Requested Topics of Interest

1. A brief background on trends in the incidence of lung disease related to coal mine dust exposures in underground mines.

2. What is known about mining factors associated with observed increases in the prevalence and severity of pneumoconiosis in coal miners in some areas of central Appalachia.

3. Limitations in researchers’ understanding of trends in lung disease incidence.

4. To the extent that CPDM exposure data have been used to plan or carryout health studies of coal mine workers, what new information has that data provided, or might provide in the future?

5. What data are needed in addition to the CPDM data being reported by mine operators?
Coal Mine Dust is the Sole Cause of CWP

Dust fills the air as a miner operates rock crushing machinery below the earth’s surface.
Coal Mine Dust is the Sole Cause of CWP

- Onset associated with length of exposure (>20 years)
- Severity dependent upon
  - Amount of dust inhaled
  - Years of exposure
  - Dust composition (coal rank, crystalline silica)
- Lack of association with
  - Race
  - Sex
  - Age
  - Smoking

*Figure 5. Prevalence of simple CWP category 1 or greater among U.S. coal miners by estimated cumulative coal mine dust exposure and coal rank. (Source: Atfield and Setxas (6)).*
Coal Mine Dust is the Sole Cause of CWP

- Onset associated with length of exposure (>20 years)
- Severity dependent upon
  - Amount of dust inhaled
  - Years of exposure
  - Dust composition (coal rank, crystalline silica)
- Lack of association with
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  - Dust composition (coal rank, crystalline silica)
- Lack of association with
  - Race
  - Sex
  - Age
  - Smoking
The Classic Pneumoconioses
New Epidemiological and Laboratory Observations

A. Scott Laney, PhD, David N. Weissman, MD*

KEYWORDS
• Coal • Coal workers’ pneumoconiosis • Silica • Silicosis • Asbestos • Asbestosis

KEY POINTS
• Digital chest imaging can now be used in the International Labor Office’s classification system for the presence and severity of changes of pneumoconiosis with equivalent results to classification of analog film-screen radiographs.
• The role of lung cancer screening of asbestos-exposed individuals with low-dose chest computed tomography scanning is still evolving.
• Coal workers’ pneumoconiosis, including severe forms, such as progressive massive fibrosis, is still occurring in the United States and has been seen in relatively young miners.
• Emerging exposure situations include longer work hours, work in small mines, and silica exposure from thin-seam coal mining in Appalachia, construction work, and natural gas extraction by hydraulic fracturing and environmental exposure to asbestos associated with human contamination of the environment or the presence of natural deposits.
• Newly or poorly recognized adverse health effects of exposures include lower-zone, irregular opacities in coal miners; antibodies against citrullinated peptide antigens–positive rheumatoid arthritis and antineutrophil cytoplasmic antibody–positive vasculitis in silicotics; and laryngeal and ovarian cancer in asbestos-exposed individuals.
• Soluble mesothelin-related peptides can be measured in serum to monitor the course of malignant mesothelioma with epithelioid features. The test is not approved in the United States for diagnostic purposes and its diagnostic potential is limited by low sensitivity for malignant mesothelioma at threshold serum values providing good specificity.
Tools for diagnosis and management

- Chest radiography
- Computed tomography
- Spirometry, diffusing capacity, TLV
- Biopsy
- Occupational history
Disease surveillance in the context of occupational health focuses on acute and chronic illnesses attributable primarily to work. While fragmented and incomplete in the United States, these systems provide important information on patterns of work-related illness within occupations and industries, opportunities for prevention, and measures of intervention effectiveness. There is growing interest in broader disease surveillance among working populations, focused on chronic diseases, which interface with productivity and drive healthcare costs. This places (less emphasis) on work as a causal factor but enhances awareness of work and the workplace as an opportunity for intervention and prevention.

An important component of comprehensive occupational disease surveillance is health surveillance, which can include environmental monitoring, hazardous material registries, industrial hygiene and engineering controls. Surveillance also requires action in response to information acquired. This can involve providing information to workers, employers, unions, health and safety organizations, and clinicians. It can involve the development or application of interventions to reduce or eliminate exposures associated with documented outcomes or it can involve the development of guidelines, regulations, and policy.

Clinicians play critical roles in surveillance systems. The information they collect regarding the health status of patients, diagnoses, functional status, and ability to work are essential to understanding the status of populations. In many states, reporting work-related illnesses and injuries is mandated, creating a system that alerts public health agencies to clusters of events and emerging hazards.

**Purpose of Occupational Health Surveillance**

The primary purpose of occupational health surveillance is the primary prevention of occupational and work-related diseases and injuries. As described in the Technical and Ethical Guidelines for Workers' Health Surveillance, an International Labor Office, and the objectives of workers' health surveillance programs are to:

1. Describe the health status of working populations and socioeconomic groups, by examining the outcomes of occupational injuries and diseases, their severity, and trends in mortality and morbidity.
2. Stimulate occupational epidemiological studies and explain the causes of occupational injuries and diseases by identifying the physical, biological, organizational, psychological, and occupational exposure factors that cause specific injuries and diseases or their respective risk factors.
3. Predict the occurrence of occupational injuries and diseases and their distributions in working populations in order to determine the specific focus for prevention.
4. Prepare action-oriented research and intervention studies to eliminate causal factors through preventive and tertiary measures, and mitigate their consequences by corrective and rehabilitative activities.
5. Assess the effectiveness of previously implemented control measures.

Public health surveillance systems seek to assess the burden and distribution of occupational diseases in the population. Unlike medical surveillance programs, which target specific groups of workers with known or possible exposure to specific risk factors, these systems survey the population at large to identify patterns and trends within industries, occupations, and workplaces. Population-based occupational health surveillance is most often conducted by federal, state, or local health authorities with statutory authority to monitor and follow-up on work-related mortality and morbidity. Medical monitoring, most commonly accomplished through medical tests and procedures, is focused on the
Healthy lung

Simple CWP

Progressive massive fibrosis
Healthy Lung  Simple Pneumoconiosis  PMF
Classification of Radiographs

ILO classification

Profusion of small opacities

Large opacities

0/- 0/0 0/1 1/0 1/1 1/2 2/1 2/2 2/3 3/2 3/3 3/+ A B C

Profusion of small opacities

Large opacities
Coal Mine Dust Lung Disease

• Coal mine dust causes a spectrum of lung diseases
  – Coal Workers’ Pneumoconiosis (CWP)
  – Silicosis
  – Mixed dust pneumoconiosis
  – Dust-related diffuse fibrosis
  – Chronic obstructive pulmonary disease (COPD)
Concise Clinical Review

Coal Mine Dust Lung Disease
New Lessons from an Old Exposure

Edward L. Peterson, Cecile Rose, and Robert Cohen

Coal mining remains a sizable industry, with millions of working and retired coal miners worldwide. This article provides an update on recent advances in the understanding of respiratory health issues in coal miners and focuses on the spectrum of disease caused by inhalation of coal mine dust, termed coal mine dust lung disease. In addition to the historical interstitial lung disease (coal worker's pneumoconiosis, silicosis, and mixed dust pneumoconiosis), coal miners are at risk for dust-related diffuse fibroses and chronic airway diseases, including emphysema and chronic bronchitis. Recent recognition of rapidly progressive pneumoconiosis in younger miners, mainly in the eastern United States, has increased the sense of urgency and the need for vigilance in medical research, clinical diagnosis, and exposure prevention. Given the risk for disease progression even after exposure removal, along with limited treatment options, there is an urgent need for research on the prevention and management of lung disease associated with work in coal mines.

