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June 5, 2008

Greg Weigel
EPA Idaho Operations Office
1435 North Orchard Street
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RE: Evaluation of risk for students/staff exposed to elemental mercury at two schools

Dear Mr. Weigel,

The Bureau of Community and Environmental Health, ATSDR Cooperative Agreement Program has completed an evaluation of risk for students and staff exposed to elemental mercury at two schools, one in Boise and one in Emmett. What follows in this letter is the final evaluation with our conclusions and recommendations.

BACKGROUND

Purpose

Elemental mercury spills occurred at two separate schools in SW Idaho recently. The first spill occurred in a chemistry lab storeroom at Emmett High School on February 15. The EPA On-scene Coordinator report for this site is available at: http://epaosc.net/site_profile.asp?site_id=3871%20
The Emmett site was not investigated by EPA until February 23. The second spill occurred in a classroom at St. Joseph's School in Boise on February 22. The EPA On-scene Coordinator report for this site is available at: http://epaosc.net/site_profile.asp?site_id=3869%20

EPA and the health districts contacted BCEH to help interpret risk from confirmed exposures at these two locations. This document evaluates the health risk to the students and staff exposed to mercury vapors. The document is also intended to be used as a guide for interpreting the public health risk from future exposures, as there are still a large number of mercury-containing thermometers in circulation. Cleanup efforts are already underway or completed at these sites, thus this evaluation will focus on retrospective exposure and risk. Findings will be communicated to impacted students, staff and parents of students via EPA and the health districts.

Elemental Mercury Toxicity

Note that health effects in humans are only known to occur at exposure levels above the comparison values listed in the ‘Approach’ section below. At sufficient dose, mercury vapor can cause effects in the central and peripheral nervous systems, lungs, kidneys, skin and eyes in humans. It is also mutagenic and affects the immune system at sufficient dose (Hathaway et al. 1991; Clayton and Clayton 1981; Rom 1992). Acute exposure to high concentrations of mercury vapor causes severe respiratory damage, while chronic exposure to lower levels is primarily associated with central nervous system damage (Hathaway et al. 1991). According to reports from EPA, cleanup occurred before chronic exposure could occur at these schools so only acute exposures will be considered here.

DISCUSSION

Approach

No direct dermal (skin) exposure was reported, so this evaluation will focus on inhalation exposure only. Readings from the bag headspace (for contaminated clothing/shoes) and ambient room air readings are considered. Readings from the floor are not considered since this is not proximal to a person’s breathing space. Comparison values used in this evaluation are acute values for exposure duration of 14 days or less. The comparisons all relate to the volume of contaminated air a person could inhale. The values considered are:

- 1) The Occupation Safety and Health Administration’s (OSHA) permissible exposure limit (PEL) ceiling limit of 100,000 ng/m³ (ceiling means this level should at no time be exceeded);
- 2) The National Institutes of Occupational Safety and Health’s (NIOSH) reference exposure level (REL) for 10 hours of exposure (time-weighted over the whole 10 hours) of 50,000 ng/m³, and;
- 3) the California Office of Environmental Health Hazard Assessment’s (OEHHA) reference exposure level (REL) for one hour of exposure at 1,800 ng/m³.

Note that the ATSDR comparison value for mercury inhalation exposure is for a chronic exposure, not an acute exposure, and is not relevant to this assessment.

Comparison to OSHA, NIOSH and OEHHA Standards

Table 1. Mean Detected Mercury Concentration in Air

Parameter	Value	Unit	Comments
Mean Concentration (C)	St. Joseph’s 320-3,000 (ambient) 1,500-16,000 (clothes) Emmett HS 4,000->10,000 (ambient) 120,000 – 500,000 (shoes)	ng/m ³	Clothes and shoes were bagged and headspace (air inside) was measured. Ambient samples represent room concentrations at various heights above the floor.
OSHA PEL	100,000	ng/m ³	Acute; ceiling
NIOSH REL	50,000	ng/m ³	Acute; 8 hr
OEHHA REL	1,800	ng/m ³	Acute; 1 hr

Both the OSHA and NIOSH standards are based on the risk of central nervous system damage and eye, skin, and respiratory tract irritation, but the standards are set at levels below which these are

known to occur, and these effects are not expected to occur in the entire population at exposure levels just above the standards. OEHHA's acute REL for mercury vapor is based on developmental effects in the offspring of female rats that were exposed to 1.8 $\mu\text{g}/\text{m}^3$ of mercury vapor for one hour each day during gestation. OEHHA assigned an uncertainty factor of 1,000 to the study's Lowest Observable Adverse Effect Level (LOAEL) to arrive at their acute REL. An uncertainty factor of 1000 was used because the animal findings were based on a LOAEL, there was extrapolation from animals to humans, and because of the variability of expected responses in human populations.

