Health Consequences of Overexposure to Respirable Coal and Silica Dust

Jay Colinet
Senior Scientist
Dust Control, Ventilation, and Toxic Substances Branch
NIOSH Office of Mine Safety and Health Research
Pittsburgh, PA

Acknowledge colleagues at DRDS

- Anita Wolfe - Public Health Advisor
- Edward L. Petsonk, MD - Senior Medical Officer

Presentation Outline

- Lung diseases in coal mining
- Magnitude of impact on coal mining industry
- Regional “Hotspot” findings
- Best Practices efforts of NIOSH
- Black Lung Video

Respirable dust in coal mining

- Dust less than 10 microns in size (cannot be seen with the eye)
- Overexposure can cause lung disease
- X-ray surveillance program available for underground coal miners
- Current exposures limits established in U.S. in 1969
- Personal sampling conducted by MSHA and mine operators on a periodic basis
- Control technologies developed and utilized to reduce worker exposures

Diseases caused by inhalation of coal mine dust

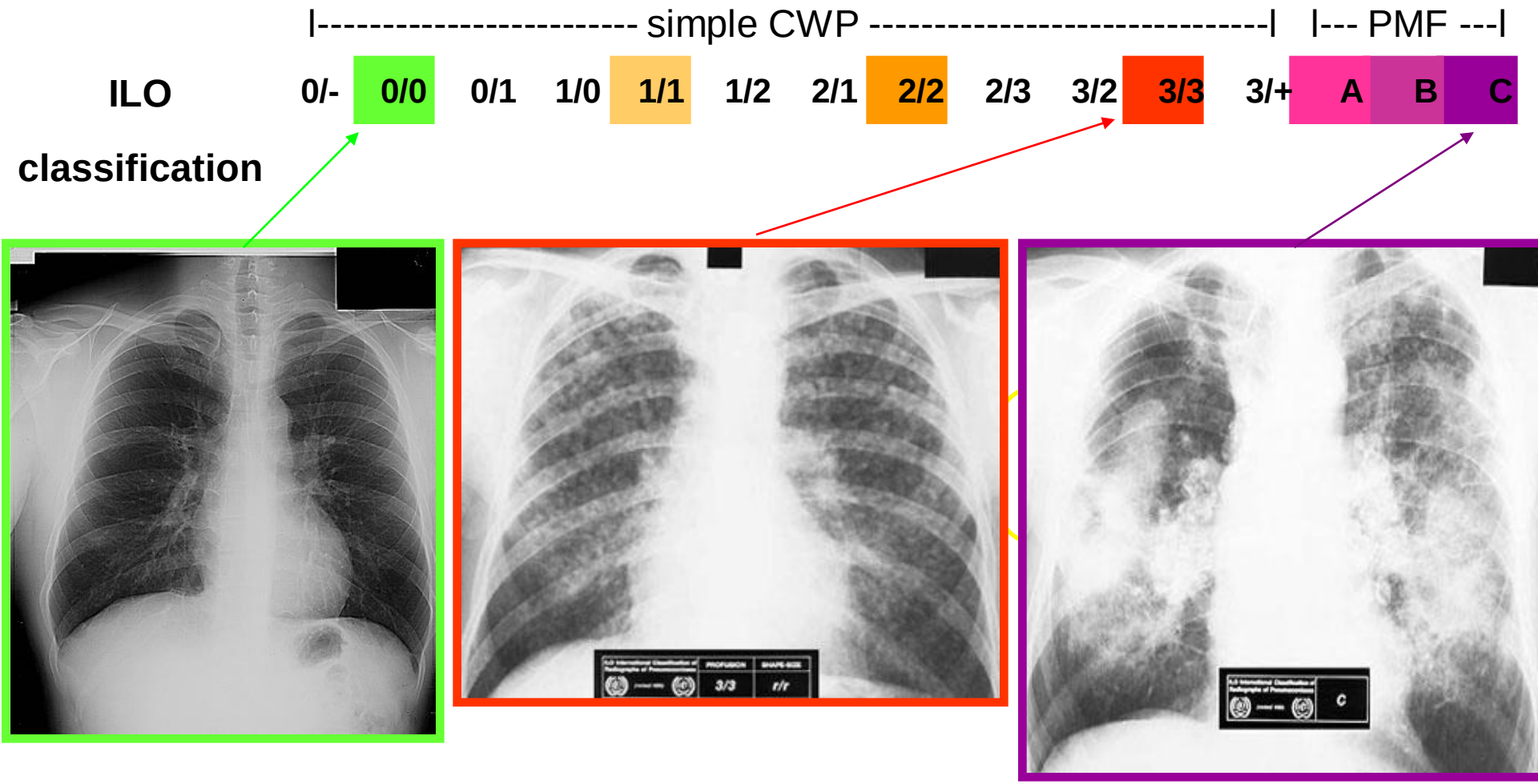
- Fibrotic diseases – damage/destroy lung tissue
  - Coal workers' pneumoconiosis "CWP"
  - Silicosis
- Airflow diseases "COPD" – block movement of air in and out of lungs
  - Bronchitis
  - Emphysema
  - Mineral dust airway disease

Fibrotic lung diseases in miners

CWP and silicosis

- Similar patterns on chest x-ray
- Simple and Complicated forms of disease
- Complicated = Progressive Massive Fibrosis (PMF)
- Smoking does not cause these diseases or accelerate progression of the diseases
- ILO standards used to determine severity
- Cannot be cured, so prevention is the key