Keywords: pneumoconiosis; silicosis; pulmonary fibrosis; chronic obstructive pulmonary disease; coal mining

In recent years the country has been riveted by stories of tragic disasters in our nation’s coal mines, including the explosions and fires at the Sago and Upper Big Branch mines in West Virginia. Less attention has been paid to the increase in prevalence and severity of the chronic lung disease that results from coal mine dust exposure. This article provides a review of the spectrum of disease caused by prolonged inhalation of mine dust, “coal mine dust lung disease” (CMDLD). CMDLD includes the historical interstitial lung diseases (coal worker’s pneumoconiosis [CWP], silicosis, and mixed dust pneumoconiosis) but also includes the more recently described entity of dust-related diffuse fibrosis (DDF). Coal mine dust also causes chronic obstructive pulmonary disease, which often are not recognized as being related to this exposure.

CONTEMPORARY COAL MINING

Coal mining remains a sizable industry due to its important role in energy production. Modern mining technology has improved productivity, with the capability to pulverize thousands of tons of coal per shift. These tasks generate clouds of respirable dust particles with toxic radicals on their surfaces. The number of coal miners in the United States declined steadily after World War II as the industry became more mechanized. This trend reversed in 2003, and by 2011, 145,437 miners worked in 1,735 underground and surface coal operations, providing about 30% of all domestic energy and more than 40% of the electricity. With 28% of the world’s recoverable coal reserves, mining employment in the United States is likely to remain high for many years. Many countries engage in coal mining: China alone employs more than 6 million miners. Due to the potential for a large burden of lung disease, the respiratory health of coal miners remains an important consideration for physicians in the United States and worldwide.

RESURGENT PNEUMOCONIOSIS—EVIDENCE FOR INCREASES IN PREVALENCE AND SEVERITY

Although many physicians believe these diseases are only of historical interest, evidence published during the last few years from several independent data sources points toward an ongoing increase in both the prevalence and severity of CMDLD.

U.S. COAL MINER CHEST RADIOGRAPHS SURVEILLANCE PROGRAMS

Starting in about 2000, surveillance of working U.S. coal miners began to show an increased prevalence of disease in the progression of time.

SUPPLEMENT

Respiratory Diseases Caused by Coal Mine Dust

A. Scott Laney, PhD and David N. Weissman, MD

Objective: To provide an update on respiratory diseases caused by coal dust. Methods: This article presents the results of a literature review initially performed for an International Conference on Occupational and Environmental Lung Disease held in summer 2013. Results: Coal mine dust causes a spectrum of lung disease collectively termed coal mine dust lung disease (CMDLD). This includes Coal Workers’ Pneumocooniosis, silicosis, mixed dust pneumoconiosis, dust-related diffuse fibrosis (which can be mistaken for idiopathic pulmonary fibrosis), and chronic obstructive pulmonary disease (COPD). CMDLD continues to be a problem in the United States, particularly in the central Appalachian region. Treatment of CMDLD is symptomatic. Those with end-stage disease are candidates for lung transplantation. Because CMDLD cannot be cured, prevention is critical. Conclusions: Coal mine dust remains a relevant occupational hazard and miners remain at risk for CMDLD.

Coal is an important global commodity and will remain so for the foreseeable future. Thus, mining of coal will also remain important. Despite improvements in exposure assessment and ventilation controls and the existence of protective government regulations, coal miners are still at risk for respiratory diseases caused by coal mine dust and their associated morbidity and mortality. Thus, clinicians must be prepared to diagnose these diseases and recognize their association with work in coal mining. This review provides background

Wyoming (40%), West Virginia (12.3%), Kentucky (9.9%), Pennsylvania (5.4%), and Texas (4.2%). Coal can be obtained by underground mining (primarily in the Eastern United States) or surface mining (dominant in the Western United States). Types of coal also vary by region. Anthracite coal (hard coal, highest rank), typically used in metallurgy and domestic heating, is limited geographically mainly to Appalachia and Pennsylvania. Bituminous coal (soft coal, lower rank), typically used for electric power generation and coke for steel making, is the most abundant type of coal found in the United States and found primarily in Appalachia and in Midwestern states such as Illinois. Subbituminous coal (often lower rank than bituminous), typically used in electric power generation and heating, is primarily found in Montana, Wyoming, Colorado, New Mexico, Washington, and Alaska. It is the most produced type of coal in the United States, accounting for 45% of coal production in 2011. Over the past several decades, there has been a shift from underground, bituminous coal production in the Eastern United States to surface, subbituminous coal production in the Western United States. Western coal production currently accounts for 58% of US coal production and is anticipated to reach 68% by 2040.

RESPIRATORY DISEASES ARE CAUSED BY INHALING COAL MINE DUST

Inhalation of coal mine dust is known to cause several types of respiratory diseases in the lung, including the following:

- **Coal Workers’ Pneumocooniosis (CWP)**: This disease is characterized by the presence of nodules in the lungs, which are composed of coal dust and other particles. It is the most common type of pneumoconiosis and is often referred to as “black lung”.
- **Mixed Dust Pneumoconiosis**: This type occurs when coal dust is mixed with other mineral dusts, such as silica or asbestos, in the workplace. It can cause a more severe form of disease.
- **Dust-Related Diffuse Fibrosis (DRD)**: This condition is characterized by the development of scar tissue in the lungs, which can lead to respiratory symptoms and disability.
- **Chronic Obstructive Pulmonary Disease (COPD)**: This is a long-term condition that affects the airways and air sacs in the lungs. It can be caused by prolonged exposure to coal dust and is characterized by shortness of breath and coughing.

These diseases can have serious health implications and should be monitored and managed by healthcare providers to prevent further progression.
Federal Coal Mine Health and Safety Act

- Passed by Congress in 1969
- Empowers NIOSH to conduct health surveillance
Healthy Lung | Simple Pneumoconiosis | PMF
Coal Mine Dust Lung Disease: Data Sources

- Routine CWHSP radiographic surveillance
- Enhanced NIOSH surveillance (NIOSH mobile unit)
- State and Federal disability compensation programs
- Mandated accident and injury reporting systems
- National transplant registry (UNOS)
- Mortality data
- Clinical experience
Coal Mine Dust Lung Disease: Where are We?

- Increased incidence of CWP
- Increased severity
  - PMF outbreak
  - Increase in lung transplants
  - Premature mortality
- Rapid onset
- Rapid progression
- Geographic clustering
- Higher prevalence associated with small mine size

- Low seam height associated with CWP
- Severe disease in surface miners
- High prevalence of abnormal spirometry in former miners
- Silica exposure implicated
- Irregular opacities in lower lung zones a common finding
- Radiographic profusion associated with lung function
Respiratory morbidity among U.S. coal miners in states outside of central Appalachia

Laura E. Reynolds MPH, BSN, RN\textsuperscript{1,2}  |  David J. Blackley DrPH\textsuperscript{1}  
Anthony S. Laney PhD, MPH\textsuperscript{1}  |  Cara N. Halldin PhD\textsuperscript{1}

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Background: Recent NIOSH publications have focused on the respiratory health of coal miners in central Appalachia, yet 57% of U.S. coal miners work in other regions. We characterized respiratory morbidity in coal miners from these regions.

