

Health Consultation

LUXEMBURG SINGLE RESIDENCE MERCURY SPILL

LUXEMBURG, KEWAUNEE COUNTY, WISCONSIN

FEBRUARY 23, 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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HEALTH CONSULTATION

**Single-Family Residence Mercury Spill
Luxemburg, Kewaunee County, Wisconsin**

Prepared by

Wisconsin Department of Health and Family Services

**Under a Cooperative Agreement With the
Agency for Toxic Substances and Disease Registry**

Summary

On July 7, 2004, an energy conservation contractor tried to remove a thermostat from the wall of a ground-floor hallway in a single-family residence in Luxemburg, Wisconsin. In trying to do so, the mercury switch broke and elemental mercury was spilled. The contractor then tried to pick up the mercury using a wet/dry vacuum cleaner.

Three adults and two children lived in the home. After the spill, the grandfather and children left the house until the contamination could be fully assessed and cleaned up. A physician who examined one of the children who had come into close contact with the mercury notified the Wisconsin Department of Health and Family Services (DHFS). Air monitoring conducted by DHFS indicated that airborne mercury levels in the home posed *no apparent health hazard*. Residents were advised that reoccupancy of the home was safe and that, as a precaution, they (a) should use a vapor-suppressant solution to wash the spill site and (b) ventilate the house as was convenient. No further actions are needed by the residents, DHFS, or other agencies regarding this incident.

Background

On July 7, 2004, the Wisconsin Department of Health and Family Services (DHFS) received a call from a physician who had examined a child who had been in close proximity to a mercury spill. DHFS contacted the homeowners and learned that a thermostat had been broken when a contractor was removing it and that mercury had spilled out. When interviewed, the contractor reported having used a wet/dry vacuum cleaner to collect the mercury. The vacuum cleaner reportedly had a high-efficiency particulate air (HEPA) filter.

DHFS visited the home on July 9, 2004. The homeowners were present, as were the energy conservation contractor involved in the incident and representatives of the Kewaunee County Health Department and the Wisconsin Department of Natural Resources. The residence was a two-story, single-family home with a full finished basement. DHFS used a Lumex RA-915+ Mercury Analyzer (S/N 432) to record airborne mercury levels. Before collecting data, the assessors performed a baseline check and calibration of the instrument against an internal standard. Airborne data collected in the home were compared with the ATSDR guidance levels described in "Suggested Action Levels for Indoor Mercury Vapors in Homes or Businesses with Indoor Gas Regulators" (ATSDR 2000).

When the assessors entered the home, mercury levels were clearly elevated, but all breathing zone levels were about 0.1 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$), which is below the ATSDR guidance of $1.0 \mu\text{g}/\text{m}^3$. Breathing zone samples were collected at about 5 feet above the floor. The spill site was at the west end of the central hallway on the first floor. The hallway had a finished wood strip floor. Levels in this area ranged from 0.4 to $0.6 \mu\text{g}/\text{m}^3$ in the breathing zone and from 1.2 to $1.6 \mu\text{g}/\text{m}^3$ at about 1 inch above the floor. Chairs had been placed on either end of the hallway to restrict traffic through the area. Breathing zone concentrations elsewhere in the house, including the basement and upstairs bedrooms, also ranged from 0.4 to $0.6 \mu\text{g}/\text{m}^3$.

Other than the hallway where the spill occurred, floor surfaces on the first and second floors were closely surveyed, and concentrations were not higher than those found at the breathing zone. The assessors used a flashlight to inspect the hallway spill site more closely, and they found several small beads of mercury. These were removed by placing clear packing tape on them, which allowed the beads to be picked up and properly disposed.

Elevated mercury concentrations also were found in the pantry closet at the west end of the hallway. Additional testing indicated that the source of mercury in the home was the trash bag in the garbage bin, which was stored in the pantry closet at the end of the hallway. The bagged vacuum cleaner was stored outside the home. Headspace was tested in the bag and found to be over 50,000 $\mu\text{g}/\text{m}^3$. Headspace is the void space in the bag above the enclosed belongings. The high reading indicated that the vacuum was contaminated and could cause further contamination if it were to be used again. Residents were advised to consult with the local health department and the Department of Natural Resources regarding disposal of the trash bag and vacuum cleaner. The airborne mercury data are summarized in Table I.