International Labour Office Classification of Radiographs



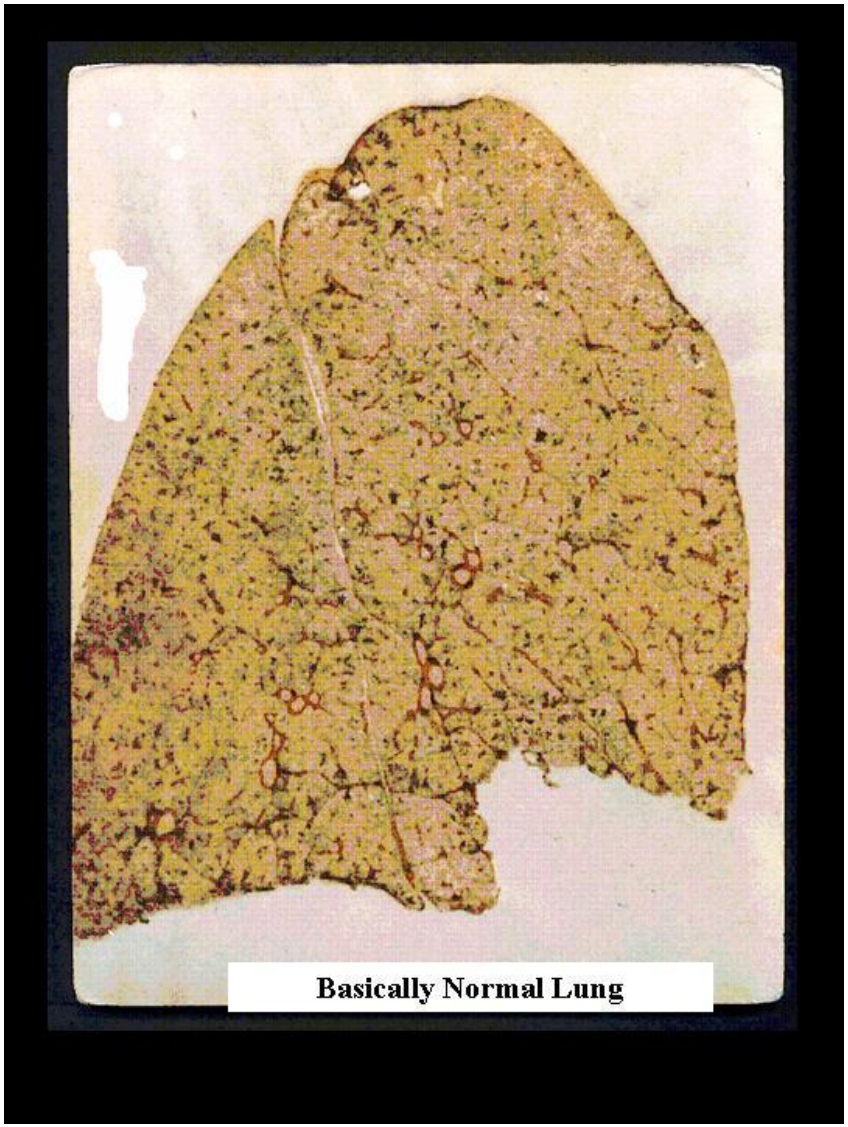
Coal Workers' Pneumoconiosis (CWP)

- Commonly called Black Lung Disease
- Chronic lung disease resulting from inhalation of respirable coal dust
- Dust deposits in the lung and damages lung tissue
- Disease development typically takes over 10 years of dust exposure

Simple CWP

- Initially worker may not have any symptoms
- As disease progresses, symptoms appear
  - Coughing
  - Wheezing
  - Shortness of breath (especially during exercise)
- Disease can advance to PMF

Coal Workers' Pneumoconiosis



Basically Normal Lung

Coal Worker
Coal Workers' Pneumoconiosis
(CWP)
Black Lung Disease

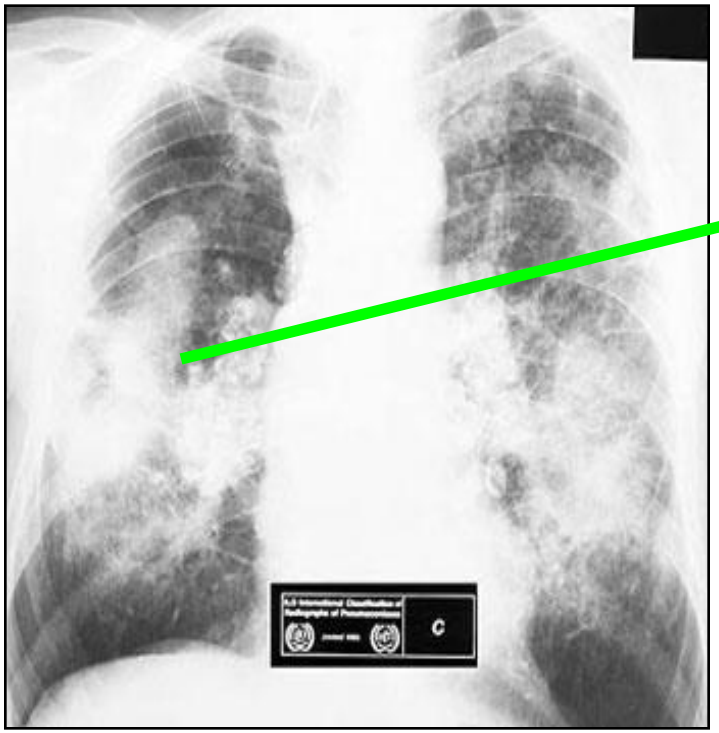
CDC Centers for Disease Control and Prevention