Methods: Active coal miners working outside of central Appalachia who received chest radiographs and/or spirometry during 2005-2013 were included. Chest radiographs were classified according to International Labour Office standards and spirometry was interpreted using the American Thoracic Society guidelines. Prevalence of coal workers' pneumoconiosis (CWP) and abnormal spirometry were compared by region.

Results: A total of 103 (2.1%) miners had CWP. The eastern region had the highest prevalence (3.4%), followed by the western (1.7%), and interior (0.8%) regions. A total of 524 (9.3%) miners had abnormal spirometry.

Conclusions: CWP occurs in all U.S. coal mining regions. Prevalence of CWP was higher in the eastern region, but lower than levels reported in central Appalachia.

KEYWORDS  
coal mining, coal workers' pneumoconiosis, lung function impairment, reduced lung function, surveillance.
Respiratory Diseases Caused by Coal Mine Dust

A. Scott Laney, PhD and David N. Weissman, MD

Objective: To provide an update on respiratory diseases caused by coal mine dust. Methods: This article presents the results of a literature review initially performed for an International Conference on Occupational and Environmental Lung Disease held in summer 2013. Results: Coal mine dust causes a spectrum of lung diseases collectively termed coal mine dust lung disease (CMDLD). These include Coal Workers’ Pneumoconiosis, silicosis, mixed dust pneumoconiosis, dust-related diffuse fibrosis (which can be mistaken for idiopathic pulmonary fibrosis), and chronic obstructive pulmonary disease. CMDLD continues to be a problem in the United States, particularly in the central Appalachian region. Treatment of CMDLD is symptomatic. Those with end-stage disease are candidates for lung transplantation. Because CMDLD cannot be cured, prevention is critical. Conclusions: Coal mine dust remains a relevant occupational hazard and miners remain at risk for CMDLD.

Coal is an important global commodity and will remain so for the foreseeable future. Thus, mining of coal will also remain important. Despite improvements in exposure assessment and ventilation controls and the existence of protective government regulations, coal miners are still at risk for respiratory diseases caused by coal mine dust and their associated morbidity and mortality. Thus, clinicians must be prepared to diagnose these diseases and recognize their association with work in coal mining. This review provides background information on the coal dust fibrosis and identifies the leading regions of concern: Wyoming (40%), West Virginia (12.3%), Kentucky (9.9%), Pennsylvania (5.4%), and Texas (4.2%). Coal can be obtained by underground mining (primarily in the Eastern United States) or surface mining (dominant in the Western United States). Types of coal also vary by region. Anthracite coal (hard coal, highest rank), typically used in metallurgy and domestic heating, is limited geographically mainly to Appalachia and Pennsylvania. Bituminous coal (soft coal, lower ranked), typically used for electric power generation and coke for steel making, is the most abundant type of coal found in the United States and found primarily in Appalachia and in Midwestern states such as Illinois. Subbituminous coal (still lower ranked than bituminous), typically used in electric power generation and heating, is primarily found in Montana, Wyoming, Colorado, New Mexico, Washington, and Alaska. It is the most produced type of coal in the United States, accounting for 47% of coal production in 2011. Over the past several decades, there has been a shift from underground, bituminous coal production in the Eastern United States to surface, subbituminous coal production in the Western United States. Western coal production currently accounts for 58% of US coal production and is anticipated to reach 68% by 2040.

RESPIRATORY DISEASES ARE CAUSED BY INHALING COAL MINE DUST

Inhalation of coal mine dust is known to cause several types of respiratory disease. To emphasize that these diseases are associated with coal mining, we use the term ‘coal mine dust’ to describe particles of coal that affect the lung and respiratory system.
Prevalence Coal Workers’ Pneumoconiosis among coal miners, by underground mining tenure —United States

NIOSH Surveillance Data
Prevalence Coal Workers’ Pneumoconiosis among coal miners, by underground mining tenure —United States
Prevalence Coal Workers’ Pneumoconiosis (CWP) among coal miners, by underground mining tenure — Kentucky, Virginia, and West Virginia

NIOSH Surveillance Data
Prevalence of progressive massive fibrosis (PMF) among working underground coal miners with at least 25 years of underground mining tenure in KY, VA, and WV
Resurgence of Progressive Massive Fibrosis in Coal Miners — Eastern Kentucky, 2016

David J. Blackley, DrPH; James B. Crum, DO; Cara N. Halkin, PhD; Eileen Storey, MD; A. Scott Laney, PhD
SHORT REPORT

Radiographic disease progression in contemporary US coal miners with progressive massive fibrosis

A Scott Laney, David John Blackley, Cara N Halldin

ABSTRACT

Introduction Among contemporary US coal miners, there has been an increase in the prevalence and severity of pneumoconiosis, including its advanced form progressive massive fibrosis (PMF). We examine radiographic progression in Coal Workers’ Health Surveillance Program (CWHSF) participants.

Methods CWHSF participants with a final determination of PMF during 1 January 2000–1 October 2016 with at least one prior radiograph in the system were included. We characterised demographics, participation and progression patterns.

Results A total of 192 miners with a PMF determination contributed at least one additional radiograph (total count: 2–10). Mean age at first radiograph was 28.8 years, 162 (84%) worked in Kentucky, Virginia or West Virginia and 163 (86%) worked exclusively underground. A total of 163 (85%) miners had a normal initial radiograph. Mean time from most recent normal radiograph to one with a PMF determination was 20.7 years (range: 1–43) and 27 (17%) progressed to PMF in less than 10 years.

Discussion Dust exposure is the sole cause of this disease, and a substantial number of these miners progressed from normal to PMF in less than a decade. Participation in CWHSF is voluntary, and these findings are influenced by participation patterns, so for many miners it remains unclear how rapidly their disease progressed. National Institute for Occupational Safety and Health recommends all working miners to participate in radiographic surveillance at 5-year intervals. Improved participation could allow more precise characterisation of the burden and characteristics of pneumoconiosis in US coal miners and provide an important early detection tool to prevent cases of severe disease.

What this paper adds

- Dust exposure is the sole cause of progressive massive fibrosis (PMF).
- Surveillance data from US Coal Workers’ Health Surveillance Program suggest a substantial number of coal miners in this study progressed from normal to PMF in less than a decade.
- It is likely that some miners work for years with severe lung disease that went undetected by the surveillance programme until they participated close to or after retirement.
- The National Institute for Occupational Safety and Health recommends that all miners participate in spirometric and radiographic surveillance at 5-year intervals throughout their working career.

rise frequency of lung transplants for pneumoconiosis, increasing numbers of disability claims filed for state and federal black lung compensation, presence of severe disease in surface miners, elevated rates of abnormal lung function in former miners, increases in mean years of potential life lost among coal miners with pneumoconiosis, rapidly progressive disease, and advanced disease in relatively young miners.

