



Evaluation of Exposure: Preliminary Findings

- Purpose of the Study
- Research Methods
- Discussion of Analysis by Research Question
- Integration with HHRA
- Community Reporting

Community Advisory Committee Meeting, Thursday , March 25, 2010

March 25, 2010

Re-cap- purpose of the study

- Preliminary info from the HHRA for the Flin Flon area indicated that further information would assist to fully understand exposure to potential human health risks associated with some metals in the community
- The most direct way to obtain additional information on human health risks is to assess human exposure through biological samples (e.g. blood, urine)
- This additional information is being used to supplement the HHRA

The study looked at 3 metals

- The metals that were measured are **lead, total and inorganic arsenic** and **inorganic mercury**. The reason for choosing these is that the Human Health Risk Assessment will benefit from some additional information for these three metals. The study investigated the following questions:
 - *What is the current level of exposure in the bodies of the child population in the Flin Flon Area?*
 - *Do Flin Flon area children have higher arsenic, lead, and/or inorganic mercury levels than residents living in other parts of Canada?*
 - *Are there any potential health risks from these levels of exposure?*
 - *What personal factors are associated with the levels of exposure (e.g., place of residence, parent's place of work, level of COC in soil, age, gender, diet, personal habits, etc.)?*

Study focused on children

- Current and recent exposure would be more apparent among children because:
 - Children are potentially exposed at higher levels because they eat, drink and breathe relatively more than adults when you take into account their body size.
 - Behaviour and habits are also important. Children's normal activities, such as putting hands in their mouths or playing on the ground, create additional opportunities for exposures.
- In short, if the average exposure levels in children are not elevated, it would be unlikely for other age groups to have elevated levels from just living in an exposed community (and not through their occupation).

How the study was implemented

- **Research team-** led by Dr. Murray Lee (Habitat Health Impact Assessment), in partnership with Intrinsic, Goss Gilroy, and Environmental & Occupational Health Plus (EOHP). Experience in large-scale field studies on human health (medicine and epidemiology) and toxicology.
- **Oversight-** Technical Advisory Committee and Community Advisory Committee.
- **Review-** Local health authorities and independent scientific reviewers familiar with these types of studies who were not part of the study team.
- **Funding-** As with the Flin Flon Soil Study, Hudson Bay Mining and Smelting is paying for costs associated with this study. HBMS does not have input into the study design, analysis, or interpretation.

Re-cap of study activities

- Through September and October 2009 the study team conducted interviews with 251 households.
- Data collected from 447 individuals.
- 379 urine samples, 202 blood sample
- Urine analyzed for arsenic (inorganic, and total) and inorganic mercury.
- Blood was analyzed for lead.

Table 1: Sample Targets

Area	<i>Blood Planned</i>	<i>Blood Achieved</i>	<i>Urine Planned</i>	<i>Urine Achieved</i>
West Flin Flon	150	43	150	86
East Flin Flon	50	84	75	156
Creighton and Channing	50	75	75	137
Total	250	202	300	379

Table 2: Response Rate

Level	Criteria	Count
Household Level	1: # households in FF and Creighton (census)	2945
	2: # invitation letters delivered	2354
	3: # contacts made	1653
	4: # eligible households (children <15 years)	409
	5: # households participated	251
Individual Level	6: # eligible children (from 5, above)	477
	7: # children participated in survey	477
	8: # children providing at least one bio sample	447
	9: # of blood samples collected	202
	10: # urine samples collected	379
	Response Level (Household)	61%
	Response Level (Individual)	94%

Discussion of Findings by Research Question

Question #1: Current levels...(Lead)

- Overall 202 blood samples from children under 7 years old.
- Range: 0.46 µg/dL to 21 µg/dL.
- Mean blood lead level for Flin Flon Area was 2.75 µg/dL (95% CI: 2.51 – 2.95).
- The median was measured as 2.49 µg/dL.
- Approximately 13% of the samples (n= 27) were at or above the level for follow-up (5 µg/dL).
- Approximately 2% of the samples (n=5) were at or above the Health Canada blood lead intervention level guideline of 10 µg/dL.

