Minnesota Taconite Workers Lung Health Partnership

Minnesota Taconite Workers Health Study

May 31, 2012

Agenda

- Welcome - John Finnegan, Ron Dicklich
- Introduction - Jeff Mandel
- Project Updates:
  - Occupational Exposure Assessment: Gurumurthy Ramachandran
  - Mortality and Incidence Studies: Bruce Alexander
  - Respiratory Health Survey: Jeff Mandel
  - NRRI Airborne Particulates: Larry Zanko
- Discussion

Overall Study Status

- All studies on track for providing general findings over next 6-9 months
- Health investigations slower because of multiple sources of work history information
- Excellent cooperation from companies and local unions
- Current working conditions safe under normal operating conditions

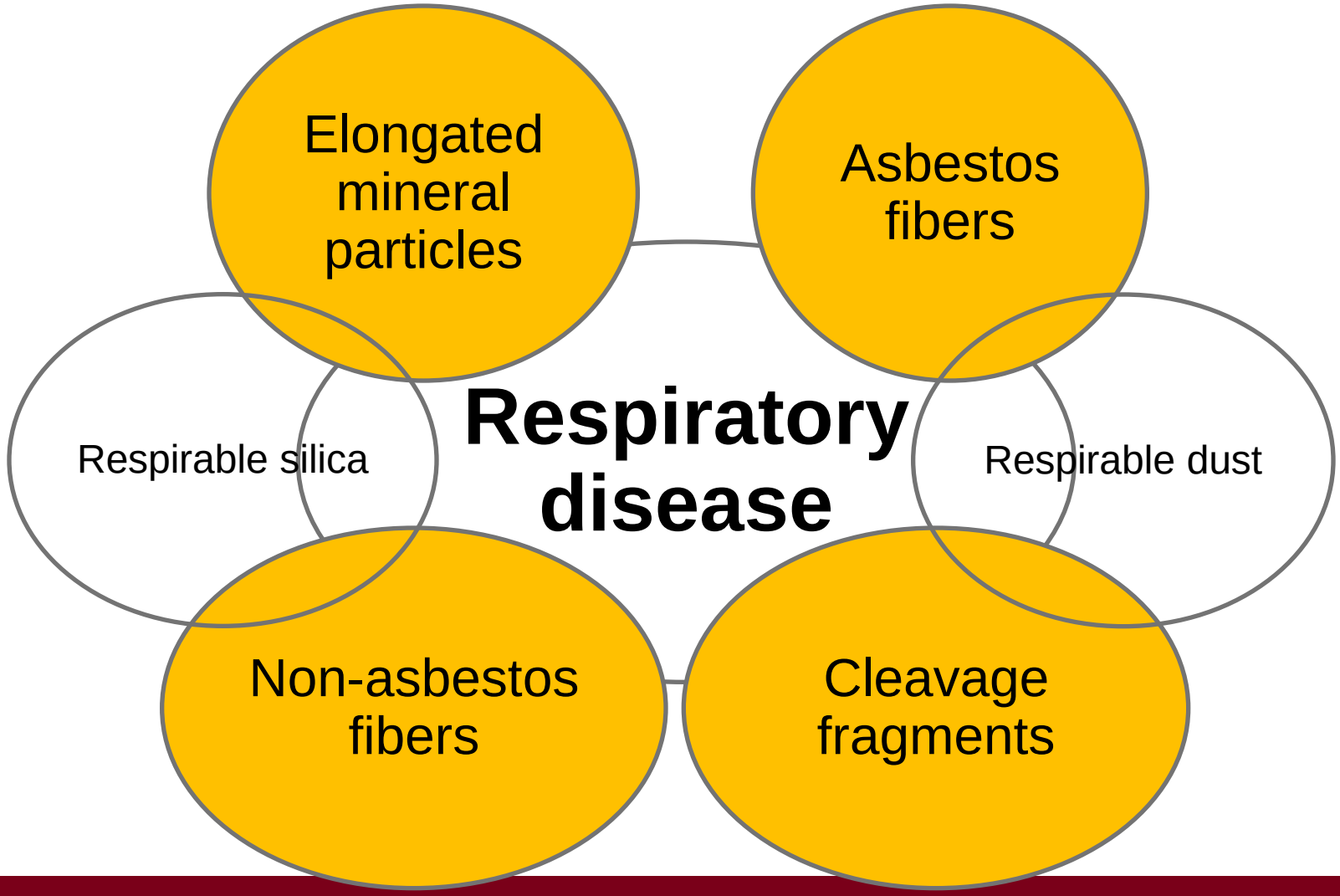
Study Timeline*

Component	Report Expected
Occupational Exposure Assessment	Mid- to late 2012
Mortality (cause of death) Study	Late 2012
Incidence Studies (mesothelioma, lung cancer)	Late 2012 or early 2013
Respiratory Health Survey of Taconite Workers and Spoused	Late 2012 or early 2013
Environmental Study of Airborne Particulates	Mid- to late 2012

* This timeline is an estimate based on current information and is subject to change as new information becomes available.

