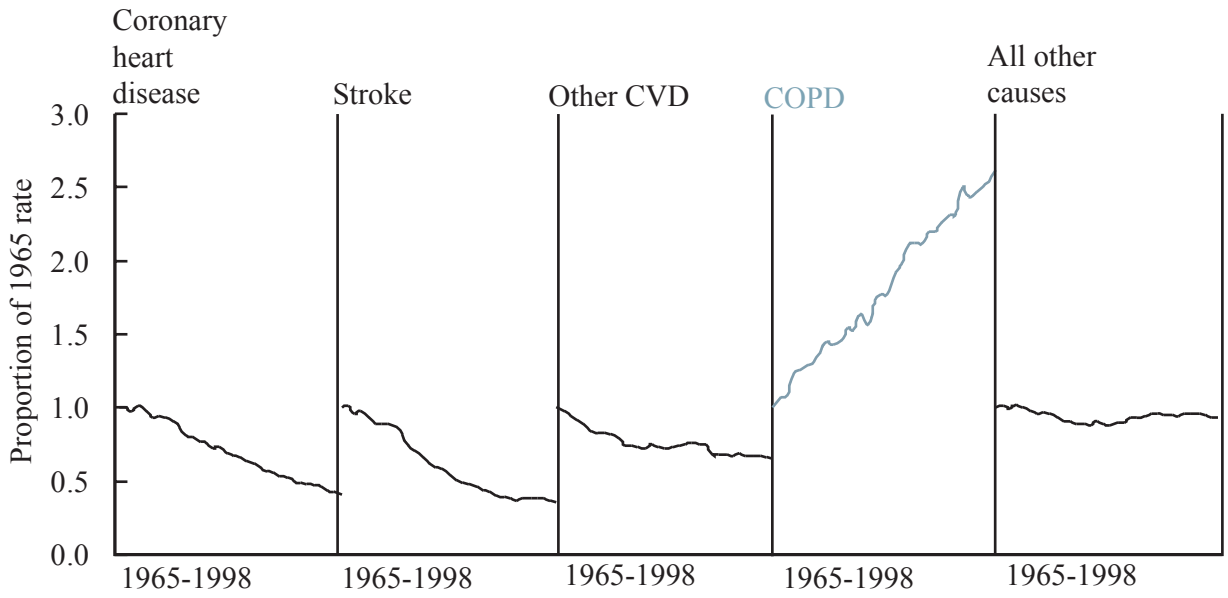
2007 Colorado Chronic obstructive pulmonary disease (COPD) Surveillance Report



Colorado COPD Coalition

AMERICAN LUNG ASSOCIATION® of Colorado

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Table of Contents

Part 1: List of Figures

Part 2: List of Tables

Part 3: Executive Summary

Chronic obstructive pulmonary disease (COPD) is a leading cause of morbidity and mortality locally, nationally, and globally. The Colorado COPD Coalition was formed to create and implement a sustainable and coordinated campaign to address this endemic health crisis here in Colorado. To this end, the Colorado COPD Coalition commissioned the 2007 COPD Surveillance report to summarize what is known about the burden of COPD in the state and to discover what gaps in our knowledge need to be addressed.

Colorado, like other states in the Mountain West, has one of the highest rates of death from COPD in the nation. In 2003, Colorado ranked seventh with an age-adjusted rate of 53.7 COPD deaths per 100,000 people. COPD was also the fourth leading cause of death in Colorado in 2005. And since 1998, COPD has claimed the lives of over 1,700 Coloradans each year with the number of deaths per year on the rise. In Colorado there are 4,000-6,000 COPD hospitalizations each year, resulting in over $70 million in annual charges.

While the number of deaths and hospitalizations due to COPD are significant, they undoubtedly underestimate the true burden of COPD in the state. COPD is a contributing factor in many deaths and hospitalizations from other causes like cardiovascular disease, lung cancer, and respiratory infections. Additionally, many people have COPD that is not yet serious enough to result in hospitalization or death but may have significant influence on their quality of life.

The true prevalence of COPD in Colorado is unknown. Future surveillance should attempt to characterize the number of people currently diagnosed with COPD and, perhaps more importantly the number of people who have COPD but who do not yet carry a diagnosis. Based on national data, the American Lung Association estimates that between 140,000 and 190,000 Coloradans have a diagnosis of COPD. Given that the prevalence of COPD measured by lung function testing is approximately 2.4 times higher than the number based on self-report, we suspect the disease effects between 330,000 and 450,000 people in Colorado.

Although exposure to tobacco smoke in Colorado has decreased in recent years, the burden of COPD is expected to persist due to the aging of the population and the number of people who smoked in years past. The ongoing abuse of tobacco, particularly in younger Coloradans, suggests that COPD will continue to be a problem for many years to come. Recent studies estimate that upwards of 25% of Coloradan high school students smoke.

This report attempts to characterize the burden of COPD in specific populations so that we can better target public health interventions to reduce that burden. The

population most affected by COPD is older Coloradans, as the prevalence of the disease (as well as rates of death and hospitalization) increases dramatically with age. Although the age-adjusted rates of COPD hospitalization and mortality in men are higher than those in women, the number of hospitalizations and deaths due to COPD by gender are similar because of the larger population of older women at risk. Smoking prevalence is also similar in men and women, which suggests that COPD will continue to be a significant problem for both genders.

COPD mortality rates are higher in rural and frontier counties than in urban counties. This is likely due to the fact that rural Colorado has, on average, an older population, as the differences resolve with age-adjustment. Nonetheless, the increased burden of COPD in rural Colorado is real and should be a focus of future surveillance and intervention.

In summary, COPD is a significant problem in the state of Colorado and will likely remain a significant problem for the foreseeable future. Current data underscore the need to target interventions in the groups at highest risk, especially former smokers, older people, and rural Coloradans. Today, significant gaps exist in our knowledge. Future data and surveillance efforts should attempt to better characterize the prevalence, morbidity, economic costs, and burden of COPD in specific populations including racial/ethnic minorities, rural communities and groups with social and economic disadvantages.

Part 4: Introduction

The Global Initiative on Chronic Obstructive Lung Disease (GOLD) defines chronic obstructive pulmonary disease (COPD) as "a preventable and treatable disease… characterized by airflow limitation that is not fully reversible. The airflow limitation is usually progressive and associated with an abnormal inflammatory response of the lung to noxious particles or gases.[1]" Airflow limitation refers to difficulty exhaling air from the lungs. This occurs because inflammation in the lungs causes narrowing of the airways (see Figure 1). Emphysema and chronic bronchitis are terms used to describe some of the features of COPD, and are more often familiar to the public. COPD is, however, a more inclusive term and is thus preferred.

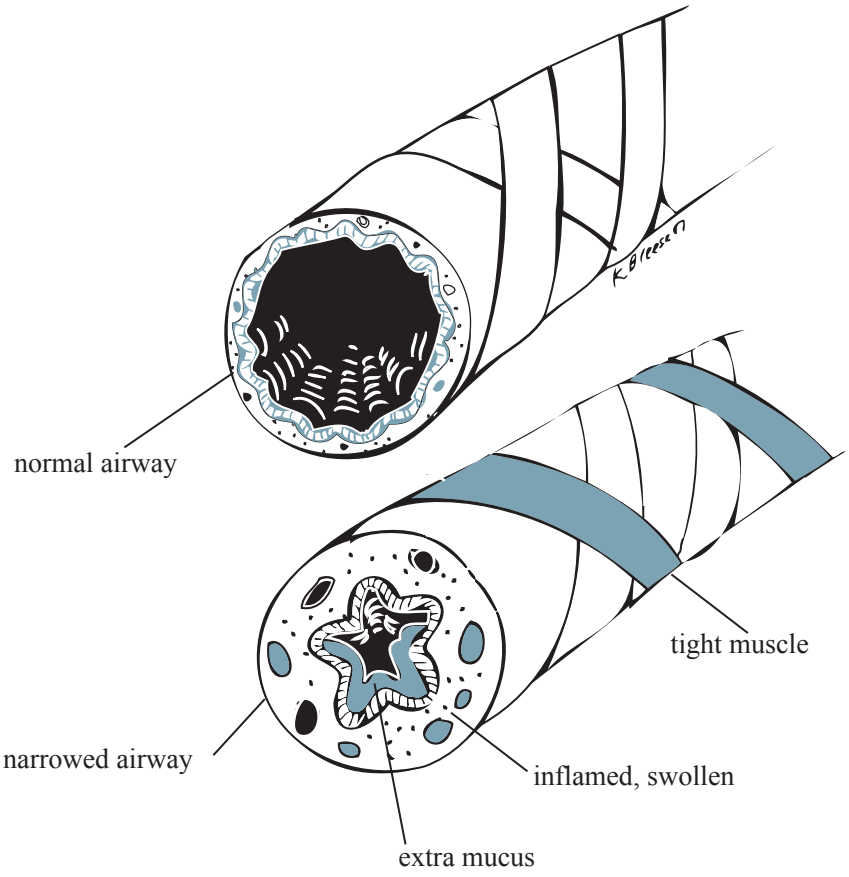

Figure 1: Narrowed airway in comparison to normal airway

Symptoms: The most common symptoms of COPD are chronic cough, sputum (or mucus) production, and shortness of breath or dyspnea. Many people will develop COPD with significant airflow limitation long before they develop symptoms because the lungs have functional reserve. In addition, people with COPD learn to avoid strenuous activities which bring out their symptoms, and may either deny symptoms or attribute them to part of the normal aging process.

Risk Factors: Globally, tobacco smoke is the most important risk factor for the development of COPD. However, not all smokers will develop COPD and some people with COPD have never smoked. This finding suggests the importance of additional risk factors. These potential risk factors include: second-hand smoke, occupational exposure to dusts or chemicals, outdoor air pollution, indoor air pollution from the combustion of biomass fuels for cooking and heating, poor lung growth and development, infections, and genetic factors including alpha-1 antitrypsin deficiency (see Table 1)[1].