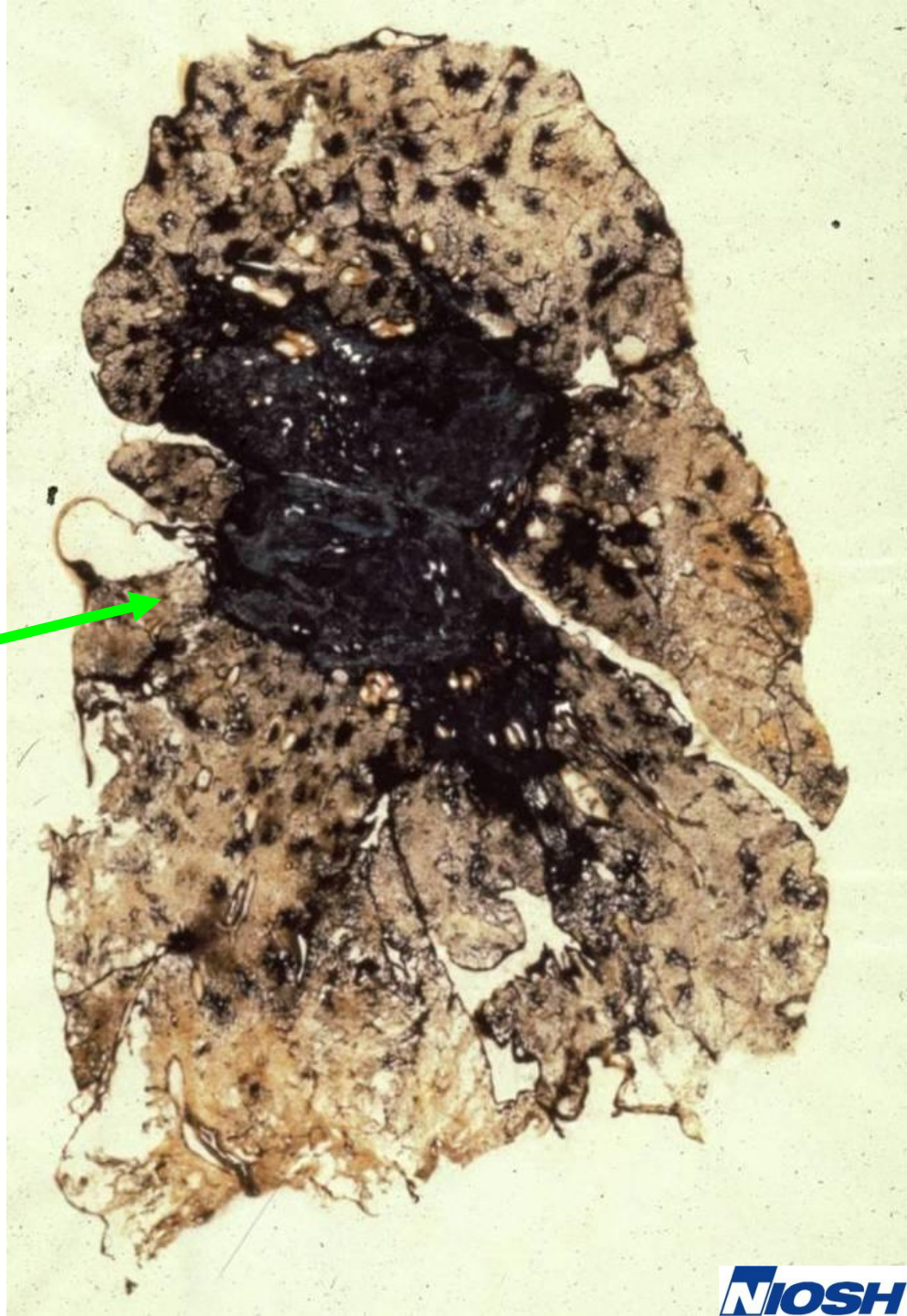
NIOSH

Complicated CWP

- Progressive Massive Fibrosis (PMF)
- Fibrous tissue develops in lungs
- Lungs become stiff and cannot expand fully
- Breathing becomes difficult
- Lips and fingernails may have bluish tinge
- Fluid retention and signs of heart failure

Complicated CWP
(Progressive Massive Fibrosis)





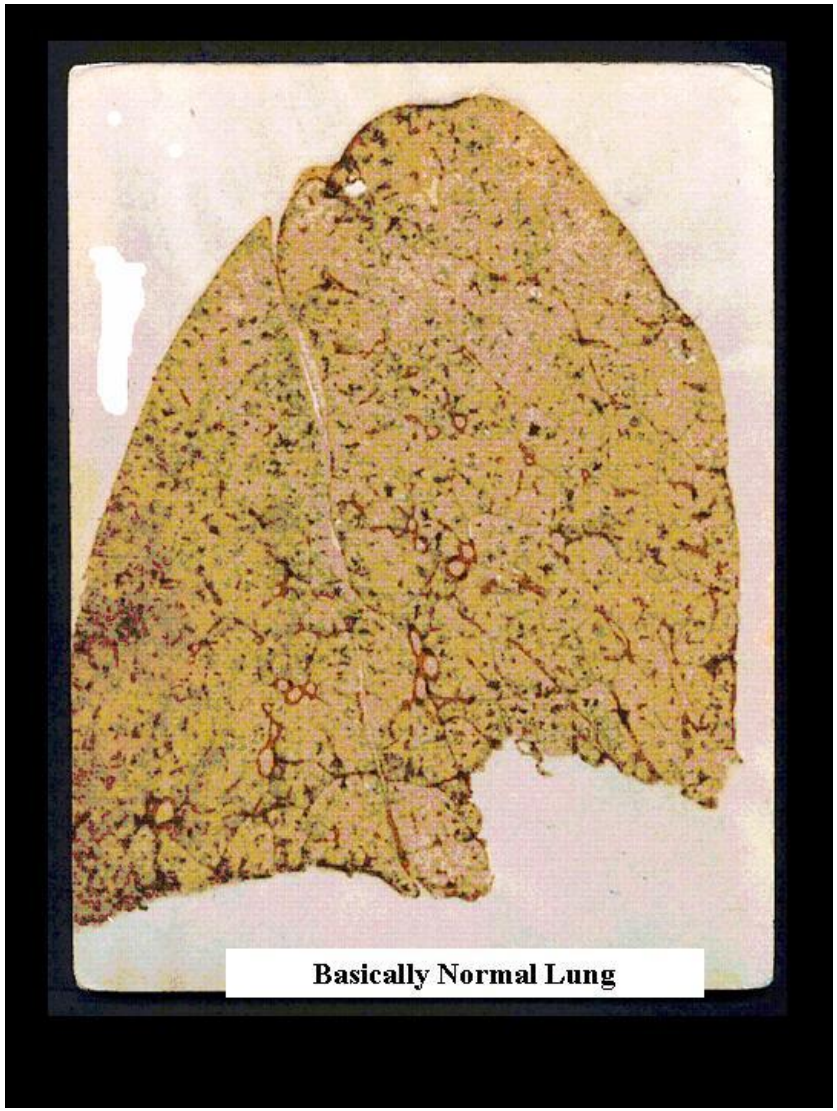
Exposure to respirable crystalline silica