It is possible that the OSHA and NIOSH comparison values are not protective enough for a school setting where pre-teen and teenage students are exposed. The OEHHA REL raises concern for *in utero* exposures; however, no pregnant individuals were reported to be exposed at either school. Also, the OEHHA REL may not be practical because personal exposure to mercury from other sources, including dental work and ambient sources, may be around the same order of magnitude as this REL (Underwood, 2005). What must be stressed when evaluating the exposures in the rooms where they occurred is *the duration* –no student or teacher remained in the vicinity of spill at either school for more than a few minutes. In contrast, the OSHA and NIOSH comparison values are full-day time-weighted average values for 8 hours or 10 hours of exposure, respectively. The duration of exposure to contaminated shoes for the teacher and student from Emmett HS is believed to be closer to a normal 8 hour day, so OSHA and NIOSH comparison values are more relevant for these two individuals.

The exposure from both the teacher's shoes and the student's shoes at Emmett HS exceeded the OSHA PEL ceiling limit, the NIOSH REL time-weighted average, and the OEHHA REL. It must be noted, however, that the readings for the shoes were taken after the shoes had been bagged and allowed to off-gas, and were not taken as 'spot' readings in the ambient environment. Actual exposure to wearers of the shoes would be expected to be much lower than the bagged readings unless the wearers stayed in a confined space for a long period of time, which is unlikely. Therefore, exposure to these two individuals is estimated to be much lower than the measured bagged air readings. All exposures at Emmett HS and St. Joseph's exceeded the OEHHA REL; however, this REL is based on behavioral deficits of rat pups exposed *in utero*. Since no pregnant women were exposed in the schools, the OEHHA REL does not apply to this situation. No other individuals are believed to have been exposed at the higher level encountered by the teacher and student at Emmett HS. According to a study on mercury, acute inhalation of mercury vapor may result in symptoms that include chills, nausea, general malaise, tightness in the chest, chest pains, dyspnea, cough, salivation, and diarrhea (Hathaway et al. 1991). If none of these symptoms were reported by the teacher and student exposed at Emmett HS, it is unlikely that measurable long-term damage was sustained by either individual. If either individual is concerned or feels perhaps some symptoms were sustained, s/he should consult a physician.

Exposure Uncertainty

The focus here is on the teacher and the student at Emmett HS. It is possible that these two were exposed at a higher mean level or lower mean level, depending on a few variables. The shoes were tested well after the initial contact with the spilled mercury occurred, so it is possible that the initial concentration on the shoes was measurably higher than what was captured by headspace sampling. On the other hand, shoes are not directly in a person's breathing space, and actual inhalation exposure concentration could be significantly lower once it travels from shoe to nose/mouth.

CONCLUSIONS

None of the students at St. Joseph's are believed to have been exposed above the OSHA or NIOSH

comparison values. Although exposure did exceed the OEHHA REL comparison value, this would only be of concern for *in utero* exposure which did not occur. This message can be relayed to families and staff involved there. The teacher and the student who entered the storeroom where the spill occurred at Emmett HS were both potentially exposed at levels above the OSHA, NIOSH and OEHHA comparison values, though duration of exposure is not certain, and extrapolation from bagged shoe concentration to breathing space concentration is speculative at best. While both did not report any symptoms of ill health, each may want to visit a physician if worried about potential health effects. No other individuals involved at either school are believed to have been exposed at a level of concern, assuming the exposure was acute only.

Exposure from shoes worn by the teacher and student at Emmett High School could have been a concern if the exposure lasted longer, but given anecdotal information from these two individuals, it appears that the shoes were not worn for more than a few hours post-spill and thus the exposure ceased within a few hours post-spill. Currently, there is *no public health hazard* at either of the schools due to the mercury spills as a result of the cleanup conducted by EPA and its contractors.

RECOMMENDATIONS

Based on BCEH's communication with Greg Weigel, EPA On-Site Coordinator, cleanup was completed according to EPA protocol and occurred rapidly following the two spills. Rooms affected were ventilated and re-sampled after they were cleaned with a mercury vacuum. Post-cleanup air concentration of mercury at both schools was below the standards listed in Table 1. Further recommendations are:

1. All individuals with confirmed or suspected exposures should consult with their physician if they experienced any adverse health effects or would like more information about the health effects of mercury exposure. No effects were reported thus far by anyone involved.
2. Contaminated areas should be properly ventilated and re-sampled following cleanup. Rooms with levels at or below EPA's reference concentration of $0.3 \mu\text{g}/\text{m}^3$ should be considered safe to use for students and teachers.
3. These two schools and other area schools should find and remove all other sources of mercury for proper disposal. Schools and school districts should contact Idaho DEQ for directions on where and how to dispose of mercury in their area. A list of sites that accept mercury thermometers is available from the Idaho DEQ website at: http://www.deq.state.id.us/waste/recycling/Recycle_category.cfm?county=&recycle_category_id=97, or by calling (208) 373-0124.

If you have questions, please feel free to contact us any time.

Best Regards,



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Attachment: References

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