To our knowledge, since 2000, two studies have reported on disease progression in US coal workers with severe pneumoconiosis. The first study used data from 1996 to 2002 and focused on geographical clustering of rapidly progressive cases. The second study found that a subgroup of miners with serial radiographs (n=43) progressed from normal to PMF in 6 years or less. We examined the...
Key Findings

- 192 cases of PMF since 2000 with multiple NIOSH encounters
- 1 in 6 progressed from normal to PMF in less than 10 years
Coal Workers’ Pneumoconiosis-Related Years of Potential Life Lost Before Age 65 Years — United States, 1968–2006

Coal workers’ pneumoconiosis (CWP) is a preventable, slowly progressive parenchymal lung disease caused by inhalation and deposition of coal mine dust in the lungs. The incidence and rate of CWP progression is related to the amount of respirable coal dust to which miners were exposed during their working lifetime (1). Early pneumoconiosis can be asymptomatic, but advanced disease often leads to disability and premature death (1,2). To characterize the impact of premature mortality attributed to CWP in the United States, CDC’s National Institute for Occupational Safety and Health (NIOSH) analyzed annual underlying cause of death data
Years of potential life lost (YPLL) before the age of 65 years and mean YPLL per decedent for decedents 25 years or older with coal workers’ pneumoconiosis as the underlying cause of death—U.S., 1968–2010.
Requested Topics of Interest

1. A brief background on trends in the incidence of lung disease related to coal mine dust exposures in underground mines.
2. What is known about mining factors associated with observed increases in the prevalence and severity of pneumoconiosis in coal miners in some areas of central Appalachia.
3. Limitations in researchers’ understanding of trends in lung disease incidence.
4. To the extent that CPDM exposure data have been used to plan or carryout health studies of coal mine workers, what new information has that data provided, or might provide in the future?
5. What data are needed in addition to the CPDM data being reported by mine operators?

A. Scott Laney, PhD, Edward L. Peterson, MD, Janet M. Hale, BS, Amber L. Wolfe, BS, and Michael D. Attfield, PhD

In the early 2000s, during the routine analysis of surveillance chest radiographs of underground coal miners, the National Institute for Occupational Safety and Health (NIOSH) began observing several aberrations in the frequency and severity of radiographic abnormalities among underground coal miners in the United States. Specifically, the overall prevalence of coal workers’ pneumoniosis (CWP) appeared to be increasing, and NIOSH identified geographical clustering of CWP and observed rapid progression and increased disease severity, including progression to the most severe and fatal stage, progressive massive fibrosis (PMF). In response to these occupational health findings, NIOSH, with support from the US Department of Labor’s Mine Safety and Health Administration, established and implemented the Enhanced Coal Workers’ Health Surveillance Program (ECWSP). ECWSP was a...

Objective: We better defined the distribution and determinants of coal workers’ pneumoniosis (CWP) among US underground coal miners.

Methods: We obtained chest radiographs from the mobile unit of an enhanced surveillance program begun in 2005 by the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention (CDC), Morgantown, West Virginia. B Readers classified them for presence of pneumoconiosis.

Results: About 15 states participated in a prevalence of CWP was higher in 3 states (Kentucky, 9.0%; Virginia, 8.0%; West Virginia, 4.8%) than in all other states (age-adjusted risk ratio [RR] = 4.3; 95% confidence interval [CI] = 3.3–5.5). 8. Miners in 3 of these states were younger and had less mining tenure, but advanced CWP (category ≥2/1): RR = 3.1; 95% CI = 3.3–5.5, and progressively fibrotic CWP (RR = 10.5: 95% CI = 3.8–29.1) was more prevalent among them. Advanced CWP and progressive massive fibrosis were more prevalent among workers at mines with fewer than 150 miners, irrespective of mining region, than among workers at larger mines.


Coal workers’ pneumoniosis and progressive massive fibrosis are increasingly more prevalent among workers in small underground coal mines in the United States

A Scott Laney, Michael D Attfield

Surveillance Branch, Division of Respiratory Disease Studies, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Morgantown, West Virginia, USA.

ABSABSTRACT

Objective: To determine whether CWP is associated with mine size.

Methods: We examined chest radiographs from 1970 to 2009 of workers who participated in the National Coal Workers’ Health Surveillance Program for the presence of small and large opacities, consistent with pneumoconiosis, based upon the International Labour Organization classification system.

Results: A total of 149,512 miners contributed 240,067 radiographs for analysis, from the 1970s to the 2000s. The prevalence of radiographic CWP increased among miners in mines of all sizes, while miners working in mines with fewer than 50 employees had a significantly higher prevalence of CWP than those who worked in mines with 50 or more employees (p = 0.0001). When adjusted for age and within-study correlation, the prevalence of CWP (PMH) by mine size was significant for all decades. Since 1999, miners from small mines were five times more likely to have radiographic evidence of PMH (0.1% of miners) compared to miners from larger mines (0.2% of miners) with a prevalence ratio of 5.0 and 95% CI 3.3 to 7.5. Conclusion: The prevalence of CWP among United States coal miners is increasing in miners of all sizes, while CWP and PMH are much more prevalent among workers from underground mines with fewer than 50 workers. Resources, especially those not associated with mine size, may be critical for the future.

What this paper adds

- There has been an increase in the occurrence and severity of coal workers’ pneumoniosis (CWP) and progressive massive fibrosis (PMF) in small coal mines since 2000.
- Factors driving these increases are not properly understood.
- This is the first study to directly examine the prevalence and severity of CWP and PMF in underground coal mines (as measured by the number of employed workers).
- CWP and PMF are significantly more prevalent among workers in underground coal mines with fewer than 50 workers compared to larger mines. Resources, especially those not associated with mine size, may be critical for the future.
Prevalence of coal workers’ pneumoconiosis by mine size, unadjusted for age and region, ECWHSP
Small mine size is associated with lung function abnormality and pneumoconiosis among underground coal miners in Kentucky, Virginia and West Virginia

David J Blackley, Cara N Hallin, Mei Lin Wang, A Scott Laney

ABSTRACT

Objectives: To describe the prevalence of lung function abnormality and coal workers’ pneumoconiosis (CWP) by mine size among underground coal miners in Kentucky, Virginia and West Virginia.

Methods: During 2005–2012, 4,941 miners completed spirometry and chest radiography as part of a health surveillance programme. Spirometry was interpreted according to American Thoracic Society and European Respiratory Society guidelines, and radiography per International Labour Office standards. Prevalence ratios (PR) were calculated for abnormal spirometry (obstructive, restrictive or mixed pattern using lower limits of normal derived from National Health and Nutrition Examination Survey (NHANES) III) and CWP among workers from small mines (<50 miners) compared with those from large mines.

Results: Among 3,771 eligible miners, those from small mines were more likely to have abnormal spirometry (18.5% vs 13.8%, p<0.01), CWP (10.8% vs 5.2%, p<0.01) and progressive massive fibrosis (4.2% vs 1.1%, p<0.01). In regression analysis, working in a small mine was associated with 37% higher prevalence of abnormal spirometry (PR 1.37, 95% CI 1.16 to 1.61) and 2.1 times higher prevalence of CWP (95% CI 1.68 to 2.70).

