Lung Disease, Miners, and Mining Communities, a Global Population at Risk
University of California, San Francisco - Division of OEM
March 14, 2019

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Disclosure of Financial Interest
- Funded by the Alpha Foundation for the Improvement of Mine Safety and Health
- Funded by HHS/HRSA/ORHP/BLCP & BLCE
- Employee of NIOSH/RHD
- Funded by USDOL/OWCP & MSHA
- Funded by Queensland Government, Australia
- Provide IME’s for Occupational Lung Disease

Goals for Today’s Talk
- Discuss examples of mining related lung disease in global populations
- Describe risks to communities from mining related activities
  - Surface Mining
  - Underground Mining
  - Mine Materials/Processing
- Give examples of mining related disasters that affect workers, their families, and their communities
Rapidly progressive coal workers’ pneumoconiosis in the United States: geographic clustering and other factors

V G dos S Antas, J P Mateus, S E Sokolow, A L Wolfe, A A Polinello, J M Hule, R D Alfillé
Results

- Risk factors
  - Smaller mine > larger mine
  - Longer tenure in jobs at face
  - Younger > older
    - Implicating recent mining conditions
- Other factors
  - Mining technique
  - Approaches to dust control
  - Enforcement of PEL

NIOSH CWHSP – Surveillance of Active Miners

- Participating medical facilities
- NIOSH mobile outreach
- Screening chest radiographs received in FY-2017
  - 7423 radiographs received
    - 3110 underground miners
    - 2383 from surface miners
    - 1930 from contractors
  - 2812/7423 from mobile outreach unit
- Screening lung function with spirometry currently being implemented as part of testing offered by CWHSP

Radiographic Findings of Pneumoconiosis in CWHSP Participants (5-year moving average)
Radiographic Findings of Pneumoconiosis in CWHSP Participants from KY, VA, and WV (5-year moving average)

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.

1/1/15-8/17/16, a total of 60 patients with PMF
49 had their radiograph taken during 2016.

High proportion of miners with very advanced disease:
- 52% category A
- 38% category B
- 10% category C

Surveillance data have indicated a resurgence of PMF in recent years, but the cases described in this report represent a large cluster not discovered through routine surveillance.

Chest radiograph image taken in 2016 of a 56-year-old male eastern Kentucky resident with 29 years of total mining tenure (including 11 years as a roof bolter). Category C PMF, Profusion q/q 3/2
The prevalence of PMF among former miners is less well understood. Data taken from the U.S. Department of Labor Office of Workers Compensation Administrative Data Set. This study is the first to report trends in the proportion of Black Lung claimants with PMF using data from the Federal Black Lung Program. These data are independent of national surveillance data and help us further understand the burden of PMF among former U.S. coal miners.
Results

- Evaluated 341,176 claims between 1970-2016
- PMF % of claims increased from 1970-2016
- PMF % of claims accelerated since 1996.
- 2,474 cases of PMF identified from 1996-2016
- This is more than 10 times the number identified CWHSP (n=225).
- Increase in PMF occurred as workforce declined and claim rate remained stable.
- PMF cases greatest from Kentucky, Virginia, and West Virginia.

Figure 1. Number of miners with PMF compared to average annual coal mine employment, 1970-2016. The number of claimants with PMF from 1970-1972 are combined due to small numbers. Office workers are included in employment totals from 1973-1977. Data sources: U.S. DOL, OWCP, DCMWC; U.S. DOL, MSHA; and the EIA.

Geographic Distribution of PMF Cases
PMF cases found in retired miners who never participated in NIOSH CWHSP.

