

Health Consultation

MADISON METROPOLITAN SCHOOL DISTRICT MERCURY SPILL

CITY OF MADISON, DANE COUNTY, WISCONSIN

MARCH 28, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Prepared by:
Wisconsin Department of Health and Family Services
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
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Summary

The Wisconsin Department of Health and Family Services (DHFS) was asked, by the Madison Health Department (MHD) and the Madison Metropolitan School District (MMSD), for assistance in assessing public health hazards associated with a small metallic mercury spill in an alternative high school setting. DHFS arrived after most of the spill had been removed. Air monitoring of the building and of clothing of students who had handled mercury found small amounts of mercury in the building, on shoes of several individuals, and on the coat of one student. However, the amount of mercury detected at that point presented no apparent health hazard. DHFS also offered follow-up health education, and assisted with decontaminating an HEPA-vacuum used in the initial cleanup.

Background and statement of issues

On December 15, 2004, DHFS staff were notified of a small spill of metallic mercury in a school building. The spill was from a mercury thermostat that had been recently replaced, but was left unattended in a classroom. The building is a small community center at 29 S. Mills St., Madison, Wisconsin, the basement of which is leased by the Madison Metropolitan School District (MMSD) for an alternative school program for high school-aged children. DHFS was asked to assist because of MMSD's concerns over exposing children to mercury, and because DHFS has had similar experience in other school districts and possesses a sensitive and portable mercury detection instrument.

Building managers, after learning of the spill, questioned the two children who had handled the mercury. The children revealed they had handled the mercury in one linoleum-tiled classroom and the adjacent tiled hallway. They later took the mercury, in a plastic cup, through the adjacent hallway, up the stairs and out of the building to a private unattached garage across the street (address 30 S. Mills St.), which they entered to smoke cigarettes. To the knowledge of school officials, the handling of mercury was confined to these areas. After obtaining this information, MMSD environmental staff properly removed visible mercury beads from the classroom and hallway, using a standard zinc dust mercury cleanup kit. They reported finding mercury beads in the classroom and hallway having a volume similar to "half a dime." According to manufacturer's specifications, the thermostat contained 4 grams of mercury. With a density of 13.1 grams per milliliter (gm/ml), this corresponds to 0.31 ml.

Discussion.

Site visit and environmental sampling. DHFS and Madison Health Department staff arrived to assess the building at 1:45pm December 15. At that time, the children had already been taken to a different building for holding until they could be screened for mercury on skin and clothing. A *Lumex Light* mercury meter (Ohio Instruments; lower detection limit $0.1 \mu\text{g}/\text{m}^3$) was used to thoroughly screen for mercury vapors in the classroom, hallway, an adjacent carpeted recreation room, stairs, and a boys lavatory near the top of the stairs. Screening consisted of systematically passing the meter intake within 1-2 inches of all accessible surfaces including floors, tabletops, drains, and trashcans. Throughout the basement classroom, recreation room, and hall, the Lumex

detected mercury between 0.1 and 0.3 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$), with most readings being $0.2 \mu\text{g}/\text{m}^3$. This compares to the Agency for Toxic Substance and Disease Registry's Minimal Risk Level, $0.2 \mu\text{g}/\text{m}^3$. The Minimal Risk Level (MRL) is that concentration below which no adverse health effects are expected following a lifetime of exposure. Because mercury is somewhat volatile (vapor pressure = 0.0012 mm Hg, 20°C), the mercury concentration is expected to diminish below the MRL over time. On the stairs and in the lavatory, no mercury was detected. The residual mercury vapor levels within the community center/school were low enough to present no apparent public health hazard.

Health staff then walked directly to screen the garage at 30 S. Mills. Air within the open and unheated garage (35°F) had $0.2 \mu\text{g}/\text{m}^3$ mercury. Several small beads of mercury visibly dispersed over one 6 x 7-foot area of the garage floor presented a public health hazard. Mercury readings taken within a few inches of the visible beads exceeded the maximum ($100 \mu\text{g}/\text{m}^3$) detectable by the instrument. The Agency for Toxic Substances and Disease Registry (ATSDR 1999) cites $10 \mu\text{g}/\text{m}^3$ as the level above which residents are advised to not occupy the affected area. Although the vapor pressure of mercury increases with temperature (0.0012 mm Hg at 20°C ; 0.0050 mm Hg at 38°C), because the garage is open and not attached to any building, future mercury concentrations in air within the garage could not be accurately predicted. The garage is used and visited frequently, although the duration of each use is not known. The most likely route of harmful exposure to the mercury in the garage is through skin contact with the visible mercury on the garage floor, which can cause contact dermatitis if handled (Pambor and Timmel 1989). Based on the possibility of mercury dermatitis, DHFS concluded that the presence of visible mercury metal on the garage floor represented a public health hazard. A recommendation to clean the garage using a HEPA vacuum cleaner was made at the time of the DHFS site visit to MMSD environmental staff.¹ These recommended actions were taken later that day.