- Silica is 20 times more toxic than coal
- Freshly fractured silica more toxic than aged silica
- Smaller particles are more toxic
- Consequences of overexposure:
  - Silicosis
  - Airways diseases
  - Pulmonary tuberculosis
  - Chronic renal disease
  - Lung cancer

Silicosis

- Chronic
  - Occurs after 10 or more years of exposure
  - Swelling in lungs
  - Troubled breathing similar to COPD
- Accelerated
  - Develops in 5 to 10 years
  - Symptoms occur faster than in chronic silicosis
- Acute
  - Develops in less than 5 years
  - Lungs become inflamed and fill with fluid
  - Severe shortness of breath and low blood oxygen

Silicosis

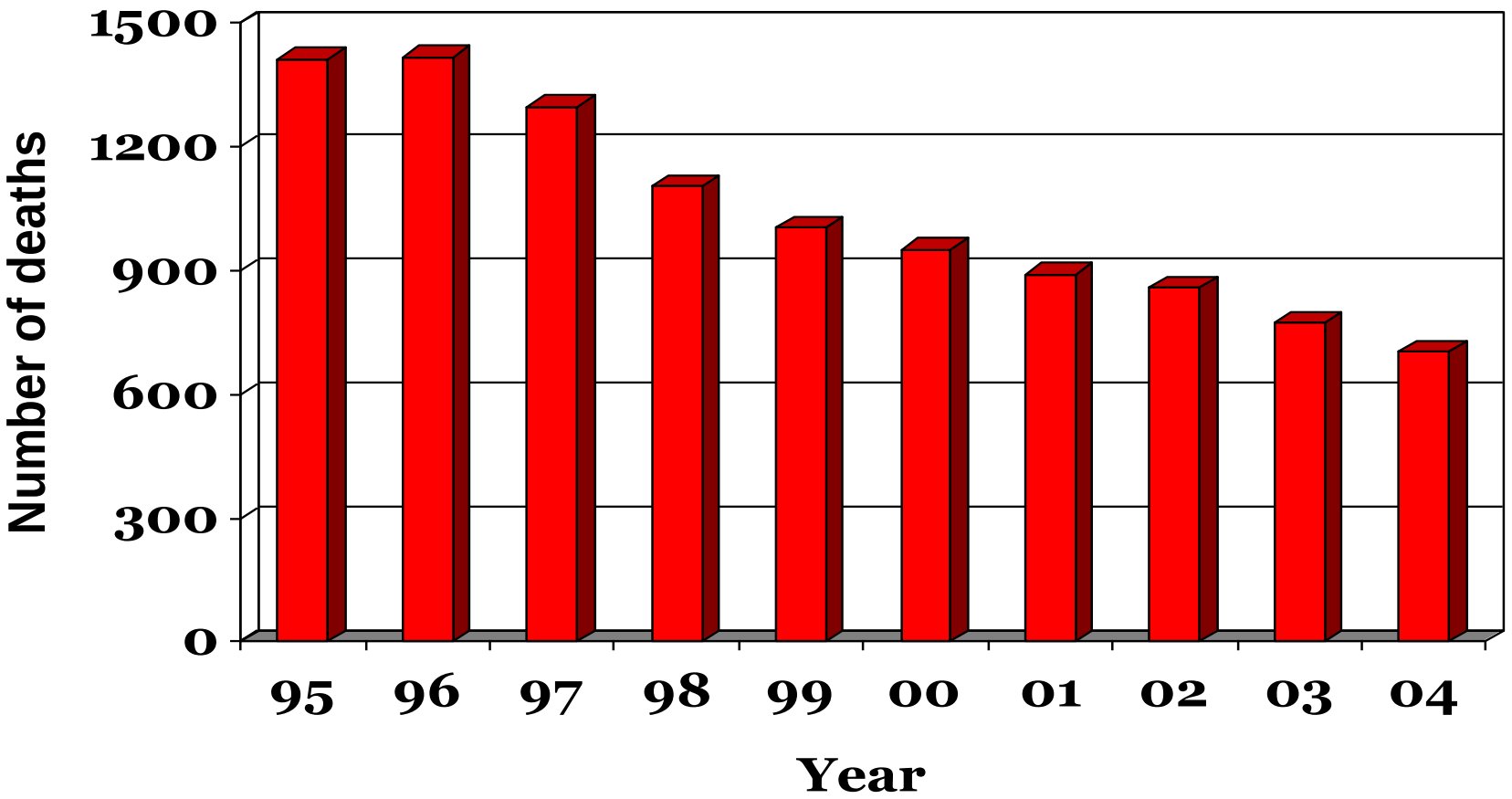

Basically Normal Lung


Section of Freeze-Dried Human Lung
Silicosis

Treatment of lung disease in coal miners

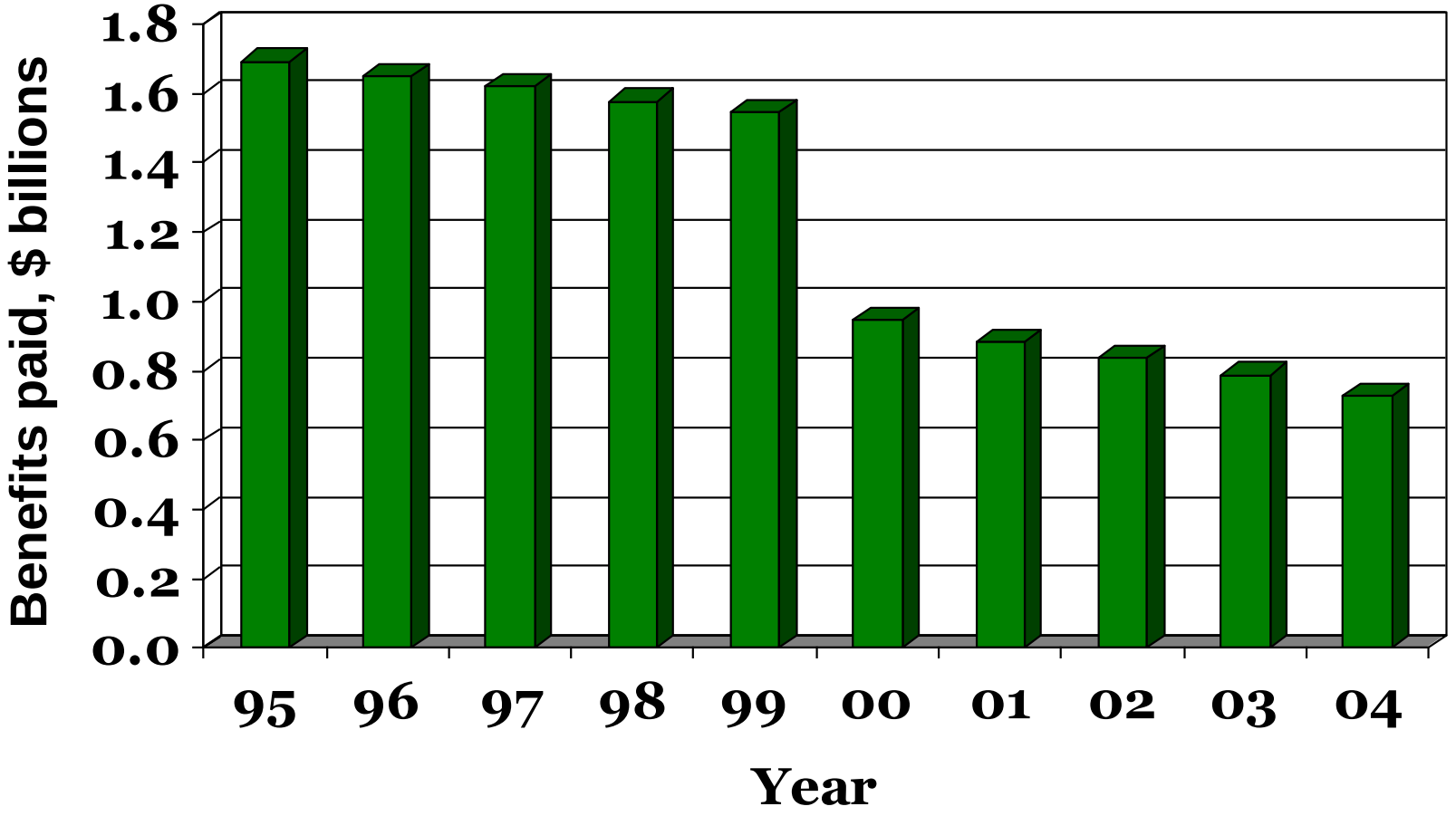
- No medication can reverse dust damage
- Treatment directed at reducing symptoms and prevention of complications
  - Vaccines against flu and pneumonia
  - Antibiotics for infections and congestion
  - Bronchodilators for airway spasm
  - Oxygen supplementation
  - Treatment for heart failure
- Lung/heart transplant as last resort

Coal miner deaths with CWP as direct or contributing cause



(total deaths from 1970 – 2004 = 69,377)