Question #1: Current levels...(Lead)

- Mean blood lead level for Flin Flon Area was 2.75 $\mu\text{g}/\text{dL}$
- Boys (3.09 $\mu\text{g}/\text{dL}$) Girls (2.34 $\mu\text{g}/\text{dL}$)
- Age: Higher in children 6 years of age (4.07 $\mu\text{g}/\text{dL}$)
- Region:
 - West Flin Flon (3.63 $\mu\text{g}/\text{dL}$)
 - Creighton (3.02 $\mu\text{g}/\text{dL}$)
 - East Flin Flon (2.29 $\mu\text{g}/\text{dL}$)
 - Channing area (2.00 $\mu\text{g}/\text{dL}$)
- West Flin Flon children (28%) at or above 5 $\mu\text{g}/\text{dL}$ compared to Creighton (16%), East Flin Flon (6%), and Channing (0%).

Question #1: Current levels...(Total Arsenic)

- 375 urine samples from Flin Flon area children between the ages of 2 ½ to 14 years.
- Range: 3 µg/L to 89 µg/L. None of the samples were at or above the level for follow-up (100 µg/L).
- Mean total arsenic level in Flin Flon area 12.30 µg/L (95% CI:11.75 – 12.88 µg/L).
- The median was 11.98 µg/L.
- Gender: Boys (12.59 µg/L) Girls (12.02 µg/L)

Question #1: Current levels...(Total Arsenic)

- Mean total arsenic level in Flin Flon area 12.30 µg/L.
- Age: Similar ranges, however, 5 to 8 years of age (13.80 µg/L) had the highest levels.
- Region:
 - West Flin Flon (14.45 µg/L)
 - Channing (13.18 µg/L)
 - Creighton (12.30 µg/L)
 - East Flin Flon (11.22 µg/L)

Q #1: Current levels...(Inorganic As)

- 375 samples. Approximately 18% were below the limit of detection.
- Range: BDL to 28 µg/L.
- The geometric mean inorganic arsenic level measured in Flin Flon area children was 6.35 µg/L (95% CI: 5.98– 6.74 µg/L).
- The median was 5.99 µg/L.
- 11 samples (3%) were at the follow up level of 20µg/L.
- Gender: Boys (6.41 µg/L) Girls (6.28 µg/L).

Q #1: Current levels...(Inorganic As)

- The geometric mean inorganic arsenic level was 6.35 µg/L
- Age: 5 to 8 years of age (7.25 µg/L) highest, compared to a mean of 5.27 µg/L among children age 9 to 14.
- Region:
 - Channing (6.98 µg/L)
 - West Flin Flon (6.94 µg/L)
 - Creighton (6.50 µg/L)
 - East Flin Flon (5.87 µg/L)

Question #1: Current levels...(Mercury)

- Half of the 375 samples were below the limit of detection, indicating very low exposure across the community.
- Range: BDL to 4 µg/g.
- The geometric mean adjusted inorganic urinary mercury level measured in Flin Flon Area children 0.11 µg/g (95% CI 50.09– 0.14 µg/g).
- The median was 0.18 µg/g.
- Gender: Boys (0.12 µg/g) Girls (0.11 µg/g).
- Age: 9 to 12 years old (0.15 µg/g) highest.

Question #1: Current levels...(Mercury)

- The geometric mean level was 0.11 $\mu\text{g/g}$
- Region:
 - Creighton (0.22 $\mu\text{g/g}$)
 - East Flin Flon (0.09 $\mu\text{g/g}$)
 - West Flin Flon (0.08 $\mu\text{g/g}$)
 - Channing (0.05 $\mu\text{g/g}$)

Question #2: Comparison of levels (Lead)

- The blood lead levels measured in Flin Flon area children were compared with numerous other studies.
 - In particular West Flin Flon levels
- There were challenges in making each comparison as there is not a “perfect” comparison for Flin Flon area children.
 - Difference in age groups
 - Differences in community characteristics
- With these cautions in mind, comparisons that have been made provide a context in which the study results can be looked at.

Question #2: Comparison of levels (Lead)

- Compared to national level studies in Canada and the US, the Flin Flon Area results are slightly higher
 - (2.57 µg/L- 3.63 µg/L compared with 0.88 µg/L - 1.77 µg/L).
- It should be noted:
 - the Canadian study (0.88 µg/L) is with older children and includes children from communities quite different from the Flin Flon area
 - the US study (1.77 µg/L) includes children from communities quite different from the Flin Flon Area.

Question #2: Comparison of levels (Lead)

- Comparison to communities with lead exposure- the results for the Flin Flon area children are comparable
 - (2.75 µg/L- 3.63 µg/L compared with 2.3 µg/L – 5.3 µg/L).
- Again, caution should be used in making these comparisons. In some cases these communities had different sources of potential exposure.
- They are also likely different from the Flin Flon area communities in potentially important ways (e.g., diet, activities, housing stock, soil levels).