Health staff then went to the MMSD Administration Building on Dayton St., where they first screened approximately 12 pairs of child and adult shoes that had been left outside the building. The air next to the shoes contained $0.2 \mu\text{g}/\text{m}^3$ mercury. This concentration of mercury presents no apparent health hazard (EPA 1995). The shoes were therefore cleared for return to their owners. Health staff were taken to the room where the children from the community center were held. One of the students who reportedly had handled mercury was present. His hands and clothing were screened; no elevated readings were seen. Under the assumption that this boy was most contaminated of those detained, the boy and the remaining children were cleared for release.

On December 15, the other student who had handled mercury was at home on suspension from school. Agency staff did not go to his home, but requested that his overcoat be bagged and brought in for screening under the assumption that he had placed his hands in the coat pockets. The coat was screened the next day, on Dec 16. Shoes and other

¹ A HEPA vacuum designed specifically for mercury removal would have been preferable. MMSD was contacted and advised to thoroughly clean the vacuum container, discard the filters, and re-test the unit with the Lumex prior to re-use. DHFS assisted with the vacuum cleaner decontamination.

clothing worn by this boy were not available for screening. Approximately $5 \mu\text{g}/\text{m}^3$ mercury was measured in the headspace of the plastic bag containing the coat. The recommended maximum (ATSDR 1999) for bagged clothing is $10 \mu\text{g}/\text{m}^3$. The residual mercury on the coat presented no apparent health hazard. The recommendation to air the coat, shoes, and other clothing worn that day was conveyed to the boy and his family via MMSD environmental staff.

The MMSD was provided, in addition to these mercury-screening results, with the attached DHFS fact sheet, which contains a brief discussion of mercury toxicity and exposure limits.

Case discussion and follow-up. MMSD officials used good judgement in acting quickly to properly clean up the spilled mercury, to detain children and staff for screening, and to leave shoes outside. That the thermostat was left where children could abuse it was unfortunate and preventable. Because the spill was small, there were no exposures of concern, and a costly cleanup was averted.

The choice of moving the children to a separate building should be discussed by MMSD as an internal matter of protocol. When chemically contaminated people are moved, each room, surface, and vehicle they contact becomes potentially contaminated. This complicates and expands the areas that must be assessed. However, since the most important issue is the children's health and safety, in each case a decision must be made by those immediately responsible as to whether leaving people where they are exposes them to further risk. Ideally, people would not be moved, or moved to the closest room within the building considered safe and comfortable. If people are moved, the new location should be one that is easy to assess and clean. There should be no contact with carpet or upholstered furniture in the holding room. Similarly, transporting people in a bus or van with hard or plastic-covered seats simplifies assessment and cleaning. Removing shoes before entering the vehicle or covering the floor with disposable paper or plastic are options to contain a spill. State and local health staff experienced with chemical emergencies are typically available to assist in making short-term decisions. Both the DHFS Bureau of Environmental and Occupational Health and the Madison Health Department have around-the-clock on-call staff available to respond to chemical emergencies and who may be able to offer immediate advice or to make an initial assessment by phone (for MHD, dial 911). In the absence of needed information, we recommend erring on the side of safety, as was done in this instance.

Child Health Considerations

The most important route of exposure to metallic mercury is through inhalation of the metal, which volatilizes at room temperature. Therefore, high school-aged children who regularly occupy a classroom containing spilled mercury are at risk of exposure. Ingestion of metallic mercury is not an important route of toxicity (Klaassen, 1996; ATSDR, 1999). In this case, the amount of mercury in the building air after the spill was first cleaned up was not great enough to present a health hazard.

Conclusions

- Small amounts of mercury vapor were detected within areas of the community center/school where mercury had been spilled and cleaned. The residual mercury levels were low enough to present no apparent public health hazard.
- Appropriate actions were taken by the Madison Metropolitan School District to contain and abate the small volume mercury spill.
- Small beads of mercury visibly dispersed over one 6 x 7-foot area of the garage floor presented a public health hazard, based on the possibility of mercury contact dermatitis.
- Small amounts of mercury vapor were detected on shoes left outside the building by people evacuated from the school. The mercury levels were low enough to present no apparent public health hazard.
- There was no apparent health hazard from a small amount of mercury contamination found on an overcoat worn by one of the students who handled mercury.