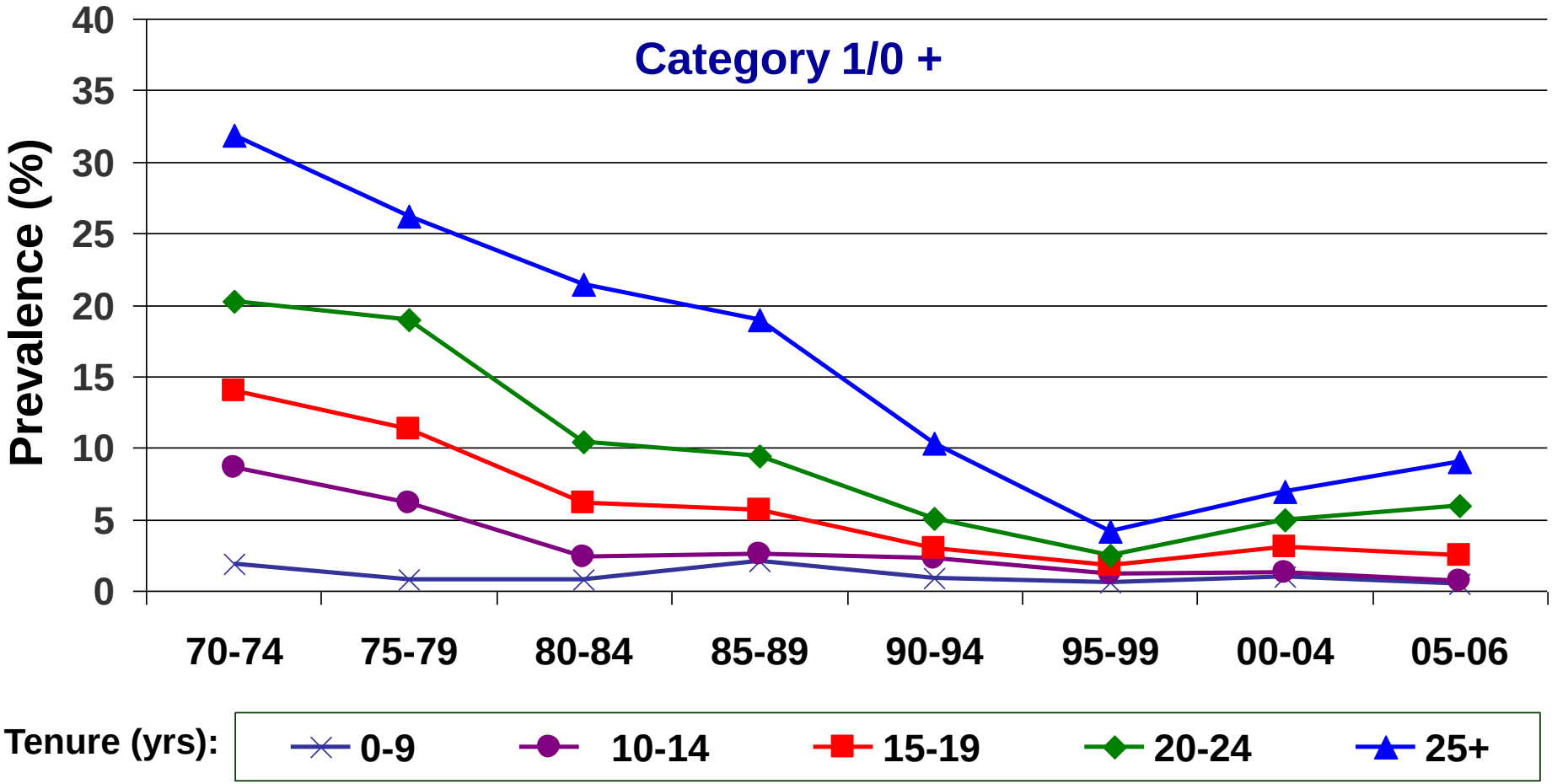
Total payments of the Federal Black Lung Program



(total paid from 1980 – 2005 = $39,173,909,000)

Trends in CWP prevalence by tenure among examinees employed at underground coal mines

(U.S. National Coal Workers' X-Ray Surveillance Program, 1970-2006)

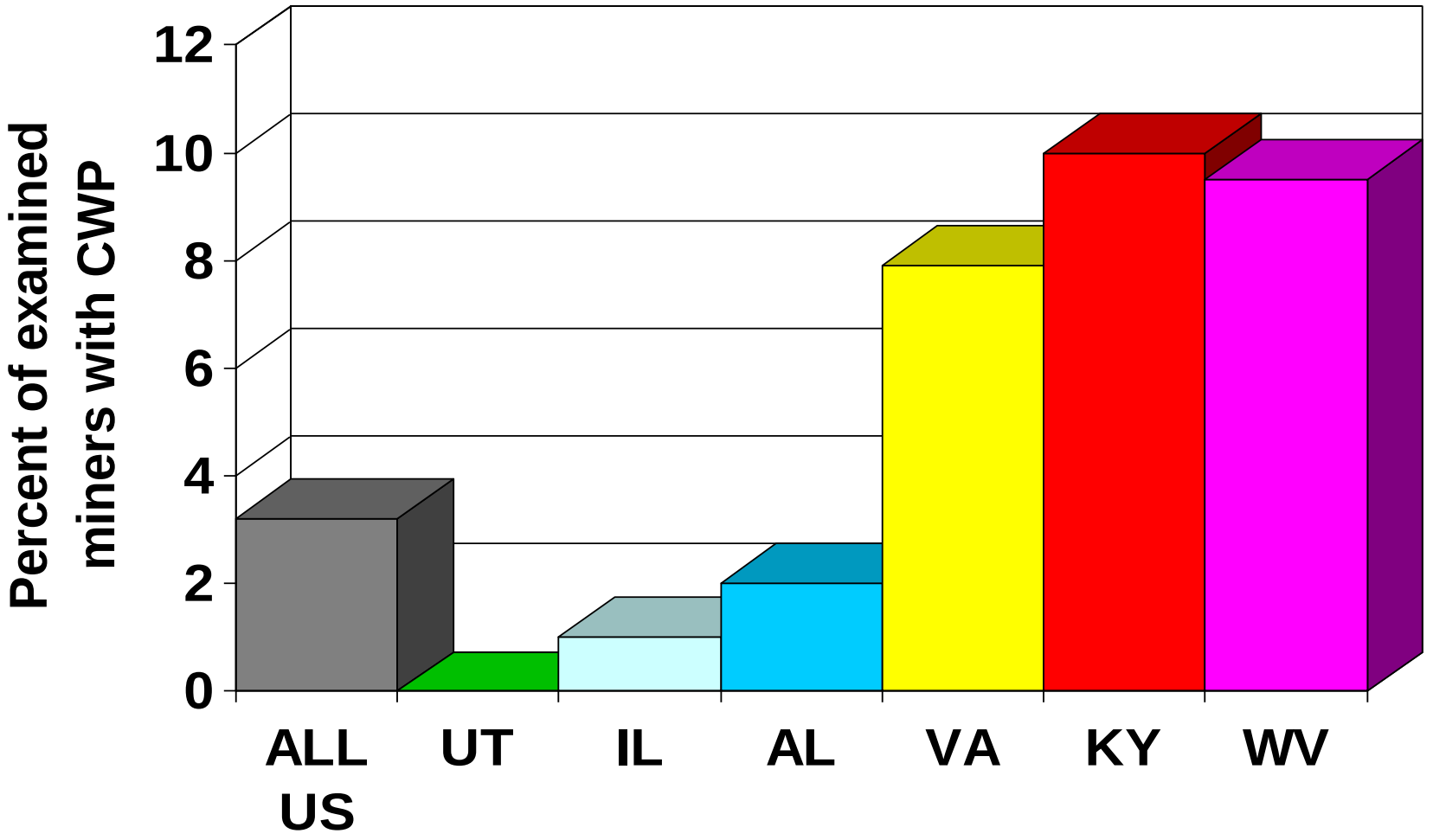


Enhanced Coal Workers' Health Surveillance Program

(mobile examination unit travels to mining regions)