Discussion

On the basis of the monitoring results, DHFS found that the level of mercury vapor exposure resulting from the broken thermostat posed *no apparent health hazard* to the residents. DHFS advised residents that reoccupancy of the home was safe. As a precaution, residents were told a) to use a vapor-suppressant solution specific for mercury to wash the hallway floor and b) to ventilate the room and home as was convenient.

The airborne mercury levels were lower than expected for a home in which a vacuum cleaner had been used to clean up a mercury spill. Past experience has shown that airborne levels can be much higher when a household vacuum has been used to clean up a thermometer spill. Thermostats contain even more mercury (about 3 grams) than do thermometers (about 0.7 grams).

The differences between a wet/dry vacuum cleaner and a regular household vacuum cleaner may explain why airborne mercury levels were lower than expected. Wet/dry vacuum cleaners do not have a beater bar at the entry point; upright household vacuum cleaners do. In wet/dry vacuum cleaners, the motor (a high temperature source) is farther from the collection reservoir than it is in regular vacuum cleaners. In addition, wet/dry vacuum cleaners typically have much stronger suction than regular household vacuum cleaners have. In addition, the HEPA filter may have been of some benefit in preventing very small beads of mercury from being discharged.

Toxicological Profile of Elemental Mercury

Elemental mercury affects the nervous system, cardiovascular system, digestive tract, and kidneys in all humans, as well as the development of young children. The primary route of entry for elemental, metallic mercury is by inhalation of vapors (ingestion and dermal absorption of metallic mercury is not usually significant). Metallic mercury readily

vaporizes at room temperature. Laboratory animals that inhaled high levels of elemental mercury vapors ($>1,000 \mu\text{g}/\text{m}^3$) had permanent neurologic damage and kidney impairment. Workers who were exposed for many years to mercury vapors between 14 and $76 \mu\text{g}/\text{m}^3$ exhibited mildly increased hand tremors, difficulty with heel-to-toe gait, and more impaired performances on neurobehavioral tests.

Table I: Airborne Mercury Data ($\mu\text{G}/\text{M}^3$) Collected With Lumex RA-915+ Mercury Analyzer — Single-Family Residence in Luxemburg, Wisconsin

Location	Average Concentration ($\mu\text{g}/\text{m}^3$)
Outdoors	0.025
Foyer BZ*	0.110
Central hallway east end BZ	0.429
Family room BZ	0.552
Kitchen BZ	0.567
Basement BZ	0.417
Main floor bathroom BZ	0.651
Bedroom hallway 2nd floor BZ	0.648
Bathroom/Laundry BZ	0.649
Spill site BZ (west end of central hallway)	0.488
Spill site BZ (west end of central hallway)	0.668
Front stairs	0.575
Garbage bin	1.300
Trash bag in pantry closet	5.000
Pants used during clean-up effort	0.590
Top stairs BZ	0.552
Southeast children's bedroom BZ	0.525
Northwest bedroom BZ	0.552
Children's shoes in plastic bag	1.000
Stair corner east end hall floor	0.900
Mid-hallway at floor	1.200
Mid-hallway at floor	1.600
Bottom stairs	0.635
Vacuum	>50

*BZ = Breathing zone (i.e., about 5 feet above floor).

The ATSDR chronic inhalation minimal risk level (MRL) for mercury vapor in air is $0.2 \mu\text{g}/\text{m}^3$ (ATSDR 1999). This MRL was derived from the study that found an increased frequency of tremors among workers exposed over 15 years to $26 \mu\text{g}/\text{m}^3$ mercury, which was designated as the *lowest observed adverse effect level* (LOAEL). Because adults in the occupational study were only exposed during work hours, this LOAEL was then adjusted to account for a continuous, 24-hour exposure. This LOAEL is comparable to the occupational 8-hour time-weighted hour threshold limit value of $25 \mu\text{g}/\text{m}^3$ established by the American Conference of Governmental Industrial Hygienists ([ACGIH] 2003). The MRL is then obtained by dividing the adjusted value by an uncertainty factor of 10 to protect sensitive humans and by a factor of 3 because a LOAEL was used rather than a *no observed adverse effect level* (NOAEL). ATSDR defines an MRL as an estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk for harmful (adverse), noncancerous effects. No evidence indicates that the inhalation of elemental mercury vapors causes cancer in humans.