Recommendations

- Shoes and clothing worn by those handling mercury should be aired outside. No follow-up screening of this clothing is required, but state or city health staff are available to provide this screening for reassurance, if requested.
- Following DHFS recommendations, additional mercury spill removal was completed in the garage at 30 S. Mills St.
- Specific protocols for mercury and other chemical spills should be reviewed by MMSD. State and city health staff are available to participate in those discussions and to provide early assistance in future chemical events.

Public Health Action Plan

- DHFS and MHD returned to the school to present mercury-specific health education. The presentation was made in a game-show format (see Appendix II.) that effectively met the educational challenges of this alternative school.
- As recommended, officials from the MMSD have contacted DHFS and MHD to arrange follow-up discussion on chemical spill protocol. The discussion will emphasize principles described in an ATSDR-sponsored article (Davis and Runkle 2004) on chemical risks in schools.

References

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Appendix I: Mercury toxicology and exposure limits.

A brief discussion of mercury toxicity. The chemical forms of mercury fall into three main categories: Elemental (metallic) mercury, mercury salts, and organic mercury. Mercury exerts many of its toxic effects after it enters the central nervous system. The different forms of mercury vary in their ability to penetrate nerve tissue. Organic mercury is most able to enter nerve tissue and fetal tissue and is therefore the most important source of mercury. Some types of bacteria produce organic mercury, particularly methyl mercury, from metallic mercury that enters the environment from natural and human sources. Organic mercury then accumulates in the food chain, becoming particularly concentrated in large fish.

Metallic mercury, the familiar “quick silver,” is not readily absorbed into the body after being eaten, and has relatively low toxicity by that route of exposure. However, metallic mercury volatilizes into the air, where it is absorbed into the body via inhalation and can then affect the nervous system and kidneys. Elevated mercury concentrations in indoor air are primarily a problem in occupations involving the handling of mercury. Mercury exposure following a small mercury spill in a non-occupational setting are not usually acutely toxic, but can result in chronic exposure if not removed.

Mercuric salts have application in industry such as the manufacture of batteries and paper. Mercuric salts are quite corrosive and if eaten, quickly damage tissues of the digestive tract and kidneys.

The major sources of the public’s exposure to mercury are through fish consumption and from spills of small amounts of metallic mercury such as might occur from breaking thermometers or from mercury stored in school laboratories. The main public health messages urge limiting consumption of certain types of fish, especially to children and women of child-bearing age, as well as the prevention and containment of metallic mercury spills.

Environmental Limits for Airborne Mercury Exposure

AGENCY	Exposure Limit (micrograms per cubic meter)	COMMENTS
National Institute of Occupational Safety and Health (NIOSH)	10,000 µg/m ³	Immediately Dangerous to Life or Health (IDLH) value allowable for a maximum of 30 minutes in emergency situations only
Occupational Safety and Health Administration (OSHA)	100 µg/m ³	Enforceable workplace standard, assuming 8 hours/day, 40 hours/week
NIOSH	50 µg/m ³	Workplace recommendation, assuming 8 hours/day, 40 hours/week
American Conference of Governmental Industrial Hygienists (ACGIH)	25 µg/m ³	Workplace recommendation, assuming 8 hours/day, 40 hours/week
Agency for Toxic Substances and Disease Registry (ATSDR)	10 µg/m ³	Level at which residents are advised to not occupy the affected area. Also a screening level for bagged clothes
ATSDR	3 µg/m ³	Target cleanup level for commercial environments
ATSDR	1 µg/m ³	Target cleanup level for residential environments
ATSDR	0.20 µg/m ³	Chronic level of exposure at which adverse effects would not be expected. Assumes exposure time of 24 hours/day for 30 years
None	0.01 µg/m ³	Typical background level

Appendix II: Health Education Materials

This is an example of educational materials presented to Madison Metropolitan School District alternative school students by the Wisconsin Department of Health and Family Services. The questions below were presented in a game-show interactive format, which was preceded by a short lecture on mercury health and safety issues.

Mercury Game Show

History	Properties	Where is it?	Health	Clean Up
<u>100</u>	<u>100</u>	<u>100</u>	<u>100</u>	<u>100</u>
<u>200</u>	<u>200</u>	<u>200</u>	<u>200</u>	<u>200</u>
<u>300</u>	<u>300</u>	<u>300</u>	<u>300</u>	<u>300</u>
<u>400</u>	<u>400</u>	<u>400</u>	<u>400</u>	<u>400</u>
<u>500</u>	<u>500</u>	<u>500</u>	<u>500</u>	<u>500</u>

History 100:

Which of these characters from the book *Alice in Wonderland*, had mercury poisoning?

- A) Alice
- B) The White Rabbit
- C) The Mad Hatter
- D) Superman

History 200:

Name the famous bay in Japan that raised public awareness on the dangers of methylmercury poisoning of fish and humans.