Table 1: Risk factors for Chronic Obstructive Pulmonary Disease (COPD)

* Genes
* Exposure to particles
  - Tobacco smoke
  - Occupational dust, organic or inorganic
  - Indoor air pollution from heating or cooking biomass in poorly ventilated dwellings
  - Outdoor air pollution
* Lung growth and development
* Oxidative stress
* Gender
* Age
* Respiratory infections
* Socioeconomic status
* Nutrition
* Comorbidities

Source: GOLD Guidelines, 2003

COPD - International Perspective: COPD is extremely common and is responsible for substantial morbidity, mortality, and cost to society. It is the fifth leading cause of death worldwide[2], and is predicted to be the third leading cause of death and fifth leading cause of disability-adjusted life years by 2020[3].

Currently, COPD is most common in developed countries where tobacco abuse has been widespread throughout the latter half of the 20th century. Among 15 industrialized countries, the United States (U.S.) has the third highest rate of COPD mortality for women and the fifth highest for men[4]. However, the significant burden of COPD is likely to increase in developing countries due to rising rates of tobacco abuse and aggressive tobacco marketing.

COPD - National Perspective: COPD is the fourth leading cause of death in the U.S.[4] It is the only leading cause of death that has had a significant increase in rate over the past several decades. Between 1965 and 1998, the age-adjusted mortality rate from COPD increased almost three-fold while the mortality rates from cardiovascular disease and stroke were more that halved (see Figure 2)[1].

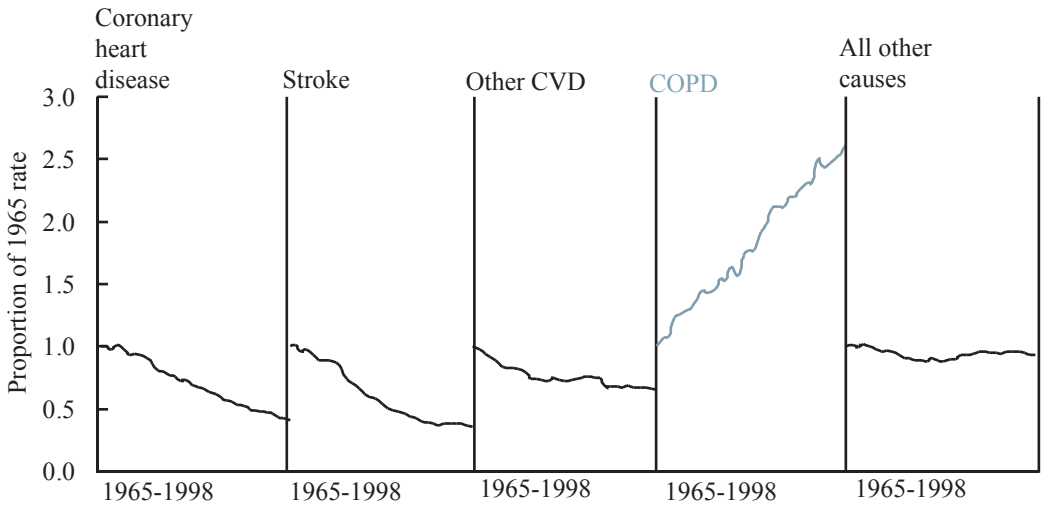

Figure 2. Temporal trends in leading causes of mortality, U.S., 1965-1998. From GOLD Slideset, available at www.goldcopd.com/OtherResources.asp?l1=2&l2=2.

In 2001, COPD resulted in 117,773 deaths[4]. The factors which explain the rise in COPD mortality are not fully delineated but are likely driven by historical increases in smoking prevalence and the aging of the U.S. population.

Mortality is only one metric for gauging the burden of COPD, another is health care utilization. In 2002, COPD was the primary reason for 673,000 hospitalizations nationally[4]. While rates of death and hospitalization due to COPD are important, they underestimate the true impact of this disease. Although death and hospitalization may account for nearly a million people with COPD, data from the National Health Interview Survey suggests that as many as 10 million people have actually been diagnosed[5]. COPD was responsible for more than 1.5 million emergency department visits in 2005, and over 13.8 million office visits in 2004.

An even larger group of people have COPD that has not yet been diagnosed by a health care provider. The National Health and Nutrition Evaluation Survey III found that many people have evidence of COPD on lung function testing but do not yet carry a diagnosis. In fact, the true number of people with COPD in the U.S. is likely closer to 24 million[5].

COPD results in significant direct and indirect healthcare expenditures. While, hospitalizations are the main driver of direct health care expenditures for COPD[6], additional direct costs include physician fees, medications, and medical equipment including oxygen and nebulizers. Indirect costs include time lost at work, transportation costs and the time spent by family members caring for family members with the disease. In 2002, these costs were estimated at $32 billion[7].

The Response to COPD: Although COPD is a leading cause of death in the U.S. and has been receiving more attention in the healthcare community, it remains largely unknown to both the general public and to policy makers. There continues to be little in the way of a concerted national effort to tackle this problem.

One project that has directly addressed COPD is the Healthy People 2010 Initiative (HP 2010). Healthy People 2010 laid out two COPD related goals: 1) to reduce the proportion of adults whose activity is limited due to chronic lung and breathing problems, and 2) to reduce deaths from COPD in adults. In addition, the Agency for Healthcare Research and Quality (AHRQ) has developed a Prevention Quality Indicator related to COPD, namely, the rate of hospital admission for COPD.

Table 2: Outcome measures in COPD

Source	Outcome Measure	Goal
HP 2010	Proportion of Adults with Activity Limitation	1.5%
HP 2010	Mortality	50% reduction
AHRQ	Hospital Admission Rate	Reduction

Colorado COPD Surveillance Report 2007: This report was drafted by the Colorado COPD Coalition to support the development of a state plan for COPD. In this report, we will summarize the data currently available on COPD in Colorado, provide some projection of the future burden based on information on current tobacco usage, outline additional data sources which can be used to explore questions related to COPD in the state, and highlight some of the most important gaps in our current knowledge base.

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Part 5: COPD in Colorado: An Overview

In 2005, COPD was the fourth leading cause of death in Colorado. Although the number of deaths due to cancer and cardiovascular disease are much higher, accidental injuries (the third leading cause of death) are a problem of similar magnitude (Table 3). In fact, between 1990 and 2005, COPD has frequently replaced injuries as the third leading cause of death.

Table 3: Leading causes of death in Colorado, 2005

Cause of death	Number of deaths	Percent of deaths
1. Malignant neoplasms	6,367	21.6
2. Heart disease	6,282	21.3
3. Unintentional injuries	1,928	6.5
4. Chronic Lower Respiratory Tract Disease	1,908	6.5

Source: Health Statistics Section, CDPHE

Colorado has one of the highest COPD mortality rates in the nation. In 2003, Colorado ranked 7th among all states. In general, the highest rates nationwide are in Appalachia and the Mountain West (Figure 3).

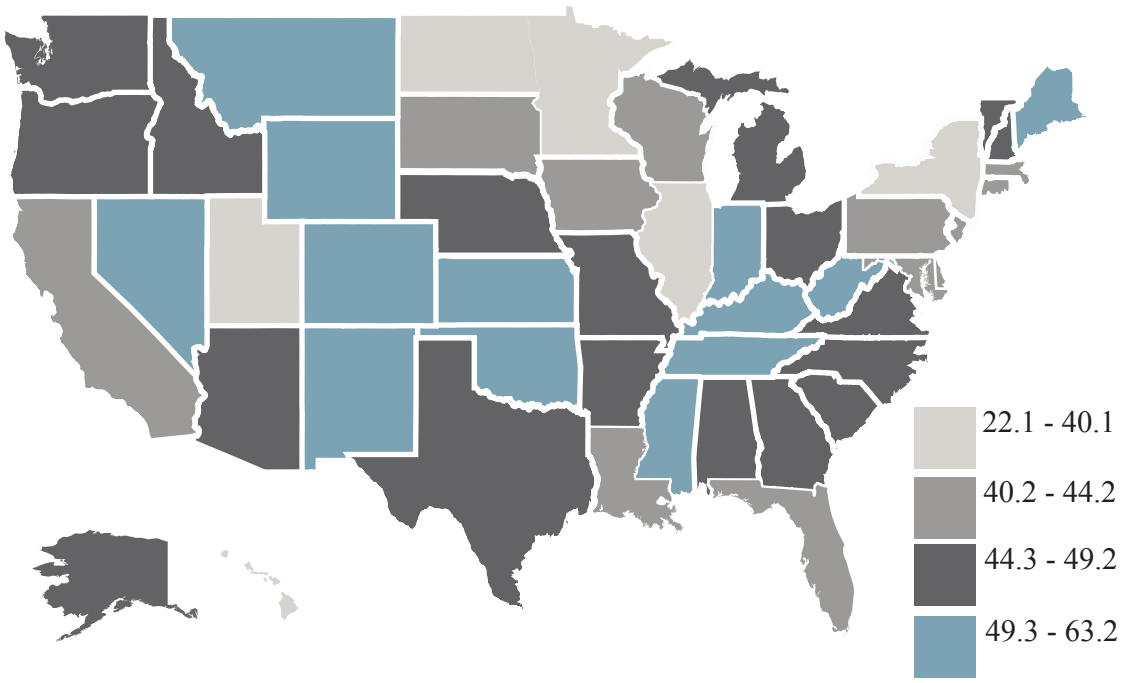

Figure 3: Chronic lower respiratory disease mortality age-adjusted to 2000 U.S. standard million/rate per 100,000.

The reason for this increased rate of COPD mortality in Colorado in not clear. One obvious explanation would be high prevalence of smoking. However, Colorado's smoking prevalence is one of the lowest in the nation. This pattern of high COPD mortality despite average or lower than average smoking prevalence is true for other states in the Mountain West like Montana, Wyoming and New Mexico (Figure 4)[1]. There is no clear explanation for this finding, but possible explanations include increased exposure to second hand smoke, air pollution, dust, agriculture, the effect of altitude, differences in the diagnosis or care of patients with COPD, and immigration of COPD patients to the region.