- Why don’t miners participate?
- Holes in the social safety net:
  - 1985 – 2005, employment in the Appalachia coal mining industry declined by 56% due to
    - Cost of coal relative to oil and natural gas
    - Increased mechanization
    - Shift to contract labor
  - Fear of job loss
  - Fear of disease and associated disability
  - Mistrust of government


Archives of Environmental & Occupational Health

Part 90 Option

Miner participates in CWHSP

Miner notified of radiographic findings consistent with CWP

Miner can exercise Part 90 option through MSHA
Exercising the Part 90 Option

- 14% of eligible miners exercised their Part 90 right in the last 30 years
- Median days to exercise Part 90 option was 63 days (range 0 - 10831 days)
- Miners who exercised their option more quickly were older and had longer mining tenures

Miners working in central Appalachia were less likely to exercise Part 90 compared to those in other states
- Miners from Virginia and Kentucky were least likely to exercise their option, at 8.9% and 9.8%
- Miners from Utah and Colorado were most likely to exercise their option, at 32.8% and 30.2%
Mining Disasters

Mining Related Disasters
- Explosions
- Inundations
- Roof Falls – Mine Collapse
- Fires
Inundations – Quecreek, Somerset, PA
July 24-28, 2002
- 9 Miners trapped for 77 hours
- Rescue hole was drilled
- Capsule lowered and all were saved

SAGO MINE EXPLOSION
JANUARY 2, 2006

INTERNATIONAL COAL GROUP
SAGO MINE
MINER I.D. No. 46-08791

Sago Mine Explosion and Fire
- 12 Miners died and one severely injured in the explosion occurred at approximately 6:26 AM on January 2, 2006.
5/22/2006  
Darby Mine, Kentucky  
5 Miners died in methane mine explosion

ARACOMA COAL COMPANY, INC.  
ARACOMA ALMA MINE #1  
JANUARY 19, 2006  
FATAL MINE FIRE  
Aracoma Alma Mine # 1  
Conveyor Belt Fire – 2 Deaths  
Logan County, WVA

Crandall Canyon Mine  
Utah  
August 6, 2007 and August 16, 2007  
Roof Fall During Retreat Mining  
3 Rescuers died in subsequent bump event
Fire and Explosion Killed 29 Miners
Analysis of the pattern of injuries from the Upper Big Branch Disaster showed 10 deaths from CO
The remainder primarily due to blast and thermal injuries
A systematic pathologic review suggests a continuing high proportion had pneumoconiosis 86%
Settlement of law suit resulting from the disaster resulted in the formation of the Alpha Foundation which is funding part of our work
Copiapó mining accident – Chile 2010
33 Men trapped for 69 days – roof fall

The Case of the Cananea Copper Mine – Sonoro Mexico
Cananea Copper Mine

- Mexico’s Largest Open Pit Mine
- Opened in 1899
- Open pit mining techniques - drilling and blasting
- Ore greater than 0.34% copper is then ground to powder
- Agitated with water and reagents

Cananea Copper Mine

- Ore greater than 0.34% copper is then ground to powder
- Agitated with water and reagents
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Sent to flotation cells
Air pumped in causing it to froth and copper mineral floats
Copper then concentrates with average of 26.6% copper and sent to smelter for processing
Ore between 0.15% and 0.34% is sent to leaching facility where sulfuric acid is poured onto material in a leaching procedure solvent extraction with electrowinning

Cananea Copper Mine

- Workers struck in 2007 over working conditions, health, and control of the union
- Site of 1906 Strike that fueled the Mexican revolution against then President Porfirio Diaz.
- Mexican army took back the site in 2010.
Strike Support Rally

Mexican Miners Union
National Forum
Cananea Union Hall

February 2, 2008

Strike was crushed by Federal Government forces in 2010
Mining Related Environmental Disasters

- Dam Failures
- Fresh Water Contamination with heavy metals, chemicals
- Air Pollution – dust, diesel exhaust particulate
- Subsidence

Cananea Copper Mine – Environmental Disaster – 8/6/14

- Massive spill of copper sulfate
- 40,000 m³ leaked into tributary of Sonora river and San Pedro River
Cananea copper mine spill  
August 6, 2014

- Polluted Arroyo Las Tinajas (17.6 km)
- Bacanuchi River (64 km)
- The main stream of the Sonora River (190 km)
- Affected seven municipalities inhabited by 20,048 people.
- The pollution led the government to close 322 wells, leaving local communities without water for domestic and farming uses.

