Update on Surveillance for Pneumoconiosis in U.S. Coal Miners

National Coalition of Black Lung & Respiratory Disease Clinics – 2018 Black Lung Conference

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The findings and conclusions in this report are those of the author and do not necessarily represent the views of the National Institute for Occupational Safety and Health.
Overview of Presentation

• Introduction

• Update on Burden of Disease
  • Coal Workers’ Health Surveillance Program
  • Other Sources of Surveillance Information

• Role of Silica and Other Silicate Minerals in Contemporary Pneumoconiosis

• Other Topics of Interest to Black Lung & Respiratory Disease Clinics
  • Spirometry Surveillance
  • B Reader Program

• Conclusion
Medical and Work History

• **Age 21**: Started mining as scoop operator

• **Age 24**: Continuous mine operator

• **Age 52**: Worked on the surface at the mine

• **Age 56**: Stopped mining

• **Age 60**: Double lung transplant. Died 4 months later.
Coal Mine Dust Lung Diseases (CMD-LD)

CMD-ILD (Interstitial Lung Disease)
- Coal Worker’s Pneumoconiosis (CWP)
- Silicosis
- Mixed Dust Pneumoconiosis
- Dust-Related Diffuse Fibrosis

CMD-OLD (Obstructive Lung Disease)
- Chronic Airway Diseases / COPD
  - Emphysema (most commonly centriacinar)
  - Chronic bronchitis
- Coal mine dust exposure and cigarette smoking have similar additive effects on emphysema severity

Petsonk EL et al. Amer J Respir Crit Care Med 2013
No Pneumoconiosis
Simple Pneumoconiosis
Progressive Massive Fibrosis
SHORT REPORT

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

- “The mean time from the most recent normal radiograph to a radiograph with a determination of PMF was **20.7 years** (median 20; range 1–43).”
- “Of these 163 miners [who had a normal x-ray at one point], 27 (16.6%) progressed to PMF in less than 10 years, 57 (35.0%) progressed to PMF in 11–20 years and 79 (48.5%) miners progressed from normal to PMF in more than 20 years.”

Laney et al., OEM, 2017
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Coal Workers’ Health Surveillance Program

- Coal miners are required to have baseline respiratory health evaluations at entry into coal mining and to be offered follow-up evaluations at about 5-year intervals.

- Evaluations currently include work history, respiratory health questionnaire, chest x-ray, and spirometry.

- Surveillance testing is provided in two ways:
  - Through local medical facilities approved by NIOSH
  - Through NIOSH mobile outreach

- NIOSH receives, processes, and reports test results. Standardized evaluation of chest x-rays is done by NIOSH-certified physicians called “B Readers.”
Radiographic Findings of Pneumoconiosis Among Underground Coal Miners Participating in CWHSP by Mining Tenure (5-year moving average)

Blackley et al., AJPH, 2018
Prevalence of PMF in KY, VA, WV Surveillance Participants with ≥ 25 Years Tenure, 1974 – 2015 (5-year moving average)

Blackley et al. MMWR 2016; 65(49):1385-1389.
U.S. Lung Transplants for CWP or Pneumoconiosis (Unspecified), 1996-2017

* 2017 data include January–June

Blackley et al., AJIM, 2018
## Division of Coal Mine Workers' Compensation (DCMWC)

### Black Lung Program Statistics

Claims filed under Part C of the Black Lung Benefits Act

**2001-2017**

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>New Claims</th>
<th>Refiled Claims</th>
<th>Successor Claims</th>
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<td>3287</td>
<td>600</td>
<td>478</td>
<td>7386</td>
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</table>

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2. Refiled claim: the claimant has filed at least once before.
3. Successor claim: a subsequent claim filed on a miner's record by another person.
4. Conversion: some dependent survivors are automatically entitled to benefits.

[https://www.dol.gov/owcp/dcmwc/statistics/PartCClaimsFiled.htm](https://www.dol.gov/owcp/dcmwc/statistics/PartCClaimsFiled.htm)
Percentage of Miners Filing for Federal Black Lung Benefits with PMF, 1970-2016

Observed PMF Percent  Modeled Trend in PMF Percent  Total number of claimants

Almberg et al., Ann Am Thorac Soc 2018
Miners Filing for Federal Black Lung Benefits with PMF, 1970-2016

Number of miners filing for Federal Black Lung Program benefits that were found to have PMF (solid line) compared to average annual coal mine employment (shaded area), 1970–2016.

Almberg et al, Ann Am Thorac Soc 2018
Number of Deaths with CWP Listed as a Multiple Cause of Death, 1996-2016

<table>
<thead>
<tr>
<th>Year</th>
<th>Deaths</th>
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<tr>
<td>2000</td>
<td>949</td>
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<tr>
<td>2001</td>
<td>886</td>
</tr>
<tr>
<td>2002</td>
<td>859</td>
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<td>772</td>
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<td>2004</td>
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<td>2014</td>
<td>363</td>
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<tr>
<td>2015</td>
<td>323</td>
</tr>
<tr>
<td>2016</td>
<td>300</td>
</tr>
<tr>
<td>Total</td>
<td>10,594</td>
</tr>
</tbody>
</table>

FIGURE 2. Years of potential life lost to life expectancy (YPLL) and before age 65 years (YPLL_{65}) and mean YPLL and YPLL_{65} per decedent for decedents aged ≥25 years with coal workers’ pneumoconiosis,* by year of death — United States, 1999–2016

Mazurek et al. MMWR, 2018
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Review of Lung Pathology Among Miners Killed in the Upper Big Branch Disaster

• 24 / 29 victims had sufficient lung tissue for examination at autopsy. The State medical examiner identified CWP in 17.