Conclusions: More than one in four of these miners had evidence of CWP, abnormal lung function or both. Although 96% of miners in the study have worked exclusively underground dust regulations implemented following the 1969 federal Coal Mine Safety and Health Act, we observed high rates of respiratory disease including severe cases. The current approach to dust control and provision of safe work conditions for central Appalachian underground coal miners is not adequate to protect them from adverse respiratory health effects.
## Spirometry and chest radiograph results among active underground Kentucky, Virginia, and West Virginia coal miners participating in ECWHSP, by mine size, 2005–2012, n = 3,771

<table>
<thead>
<tr>
<th>Spirometry</th>
<th>Small mine (n=908)</th>
<th>Large mine (n=2863)</th>
<th>Effect Measure</th>
<th>95% Confidence Interval</th>
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</thead>
<tbody>
<tr>
<td>Abnormal, n (%)</td>
<td>168 (18.5)</td>
<td>383 (13.4)</td>
<td>1.38</td>
<td>1.17 to 1.62</td>
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<td>Obstructive</td>
<td>61 (6.7)</td>
<td>132 (4.6)</td>
<td>1.46</td>
<td>1.09 to 1.96</td>
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<td>Restrictive</td>
<td>84 (9.3)</td>
<td>214 (7.5)</td>
<td>1.24</td>
<td>0.97 to 1.58</td>
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<tr>
<td>Mixed</td>
<td>23 (2.5)</td>
<td>37 (1.3)</td>
<td>1.96</td>
<td>1.17 to 3.28</td>
</tr>
<tr>
<td>PP FEV₁, mean (SD)</td>
<td>92.60 (15.2)</td>
<td>95.24 (14.1)</td>
<td>-2.64</td>
<td>-1.52 to -3.76</td>
</tr>
<tr>
<td>PP FVC</td>
<td>96.39 (13.0)</td>
<td>97.68 (12.4)</td>
<td>-1.30</td>
<td>-0.33 to -2.26</td>
</tr>
<tr>
<td>FEV₁/FVC</td>
<td>75.53 (8.4)</td>
<td>76.49 (7.5)</td>
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<td>-0.35 to -1.58</td>
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<tr>
<td>ILO Classification</td>
<td></td>
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<tr>
<td>CWP, n (%)</td>
<td>98 (10.8)</td>
<td>148 (5.2)</td>
<td>2.09</td>
<td>1.64 to 2.67</td>
</tr>
<tr>
<td>Category 1</td>
<td>69 (7.6)</td>
<td>97 (3.4)</td>
<td>2.24</td>
<td>1.66 to 3.03</td>
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<tr>
<td>Category 2</td>
<td>25 (2.8)</td>
<td>38 (1.3)</td>
<td>2.07</td>
<td>1.26 to 3.42</td>
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<td>Category 3</td>
<td>4 (0.4)</td>
<td>13 (0.5)</td>
<td>0.97</td>
<td>0.32 to 2.97</td>
</tr>
<tr>
<td>PMF, n (%)</td>
<td>22 (2.4)</td>
<td>31 (1.1)</td>
<td>2.24</td>
<td>1.30 to 3.85</td>
</tr>
</tbody>
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### Adjusted Results

<table>
<thead>
<tr>
<th>Spirometry</th>
<th>Effect Measure</th>
<th>95% Confidence Interval</th>
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<tbody>
<tr>
<td>Abnormal Spirometry</td>
<td>1.37</td>
<td>1.16 to 1.61</td>
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<tr>
<td>CWP</td>
<td>2.13</td>
<td>1.68 to 2.70</td>
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</table>

Spirometry and chest radiograph results among active underground Kentucky, Virginia, and West Virginia coal miners participating in ECWHSP, by mine size, 2005–2012, n = 3,771
Comparative Respiratory Morbidity of Former and Current US Coal Miners

Cara N. Halpin, PhD, Anita L. Wolfe, BA, and A. Scott Laney, PhD, MPH

We compared the prevalence of respiratory disease in former and current US coal miners using chest radiographs and lung function collected from 2009 to 2013 among miners of the Appalachian and Interior US coalfields. We calculated prevalence ratios (PRs) of pneumoconiosis and impaired lung function. Significantly higher prevalences of pneumoconiosis (PR = 1.8, 95% confidence interval = 1.2, 2.0) and impaired lung function were observed among former miners compared with active miners. Former miners continue to suffer negative health effects from occupational coal mine dust exposure. The respiratory health of active and former miners is a global concern because international coal production is projected to increase for decades to come. (Am J Public Health. 2015;105:2576-2577. doi:10.2105/AJPH.2015.302897)

METHODS

Between 2012 and 2013, NIOSH's Enhanced Coal Workers' Health Surveillance Program mobile surveillance unit traveled to coal mining regions in Alabama, Illinois, Indiana, Kentucky, Pennsylvania, Virginia, and West Virginia and offered chest radiographs and lung function testing (spirometry) to active and former coal miners, as previously described by Blakley et al. A comparison group of active underground coal miners who participated in the regular Coal Workers' Health Surveillance Program and in the Enhanced Coal Workers' Health Surveillance Program during 2009 to 2013 was assembled. Both programs collected work histories, demographics, and smoking status (never, current, former). Spirometry was available only for Enhanced Coal Workers' Health Surveillance Program participants.

We included only miners with 10 years or more of mining tenure in the analyses. We performed modified Poisson regression analyses using SAS version 9.3 SAS Institute, Cary, NC PROC GENMOD procedure with a robust error variance procedure to estimate prevalence ratios comparing disease among former miners with disease among active miners, for mining tenure and smoking (prevalence ratio = 2.39; 95% CI = 1.65, 3.45) and a higher prevalence of restrictive impairment when adjusting for mining tenure and BMI (prevalence ratio = 1.72; 95% CI = 1.24, 2.39).

DISCUSSION

Despite the cessation of exposure to coal mine dust for a median 14 years, former miners had significantly higher prevalence of pneumoconiosis and lung function impairment (all patterns) when compared with active miners. Lung function impairment is associated with cumulative exposure to coal dust regardless of the presence or absence of radiographic pneumoconiosis. Increased prevalence of impaired lung function is important diagnostically, because previous studies of coal miners found an association between decreased lung function and increased incidence of self-reported respiratory symptoms, diagnosis of respiratory disease, and greater risk of mortality from cardiovascular disease and chronic obstructive pulmonary disease. The consequences of exposure to respirable coal mine dust among miners are well established. Control technologies and best practice guidance are readily available to prevent those consequences, yet we continue to identify and document coal mine dust lung disease in active and former miners. Given the resurgence of pneumoconiosis in the United States since 1999, with the most prominent increases occurring in central Appalachia, and the decline in numbers of
Prevalence ratio estimates comparing coal mine dust lung disease in former miners to that in active miners, U.S., 2009 to 2013
Pneumoconiosis and Advanced Occupational Lung Disease Among Surface Coal Miners — 16 States, 2010–2011

Coal workers’ pneumoconiosis (CWP) is a chronic occupational lung disease caused by long-term inhalation of dust, which triggers inflammation of the alveoli, eventually resulting in irreversible lung damage. CWP ranges in severity from simple to advanced; the most severe form is progressive massive fibrosis (PMF). Advanced CWP is debilitating and often fatal. To prevent CWP, the Coal Mine Health and Safety Act of 1969 established the current federal exposure limit for respirable dust in underground and surface coal mines. The Act also established a surveillance system for assessing prevalence of pneumoconiosis among underground coal miners, but this surveillance does not extend to surface coal miners. With enforcement of the exposure limit, the and cooperation of surface coal mine operators, who are not required to offer chest radiographs to their employees. All participants provided written informed consent.