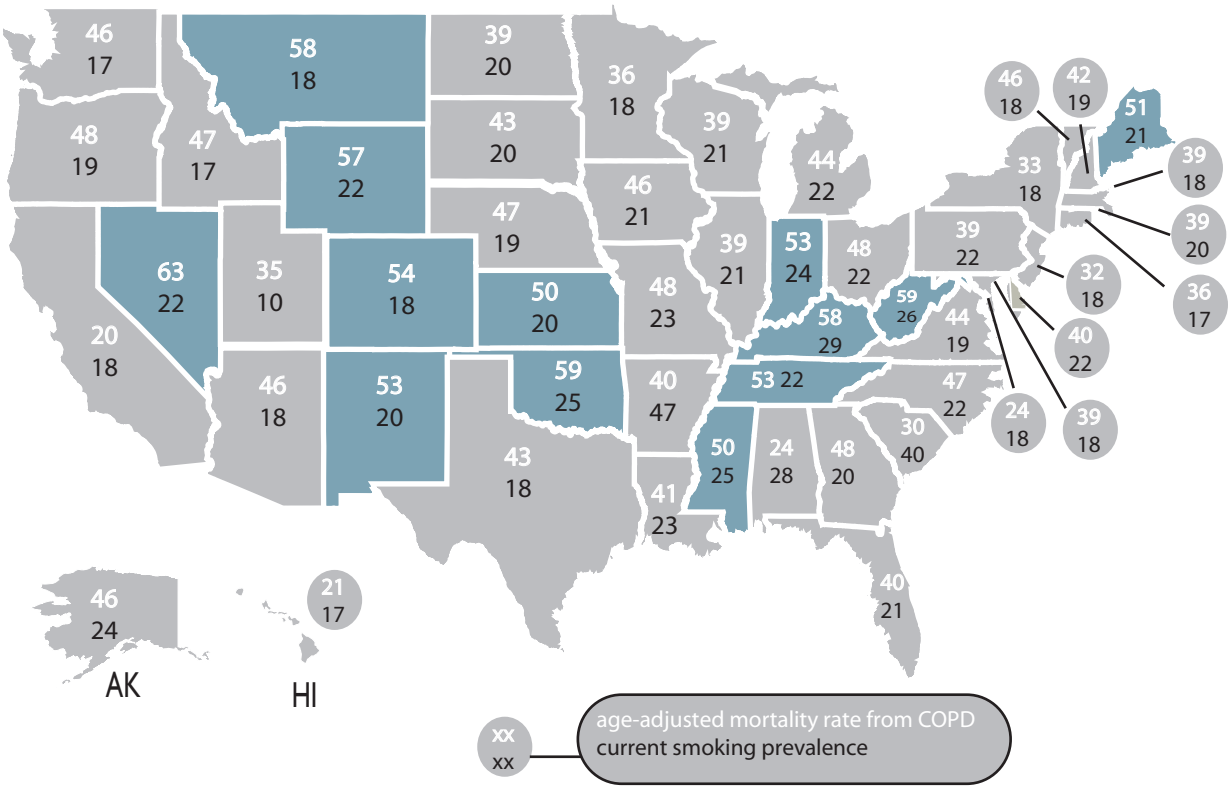

Figure 4. Comparison of U.S. age-adjusted COPD mortality and smoking prevalence

While knowing the number of people dying of COPD is important, it is perhaps more more important to know the number of Coloradans currently living with the disease. Unfortunately, less information exists on this population. We know that COPD is responsible for thousands of hospitalizations and tens of millions of dollars in hospital charges in Colorado each year (see Part 9, Temporal Trends), but do not have good measurements of the prevalence of the disease. We can, however, make calculated estimates.

Based on national data, the American Lung Association estimates that the number of people in Colorado who carry a diagnosis of COPD could be between 140,000 and 190,000[2] (See Appendix I). We know that the number of people who have undiagnosed COPD is typically much higher (2.4 times higher in the National Health and Nutrition Evaluation III survey)[3], putting the estimate of Coloradans with COPD closer to 330,000 to 450,000. These figures assume that Colorado has an average prevalence of COPD. If the elevated mortality rates from COPD in Colorado are because COPD is more common in Colorado, even these numbers are likely to underestimate the true prevalence.

Currently we have a poor understanding of the impact that living with COPD has on patients, their families, and their communities. One of the goals set forth in Healthy People 2010 is a reduction in the number of people whose activities are limited by COPD. We do not yet know what this number might be in Colorado. In addition, aside from hospital charges, we do not understand the economic burden of COPD to the state. This burden includes office and ER visits, medications, and time away from work for patients and their loved ones.

In summary, mortality data suggest that Colorado has one of the highest burdens of COPD in the nation yet many questions remain as to why this is the case, how many Coloradans are truly affected by this disease, and what the true costs are in terms of human suffering and lost productivity.

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Part 6: COPD and Related Diseases

Although COPD is responsible for nearly 2,000 deaths per year, this number actually underestimates the true burden of mortality related to the disease. COPD, as a chronic disease, often contributes to death from other causes. From 1990-2005, 25,830 Coloradans died with COPD listed as the primary cause of death. An additional 22,544 had COPD listed as a contributing cause of death. Focusing on the cases in which COPD was listed as the primary cause tells us only part of the story.

COPD, as a primarily smoking-related lung disease, shares risk factors with other smoking-related diseases such as coronary artery disease, stroke, and lung cancer. The relationship between COPD and these other diseases is more complex than just exposure to tobacco smoke. COPD is an independent risk factor for the development of cardiovascular disease[1] and lung cancer[2] after adjusting for the effects of smoking. In other words, given two people with an equivalent smoking history, one with COPD and one without, the person with COPD is at higher risk of developing cardiovascular disease and lung cancer.

COPD is also a risk factor for the development of other lung diseases, such as pneumonia, pulmonary hypertension, and pneumothorax (a collapsed lung), and is associated with high rates of depression and anxiety, osteoporosis, and significant weight loss.

The relevance of these relationships is apparent when we examine the underlying cause of death in the 22,544 people who died with COPD as a contributing cause of death. Fully 49% died of cardiovascular disease. While this might not be surprising given that cardiovascular disease is the most common cause of death in Coloradans, only 30% of Coloradans overall died of cardiovascular causes in 2005. As demonstrated in other reports, the risk of cardiovascular death is increased in people with COPD.

Cancer was responsible for 25% of deaths in patients with COPD as a contributing cause of death. Again, this is not surprising given that cancer is the second leading cause of death in Colorado. However, 53% of these cancer deaths were due to lung cancer, compared to less than 25% of cancer deaths in Colorado as a whole.

Seven percent of patients who died with COPD as a contributing cause died of other respiratory conditions. The most common was pneumonia, accounting for 73% of these respiratory deaths.

While COPD is a leading cause of death, limiting our attention to cases where COPD was the primary cause underestimates the burden of this disease. Many deaths due to other common causes such as cardiovascular disease, lung cancer, and pneumonia are directly related to COPD. Efforts at reducing the burden of COPD should also improve the outcomes in these other important public health problems.

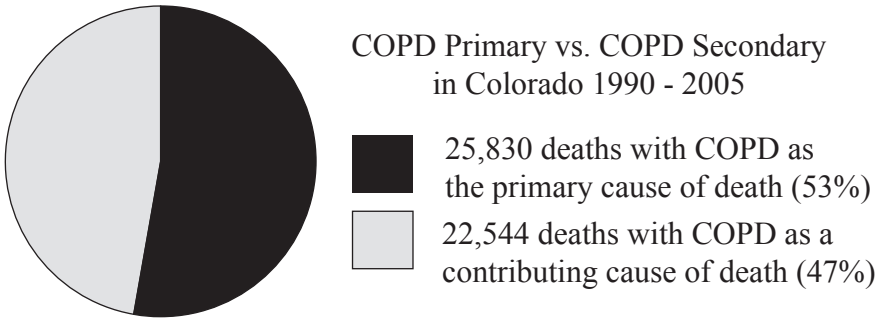

Figure 6. COPD as primary cause of death vs. COPD as secondary cause of death in Colorado 1990-2005

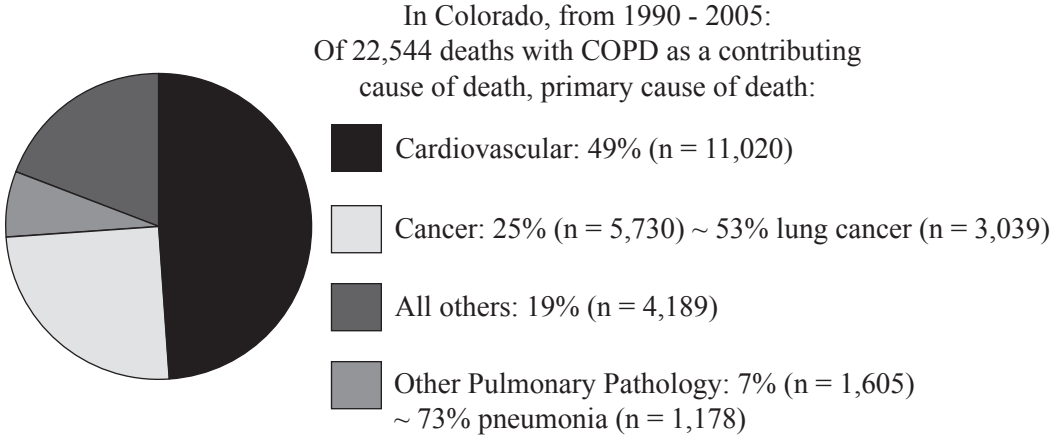

Figure 7. Breakdown of COPD as contributing cause of death in Colorado 1990-2005

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Part 7: Temporal Trends in COPD

Recent reports (developed nationally and internationally) have emphasized the steady increase in COPD mortality over time, projecting that COPD will continue to grow as a leading cause of death worldwide. This projected increase is largely driven by two factors: 1) changing demographics, with an increasing population of older adults, and 2) rising prevalence of cigarette smoking in the later half of the 20th century.

We examined trends in COPD mortality and hospitalizations in Colorado from 1990 to 2005. The number of deaths due to COPD has indeed increased steadily over that time period (Figure 8).