Occupational Exposure Assessment

Relationships between exposures and diseases



Goals for Exposure Assessment

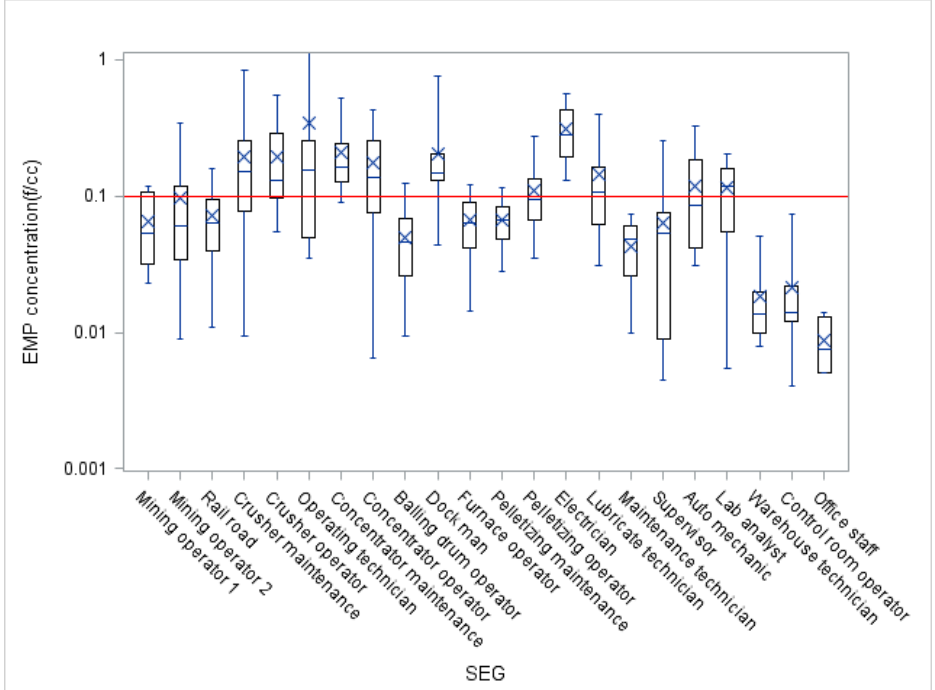
- **Assess current exposures** of workers to the dust from taconite operations and relevant components (elongated mineral particles, respirable dust, and respirable silica)
- **Assess historical exposures** of workers to dust from taconite operations and relevant components
- **Evaluate existing practices and methods** to control worker exposures in this industry

Measurement of Personal Exposures to Elongated Mineral Particles (EMP)

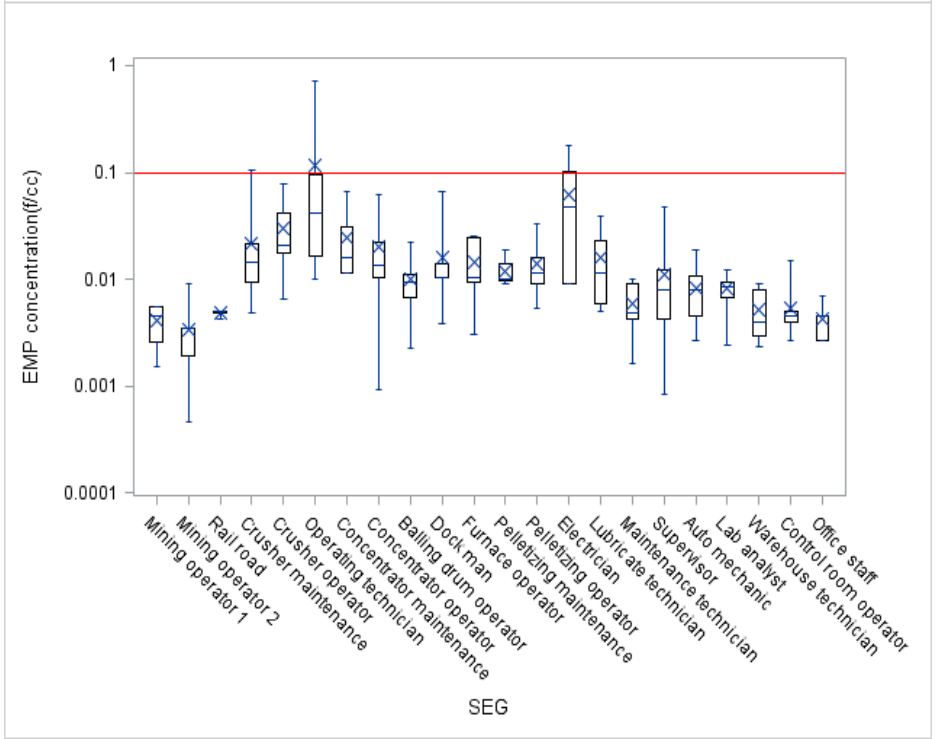
Zone (Direction)	Mine	Workers	EMP by PCM[a]	% of EMP by PCM <LOD	EMP by TEM[b]	% of EMP by TEM <LOD
4(Eastern)	1	56	276	6.9	102	68.6
1(Western)	2	34	200	68.5	34	100.0
	3	48	221	53.9	40	97.5
	4	34	203	37.0	34	100.0
	5	46	273	20.2	48	100.0
	6	22	130	48.5	22	100.0
Total		240	1303		280	