- health questionnaires
- work history
- spirometry testing
- chest x-rays

CWP prevalence by state in enhanced miner program



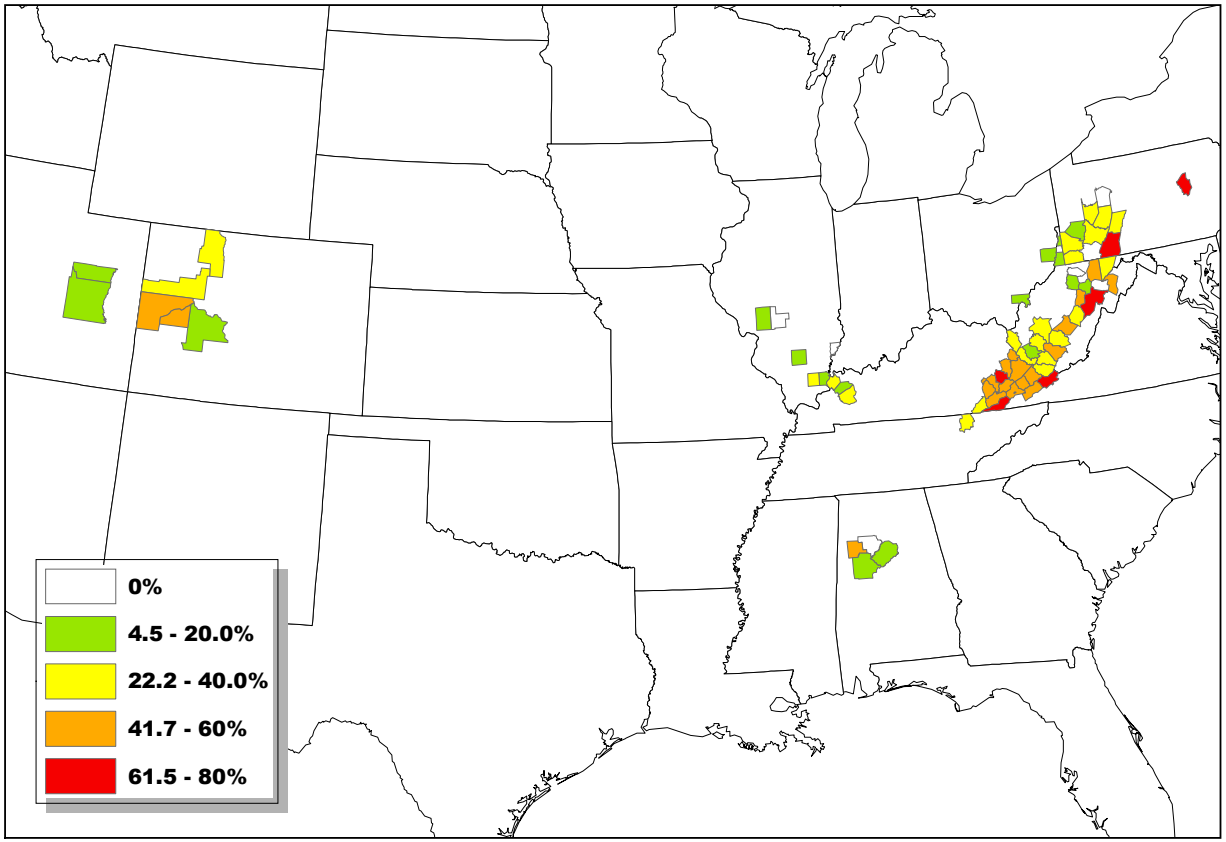
Rapidly Progressive Black Lung by County