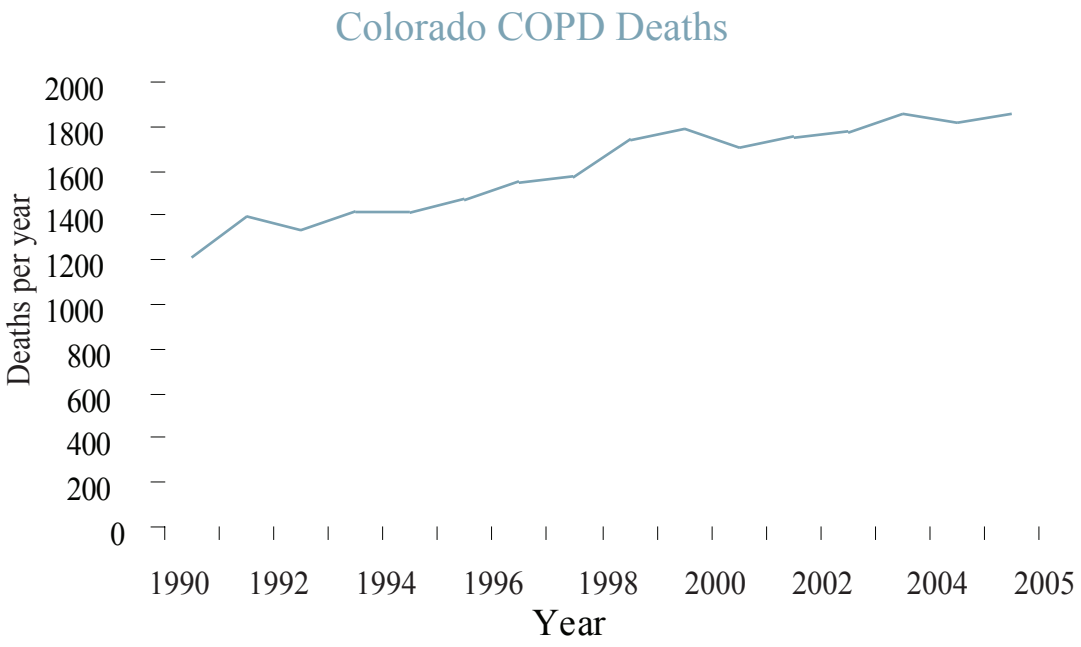

Figure 8: Colorado COPD deaths per year, age 25 and over, 1990-2005

The mortality rate from COPD, however, has remained relatively constant over this time frame (Figure 9). Thus the observed increase in COPD deaths is more likely due to an increasing population, rather than an increase in the proportion of Coloradans dying of COPD.

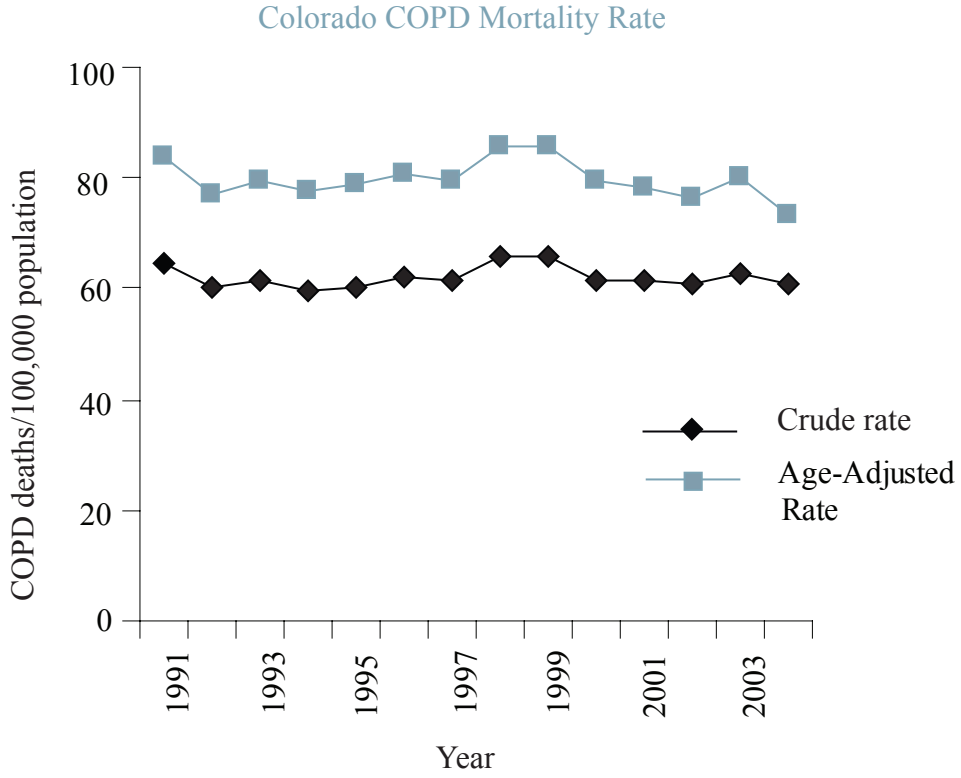

Figure 9. Colorado COPD mortality rates, age 25 and over, 1991-2004

This finding seems contrary to the increasing trends in COPD death rates described in the U.S. as a whole. Yet closer examination of temporal trends in the U.S. indicate that while COPD mortality climbed steadily from the mid-1960s until the end of the 1990s (see Figure 2 in the Introduction), COPD death rates have leveled off or declined slightly since 1999 (Figure 10).

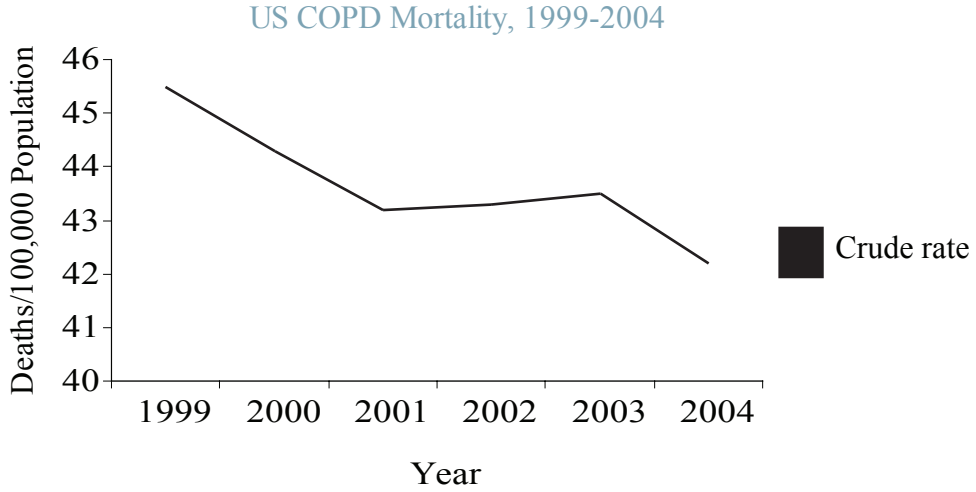

Figure 10. U.S. COPD mortality rate, all ages, 1999-2004

To explore these surprising trends in greater detail, we examined COPD mortality over time in men and women separately. COPD mortality in men has actually decreased slightly over time, while COPD mortality in women has increased over time. The net effect of these opposing trends are the stable rates seen in Figure 10, above.

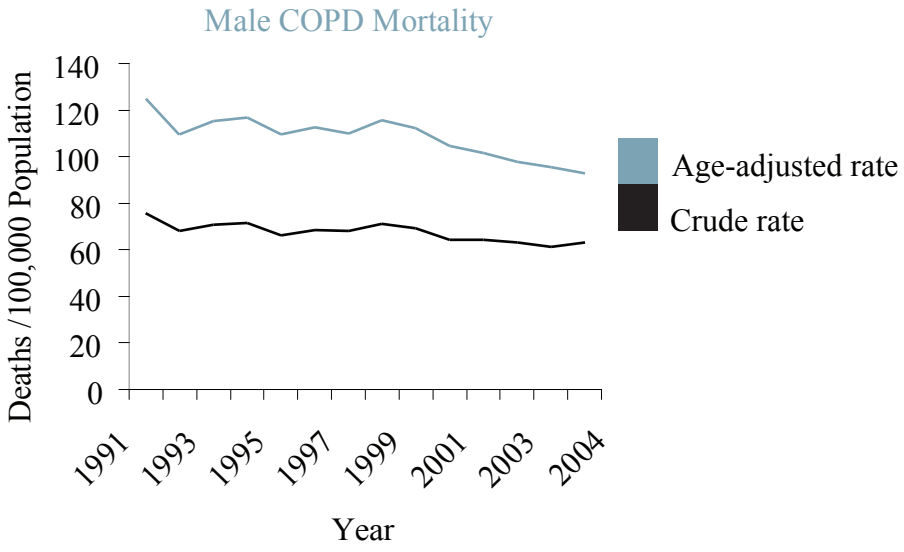

Figure 11. Colorado COPD mortality rate in males, age 25 and over, 1991-2004

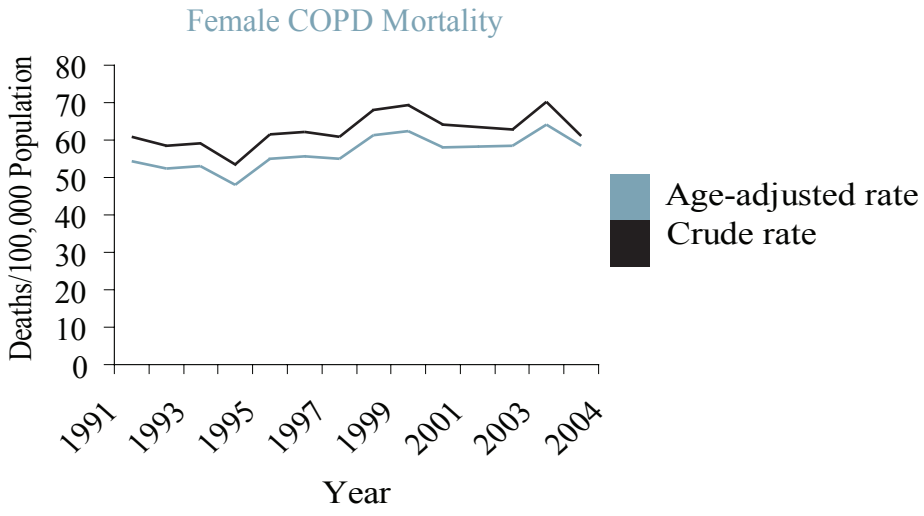

Figure 12. Colorado COPD mortality rate in females, age 25 and over, 1991-2004

The explanation for these findings is likely due to the fact that smoking was more rapidly adopted in men and men's rates of COPD mortality increased earlier. As smoking prevalence has declined, so too have COPD mortality rates. Women adopted smoking later than men and consequently the rise in COPD mortality in women has lagged behind that in men and is still on the rise.