[a] Personal samples analyzed by NIOSH 7400 phase contrast microscopy counting all EMP with length > 5 µm and aspect ratio > 3.0

[b] Personal samples analyzed by NIOSH 7402 transmission electron microscopy counting all amosite, non-amosite, and chrysotile EMP with length > 5 µm and aspect ratio > 3.0



Total EMP
NIOSH 7400



Amphibole EMP
NIOSH 7400/7402

Occupational Exposure Assessment

- The amphibole EMP concentration was much less than the total EMP concentration, a result indicating that amphibole EMP are not major components of taconite EMP
- Nearly all exposures are below the Permissible Exposure Limit

Ongoing Work (to be completed by Fall 2012)

- Determination of EMP exposures using other size-dependent metrics
- Analysis of silica exposures
- Determination of cumulative exposures over the study period to EMP, silica, respirable dust that will be used in the epidemiological analyses

Mortality and Incidence Studies

Objectives

- Compare rates of death to what is expected in Minnesota
  - Characterize overall health of population
- Evaluate all causes of death combined and deaths from specific causes
- Initial analysis by length of employment in the taconite industry

Study Population for Mortality Analysis

(Mortality Follow-up through 2007)

Alive	29,049
Presumed alive	1,792
Deceased cause of death known	13,066
Presumed deceased	254
Total*	44,161
Worked at least 1 year	31,017

*Excludes people with unreliable data for date of birth, date of death, and work history. Also excludes people who died before 1960 when the comparison data became available. The total population and population with at least one year of work are likely to change as work histories are reviewed.

Characteristics of the Study Population

		N	%
Gender	Male	41,128	93.1
	Female	3,020	6.8
	Unknown	13	0.03
Years worked	<1	13,144	29.8
	1-4	13,180	29.8
	5-9	7,385	16.7
	10+	10,452	23.7

Standardized Mortality Ratios For All Taconite Workers Mortality Cohort

Cause of Death	N	SMR*	95% CI
All causes	13,348	1.05	1.03-1.06
All cancers	3,969	1.06	1.03-1.09
Lung cancer	1,400	1.20	1.14-1.26
Mesothelioma**	45	2.90	2.11-3.87
Heart disease	3,871	1.11	1.08-1.15
Respiratory disease	883	0.99	0.93-1.06

*SMR=standardized mortality ratio using Minnesota population as a reference

**Only deaths after 2000, does not include cases identified only through state cancer registry

Select SMRs of Taconite Workers Mortality Cohort by Duration of Employment

	Duration of Employment		
	1 – 4 years	5 – 9 years	10 + years
Cause of death	SMR*	SMR*	SMR*
All Causes	1.05 §	1.09 §	1.01
All Cancers	1.02	1.10 §	1.02
Lung cancer	1.18 §	1.28 §	1.10 §
Mesothelioma**	2.73 §	3.01 §	2.72 §
Heart diseases	1.05 §	1.15 §	1.11 §
Respiratory Disease	0.92	0.99	0.93

*SMR=standardized mortality ratio

**Only deaths after 2000, does not include cases identified only through state cancer registry

§ Statistically different compared to the rest of Minnesota

Summary

In this population

- Most causes of death are at or below the expected rates
- Higher rates of death for
  - Lung cancer
  - Mesothelioma
  - Heart disease
- Rates of death for respiratory disease is similar to expected
- Pattern consistent across length of employment

Summary

- The higher rates for ‘all causes’ are strongly influenced by heart disease and lung cancer
- The higher rates for ‘all cancers’ is largely due to the excess of lung cancer deaths
- Effects of workplace exposure will be explored in case-control studies
- Lifestyle factors may be important

Respiratory Health Survey

Respiratory Health Survey
Worker Analyses

- X-ray evidence of dust-related lung disease

  6% for tissue of lung (parenchymal)

  15% for the pleural space
- Spirometry evidence of restriction 4-6%

Respiratory Health Survey

Worker Analyses

- 40% of participants with elevated body mass index (BMI)
- 50% of participants former smokers*
- 12% of participants current smokers*

Exposure role?