Work histories, including tenures in surface and underground coal mining, were collected from each miner. Radiographs were classified for changes consistent with CWP, according to the International Labour Office (ILO) International Classification of Radiographs of Pneumoconiosis (5). At least two NIOSH B Readers who had no knowledge of miners’ work history, performed the classifications (5). Identification of CWP required agreement between two readers that small pneumoconiotic opacities were present at an ILO profusion subcategory of ≥1/0 (range: 0/0–3+/±). An ILO profusion subcategory of ≥2/1 was
Is the increasing prevalence and severity of coal workers’ pneumoconiosis in the United States due to increasing silica exposure?

Robert A C Cohen

Letters to the Editor

Readers are invited to submit letters for publication in this department. Submit letters online at http://joem.edmgr.com. Choose “Submit New Manuscript.” A signed copyright assignment and financial disclosure form must be submitted with the letter. Forms available at www.joem.org under Author & Reviewer information.

Quartz Exposure Can Cause Pneumoconiosis in Coal Workers

To the Editor: We read with interest the recent article by McCunney, Morfeld, and Payne entitled What Component of Coal Causes Coal Workers’ Pneumoconiosis (CWP)?

Silica remains a major risk factor for coal miners. This was amply demonstrated by the rapid development of pneumoconiosis among Scottish coal miners who had been engaged in cutting through a fault composed of sandstone rock. Weight for weight, silica is consid-
Pneumoconiosis among underground bituminous coal miners in the United States: is silicosis becoming more frequent?

A Scott Laney, Edward L Petschak, Michael D Attfield

ABSTRACT

Objectives Epidemiological reports since 2000 have documented increased prevalence and rapid progression of pneumoconiosis among underground coal miners in the United States. To investigate a possible role of silica exposure in the increase, we examined chest X-rays (CRBs) for specific abnormalities (r-type small opacities) known to be associated with silicosis lung pathology.

Methods Underground coal miners are offered CRBs every 5 years. Abnormalities consistent with pneumoconiosis are recorded by National Institute for Occupational Safety and Health (NIOSH) Budd Levers using the International Labour Organization Classification of Radiographs of Pneumoconiosis. CRBs from 1989 to 2008 of 35673 participating miners were studied, focusing on reporting of r-type opacities (small rounded opacities 3–10 mm in diameter). Logistic regression was used to calculate prevalence ratios adjusted for miner age and proffession category.

Results Among miners from Kentucky, Virginia and West Virginia, the proportion of radiographs showing r-type opacities increased during the 1990s (prevalence ratios (PR) 2.5, 95% CI 1.7 to 3.7) and after 1999 (PR 4.1; 95% CI 3.0 to 5.5), compared to the 1980s (adjusted for profession category and miner age). The prevalence of progressive massive fibrosis in 2000–2008 was also elevated compared to the 1980s (PR 4.4; 95% CI 3.1 to 6.3) and 1990s (PR 3.8; 95% CI 2.1 to 6.9) in miners from Kentucky, Virginia and West Virginia.

Conclusions The increasing prevalence of pneumoconiosis over the past decade and the change in the epidemiology and disease profile documented in this and other recent studies imply that US coal miners are being exposed to excessive amounts of respirable crystalline silica.

What this paper adds

- Epidemiological reports since 2000 have documented increased prevalence and rapid progression of pneumoconiosis among underground coal miners in the United States.
- This study found an increase in a specific type of radiographic abnormality that has been shown to be associated with silicosis lung pathology.
- The increasing prevalence of r-type opacities, and greater number of cases of severe disease found in this study within the Appalachian coal fields point to excessive exposures to crystalline silica, a long recognized cause of rapid disease progression and severe pneumoconiosis in coal miners.
- These findings stress the need for a timely, comprehensive, accurate, and ongoing evaluation of crystalline silica exposures and control strategies in underground coal mines throughout the United States.

underground coal miners, characterised by an increase in severity, geographical clustering, rapid disease progression and advanced disease in younger miners. Since 1980, national mean exposure levels of respirable mixed coal mine dust reported for enforcement purposes have been consistently below federal permissible exposure limits and relatively unchanged on an annual basis. In the face of the established etiological association of CWF with coal mine dust, and the reported stability in
Percentage of r-type opacities by region and decade, 1980–2008
Lung Pathology in U.S. Coal Workers with Rapidly Progressive Pneumoconiosis Implicates Silica and Silicates

Robert A. Cohen1, Edward L. Petsonk2, Cecile Rose3,4, Byron Young5, Michael Regier6, Asif Najmuddin7, Jerrold L. Abraham1, Andrew Chung8, and Francis H. Y. Green9

1Feinberg School of Medicine, Northwestern University, Chicago, Illinois; 2School of Medicine and 3School of Public Health, West Virginia University, Morgantown, West Virginia; 4National Jewish Health, Denver, Colorado; 5University of Colorado School of Medicine, Denver, Colorado; 6Charleston Area Medical Center, Charleston, West Virginia; 7State University of New York, Upstate Medical University, Syracuse, New York; 8University of British Columbia, Vancouver, British Columbia, Canada; and 9University of Calgary, Calgary, Alberta, Canada.

Abstract

Rationale: Recent reports of progressive massive fibrosis and rapidly progressive pneumoconiosis in U.S. coal miners have raised concerns about excessive exposures to coal mine dust, despite reports of declining dust levels.

Objectives: To evaluate the histologic abnormalities and retained dust particles in available coal miner lung pathology specimens, and to compare these findings with those derived from corresponding chest radiographs.

Methods: Miners with severe disease and available lung tissue were identified through investigator outreach. Demographic as well as smoking and work history information was obtained. Chest radiographs were interpreted according to the International Labor Organization classification scheme to determine if criteria for rapidly progressive pneumoconiosis were confirmed. Pathology slides were scored by three expert pulmonary pathologists using a standardized nomenclature and scoring system.

Measurements and Main Results: Thirteen cases were reviewed, many of which had features of accelerated silicosis and mixed dust lesions. Twelve had progressive massive fibrosis, and 11 had silicosis. Only four had classic lesions of simple coal workers' pneumoconiosis. Four had diffuse interstitial fibrosis with chronic inflammation, and two had focal alveolar proteinosis. Polarized light microscopy revealed large amounts of birefringent mineral dust particles consistent with silica and silicates; carbonaceous coal dust was less prominent. On the basis of chest imaging studies, specimens with features of silicosis were significantly associated (P = 0.047) with rounded (type p, q, or r) opacities, whereas grade 3 interstitial fibrosis was associated (P = 0.02) with the presence of irregular (type s, t, or u) opacities.

Conclusions: Our findings suggest that rapidly progressive pneumoconiosis in these miners was associated with exposure to coal mine dust containing high concentrations of respirable silica and silicates.

Keywords: anthracosis, coal mining, pneumoconiosis, pathologic, silica
Lung explant; upper lobe is replaced by PMF; pale nodular areas within PMF lesion indicative of silicosis
Low magnification view of section from area of PMF (left image), and area with simple CWP (right image); both show predominantly silicotic lesions
The Toll of Black Lung Continues

Chester Fike
Born Feb. 3, 1952
Died Dec. 16, 2012
A victim of black lung, Chester died four months after undergoing a double lung transplant.