Miners and farmers unite to protest Grupo Mexico’s Handling of Spill 3/27/15
Charleston West Virginia – Elk River

Kanawah River Contamination
1/9/2014
- Storage Tanks of 4-methylcyclohexanemethanol (MCHM) – coal floculent ruptured and spilled into Kanawah River
- 7,500 gallons leaked
- Also contaminated with glycol ethers (PPH)

Kanawah River Contamination
Charleston, WV
- The chemical smelled like licorice in the parts per billion concentration so it was detected by the population.
- Separates fossil fuel from dirt and rock
- Used in coal prep plants
- Affected 300,000 West Virginians
- Had been classified as non-hazardous chemical and therefore not regulated
Retention Dam Failures
Brumadinho, Brazil 1/25/19

Killed 186 with 122 still missing
Owned by BHP/Vale Mining Corporation
Prior Dam Failure in 2015
Prosecutors removed top 3 executives March 3, 2019
Retention Dam Failures

<table>
<thead>
<tr>
<th>Dam/incident Location</th>
<th>Dam/incident</th>
<th>Fatalities</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mina Plakalnitsa</td>
<td>Bulgaria</td>
<td>107</td>
<td>A tailings dam at copper mine near the city of Vratsa failed. A total 450,000 cu m of mud and water inundated Vratsa and the nearby village of Zgorigrad, which is suffered widespread damage. The official death toll is 107, but the unofficial estimate is around 500 killed.</td>
</tr>
<tr>
<td>Certej dam failure</td>
<td>Romania</td>
<td>89</td>
<td>A tailings dam built too tall collapsed, flooding Certeju de Sus with toxic tailings.</td>
</tr>
<tr>
<td>Buffalo Creek Resid</td>
<td>West Virginia, United States</td>
<td>125</td>
<td>Unstable loose constructed dam caused by local coal mining company, collapsed in heavy rain. 1,121 injured, 507 houseddepends, over 6,000 left homeless.</td>
</tr>
<tr>
<td>Martin County coal dry spill</td>
<td>United States</td>
<td>0</td>
<td>Failure of a coal dry spill occurred. The water supply for over 23,000 residents was contaminated. One of the worst environmental disasters ever in the southeastern United States.</td>
</tr>
<tr>
<td>Ajka alumina plant incident</td>
<td>Hungary</td>
<td>10</td>
<td>Failure of concrete impoundment at alumina processing plant. One million cubic meters of mud contaminated a large area, within days the mud had reached the Danube River.</td>
</tr>
<tr>
<td>Montana dam disaster</td>
<td>United States</td>
<td>19</td>
<td>Tailings dam collapsed. One village destroyed, 40 people evacuated, 40 million cubic meters of tailings slurry polluted Dora River, and the river went from red.</td>
</tr>
<tr>
<td>Bavendalh dem disaster</td>
<td>United States</td>
<td>142</td>
<td>Tailings dam suffered a catastrophic failure releasing 12 million cubic meters of tailings slurry, 348 people missing.</td>
</tr>
</tbody>
</table>
Risks associated with mining to workers and their communities include all of the following except:

A. Inundations/Dam Failure
B. Infections such as HIV AIDS and Tuberculosis
C. X-ray exposure
D. Excess non-malignant respiratory disease
E. Air and water pollution

All of the following mining related contaminants have been associated with lung cancer

A. Radon
B. Silica
C. Lead
D. Diesel Exhaust
Rural communities have suffered major adverse health effects related to mining including all of the following except:

A. Subsidence
B. Air pollution
C. Water Pollution
D. Retention Dam Failures
E. Heavy metal toxicity