Role of BMI?

*not age adjusted

NRRI - Airborne Particulates

Summary of Progress on Field Sampling of Particulate Matter

- Sampling in 5 Mesabi Range/3 Non-Range Communities — *COMPLETED*
  (Silver Bay, Babbitt, Virginia, Hibbing, Keewatin, Ely, Duluth, Minneapolis)
- Sampling in 6 Taconite Facilities — *COMPLETED*
  (UTAC, Minntac, Hibtac, Keetac, Northshore, Minorca)

Summary of Progress on Laboratory Analysis of Particulate Matter

- TEM Analysis of Mineral Fibers in Air (MDH 852 Method) — *COMPLETED*
  (Braun Intertec Corp.)
- Determination of Asbestos Fibers (ISO Method 13794) — *COMPLETED*
  (EMSL Analytical Inc.)
- Modified Elutriator Method Asbestos Analysis in Rock — *COMPLETED*
  (EMS Laboratories)
- Chemical Analysis of Particulate (PIXE) — *COMPLETED*
  (Elemental Analysis, Inc.)
- SEM / EDS Particulate Physical/Chemical Analysis — *EARLY-MID SUMMER*
  (UMD Research Instrumentation Laboratory)

Summary of Progress – Lake Sediment Age Dating / Sediment Analysis

- Age dating for Silver and "North of Snort Lakes" (NRRI CWE / CARTD) — *COMPLETED*
- Elutriation Analysis (NRRI CWE / CARTD) — *Summer 2012*
- Particle Extraction Analysis (NRRI CWE / CARTD) — *Summer 2012*
- Sediment Size Distribution Analysis (NRRI CWE / CARTD) — *Summer 2012*

Summary of Progress – Data Compilation, Analysis, Interpretation

- Field Data (e.g. Wind Direction Data) — *COMPLETED*
- Gravimetric Data (Particulate Weight Analysis) — *COMPLETED*
- MDH Method 852 Data — *ONGOING – June 2012*
- ISO 13794 Data — *ONGOING – July 2012*
- Elutriator Data — *ONGOING – July 2012*
- PIXE Data — *ONGOING – Aug. 2012*
- SEM / EDS Data — *ONGOING – Sept. 2012*
- Lake Sediment Ages/Sediment Analysis — *ONGOING – Fall 2012*
- GIS Development — *ONGOING – Sept. 2012*

Anticipated Reporting Timeline

- Field/Laboratory Standard Operating Procedures — *Summer 2012*
- Quality Assurance Project Plan (QAPP) — *Summer 2012*
- Initiation of Final Report Writing — *Sept. 2012*
  - *Introduction (location, problem statement, mining history)*
  - *Geological Environment*
  - *Methods*
  - *Gravimetric Analysis*
  - *Particulate Matter Physical / Chemical Analysis - Plants*
  - *Particulate Matter Physical / Chemical Analysis – Communities*
  - *Lake Sediment Analyses – Historical Particulate Matter Results*
  - *Discussion and Interpretations*
  - *Appendices of Methodologies and Data Collected*
- Completion of Final Report Writing — *Dec. 2012*
- Peer Review of Final Report — *Last Quarter 2012/First Quarter 2013*
- Submission of Final Report — *First Quarter, 2013*

Discussion

www.taconiteworkers.umn.edu

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Study Timeline

This timeline is an estimate based on current information and is subject to change as new information becomes available.

Component	Study Purpose	Status	Report Expected
Occupational Exposure Assessment	To understand current and historical worker exposure to components of dust from taconite operations	• On-site measurements complete • Historical measurements gathered • Engineering controls assessed • Data being integrated into human health studies	Mid- to late 2012
Mortality (cause of death) Study	To compare the causes of death among the taconite workers to the general population	• Causes of death identified • Data quality control and verification in progress • Data analysis progressing	Late 2012
Incidence Studies (Mesothelioma, Lung Cancer and Non-malignant Respiratory Diseases)	To compare the incidence of diseases of interest among the taconite workers to other groups or the general population	• Cases identified • Data verification and quality control assessment on going • Exposures data integration in progress	Late 2012 or early 2013
Respiratory Health Survey of Taconite Workers and Spouses	To estimate non-malignant respiratory disease in workers and their spouses	• Screening complete • Exposure data integration in progress	Late 2012 or early 2013
Environmental Study of Airborne Particulates	To evaluate the effects of past and present taconite mining emissions on community air quality	• Community sampling complete • Detailed analyses in progress	Mid- to late 2012

Timeline date: 1/24/2012