Minnesota Taconite Workers Health Study

Minnesota Taconite Workers
Lung Health Partnership
October 17, 2011
Agenda

• Welcome - John Finnegan, Ron Dicklich

• Project Updates:
  • Occupational Exposure Assessment: G. Ramachandran, Pete Raynor
  • Mortality and Cancer Incidence: Bruce Alexander
  • Respiratory Health Survey: Jeff Mandel
  • NRRI Airborne Particulates: Larry Zanko

• Communication Planning - Jeff Mandel

• Discussion
Occupational Exposure Assessment
Relationships between exposures and diseases

- Respirable silica
- Respirable dust
- Elongated mineral particles
- Asbestos fibers
- Non-asbestos fibers
- Cleavage fragments

Respiratory disease
Occupational Exposure Assessment

• The asbestiform type of EMP is a low fraction of the total exposure and nearly all are below the PEL. Total EMP measures have been decreasing through time.

• The respirable dust measures are nearly all under the PEL.

EMP - Elongated Mineral Particle
PEL - Permissible Exposure Limits
Occupational Exposure Assessment

- Silica measures have exceeded the PEL more than the others across the sites. This is similar to MSHA findings for some specific plants.

- All of these exposure areas will be incorporated into the health studies to better understand the relationship of disease categories with the workplace.
Engineering Control Evaluations

- Best measures of control effectiveness are exposure concentrations
- Primary engineering controls are enclosures, ventilation, and particle collectors

Evaluation methods
- Toured control systems of six operating mines
- Measured air velocity into selected enclosures and in selected ducts in four mines
- Compared findings to ACGIH ventilation guidelines

Summary of findings
- Types of installed controls match ACGIH guidelines
- Velocity into some enclosures is lower than recommended
- Many collectors are newly installed
- New collectors are generally filters replacing scrubbers
Respiratory Protection

• Engineering controls are appropriate for normal operations

• Miners may be exposed to elevated dust levels when making repairs or performing maintenance

• Atypical conditions may lead to significant exposures

• Respiratory protection should be used under atypical conditions that contribute to excessive exposures

• Anticipating atypical conditions that require respiratory protection is a challenge
Mortality and Cancer Incidence
Objectives

• Compare rates of death to what is expected in Minnesota
  – Characterize overall health of population

• Detailed analysis for mesothelioma, lung cancer, and nonmalignant respiratory disease (NMRD)
  – Work history
  – Estimated exposure to respirable dust
  – Silica and elongated mineral particles
# Taconite Study Population Born After 1920: Status Through 2007

<table>
<thead>
<tr>
<th>Status</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Alive</td>
<td>30,660</td>
</tr>
<tr>
<td>Deceased cause of death known</td>
<td>13,658</td>
</tr>
<tr>
<td>Presumed deceased</td>
<td>266</td>
</tr>
<tr>
<td>Presumed alive</td>
<td>751</td>
</tr>
<tr>
<td>Unknown</td>
<td>197</td>
</tr>
<tr>
<td>Total*</td>
<td>45,532</td>
</tr>
</tbody>
</table>

*Subject to change as work histories are reviewed
# Taconite Worker Health Study Diseases of Interest

From MCSS\textsuperscript{a} and Death Certificates

<table>
<thead>
<tr>
<th></th>
<th>Mesothelioma</th>
<th>Lung Cancer\textsuperscript{b}</th>
<th>NMRD\textsuperscript{bc}</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCSS only</td>
<td>28</td>
<td>373</td>
<td>na</td>
</tr>
<tr>
<td>Death Certificate only</td>
<td>19</td>
<td>688</td>
<td>645</td>
</tr>
<tr>
<td>Both</td>
<td>35</td>
<td>620</td>
<td>na</td>
</tr>
<tr>
<td>Total</td>
<td>82\textsuperscript{d}</td>
<td>1,681</td>
<td>645</td>
</tr>
</tbody>
</table>

\textsuperscript{a}: MCSS = Minnesota Cancer Surveillance System  
\textsuperscript{b}: Born 1920 or later  
\textsuperscript{c}: NMRD = Nonmalignant respiratory disease.  
\textsuperscript{d}: Includes 4 from Minnesota not pathologically confirmed
Estimating Exposure

- Full work history abstraction: 11,645 workers
- ~90,000 work history entries
- 10,708 unique job titles
- Goal: Reduce the job titles to 29 Similarly Exposed Groups (SEG) for the exposure reconstruction
- Concentrations of respirable dusts for each SEG
Challenges

• Gender information missing for ~23% of cohort
  – Linking to external databases to correct
• Missing work history information
  – Exploring other sources
  – Update records with current companies
• Mapping obscure job titles from work history record
Respiratory Health Survey
Respiratory Health Survey

Results of screening

- Overall participation adequate
- Company participation comparable
- Older participated at higher rates
- Distance from test center affected participation

- 1188 workers participated
- 498 spouses participated
- 134 questionnaire only
Respiratory Health Survey