Mortality is only one way to examine changes in the burden of COPD over time. There have also been trends in COPD hospitalizations over time. Rates of hospitalizations for COPD increased between 1990 and 1999. Since that time, rates have fallen (Figure 13). Similar tends are seen in the number of hospitalizations for COPD, with decreases seen since 2001. In contrast to the gender differences observed in COPD mortality, trends in COPD hospitalizations are similar in men and women.

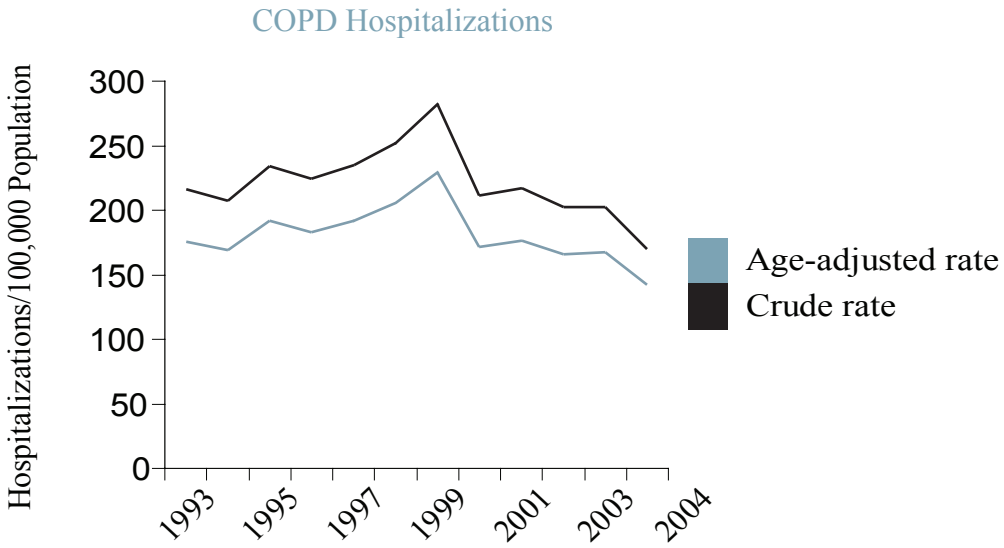

Figure 13. Colorado COPD hospitalization rates, ages 25 and over, 1993-2004

While the rate and number of COPD hospitalizations have fallen in recent years, the economic burden of these hospitalizations has continued to rise. Charges related to hospitalization for COPD in Colorado exceed 70 million dollars per year.

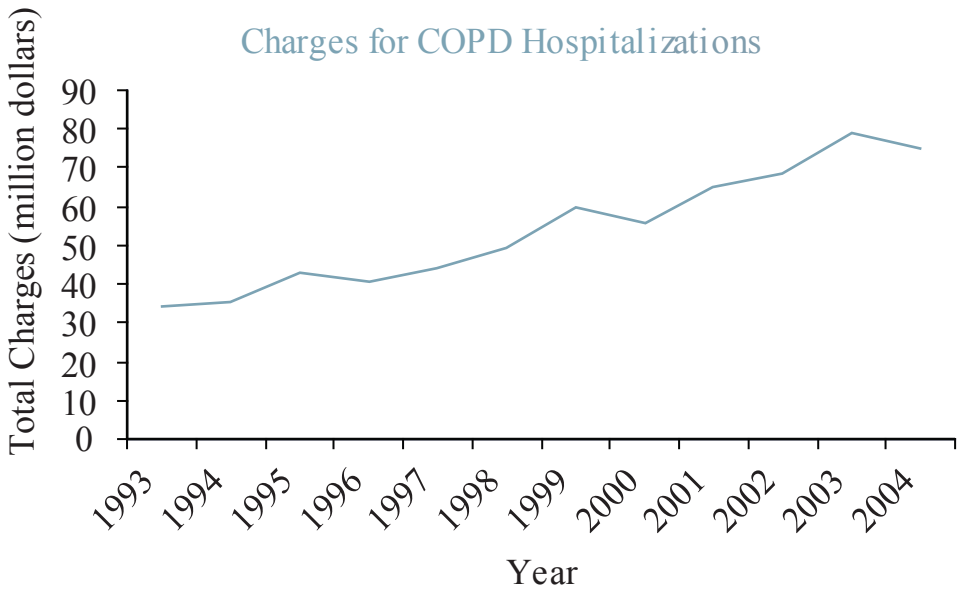

Figure 14. Annual total charges for COPD hospitalization in Colorado, 1993-2005

What is the significance of these findings? First, it is important to recognize that while upward trends in COPD mortality and hospitalizations have decreased in recent years, the burden of COPD in Colorado remains significant and will likely continue for decades to come. Furthermore, it is not certain that the decreases seen in recent years will continue, as the population continues to age and exposure to tobacco and other irritants persists. While overall rates have indeed declined, rates in specific populations, such as women, continue to rise. Finally, it is important to consider these trends over time when evaluating the impact of public health measures over time. Current declines in COPD mortality and hospitalization likely reflect previous efforts to decrease smoking rates and improve air quality as well as advances in COPD treatment. Current initiatives to improve outcomes in COPD will have to account for previous interventions and the trends seen in recent years.

Part 8: COPD in Specific Populations

In order to better understand where the burden of COPD lies in the state of Colorado, we compared COPD mortality and hospitalizations in different populations according to age, gender, race/ethnicity, and geography. We also examined the exposure to tobacco in those populations.

Age: In general, COPD is a disease of older adults. We have restricted our analysis to age 25 and over, as COPD is extremely uncommon under age 25 and would likely represent a misdiagnosis. In general, as age increases so does the rate of hospitalization and death from COPD (Table 1). It is worth noting that rates of COPD hospitalization begin to rise approximately 10 years before the rates of COPD mortality.

Table 4: Crude COPD hospitalization and mortality rates by age category, age 25 and over, Colorado, 2004 (* Events per 100,000 population)

Age category	COPD hospitalization rate	COPD mortality rate
25-34	0.89	0
35-44	9.73	0.96
45-54	53.79	6.99
55-64	187.72	43.60
64-75	573.93	173.25
75+	774.51	566.60

Gender: As shown in Part 7: Temporal Trends in COPD, there are important differences in COPD between men and women. Historically, men have had much higher rates of mortality from COPD than have women. While COPD mortality in men has declined in recent years, it is rising in women and the gap in mortality rates is closing.

Another important difference between men and women is the age distribution. In general, women live longer than men. The population of women contains more elderly people than does the population of men. The result is that while the age-adjusted mortality rates due to COPD are different, the actual number of people dying of COPD (and the crude rates of COPD mortality) are quite similar between men and women (Table 2). However, isolated examination of the age-adjusted rate is misleading as it underestimates the true burden of COPD in Coloradan women.

Table 5: Colorado COPD mortality by gender, age 25 and up, 2004
(* Events per 100,000 population)

Gender	Number of deaths	Crude rate*	Age-Adjusted rate*
Male	939	63.2	98.0
Female	884	58.5	64.8

The scope of the COPD problem in women is even more pronounced when examining hospitalizations. While men have somewhat higher age-adjusted rates of hospitalization than women, the actual number of hospitalizations (and the crude rate) are higher in women than men (Table 3). COPD is clearly a major problem for women in Colorado, and will likely increase if current trends continue.

Table 6: Colorado COPD hospitalizations by gender, age 25 and up, 2004
(* Events per 100,000 population)

Gender	Number of hospitalizations	Crude rate*	Age-Adjusted rate*
Male	2010	135.3	185.1
Female	2248	148.8	160.8

Race/Ethnicity: In Colorado, as in the U.S. as a whole, COPD mortality is highest among whites. The fact that these disparities are greatest in crude rates, and decreased by age-adjustment, indicates that at least some of this disparity is due to an older average population in whites. However, some disparity does persist after age-adjustment, suggesting that whites do, in fact, have a higher rate of death from COPD than non-whites. Although the reasons for this are not entirely clear, it likely includes historical trends in smoking prevalence which increased earlier in whites than in other racial/ethnic groups. Competing mortality from other causes may also contribute to the observed differences.

Examining contemporary smoking data (see Tobacco Use in Specific Populations, page 28), it appears that the prevalence of tobacco abuse among blacks and Hispanics is similar to that among whites, and that the prevalence of tobacco abuse among American Indians is even higher. It is likely that COPD mortality in these racial/ethnic minorities will increase in future years.

Table 7. Colorado COPD mortality by racial/ethnic group, age 25 and up, 2005 (*Events per 100,000 population)

Race	COPD deaths	Population	Crude rate*	Age-Adjusted rate*
White	1694	2365023	71.63	82.57
Hispanic	116	424321	27.34	61.13
Black	33	117589	28.06	48.45
Asian	7	87296	8.02	14.54
American Indian	6	42666	14.06	24.63

Geography: Colorado is a state with significant geographic and demographic diversity in its communities. We examined the burden of COPD in urban, rural, and frontier counties. Counties are designated by the Colorado Rural Health Center and the Colorado Department of Public Health and the Environment as follows: Urban: One city with 50,000 or more inhabitants or a Census Bureau-defined urbanized area (of at least 50,000 inhabitants) and a total metropolitan population of at least 100,000. Frontier: 6 or fewer people/square mile. Rural: Neither urban nor frontier. A map of Colorado showing the counties and their designations is shown in Figure 15.