- A) Isuzu
- B) Nagasaki
- C) Tokyo
- D) Minamata

History 300:

Mercury has been known and used since ancient times. The Chinese were using mercury before 2000 B.C.

True or False?

The ancients did not realize mercury was toxic, and allowed only royalty to mine the cinnabar ore.

History 400:

The chemical symbol for mercury (Hg) is short for hydrargyrum, which is Latin for:

- A) liquid silver
- B) shaky water
- C) shiny metal
- D) heavy metal

History 500:

True or False?

The world's oldest continuously operating mine for mercury is located in Spain, and has been used since 400 BC.

Properties 100:

At room temperature, Mercury

is a:

- A) solid
- B) liquid
- C) gas
- D) plasma

Properties 200:

Which of the following best describes the odor of mercury vapor?

- A) rotten eggs
- B) no odor
- C) gasoline
- D) metallic

Properties 300:

When mercury evaporates into the air, it is called

- A) mercury fume
- B) mercury gas
- C) mercury dust
- D) mercury vapor

Properties 400:

A gallon of water weighs about eight pounds. How much does one gallon of mercury weigh?

- A) 1 lb.
- B) 25 lbs.
- C) 47 lbs.
- D) 104 lbs.

Properties 500:

Mercury (Hg) is a:

- A) halogen
- B) noble vapor
- C) transition metal
- D) amino acid

Where is it? 100:

Mercury can be found in which of the following devices?

- A) sanding machine

- B) thermometer**
- C) chainsaw
- D) telephone

Where is it? 200:

Which of the following are most likely to have the highest levels of mercury?

- A) large fish**
- B) snakes
- C) birds that live in a rainforest
- D) small fish

Where is it? 300:

Where are you not likely to find mercury in your home?

- A) thermometer
- B) thermostat**
- C) athlete's foot creme
- D) refrigerator

Where is it? 400:

Which of these types of lights contains mercury?

- A) lava lamp
- B) fluorescent light bulb**
- C) regular ("incandescent") light bulb
- D) bees wax candle

Where is it? 500:

The majority of mercury entering lakes, streams, rivers and oceans comes from the atmosphere.

Which of the following adds the MOST mercury to the environment:

- A) coal-fired power plants**
- B) using mercury in dental amalgams
- C) breaking mercury thermometers
- D) recycling fluorescent bulbs

Health 100:

Why is it dangerous for pregnant women to be exposed to mercury?

- A) it will turn her hair blue
- B) it will make her eat more
- C) it can hurt the development of the fetus**
- D) it will make her smell bad

Health 200:

After a thermometer breaks, what is the main way a person will absorb the mercury into their body?

- A) breathing mercury vapor**
- B) swallowing mercury beads
- C) mercury soaking through the skin
- D) washing your hair with mercury shampoo

Health 300:

Who are more likely to be affected by mercury exposure?

- A) just male adults
- B) teenagers
- C) babies**
- D) people aren't affected by mercury

Health 400:

Which of the following is NOT a symptom of mercury poisoning?

- A) difficulty walking
- B) birth defects
- C) numbness or swelling of the fingers
- D) increased hair growth

Health 500:

The half-life of inorganic mercury (Hg) in the body is:

- A) 15 minutes
- B) 3 days
- C) 30 days
- D) 4 years

Clean Up 100:

What should you do with waste liquid mercury?

- A) take it to a household hazardous waste collection site
- B) pour it down the drain
- C) throw it in the trash
- D) pour it out in your backyard

Clean Up 200:

Which of the following are health officials MOST worried about?

- A) students breathing mercury vapors
- B) students eating beads of mercury
- C) students touching beads of mercury
- D) health officials are not concerned about mercury

Clean Up 300:

The best way to clean up a small mercury spill is

- A) use a wet sponge
- B) use a mercury spill clean up kit
- C) use a vacuum cleaner
- D) use a broom

Clean Up 400:

True or False?

The State of Wisconsin Department of Health and Family Services always pays for cleaning up mercury spills in schools and private homes.

Clean Up 500:

What do we use to detect mercury (Hg) vapors in the air?

- A) Lumex
- B) GPS receiver
- C) we can smell mercury in the air
- D) a yellow canary

FINAL QUESTION:

What agency can you call if mercury is spilled in your home or school?

Answer: any of a number of agencies -- the poison control center, state or local health departments, state environmental protection agency, etc.

CERTIFICATION

This health consultation for Madison Metropolitan School District Mercury Spill was prepared by the Wisconsin Department of Health and Family Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methods and procedures existing at the time the health assessment was begun. Editorial review was completed by the Cooperative Agreement Partner.

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The Division of Health Assessment and Consultation, ATSDR, has reviewed this health consultation, and concurs with its findings.

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