RESEARCH NEEDS AND GAPS: CARDIOVASCULAR DISEASES IN MINERS

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Overview: cardiovascular diseases (CVD)

- Chronic diseases, including heart disease, cancer and stroke, are the leading causes of death in the US.
- More than 81 million Americans have cardiovascular disease, at an estimated cost of $503 billion in 2010.
- Multiple risk factors (personal & occupational) for CVD.
- Estimated proportion of CVD associated with work-related factors ranges from 15 – 35%.
- Workers are much more likely to make health behavior changes, such as quitting smoking, when health promotion programs are coupled with workplace hazard assessment and changes in the work environment.
Key research needs: cardiovascular diseases in miners

- Better epidemiologic data on rates of and risk factors for cardiovascular diseases in US miners
- Exposure monitoring for relevant hazards: noise, vibration, fine particulates, shift work
- Assessment and integration of both personal and occupational risk factors
- Data on effectiveness of integrated workplace health promotion and hazard reduction in improving miners’ health
Cardiovascular diseases (CVD)

- Hypertension
- Ischemic heart disease
- Congestive heart failure
- Arrhythmias
- Sudden death
- Other vascular diseases: stroke, PVD, aortic aneurysm

Pathogenesis of atherosclerosis

- Inflammation
- Oxidative stress
- Endothelial dysfunction
## Multiple risk factors for cardiovascular diseases

<table>
<thead>
<tr>
<th>Personal</th>
<th>Occupational/Mining</th>
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<tbody>
<tr>
<td>Smoking</td>
<td>Noise</td>
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<tr>
<td>High lipids/cholesterol</td>
<td>Particulates (PM 2.5)</td>
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<td>Physical inactivity</td>
<td>Stress (high demand/low control work; shift work; long hours)</td>
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<tr>
<td>Diet/alcohol</td>
<td>Temperature extremes</td>
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<tr>
<td>Hypertension</td>
<td>Vibration</td>
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<tr>
<td>Obesity</td>
<td>Carbon monoxide</td>
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<tr>
<td>Diabetes mellitus</td>
<td>Lead</td>
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<tr>
<td>Family history of heart disease</td>
<td>Some chemicals (solvents, CS2, nitrates)</td>
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Workplace exposures and work schedule factors contribute to obesity, smoking, alcohol use, and lack of exercise as well as to work-family stress and conflict.
Studies from Scandinavia, Germany, South Africa show increased death from CVD in miners.

  - Data from Swedish National Census, 1970-1995
  - 11,896 silica-exposed men (mine and stone workers) compared to working male reference group (with similar smoking rates)
  - Increased mortality from *ischemic heart disease* (SMR 1.31, 95% CI 1.24 – 1.38)
Little scientific information on cardiovascular disease risks in US miners.

- **Enterline PE. A review of mortality data for American coal miners.** Ann NY Acad Sci 1972;200: 260-72
  - Work accidents and respiratory disease did **not** account for the excess in total mortality (mortality rates remained 1.4 to 1.7 times the death rates for all working males).
  - **USPHS death certificate data:** SMR>200 for general arteriosclerosis (233) and “other myocardial degeneration” (238); strokes (148); hypertensive heart disease (148)
  - **1967 Society of Actuaries study:** coronary heart disease SMR 126
  - **Cohort of 553 miners followed prospectively for 28 years:** increased SMR for stroke (205) and heart disease (124)
It will be important to leverage existing federal resources, databases and expertise.

- NIOSH
- MSHA
- Department of Labor
  - Comprehensive mining occupational histories (exposures)
  - Smoking and medical histories (including cardiovascular diseases)
  - Validated spirometry and chest x-rays with B readings
  - EKGs
- Health Resources & Services Administration –Miners Clinics network
HRSA-funded Miners Clinics

1. Screening and surveillance for lung diseases, with counseling and referral for those with pneumoconiosis
2. Screening and surveillance for other medical conditions, with case management, follow-up and referral as needed
3. 15 clinics (CO, WY, NM, IL, KY, WVA, VA, PN, OH)
4. Miners Clinic of Colorado: 1982 miners screened since 2004 (259 in past year)

- Medical and occupational questionnaires, physical exam, spirometry, chest x-ray with B reading
Characteristics of MCC miner population, 2011-2012

- **Mean Age:** 65 years (range 29-87)
- **Gender:** 95% male
- **Commodity: (≠100%)**
  - Coal – 169 (65%)
  - Metal – 129 (28%)
  - Aggregate – 9 (3%)
  - Nonmetal – 7 (3%)
  - Other – 15 (6%)
  - Multiple – 65 (25%)
Approach/Methods

• We queried our HRSA database for FY 2011-2012:
  • High blood pressure [measured] or MD diagnosis of hypertension [questionnaire]
  • Heart conditions: chest pain, angina, heart attack, stroke, diabetes, high cholesterol [questionnaire]
  • Depression [questionnaire]
  • Obesity/Body Mass Index [measured]
  • Obstructive sleep apnea symptoms or MD diagnosis of OSA [questionnaire]
Cardiovascular diseases in MCC miners

- 105 (42%) reported high cholesterol.
- 67 (26%) patients reported chest pain.
- 20 (8%) had experienced angina.
- 24 (9%) reported having had a heart attack.
- 16 (6%) reported having had a stroke.

http://science.nationalgeographic.com
Hypertension

High blood pressure in our miners

- 120 (47%) patients had been previously diagnosed with hypertension.
- 95 (36%) were found to have high blood pressure at their visit (BP > 140/90).

Consequences of untreated hypertension

- 4 times as likely to die of stroke
- 3 times as likely to die of heart disease (CHF and CAD)
- Chronic kidney disease and kidney failure
High rates of treatable and preventable CV diseases and risk factors in our miner group.

1. Obesity (BMI>30): **86%**
2. High blood pressure: **47%**
3. High lipids/cholesterol: **43%**
4. Obstructive sleep apnea: **35%**
   1. Poor concentration/inattention
   2. Errors and accidents (2-3x MVA rates)
5. Adult onset diabetes: **23%**
6. Other cardiovascular diseases (angina, previous heart attack): **23%**
7. Current smoking: **7%**  [Ex-smokers: **36%**]
Research opportunities

- Health status surveys of mining communities – to understand interactions of work and lifestyle factors that intensify or reduce cardiovascular disease risk
- Exposure assessment targeted at multiple mining risks – noise, stress (shift work), particulates (type, peak, particle size, geochemistry), vibration, heat
- Biomarkers – role of inflammatory markers of CVD risk for targeted intervention and prevention
- Integrated health promotion and hazard reduction – We can’t just tell miners to work safer, lose weight and live better (exercise, smoking, alcohol).
- COLLABORATION and ACCESS to mines and miners
Questions?