It is time to end this preventable disease

76,000 deaths since 1968
$45 billion spent in federal compensation
New cases being diagnosed, including in young miners

A new rule issued by the U.S. Department of Labor’s Mine Safety and Health Administration will greatly improve the protection of America’s coal miners from this debilitating disease. The rule is the centerpiece of MSHA’s initiative to End Black Lung—Act Now! To learn more, visit www.msha.gov/endblacklung.

Faces of Black Lung

“When I started working in the mine, I was looking forward to earning a good living....I never expected to get black lung.”

Department of Health and Human Services
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

MINE SAFETY AND HEALTH ADMINISTRATION
UNITED STATES DEPARTMENT OF LABOR

CDC
NIOSH
Debilitating Lung Disease Among Surface Coal Miners With No Underground Mining Tenure

Cara N. Halldin, PhD, William R. Reed, PhD, Gerald J. Joy, MS, Jay F. Colinet, MS, James P. Rider, BS, Edward L. Petsonk, MD, Jerrold A. Abraham, MD, Anita L. Wolfe, BA, Eileen Storey, MD, and A. Scott Laney, PhD

**Objective:** To characterize exposure histories and respiratory disease among surface coal miners identified with progressive massive fibrosis from a 2010 to 2011 pneumoconiosis survey. **Methods:** Job history, tenure, and radiograph interpretations were verified. Previous radiographs were reviewed when available. Telephone follow-up sought additional work and medical history information. **Results:** Among eight miners who worked as drill operators or blasters for most of their tenure (median, 35.5 years), two reported poor dust control practices, working in visible dust clouds as recently as 2012. Chest radiographs progressed to progressive massive fibrosis in as few as 11 years. One miner’s lung biopsy demonstrated fibrosis and interstitial accumulation of macrophages containing abundant silica, aluminum silicate, and titanium dust particles. **Conclusions:** Overexposure to respirable silica resulted in progressive massive fibrosis among current surface coal miners with no underground mining tenure. Inadequate dust control during drilling/blasting is likely an important etiologic factor.

Inhalation of respirable coal mine dust causes coal workers’ health (NIOSH), designed to detect pneumoconiosis among working underground coal miners by offering periodic chest radiographs. Miners are not charged for participation in this voluntary program. Under Part 90 of the Coal Act, miners with evidence of pneumoconiosis are offered the opportunity to transfer to a less dusty occupation at the mine (if one exists).

In 2012, there were more than 50,000 surface coal miners in the United States—44.3% of the coal mining workforce. Nevertheless, the benefits of pneumoconiosis surveillance under the Coal Act were not extended to surface miners until 2014. Consequently, surface miners did not generally have access to free periodic chest radiographs, and much less is known about the prevalence of dust-related lung disease in this group.

Surface coal mining has generally been considered less dusty than underground mining; however, highwall drills at surface mining operations can generate large quantities of respirable dust containing significant levels of crystalline silica. Working as a surface driller is a recognized risk factor for pneumoconiosis. Drill operators and workers in the vicinity of the drill may experience exposure to...
Miner 7*
Age: 60 years
Tenure: 40 years
Job history: Driller
Profusion: 1/1
PMF stage: A
Miner 9

- Medical record review
  - Significantly reduced lung and cardiopulmonary function
  - Diagnosed with silicosis and COPD
  - Advised to avoid further dust exposure

**Age: 46**
Small Opacity Profusion: 0/0
No evidence of PMF

**Age: 57**
Small Opacity Profusion: 2/1
PMF Stage: A
Black Lung Claims, by total received
All filings since July 1, 1973, including terminated, non-approved claims and Medical Benefits Only claims

Source: Department of Labor Division of Coal Mine Workers' Compensation Black Lung Program Statistics
Map by Alexandra Kanik
Black Lung Claims, by dollars paid

Disbursements of income and medical benefits for claims paid by the Black Lung Disabilities Trust Fund, and claims in interim pay status during 2015. Does not include benefits paid by liable coal mine operators and insurers.

Source: Department of Labor Division of Coal Mine Workers’ Compensation Black Lung Program Statistics.
Map by Alexandra Kanik
Brief Report

Lung Transplantation Is Increasingly Common Among Patients With Coal Workers’ Pneumoconiosis

David J. Blackley, Dr., Cara N. Haldin, PhD, Kristin J. Cummings, MD, and A. Scott Laney, PhD

Background: The prevalence of coal workers’ pneumoconiosis (CWP) in U.S. coal miners has increased, and severe presentations are increasingly common.

Methods: We describe trends in lung transplantation during 1996–2014 for recipients with a primary diagnosis of CWP or pneumoconiosis unspecified, and we summarize recipient characteristics and estimate survival.

Results: A total of 47 transplants were included; nearly three-quarters were performed during 2008–2014. All recipients were male, 96% were white, and the mean age was 56 years. Mean FEV₁% was 35% and FVC% was 53%. Mean time on a waitlist was 155 days, and 60% of transplants were bilateral. Median survival was 3.7 years.

Conclusions: These transplants reflect the use of a scarce resource for an entirely preventable disease, and highlight the need for enhanced efforts to reduce coal mine dust exposures. Am. J. Ind. Med. 59:175–177, 2016. Published 2016. This article is a U.S. Government work and is in the public domain in the USA.

KEY WORDS: coal workers’ pneumoconiosis; lung transplantation; occupational lung disease; coal mining
Requested Topics of Interest

1. A brief background on trends in the incidence of lung disease related to coal mine dust exposures in underground mines.

2. What is known about mining factors associated with observed increases in the prevalence and severity of pneumoconiosis in coal miners in some areas of central Appalachia.

3. Limitations in researchers’ understanding of trends in lung disease incidence.

4. To the extent that CPDM exposure data have been used to plan or carryout health studies of coal mine workers, what new information has that data provided, or might provide in the future?

5. What data are needed in addition to the CPDM data being reported by mine operators?
Misclassification of occupational disease in lung transplant recipients

David J. Blackley, DrPH, a
Cara N. Halldin, PhD, a
Robert A. Cohen, MD, a,b
Kristin J. Cummings, MD, a
Eileen Storey, MD, a and
A. Scott Laney, PhD a

From the aRespiratory Health Division, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Morgantown, West Virginia, USA; and the bSchool of Public Health, University of Illinois at Chicago, Chicago, Illinois, USA.

when Codes 1610 (occupational lung disease: other), 999 (other), 1600 (congenital: other), 1613 (pulmonary fibrosis: other) and 1997 (lung disease: other) are entered, and are optional for other diagnosis codes. Two investigators independently reviewed each free-text diagnosis to identify patients with conditions that arise only from occupational exposures, d and compared the 2 resulting case lists to assess agreement. Before the comparison, the proportion of specific positive agreement was high (0.989), and if a case was not an unambiguous occupational lung disease, then it was excluded. We assigned cases to 7 categories: silicosis; coal workers’ pneumoconiosis (CWP); asbestosis; pneumoconiosis not otherwise specified (PNOS); hard metal pneumoconiosis; berylliosis; and a single category to include hypersensitivity pneumonitis with specified work-
Examination of Potential Sources of Bias in the US Coal Workers’ Health Surveillance Program

A. Scott Laney, PhD, and Michael D. Attefield, PhD

Twenty years ago, the National Institute for Occupational Safety and Health (NIOSH) reported on the trend in pneumoconiosis prevalence among US coal miners for 1970–1986.1 The primary conclusion from those data was that the reduction in underground coal mine dust exposure mandated by federal regulations in 1969 led to lower prevalence of pneumoconiosis among underground coal miners. Overall, these results and conclusions were uncontroversial. Since that time, NIOSH has continued to report findings from the Coal Workers’ Health Surveillance Program (CWHSP) in the scientific literature,2 in government reports,3,4 and on the NIOSH Website.5,6 Figure A (available as a supplement to the online version of this article at http://www.ajph.org) shows trends in the national prevalence of coal worker pneumoconiosis (CWP) from 1970 to 2009 as reported on the Website in early 2012. In addition to showing the

Objectives. We examined the potential influences of certain selection factors on the utility of the Coal Workers’ Health Surveillance Program (CWHSP) data for tracking disease distribution and trends.