• Lung tissue for 7 miners (mean age 43±10 years, mean tenure 15±12 years) was obtained & examined in follow up

• 6 / 7 had at least minimal profusion of coal macules consistent with CWP

• 1 / 7 had evidence of silicotic nodules and also a lesion that might have qualified as PMF, but was truncated in sampling

• 1 / 7 had diffuse dust-related interstitial fibrosis

• PLM shows birefringent particles consistent with silica and silicates

Cohen et al. Am J Respir Crit Care Med 187;2013:A6063
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 Najmuddin², Jerrold L. Abraham⁷, Andrew Churg⁸, and Francis H. Y. Green⁹

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.

Pneumoconiosis among underground bituminous coal miners in the United States: is silicosis becoming more frequent?

A Scott Laney, Edward L Petsonk, Michael D Attfield

Percentage of r-type opacities by region and decade, 1980–2008

Occup Environ Med. 2010 Oct;67(10):652-6
Coal Mine Dust is a Complex Mixture

• Respirable coal mine dust standard: full-shift average of 1.5 mg/m³
• Reduced respirable coal mine dust standard if content of respirable quartz dust exceeds full-shift average of 100 µg/m³
  • Reduced standard (mg/m³) = 10 / [%] quartz
  • Standard never exceeds 1.5 mg/m³
60 cases of clinic-identified PMF during January 2015–August 2016
26 were roof bolters and 20 were operators of continuous miners
Slope mining through sandstone identified as a possible risk factor
Underground Coal Mining

http://www.uky.edu/KGS/coal/coal-diagram-download.php
Mackie Branham, Jr., was diagnosed with the complex form of black lung at age 38.

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."

February 6, 2018

Progressive Massive Fibrosis in Coal Miners From 3 Clinics in Virginia

Results

We identified 416 coal miners meeting the case definition, among approximately 11,200 observed during the study period. Each was white and male, mean age was 61.8 years (range, 38.6-88.7), and most resided in Kentucky or Virginia (Table). Mean coal mining tenure was 27.9 years (range, 8-64); 80 miners (22.7%) reported a tenure of 20 years or less. Forty-two (12.4%) cases were in persons still working as coal miners at the time of radiograph.

A total of 154 miners (37.0%) were classified as having category B or C large opacities and 272 (65.4%) had profusion of small opacities in the subcategory of 2/1 or greater (Figure). Nearly one-third of radiographs (n=122, 29.3%) had background small opacities classified as r-type.

Discussion

To our knowledge, this is the largest cluster of PMF reported in the scientific literature.

Blackley et al., JAMA, 2018
## Themes from Interviews\(^1\) of 19 Miners with PMF from 3 Clinics in Virginia

<table>
<thead>
<tr>
<th>Theme</th>
<th># Miners</th>
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<tbody>
<tr>
<td>Reported continuous miner cut rock</td>
<td>18</td>
</tr>
<tr>
<td>Reported continuous miner cut substantial(^2) amounts of rock</td>
<td>13</td>
</tr>
<tr>
<td>Did not consistently maintain ventilation</td>
<td>14</td>
</tr>
<tr>
<td>Improperly sampled respirable coal mine dust</td>
<td>13</td>
</tr>
<tr>
<td>Reported dust samplers were placed in air intake or power center</td>
<td>9</td>
</tr>
<tr>
<td>Reported maintaining better work practices when MSHA/corporate present</td>
<td>8</td>
</tr>
<tr>
<td>Reported using respirator</td>
<td></td>
</tr>
<tr>
<td>- Intermittently when needed</td>
<td>15</td>
</tr>
<tr>
<td>- Always</td>
<td>1</td>
</tr>
<tr>
<td>- Never</td>
<td>3</td>
</tr>
<tr>
<td>Did not participate in CWHSP at recommended intervals</td>
<td>19</td>
</tr>
<tr>
<td>Continued to work after first abnormal chest radiograph</td>
<td>7</td>
</tr>
</tbody>
</table>

\(^1\)9 roof bolters, 7 continuous miner operators, 1 shuttle car operator, 2 combination of jobs. Interviews were semi-structured; some themes emerged spontaneously and not all miners were asked or provided an answer to every question. Therefore, a denominator cannot be determined and results should be interpreted accordingly.

\(^2\) Mentioned cutting rock of 12 inches or more, slope/roll, or "significant" to estimate the amount of rock.
What is Needed for Better Prevention?

**Primary Prevention**
- How to enable/ensure universal compliance with regulations?
- Are there other components of coal mine dust that should be measured and controlled?

**Secondary Prevention**
- How to ensure early disease detection?
- How to assist those with early CMD-LD?

**Tertiary Prevention**
- Is it possible to alter the clinical course?
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Miners are eligible to have spirometry testing as part of the health screening offered by CWHSP

Operators notified this summer to contact NIOSH about adding spirometry to surveillance plans

32 facilities (31 fixed, 1 mobile) approved to provide spirometry

8 spirometer models from 4 manufacturers able to provide electronic data and reports according to specifications

9 additional models from 7 manufacturers are able to provide standardized reports, but do not yet generate standardized electronic data

See: https://www.cdc.gov/niosh/topics/cwhsp/CoalMinerHealth.html
Update on B Reader Program

- B Readers are physicians who have successfully passed an examination documenting their ability to use the International Labour Organization (ILO) classification system.
- Currently working with ILO to update classification system.
- Examination is now available in electronic format.
- Work is in progress to update training syllabus and examination.

Figure 1: Bar graph shows profusion of small opacities for 158,370 classifications by reader type. Small opacity profusion classifications are standard ILO designations.

Halldin et al. Radiology. 2017 Apr 21;162437.
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