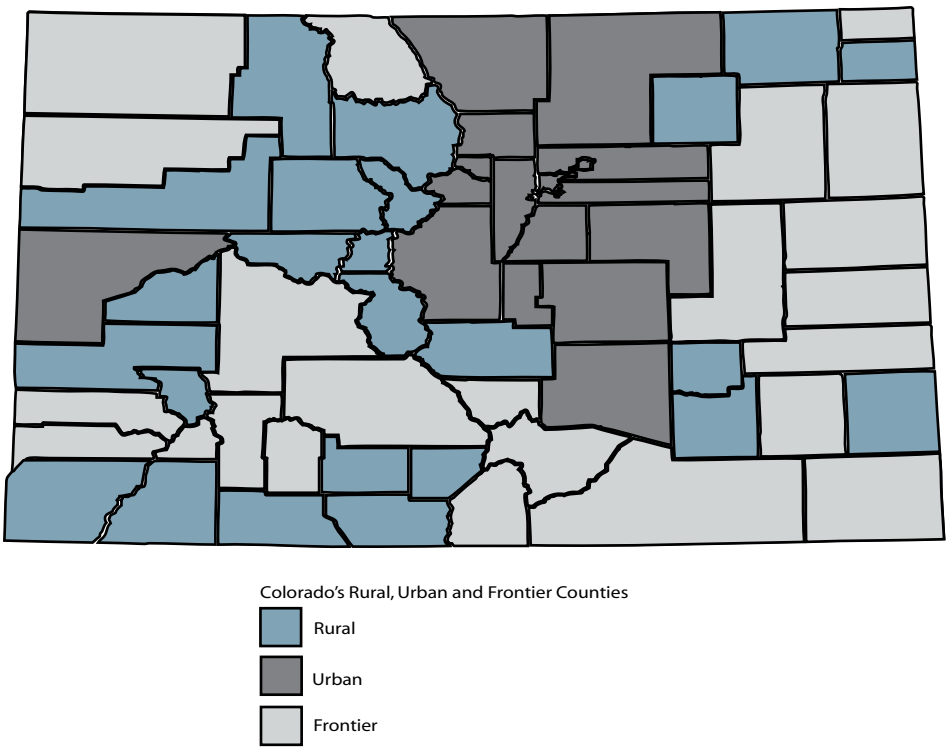

Figure 15: Map or Colorado's rural, urban, and frontier counties.

The highest crude rates of COPD mortality are in rural and frontier counties (Table 8). Examining this further, we compared the average COPD mortality rate across all counties in each category. We found that the crude rates of COPD mortality were highest in frontier counties, intermediate in rural counties, and lowest in urban counties.

Table 8: Counties with crude rates of COPD Mortality > 110/100,000; 1990-2004, age 25 and over (*Rates are COPD deaths per 100,000 population)

County	Region	Crude rate*	Age-Adjusted rate*
Bent	Frontier	153.078	128.231
Otero	Rural	157.001	119.245
Dolores	Frontier	139.89	119.384
Sedgwick	Frontier	134.748	86.293
Kiowa	Frontier	136.278	93.946
Washington	Frontier	132.826	99.969
Huerfano	Frontier	115.476	87.806
Fremont	Rural	110.595	99.855
Lincoln	Frontier	111.029	95.071
Rio Grande	Rural	118.491	101.818

Table 9: COPD mortality by region

Region	Crude rate*	Age-Adjusted rate*
Urban	39.9	54.5
Rural	51.4**	53.1
Frontier	57.1***	51.4

*Rates are COPD deaths per 100,000 population

** p <0.05 vs. urban (RR 1.29 (95% CI 1.24-1.33))

*** p < 0.05 vs. urban (RR 1.43 (95% CI 1.34-1.52))

and rural (RR 1.11 (95% CI 1.04-1.19))

Source: Health Statistics Section, CDPHE

The fact that there is a difference in average COPD mortality rates between urban, rural, and frontier counties suggests that much of the difference in COPD mortality is due to variations in demographics in these regions. Rural and frontier counties have, on average, older populations. As with gender differences, examining only age-adjusted rates misses a significant part of the public health message. Elevated crude rates of COPD mortality suggest that rural and frontier counties have an increased burden of COPD (relative to urban Colorado), and that much of that burden is due to older populations living in rural and frontier areas.

Although age-adjustment does away with the differences in average COPD mortality, there remain areas in rural Colorado which have elevated rates of COPD mortality even after age-adjustment (Figure 16). The southeastern counties of Bent, Crowley, Otero, and Prowers have particularly high rates of crude and age-adjusted COPD mortality (Table 8).

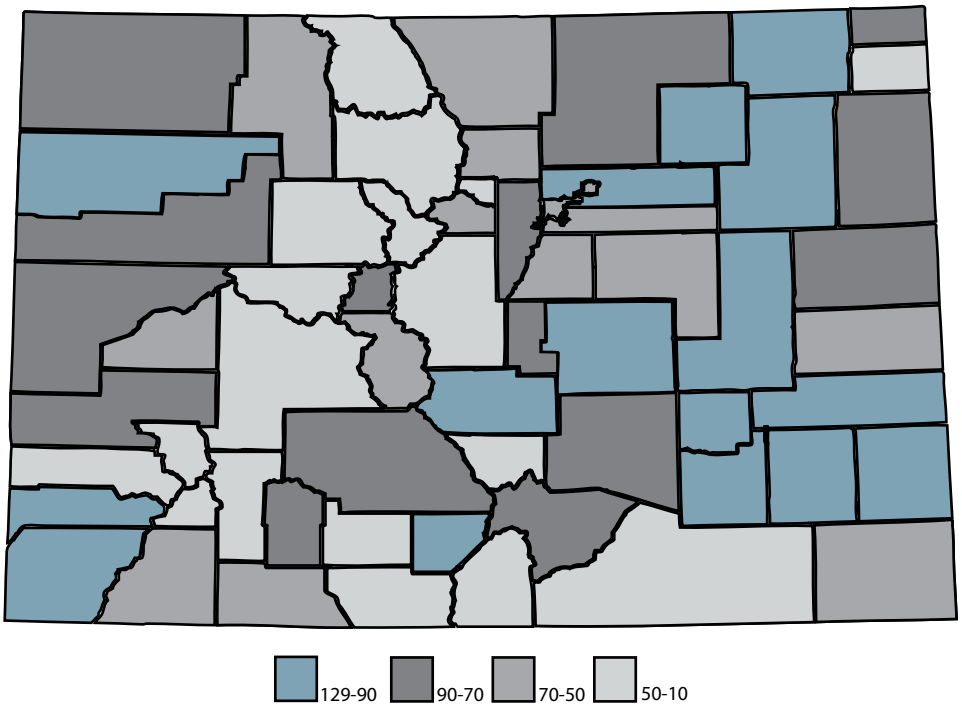

Figure 16: Age-adjusted COPD mortality rates in Colorado. COPD deaths/100,000 population per year, 1990-2005, age 25 and over.

Table 10: Counties with age-adjusted rates of COPD mortality > 100/100,000; 1990-2004, age 25 and over (*Rates are COPD deaths per 100,000 population)

County	Region	Crude rate	Age-Adjusted rate
Bent	Frontier	153.078	128.231
Crowley	Rural	107.796	129.841
Otero	Rural	157.001	119.245
Rio Blanco	Frontier	99.759	116.122
Prowers	Rural	124.89	115.953
Adams	Urban	66.961	106.733
Dolores	Frontier	139.89	119.384
Rio Grande	Rural	118.491	101.818

The explanation for these findings is not entirely clear. We have pointed out that some of the disparity in COPD mortality is related to demographics. Another obvious explanation would be differences in smoking behavior. However, recent data do not suggest a significantly elevated prevalence of tobacco abuse in rural Colorado as compared to urban Colorado. Other explanations could include differences in medical diagnosis or care, increased exposure to second-hand smoke, or increased exposure to other environmental air pollutants.

Tobacco Use in Specific Populations: Because smoking is the most important risk factor for developing COPD, examining disparities in tobacco use can give us some insight into disparities in developing COPD. Data on smoking in Colorado come from two primary sources: the Behavioral Risk Factors Surveillance System (BRFSS) and the Tobacco Attitudes and Behaviors Survey (TABS).

In summary, smoking prevalence is slightly higher in women than in men and is higher in rural populations in comparison to urban and suburban populations. Smoking is much more common in younger adults (a finding that suggests the risk of COPD will not be diminished in the near future) and using white race/ethinicity as the referent group, blacks and Asians have a lower prevalence of tobacco abuse, whereas latinos have a somewhat higher prevalence, and American Indians have a significantly higher prevalence of tobacco abuse. The most striking correlations with prevalence of tobacco abuse are measures of socioeconomic disadvantage, including income, education, insurance status, and the presence of a disability or inability to work.

Table 11: Colorado tobacco use in specific groups		
Group	Number that smoke	% of group that smokes
all adults	627,747	19.6
Sex		
male	323.993	20.3
female	303,754	19.0
Age Group		
18-24	129.734	30.2*
25-64	460,745	19.6
65+	37,259	9.0
Ethnicity		
white (non-Hispanic)	470,465	19.0
Hispanic or Latino (all)	102,114	21.5
black or African American	19,713	17.8
American Indian	15,444	35.7*
Asian American	9,731	16.3
all other	10,279	29.0*
Income §		
median or above	339,559	16.7
below median	155,076	27.1*
poverty	58,849	35.7*
Completed high school §		
yes	553,523	18.4
no	70,252	42.8*
Has health insurance §		
yes	407,335	16.2
no	134,256	41.2*
Disabled / unable to work §		
no	597,249	19.2
yes	29,008	43.7*
Region		
urban or suburban	483,630	19.3
rural	144,117	21.0

* much higher than national average

§ people with unknown status are not shown

Source: Adapted from Unequal Tobacco Burdens A report on Colorado disparities in use and exposures Arnold H. Levinson, Ph.D. Spring 2002

Part 9: COPD Surveillance Deficiencies and Future Needs

Although a great deal of data exists on COPD in Colorado, much more is needed to fully comprehend the problem.

Prevalence: Currently, there is no prevalence data for the state. Obtaining some measure of COPD prevalence should be the highest priority for future data gathering. Prevalence estimates can come from two different modalities: self-report or spirometry.