Spirometry Findings in Workers:

• 17.4% with obstructive (asthma-like) pattern
• 9.2 borderline obstructive
• 4.3% with restrictive (lower air flow) pattern
• 3.0% with mixed (obstruction and restriction) pattern
Respiratory Health Survey

Initial Chest X-ray Findings in Workers*:

Abnormalities:
- in tissue of lung (parenchymal) 4-6%
- in tissue surrounding lung (pleural) 10-15%

*Independent readers
Respiratory Health Survey

Next Steps

• Compare spirometry with other tests
• Use exposure information in analysis
• Assessment of “non-response” group
NRRI - Airborne Particulates
<table>
<thead>
<tr>
<th>Iron Range Communities</th>
<th>Sampling Events</th>
<th>Non-Iron Range Communities</th>
<th>Sampling Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver Bay High School</td>
<td>11 (4W/7S)</td>
<td>Duluth NRRI Rooftop</td>
<td>10 (4W/6S)</td>
</tr>
<tr>
<td>Virginia Court House</td>
<td>9 (4W/5S)</td>
<td>Ely Fernberg Site</td>
<td>7 (4W/3S)</td>
</tr>
<tr>
<td>Hibbing High School</td>
<td>9 (4W/5S)</td>
<td>UMTC-Minneapolis</td>
<td>6 (3W/3S)</td>
</tr>
<tr>
<td>Keewatin Elementary School</td>
<td>6 (3W/3S)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Babbitt Municipal Building</td>
<td>15 (7W/8S)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>In-Plant Sampling – Now Completed – Analysis in Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taconite Facility</td>
</tr>
<tr>
<td>United Taconite (Cliffs Natural Resources)</td>
</tr>
<tr>
<td>Hibtac (Cliffs Natural Resources)</td>
</tr>
<tr>
<td>Minntac (U.S. Steel Corp.)</td>
</tr>
</tbody>
</table>
### Natural Resources Research Institute

#### Environmental Study of Airborne Particulates – October 2011

**Sample Analysis – Filters and Substrates**

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>Remaining</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEM Analysis for Mineral Fibers in Air (MDH 852 Method - Braun Intertec Corp.)</td>
<td>~30 in progress</td>
</tr>
<tr>
<td>Determination of Asbestos Fibres - Indirect Transfer TEM Analysis (EMSL Analytical, Inc. (ISO 13794))</td>
<td>~60 in progress</td>
</tr>
<tr>
<td>Proton-induced X-ray Transmission Analysis (Elemental Analysis, Inc.)</td>
<td>~60 in progress</td>
</tr>
<tr>
<td>Modified Elutriator Method (EMS Laboratories)</td>
<td>Completed – data being evaluated</td>
</tr>
<tr>
<td>Scanning Electron Microscopy / Energy Dispersive Spectroscopy (UMD/NRRI utilizing EDS/EBSD methods)</td>
<td>~75 in progress</td>
</tr>
</tbody>
</table>

### Lake Sediment Sampling

- Age dating is now complete for Silver and “North of Snort” Lakes
- Confirmation dating of Silver Lake sediments by $^{137}$Cs confirms dependable dates in the upper core to 1907
- Elutriation, particle extraction, and sediment sample analysis is ongoing and will continue during fall and winter
Natural Resources Research Institute
Environmental Study of Airborne Particulates – October 2011

Plans for Remainder of 2011

• Review of Quality Assurance Project Plan (QAPP) / Standard Operation Procedures / Glossary
• Completion of lake sediment analysis
• Completion of laboratory analysis of samples (TEM, PIXE, Elutriator)
• Continued particle analysis via SEM/EDS/EBSD at the University of Minnesota Duluth
• Completion and review of in-plant gravimetric data reports and community gravimetric data reports
• Continued evaluation and interpretation of laboratory data
• Initiation of final project report
Communication Planning
Communication Planning

• General order of study component reports:
  – Occupational exposure assessment (SPH)
  – Environmental exposure characterization (NRRI)
  – Mortality study (minimal exposure information)
  – Respiratory Health Survey (minimal exposure information)
  – Case-control studies (mesothelioma, lung cancer, non-malignant respiratory disease); detailed exposure information
Communication Planning

• Reporting process
  – External scientific peer review
  – Communication with stakeholders
  – General communication
Communication Planning

• Multiple studies are being done

• Results will be reported
  – As study components are completed
  – As one final report

• Feedback?
Summary
Summary

• The asbestiform type of EMP a low fraction of total exposure
• General dust levels are nearly all under the PEL
• Silica levels exceed the PEL in some cases – similar to MSHA findings
• Engineering controls are appropriate for normal operations
Summary

- Ongoing analysis of lung function tests and chest X-rays from workers and spouses
- Diseases identified will be assessed by exposure categories
  - Mesothelioma
  - Lung cancer
  - Non-malignant lung disease
Summary

• Work that characterizes community dust is in final (analytic) stage
• Reports on each study component expected over next year or so
• One final report to be issued at the end