Methods. We combined data from the CWHSP and the Energy Information Administration to examine any influence of variable worker participation on observed disease prevalence. We evaluated effects of differential participation by coal mining region, temporal changes in employment, and active surveillance efforts.

Results. The published findings of pneumoconiosis distribution and trends from the CWHSP were robust compared with the various participation factors that might have affected their validity for population-based estimates of disease burden. Exploration of factors that could potentially bias the findings generally led to small increases in the primary estimates, mostly for the early years of the program.

Conclusions. We confirmed previously reported findings that there was a high prevalence of coal worker pneumoconiosis (CWP) around 1970–1974, a substantial decline in 1995–1999, and indications of an increase since then. Overall our findings suggest that the previously reported distribution and trends in CWP prevalence were broadly accurate. (Am J Public Health. Published online ahead of print May 16, 2013; e1–e6. doi:10.2105/AJPH.2012.301051)
DEPARTMENT OF LABOR
Mine Safety and Health Administration
30 CFR Parts 70, 71, 72, 75, and 90
RIN 1219–AB64
Lowering Miners’ Exposure to Respirable Coal Mine Dust, Including Continuous Personal Dust Monitors
AGENCY: Mine Safety and Health Administration, Labor.
ACTION: Final rule.
• Included spirometry testing
• Extended surveillance to surface miners
• Symptom assessments
Outbreak of Progressive Massive Fibrosis in Coal Miners — Eastern Kentucky, 2016
Case definition

• An ILO interpretation of large opacity category A, B or C in a coal miner who received a radiograph from the Clinic in Pikeville, Kentucky during January 7, 2015 – August 17, 2016, with completed radiograph reading sheet, and completed occupational history form
In addition to a digital radiograph, many patients had additional information, including:

- Serial radiographs
- CT scans
- Pathology notes
- Detailed occupational histories
- Worker’s compensation status
Cases as of 8/17/16

• 60 cases of clinic-identified PMF in the last 20 months
  – More since then
• 49 cases in 2016 year-to-date
• 34 cases in last 6 months
Primary job in the mines

<table>
<thead>
<tr>
<th>Job Type</th>
<th>Number (%)</th>
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<tbody>
<tr>
<td>Roof Bolter</td>
<td>26 (43.3)</td>
</tr>
<tr>
<td>Continuous Miner</td>
<td>20 (33.3)</td>
</tr>
<tr>
<td>Loader/Scooper</td>
<td>3 (5)</td>
</tr>
<tr>
<td>Shuttlecar Driver</td>
<td>3 (5)</td>
</tr>
<tr>
<td>Maintenance/Electrical</td>
<td>3 (5)</td>
</tr>
<tr>
<td>Driller</td>
<td>3 (5)</td>
</tr>
<tr>
<td>Longwall Shear</td>
<td>1 (1.7)</td>
</tr>
<tr>
<td>Dozer Driver</td>
<td>1 (1.7)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>60 (100)</strong></td>
</tr>
</tbody>
</table>
A. Two miners use a roof-bolting machine to install the bolts that support the roof of an underground coal mine. B. A continuous miner machine extracts coal from the mine face with a rotating drum.
Mackie Branhm, Jr., was diagnosed with the complex form of black lung at age 38.
Fighting For Breath: Black Lung's Deadliest Form Increases

By BENNY BECKER  •  DEC 21, 2016
Resurgence of Progressive Massive Fibrosis in Coal Miners — Eastern Kentucky, 2016

The factor or combination of factors that led to this increase in cases of PMF in eastern Kentucky and whether there are more unrecognized cases in neighboring coal mining regions are unknown. Because PMF takes years to become manifest, the specific exposures or mining practices that led to these cases are also unknown. New or modified mining practices in the region might be causing hazardous dust exposures. While obtaining detailed occupational histories, the reporting physician identified the practice of “slope mining” (5) as a potential exposure in eastern Kentucky (slope mining involves teams of miners operating continuous miner machines, designed to cut coal and other soft rock, to cut shafts through hundreds of feet of sandstone to reach underground coal seams) (Figure 2). The sandstone formation underlying eastern Kentucky is >90%
The NIOSH report suggests another piece of the puzzle could be the popularity of a technique called slope mining, which involves making a long cut through rock in order to reach a coal seam. In central Appalachia, this usually means cutting through sandstone. Sandstone breaks down into silica dust, which can be much more harmful than coal dust. Branham said he once spent six straight months making this kind of cut, regularly working shifts as long as 16 hours.

It was "pure rock dust," he says. "I had my respirators on and you'd actually have to remove it to help take a breath every once in a while because the dust packed so much around your filters you couldn't get no air in."
"I can no longer provide for my family." - Mackie Branham

"The more I talk, the more I get out of breath." - Mackie Branham

Mackie Branham, Jr., was diagnosed with the complex form of black lung at age 38.
Requested Topics of Interest

1. A brief background on trends in the incidence of lung disease related to coal mine dust exposures in underground mines.

2. What is known about mining factors associated with observed increases in the prevalence and severity of pneumoconiosis in coal miners in some areas of central Appalachia.

3. Limitations in researchers’ understanding of trends in lung disease incidence.

4. To the extent that CPDM exposure data have been used to plan or carryout health studies of coal mine workers, what new information has that data provided, or might provide in the future?

5. What data are needed in addition to the CPDM data being reported by mine operators?
Continuous Personal Dust Monitor (CPDM)

- Use of CPDM mandated in February, 2016
- Unlike older gravimetric samplers, miners wearing CPDM are able to use readouts to make immediate adjustments to reduce exposure
- As of December, 2016 the percentage of samples exceeding the MSHA dust exposure limit declined from 3.1% (pre-CPDM) to 0.3% (post-CPDM)

https://www.cdc.gov/niosh/mining/features/CPDMhelpsminersavoiddust.html

Question: Are the exposure reduction benefits of CPDM maintained on days when miners don’t wear them and thus don’t have the benefit of continuous exposure readouts?
Coal Mine Dust Lung Disease: Where are we Going?

- Intensive investigation of Eastern Kentucky coal miners
- Active surveillance using the ECWHSP in central Appalachia
- Capture/Recapture analysis of DOL OWCP and CWHSP data
- Mortality studies
- Shape/size and location of PMF lesions
- Cardiopulmonary evaluation of miners in the ECWHSP
- CWP in non-Appalachian miners
- CWP and lung function in former miners (entire U.S.)
- Studies of radiographic progression
- Federal rule-making (updates to 42CFR37) to enhance surveillance
- Examination of part 90 transfer rights