Questions to identify self-reported COPD have been used in national surveys to categorize COPD prevalence. These surveys include the National Health Interview Survey (NHIS) and the National Health and Nutrition Examination Survey (NHANES) III. To capture self-reported COPD, Colorado should utilize these same questions to facilitate comparability between Colorado rates and rates in the country as a whole. Additional effort should be spent on ensuring a proper sampling frame. The most convenient way to utilize an existing sampling frame to answer questions about COPD prevalence, would be the addition of a COPD module to the Behavioral Risk Factors Surveillance System (BRFSS). This can be done on a state-level.

Self-report has the advantage of ease in obtaining estimates of COPD prevalence. However, self-report is also prone to misclassification. Patients can over- or under-report COPD. Therefore, the most reliable estimates of COPD prevalence come from surveys which test lung function through the use of a device called a spirometer.

Methods exist for performing spirometric surveys on a large scale. Examples include NHANES III, as well as international surveys such as the PLATINO and BOLD projects. Although it is important to encourage the use of spirometry in the clinical setting for diagnosis and management of COPD, this will not provide useful prevalence data. As with self-reported prevalence, attention needs to be paid to the sampling frame as well as the technical aspects of spirometry. As spirometry needs to be performed in person, it is unlikely that this could be added on to any existing data and surveillance activities. It would need to be initiated specifically for the purpose of obtaining COPD prevalence estimates, and should include a broad range of Colorado populations representing gender, racial/ethnic, chronologic, geographic, and socioeconomic diversity.

Activity Limitation: One of the outcome measures proposed by the Healthy People 2010 initiative is a decrease in the proportion of adults whose activities are limited by chronic breathing problems. National data comes from self-report, with questions administered during the NHIS. Currently, Colorado does not collect such data. Future efforts should attempt to quantify activity limitation and other patient-centered outcomes related to COPD. As with self-reported prevalence, BRFSS may provide

the most convenient way to acquire data on activity limitation.

Health Care Utilization: Good data exists on hospitalizations related to COPD and is available from the Colorado Hospital Association (CHA). We do not have, however, data on the number of ER visits or office visits related to COPD in Colorado. Such data might be obtained by approaching hospitals, insurers, and other providers of healthcare. An alternate strategy would be to interrogate national databases such as the National Ambulatory Medical Care Survey (NAMCS) and the National Hospital Ambulatory Medical Care Survey (NHAMCS).

Economic Impact: Our current knowledge of the economic impact of COPD on the state of Colorado is limited, as it is based entirely on hospital charges. Additional efforts should be made to capture other health care utilization (see above), as well as expenditures on medications and medical supplies (including oxygen use), time off work, and time spent by family members caring for patients with COPD.

Health Disparities: Particular attention should be made to better characterize the burden of COPD in particular populations. Specifically, attention should be paid to older populations, rural and frontier populations, racial/ethnic minorities, and persons with socioeconomic disadvantage.

Part 10: Data Sources

Colorado Department of Public Health and the Environment

Description: The Colorado Department of Public Health and the Environment (CDPHE) collects deaths, tobacco use, and cancer diagnoses in the state of Colorado. They collect records of over 20,000 deaths per year, of which approximately 1,800 are from COPD and an additional 1,500+ which have COPD as a contributing cause.

Databases: Death statistics are available in a number of forms: aggregated reports, the Colorado Health Information Dataset (CoHID), or raw data obtained after submitting a formal data request. Data on tobacco use is obtained through two surveys: Behavioral Risk Factors Surveillance System (BRFSS) and the Tobacco Attitudes and Behaviors Survey (TABS). Again, this information can be acquired through aggregated reports or from CoHID. Data on cancers which might be relevant to COPD (e.g. lung cancer) are kept by the Colorado Central Cancer Registry, and can be obtained via CoHID or by formal request.

Contact Information:

CDPHE Health Statistics Section:

Colorado Department of Public Health and Environment
Health Statistics Section
4300 Cherry Creek Drive South
CHEIS-HS-A1
Denver, Colorado 80246-1530
FAX: (303) 691-7704
Phone : (303) 692-2160
E-mail: health.statistics@state.co.us
Attention: Mary Chase

CoHID

Contact CDPHE Health Statistics Section
E-mail: cohid@state.co.us
Website: www.cdphe.state.co.us/cohid/

State Tobacco Education and Prevention Partnership (STEPP)

STEPP Colorado Department of Public Health and Environment
Prevention Services Division
4300 Cherry Creek Drive South
Denver, CO 80246-1530
Phone: (303) 692-2510 or 1-(800) 886-7689 (toll-free)
E-mail: stepprpt@state.co.us
Website: www.cdphe.state.co.us/pp/tobacco/
Attention: Carsten Bauman

BRFSS

Contact CDPHE Health Statistics Section
Website: www.cdphe.state.co.us/hs/brfss

Cancer Registry

Colorado Central Cancer Registry
Colorado Department of Public Health and Environment
Prevention Services Division
4300 Cherry Creek Drive South
PSD-CR-A5
Denver, CO 80246-1530
Phone: 303-692-2540
E-mail: cdphe.pscaregistry@state.co.us
Website: www.cdphe.state.co.us/pp/cccr/index.html

State Demography Office

Description: The State Demography Office is the primary state agency for population and demographic information.

Databases: Summary reports and raw data can be obtained by formal request. Population estimates for denominator values of rate calculations are also available on CoHID (see CDPHE).

Contact Information:

State Demography Office

Colorado Department of Local Affairs
Division of Local Government
1313 Sherman Street, Room 521
Denver, CO 80203
Phone: (303) 866-4147
Fax: (303) 866-4317
E-mail: dola.helpdesk@state.co.us
Website: www.dola.state.co.us/dlg/demog/index.html

Colorado Hospital Association

Description: The Colorado Hospital Association collects information on all inpatient and ambulatory surgery data of member hospitals throughout the state. This includes information on more than 4,000 hospitalization per year from COPD.

Databases: The discharge database includes information on demographic variables, dates of hospitalization, diagnoses, procedures, payer status, disposition, charges, and days on mechanical ventilation. This information can be obtained with a formal data request and with a charge per record accessed.

Contact Information:
Colorado Hospital Association
7335 E.Orchard Rd.
Greenwood Village, CO 80111
Phone: (720) 489-1630
Website: www.cha.com/ or www.hospitalquality.org/
Attention: Bob Finn, Director of Information Services

Kaiser Permanente

Description: Kaiser Permanente (KP) is the largest nonprofit health plan in the United States. KP operates out of two areas in Colorado, the Denver/Boulder area and Colorado Springs, and covers over 480,000 Coloradans. The estimated prevalence of COPD at KP in Colorado is 4%, representing around 19,000 individuals.

Databases: KP maintains a number of databases that can be accessed for research, including the electronic medical record, automated administrative data (including information about membership, outside claims, deaths, and costs), automated clinical data (including outpatient visits, hospitalizations, emergency department visits, labs, home health, and long-term care), and automated pharmacy data. This information is not publicly available, but can be accessed by researchers at the KP Colorado Clinical Research Unit (CRU).

Contact Information:
Kaiser Permanente Clinical Research Unit
10065 E. Harvard Ave Ste 300
Denver, CO 80237-8066
Phone: 303-614-1300
Fax: 303-614-1305
E-mail: Betty.J.Walker-Simmons@kp.org
Website: www.kpco-cru.org/Default.htm

Department of Veterans Affairs

Description: The Department of Veterans Affairs (VA) provides healthcare for eligible veterans and their families. The VA is a national healthcare system, operating 154 medical centers. Centers are located in every state and in Puerto Rico and the District of Columbia. In 2005, the VA provided healthcare to 5.3 million people. Over 100,000 carry a diagnosis of COPD. Colorado is administered under the Veterans Integrated Service Network (VISN) 19.

Databases: The VA maintains a number of databases which contain information on inpatient and outpatient encounters (Medical SAS files), pharmacy services (Decision Support System (DSS) and Pharmacy Benefits Management (PBM)), and vital statistics (VA Vital Status File and Beneficiary Identification & Records Locator System (BIRLS) Death File). Detailed documentation on the contents of these datasets, and information about applying for access, and available at the VA Information Resource Center (VIReC) website, listed below. In general, access will require collaboration with a VA researcher.

Contact Information:

VA Information Resource Center (VIReC)

Building 1, Room C303
Hines VA Hospital (151V)
5th Avenue Roosevelt Road
Hines, IL 60141-5000
Phone: 708-202-2413
Fax: 708-202-2415
E-Mail: virec@va.gov
Website: www.virec.research.va.gov
Attention: Robert Keith, MD

Centers for Medicare and Medicaid Services (CMS)

Description: CMS administers two large, federally-sponsored healthcare programs: Medicare and Medicaid. Between these two sources, CMS is the single largest payer of healthcare in the country. Medicare is an insurance program that covers Americans age 65 or over, as well as those with disabilities and/or end-stage renal disease. Medicaid is administered at a state-level, and provides payment for medical services for eligible participants, usually on the basis of low-income.

Databases: CMS has a number of datasets which contain information about inpatient and outpatient encounters, long-term care, and pharmacy utilization, as well as charges and expenditures. In general, they fall into one of three categories: identifiable data files, limited data set files, and non-identifiable files. Detailed documentation on the contents of these datasets, and information about applying for access, and available at the CMS website (www.cms.hhs.gov/FilesForOrderGenInfo/: CMS Home > Research, Statistics, Data and Systems > Files for Order - General Information > Overview). All requests for identifiable data or limited data set files must be developed and reviewed with the assistance of the Research Data Assistance Center (ResDAC). Non-identifiable files contain only summary information and are in the public domain.