ORIGINAL ARTICLE

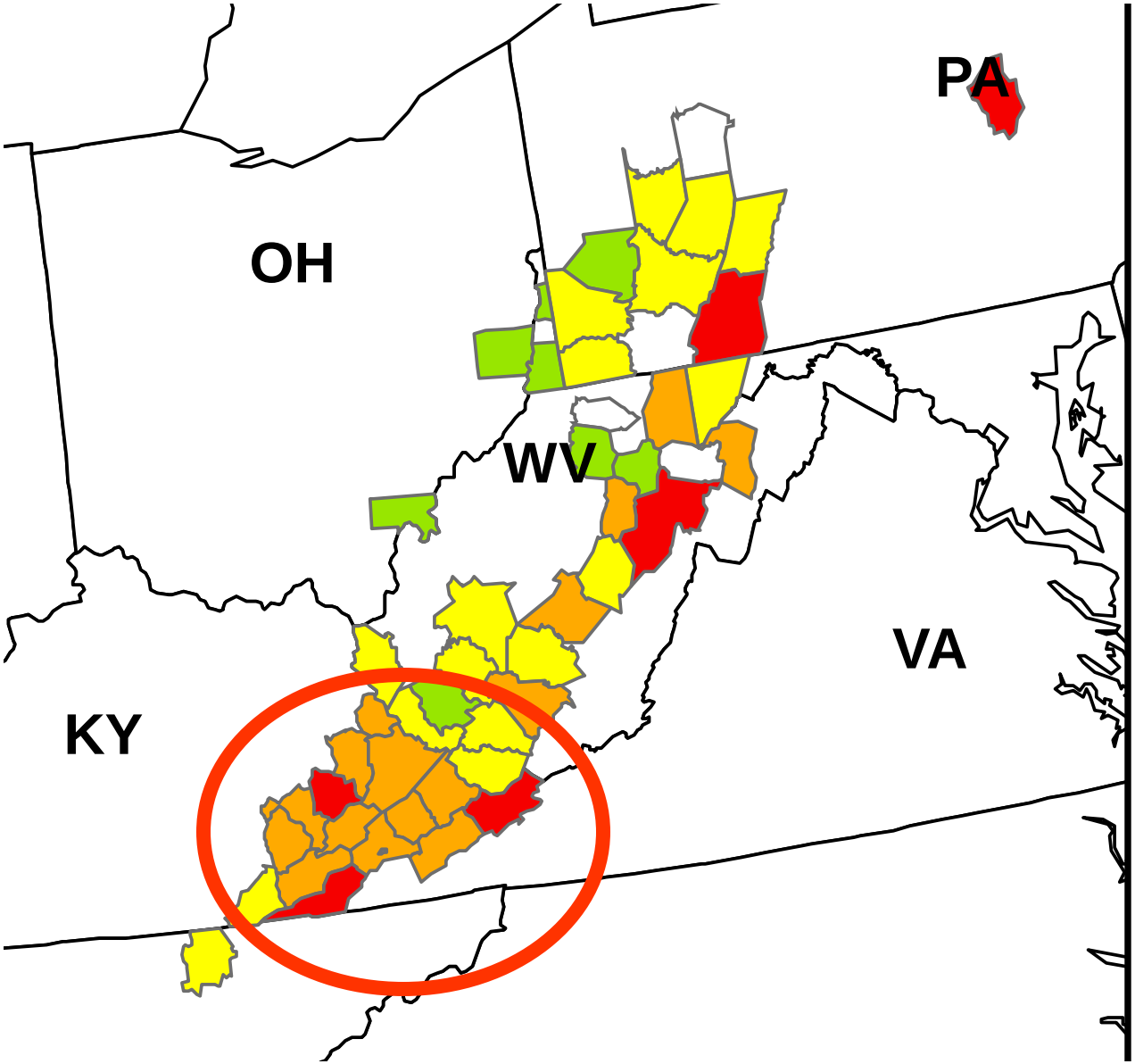
Rapidly progressive coal workers' pneumoconiosis in the United States: geographic clustering and other factors

V C dos S Antao, E L Petsonk, L Z Sokolow, A L Wolfe, G A Pinheiro, J M Hale, M D Attfield

Occup Environ Med 2005;62:670–674. doi: 10.1136/oem.2004.019679



“Hotspots” Southern Application Region



Need for:
"Best Practices for Controlling Respirable Dust in Coal Mines"

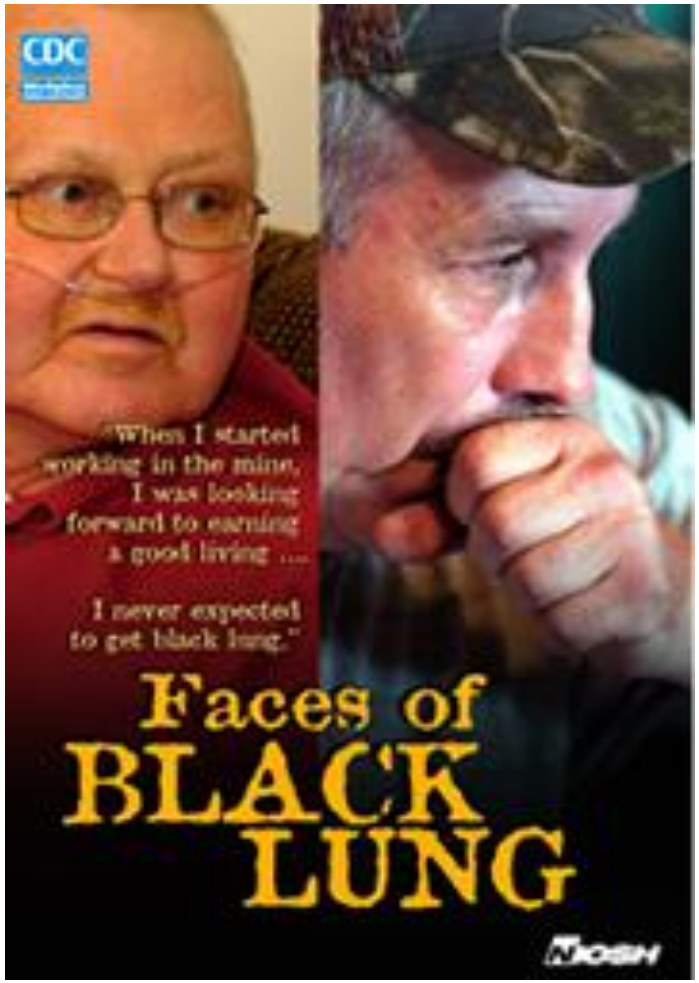
- Overexposures continue for high-risk occupations
- DRDS identified an increase in lung disease, rapid progression of the disease, and disease in younger miners (ECWHSP)
- S-Miner Bill proposed reduced dust standards
  - 1.0 mg/m^3 coal mine dust standard
  - 50 μg/m^3 silica dust standard
- MSHA has placed dust on regulatory agenda for 2011
- Geologic conditions increasingly difficult (more rock)
- Production increases generate more dust

NIOSH efforts:

- Initiated project to examine control technologies, operating practices, and working conditions found in SAR
- Initiated effort to compile publications that summarizes dust control technologies for coal and metal/nonmetal mining (two Best Practices Information Circulars)
- Conduct workshops to assist in transferring information to stakeholders
- DRDS produced “Faces of Black Lung” video to raise awareness

Faces of Black Lung DVD

- DRDS interviewed two miners that have contracted CWP
- Miners discuss the importance of protecting themselves from dust exposure
- Copies available from Anita Wolfe (304) 285 - 6263



Website for video: http://www.cdc.gov/niosh/docs/video/2008-131/default.html