The goals for indoor airborne mercury levels were ATSDR's "Suggested Action Levels for Indoor Mercury Vapors in Homes or Businesses with Indoor Gas Regulators" (ATSDR 2000). In this guidance, ATSDR recommends that mercury vapor levels in the breathing zone of a home after a spill do not exceed $1.0 \mu\text{g}/\text{m}^3$ and that at or below this level is acceptable for the reoccupancy of any structure. Exceeding the action level of $1.0 \mu\text{g}/\text{m}^3$ prompts the need for cleanup or other remedial actions to reduce exposures. This recommended action level is based on both animal laboratory studies and human epidemiologic studies that evaluate the effects of inhaling air containing elevated levels of mercury vapor. ATSDR's suggested action level recommends that if mercury vapor levels in a home reach or exceed $10.0 \mu\text{g}/\text{m}^3$, residents are isolated from the exposure and actions are taken to remediate the spill. The ATSDR guidance also recommends an action level of $10.0 \mu\text{g}/\text{m}^3$ when testing air from a plastic bag in which mercury-contaminated clothing was placed. Clothing should be discarded when mercury vapor in the bag reaches or exceeds $10.0 \mu\text{g}/\text{m}^3$.

In summary, residents in the Luxemburg home breathed mercury vapors for a short time. Taking into consideration the levels they breathed over this time frame, it is not likely that this exposure caused harmful health effects and, as a result, the exposure posed *no apparent human health hazard*.

Risk Communication

During the site visit on July 9, 2004, exposure guidance levels were explained to the residents. DHFS provided the airborne mercury data to the residents and explained to them that reoccupancy of the home was safe. Residents were encouraged to speak with their physicians regarding exposure concerns. As a precautionary measure, DHFS suggested that the residents a) use a mercury vapor suppressant solution to wash the hallway floor and b) ventilate the room and home.

Child Health Considerations

DHFS recognizes that children can be especially sensitive to contaminants. Children are often at greater risk than adults to certain kinds of exposure from hazardous chemicals in the environment. Children engage in activities, such as playing outdoors and hand-to-mouth behaviors, that increase their exposure to hazardous substances. Because children are smaller than adults and because they play on their hands and knees, they breathe air close to the ground that can have more dust, soil particles, and vapors. Children have a lower body weight, but a higher intake rate, resulting in greater exposure to hazardous substances per unit body weight. Also, children's bodies are developing and can be permanently damaged if toxic exposures are high enough during critical growth stages. For these reasons, DHFS considers children as being one of the most sensitive populations evaluated in this health consultation, and the agency always takes into account children when evaluating exposures to contaminants. Children who live in the Luxemburg house were not exposed to levels of mercury vapor that are expected to adversely affect their health.

Conclusions

The level of mercury vapor exposure caused by a broken thermostat in the Luxemburg home posed no apparent health hazard to the residents.

Recommendations

No further actions are needed by the residents, DHFS, or other agencies, regarding this incident.

Public Health Action Plan

As needed, DHFS will continue to review and possibly revise its guidance for responding to mercury spills and has provided this guidance to those involved with this incident, including state and local officials. While the amounts of mercury involved in such releases is often very small and would not typically be expected to represent a hazard, vacuuming after such a spill can produce airborne mercury exposures of public health concern. Guidance in the fact sheets and information conveyed in presentations to Wisconsin hazardous material responders have been directed at increasing awareness of this topic.

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References

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Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for mercury, update. Atlanta: US Department of Health and Human Services.

American Conference of Governmental Industrial Hygienists Worldwide. 2003. TLVs and BEIs based on the documentation of the threshold limit values for chemical substances and physical agencies and biological exposure indices. Cincinnati, Ohio: American Conference of Governmental Industrial Hygienists.

CERTIFICATION

This Luxemburg Single Family Residence Mercury Spill Health Consultation 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 the approved methodology and procedure existing at the time the public health consultation was begun.



Technical Project Officer, CAT, SPAB, DHAC, ATSDR

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



Lead, CAT, SPAB, DHAC, ATSDR