Question #2: Comparison of levels (Arsenic)

Total and Inorganic Arsenic

- The Flin Flon area levels of both total and inorganic arsenic were similar to recent studies in other Canadian communities
 - including both communities with potential soil exposure (e.g., Falconbridge, Wawa, Deloro) and
 - comparison communities with no soil contamination (e.g., Hanmer, Havelock).

Question #2: Comparison of levels (Inorganic Mercury)

- The Flin Flon Area levels of inorganic mercury were below levels found in other recent studies, including similarly aged populations in other studies.
- We note that half of the samples were below the detection limit.

Question #3: Potential Health Risks...(Lead)

- None of the blood lead levels measured in the Flin Flon area are associated with symptomatic clinical effects.
- Considering the available literature, the blood lead levels measured in the Flin Flon area and specifically in West Flin Flon may be associated with asymptomatic, population effects.
 - Studies indicate childhood blood lead levels above 10 $\mu\text{g}/\text{dL}$ may be linked to decreased intelligence and impaired neurobehavioral development.
- Health Canada's 1994 blood lead intervention level of 10 $\mu\text{g}/\text{dL}$ is under review. Some other agencies (e.g. US CDC, City of New York) advise action at 5 $\mu\text{g}/\text{dL}$ for children.

Question #3: Potential Health Risks...(Lead)

- The US CDC state that there is no known minimum threshold of harm for lead exposure.
- Health Canada's policy is to reduce exposure to lead wherever practical.
- Participants with levels at or above 5 µg/dL were asked to follow up with physician – conservative level

Question #3: Potential Health Risks... (Total and Inorganic Arsenic)

- Total and inorganic arsenic levels found in children in the Flin Flon area were not high enough to be associated with health risks.
- Overall, finding a measurable amount of CoC in blood or urine does not mean that it causes an adverse health effect.
- The results for Flin Flon area children are similar to levels observed in children in other Canadian communities with limited exposure to arsenic in soil.
- No levels were measured at or above the physician follow-up level of 100 µg/L.

Question #3: Potential Health Risks...(Inorganic Mercury)

- Urinary inorganic mercury levels found in children in the Flin Flon area were not at a level associated with health risks.
- The large majority of samples of samples collected from the Flin Flon area had no detectable levels of inorganic mercury.
- No levels were measured at or above the physician follow-up level of 10 µg/L.

Question#4: Associated Factors ...(Lead)

- The study results indicated that the blood lead levels in Flon Flon children were associated with:
 - Child's gender- Boys were more likely to have higher levels than girls
 - Area of residence- Children living in West Flin Flon were more likely to have higher levels than East Flin Flon children
 - Adult currently smoking or using tobacco- Children living in households with adults who smoke or used tobacco were more likely to have higher levels
 - Average hours child spends away from home- Children who spent more hours away from home were more likely to have higher levels
 - Year the house was constructed- Children living in older houses were more likely to have higher levels.

Question#4: Associated Factors ...(Total Arsenic)

- Overall, levels were similar to other Canadian communities, and not associated with health risks.
- The only personal factors associated with total arsenic exposure levels was area of residence.
 - Children in East Flin Flon being more likely to have lower levels of total arsenic exposure.

Question#4: Associated Factors ...(Inorganic Arsenic)

- The main factors associated with levels of inorganic arsenic included:
 - Child's age- Older children were more likely to have higher levels than younger children
 - Child eating dirt- Children who ingested soil or dirt were more likely to have higher levels.
 - Eating outside 7 days ago- Children who ate outside were more likely to have higher levels
 - Source of water for drinking and cooking- Children who used only bottled water for drinking and cooking were more likely to have lower levels than those children who used only tap water
- These associated factors are consistent with what other studies have found about arsenic exposure (e.g., active outdoors, water source).

Question#4: Associated Factors ...(Inorganic Mercury)

- Caution in interpreting model results given high number of non-detects (50%)
- The model results indicated that inorganic mercury levels in urine:
 - increase with the number of dental amalgams
 - eating local game
 - region of residence -Children living in Creighton were more likely to have higher levels. Children living in Channing were more likely to have lower levels.

Questions about the Evaluation of Exposure?

Next Steps for Evaluation of Exposure

- Peer Review (under way)
- Summary Report
- Bridge Report
- Community reporting
- **Integration with HHRA**
 - Next step is to integrate the Exposure Evaluation findings with HHRA results....
 - Intrinsic will guide this part of the discussion