Contact Information:

Research Data Assistance Center

University of Minnesota
School of Public Health
Division of Health Services Research & Policy
420 Delaware St. SE, MMC 97
Minneapolis, MN 55455-0381
Phone: 1-888-9-ResDAC or (1-888-973-7322)
Fax: 612-378-4866
E-Mail: resdac@umn.edu
Website: www.resdac.umn.edu

Part 11: Technical Notes

Terminology

Count: number of events (e.g. deaths, hospitalizations)
Crude Rate: number of events / population at risk, over a specified time period
Age-Adjusted Rate: age-specific crude rates applied to a standard population. In this report, we use the 2000 U.S. Census

Numerators

Numerous definitions of COPD exist for use with administrative data. In addition, different definitions are used for mortality and hospitalizations. Further complicating the matter, mortality definitions use both International Classification of Disease, 9th Revision (ICD-9, used prior to 1999) and 10th Revision (ICD-10, used since January 1st, 1999) codes, whereas hospitalization data uses 9th revision codes exclusively. Both codes tend to correspond well, although ICD-10 codes capture slightly more deaths from COPD. This has been examined in other datasets, and the ratio of comparability for chronic lower respiratory tract disease is 1.04782.

Mortality

The National Center for Healthcare Statistics (NCHS) uses a broad definition of COPD, more properly termed "chronic lower respiratory tract disease." Although the vast majority of deaths due to chronic lower respiratory tract disease are from COPD, a proportion of these deaths are from other diseases such as asthma and bronchiectesis (Table 12).

Table 12: Proportion of chronic lower respiratory tract deaths due to COPD

Diagnosis	ICD-9 codes	ICD-10 codes	% of 2001 deaths
Chronic Lower Respiratory Tract Disease	490-496	J40-J47	100
COPD	490-492,496	J40-J44	95.74
Asthma	493	J45,J46	3.47
Bronchiectesis	494	J47	0.79
Hypersensitivity Pneumonitis	495		

Source: NIH/NHLBI. Morbidity and Mortality: 2004 Chart Book on Cardiovascular, Lung, and Blood Diseases.
Available at www.nhlbi.nih.gov/resources/docs/04_chtbk.pdf.

For the purposes of the Colorado COPD Surveillance Report 2007 we elected to focus of COPD, rather than on chronic lower respiratory tract disease. The codes used to identify deaths from COPD, and the frequency of these codes, are demonstrated in Table 13 below.

Table 13: Use of specific codes for COPD, 2005 Colorado mortality data, ages 25 and up

Diagnosis	ICD-9 codes	ICD-10 codes	% of 2005 COPD deaths
COPD	490-492, 496	J40-J44	100
Chronic Bronchitis	490-491	J40-42	0.3
Emphysema	492	J43	9.9
Other COPD	496	J44	89.8

Hospitalization

The codes used to identify COPD deaths do not perform as well in hospitalization databases. For example, if we use the NHIS definition of chronic lower respiratory tract disease used for mortality in the Colorado Hospital Authority's database we find that a much greater proportion of hospitalizations are due to asthma (Table 14). This is because asthma, while a relatively uncommon cause of death, is an important cause of hospitalization.

Table 14: Use of Chronic Lower Respiratory Tract disease definition, applied to Colorado Hospital Association data, 1993-2004

Diagnosis	ICD-9 codes	% of hospitalizations
Inclusive COPD Definition	466, 490-496	100
COPD	490-492, 496	52.7
Asthma	493	46.3
Bronchiectesis	494	0.8
Hypersensitivity Pneumonitis	495	0.2

Because an AHRQ Prevention Quality Indicator exists for COPD hospitalization, we chose to apply their ICD-9 definitions of a hospitalization for COPD, in the interest of comparability (Table 15). (Note: this definition excludes asthma but includes bronchiectesis. This definition also allows for acute bronchitis as a primary diagnosis so long as it is accompanied by another COPD diagnosis.)

Table 15: AHRQ Prevention Quality Indicator for COPD admission rate

Numerator:

All non-maternal discharges of age 18 years and older with ICD-9-CM principal diagnosis code for COPD

Include ICD-9-CM diagnosis codes:

490	BRONCHITIS NOS*	4919	CHRONTIC BRONCHITIS NOS
4660	AC BRONCHITIS*	4920	EMPHYSEMATOUS BLEB
4910	SIMPLE CHR BRONCHITIS	4928	EMPHYSEMA NEC
4911	MUCOPURUL CHR BRONCHITIS	494	BRONCHIECTASIS OCT00-

* Qualifies only if accompanied by secondary diagnosis of 491.xx, 492.x or 496 (i.e. any other code on this list)

Exclude:

* Tranfer for institution

* MDC 14 (pregnancy, childbirth or puerperium)

Source: Adapted from Prevention Quality Indicators: Technical Specifications Department of Health and Human Services Agency for Healthcare Research and Quality October 2001 Version 3.0b (May 1, 2006)
http://www.qualityindicators.ahrq.gov

Age Range

The second main issue with respect to defining rates for COPD is the age-range selected. This choice affects both the numerator and denominator, but has a much larger affect on the denominator. Numerous definitions of the appropriate age-range exist, and result in dramatically different rate estimates. A few illustrative examples are given below.

- NCHS: total population
  - 43 deaths / 100,000
- Mannino, in MMWR: age 25 and over
  - 67 deaths / 100,000
- Health People 2010: age 45 and over
  - 120 deaths / 100,000

In general, the denominator should include all persons at risk for the disease. As COPD is a disease of adults, including children in the denominator is probably not appropriate. Although the vast majority of cases of COPD occur in older adulthood (45 and over), some cases do occur in younger adults. We elected to use an age range of 25 and over throughout the report. In some cases, this will make it difficult to compare rates from this report to other sources. However, there is no standard definition and no single choice that would allow comparison with all other sources. We chose 25 and over because it seemed most appropriate.

References

1. NIH/NHLBI. Morbidity and Mortality: 2004 Chart Book on Cardiovascular, Lung, and Blood Diseases. Available at www.nhlbi.nih.gov/resources/docs/04_chtbk.pdf.

2. National Center for Health Statistics, Anderson RN, Miniño AM, Hoyert DL, Rosenberg HM. Comparability of cause of death between ICD-9 and ICD-10: preliminary estimates. Hyattsville, MD: US Department of Health and Human Services, CDC, National Center for Health Statistics, 2001. (National vital statistics reports; vol 49, no. 2). Available at http://www.cdc.gov/nchs/data/nvsr/nvsr49/nvsr49_02.pdf.

3. Prevention Quality Indicators: Technical Specifications Department of Health and Human Services Agency for Healthcare Research and Quality October 2001 Version 3.0b (May 1, 2006) http://www.qualityindicators.ahrq.gov

Part 12: Appendix 1

Adapted from: Estimated Prevalence and Incidence of Lung Disease byLung Association Territory -- American Lung Association, Epidemiology and Statistic Unit, Research and Scientific Affairs, Sept. 2004.

County:	Total Population	Lung Cancer	Pediatric Asthma	Adult Asthma	Chronic Bronchitis	Emphysema
Adams County	374,099	201	8,547	20,828	11,519	3,328
Alamosa County	15,130	8	340	844	480	152
Arapahoe County	510,136	267	11,336	28,636	16,429	5,174
Archuleta County	11,012	5	216	639	388	141
Baca County	4,392	2	84	248	160	74
Bent County	5,717	3	1103	31	197	73
Boulder County	279,197	160	5,235	16,637	9,303	2,706
Broomfield County	40,823	NA	981	2,237	1,248	357
Chaffee County	16,833	9	269	1,020	626	246
Cheyenne County	2,162	1	50	116	71	29
Clear Creek County	9,447	5	168	574	337	104
Conejos County	8,423	5	216	435	265	106
Costilla County	3,590	2	68	207	130	55
Crowley County	5,449	3	84	340	189	56
Custer County	3,648	2	63	217	138	56
Delta County	28,916	15	556	1,649	1,039	445
Denver County	560,415	305	10,751	32,846	18,615	5,946
Dolores County	1,865	1	32	110	69	28
Douglas County	211,091	97	5,431	11,328	6,213	1,601
Eagle County	45,091	23	894	2,681	1,425	324
El Paso County	543,818	11	12,635	30,011	17,034	5,267
Elbert County	21,959	284	515	1,219	697	206
Fremont County	47,423	26	804	2,850	1,683	608
Garfield County	47,249	24	1,072	2,635	1,497	459
Gilpin County	4,893	3	85	300	173	51
Grand County	12,984	7	229	788	454	139
Gunnison County	14,148	8	214	893	489	133
Hinsdale County	778	0	13	48	30	11
Huerfano County	7,831	4	131	470	288	113
Jackson County	1,530	1	30	88	54	21
Jefferson County	531,723	289	10,966	30,534	17,809	5,891
Kiowa County	1,492	1	28	86	54	23
Kit Carson County	7,948	4	174	441	263	97
La Plata County	45,668	4	814	2,747	1,586	506
Lake County	7,796	24	172	442	245	69
Larimer County	264,605	138	5,189	15,467	8,789	2,746

County:	Total Population	Lung Cancer	Pediatric Asthma	Adult Asthma	Chronic Bronchitis	Emphysema
Las Animas County	15,455	8	300	883	549	225
Lincoln County	5,905	3	110	345	204	74
Logan County	21,084	11	424	1,206	712	258
Mesa County	121,419	64	2,461	6,898	4,162	1,589
Mineral County	860	0	14	52	33	13
Moffat County	13,370	7	307	740	433	143
Montezuma County	24,157	13	538	1,331	814	313
Montrose County	35,314	18	762	1,963	1,197	464
Morgan County	27,709	15	690	1,464	864	314
Otero County	19,794	11	433	1,088	672	274
Ouray County	3,921	2	69	235	146	54
Park County	15,993	8	302	954	557	173
Phillips County	4,531	2	100	247	154	65
Pitkin County	14,994	8	206	967	558	169
Prowers County	14,209	8	349	756	445	160
Pueblo County	146,880	77	3,093	8,245	4,924	1,849
Rio Blanco County	6,042	3	128	343	204	71
Rio Grande County	12,273	7	275	672	414	165
Routt County	20,405	11	372	1,237	695	191
Saguache County	6,439	3	145	358	212	72
San Juan County	552	0	8	35	22	7
San Miguel County	7,165	4	103	462	252	62
Sedgwick County	2,681	2	49	154	99	44
Summit County	24,869	13	364	1,598	839	186
Teller County	21,586	11	441	1,252	743	243
Washington County	4,889	3	102	272	170	71
Weld County	205,014	99	4,791	11,296	6,329	1,900
Yuma County	9,751	5	218	532	326	131

Notes

Colorado COPD Coalition