HEALTH CONSULTATION

Hayes Middle School
Mercury Spill Event

Eaton County

Prepared by

Michigan Department of Community Health
Under a Cooperative Agreement with
Agency for Toxic Substances and Disease Registry

Background and Statement of Issues

On Friday November 30, 2001, the Michigan Department of Community Health (MDCH) received a call from an environmental contractor with questions regarding cleanup levels for a school setting. The incident involved a teacher who had used elemental mercury in a science demonstration and allowed students to hold it in their hands. At the time of the call, the contractor did not want to give identifying details on the school, so the MDCH staff member answered his questions and strongly encouraged him to have the school phone MDCH for assistance. Within an hour, a representative of the Hayes Middle School in Grand Ledge, Michigan phoned and described the science demonstration and the subsequent spill that had potentially exposed as many as 3 classes of sixth grade students. The incident had happened late in the afternoon on Thursday, November 29, 2001.

MDCH phoned the school, spoke to an administrator and helped them understand the actions that needed to be taken, particularly the health communication activities. MDCH gave them some initial recommendations regarding containing the contamination and contacting those potentially exposed to arrange testing their shoes, other clothing and possibly their homes and vehicles. MDCH sent the school sample letters, activity flow sheets, mercury fact sheets, and sample questions to use while interviewing students.

MDCH then contacted the Barry-Eaton District Health Department and notified them of the spill and requested their assistance in working with the school. At the time, the District Health Department had already borrowed the MDCH Lumex RA 915+ mercury vapor analyzer for use on two other mercury incidents, so MDCH encouraged them to use it for in the Hayes Middle school investigation. The Lumex is capable of measuring mercury vapor with a detection limit in the single nanogram per cubic meter of air (ng/m^3) range.

The school immediately developed a questionnaire and began using it to interview all of the students who had attended any of the teacher's classes on the previous day. They made arrangements with the Sparrow Health System at their St. Lawrence Hospital Campus for blood tests for any potentially exposed student whose parents wanted them tested. The District Health Department started characterizing the extent of the contamination throughout the school, the school buses, and made arrangements to sample some private homes. Selected results of the characterization sampling are presented in Table 1.

Table 1.
Selected School Chacterization Samples in ng/m3
Science Classroom (Room 105)

Location in Classroom	ng/m^3 mercury
Range of floor samples throughout the room	1,599 to 3,991
Trash can	7,355
Floor next to plastic bag	4,247

Wall mounted electrical outlet ledge	4,947
At foot of student chair #1	13,900
At foot of student chair #2	13,860
Tennis ball on floor	2,399
Foot of work table #3	4,021
Foot of worktable #4	5,545
Non-floor, approximate breathing zone sample (range)	1,000 to 1,600
Hallway and classrooms 104 through 109	< 1200
10 bus sample range	0 to 14
Mop used to clean Room 105	50,000+
One student's clothing and book bag and books (range)	326 to 26,819
Science teacher's home and vehicle (range)	3 to 540

The sampling of private residences did not reveal any contamination except for some of the clothing students had worn to class the day of the spill.

Community Health Concerns

The press coverage resulting from this spill incident gave the impression that dermal contact with elemental mercury is an important route of exposure. In the days following the initial article there were several letters to the editor of the local newspaper. The sense of most of the letters was that the school and health department overreacted to the teacher's demonstration. The letters' authors wrote that they had handled mercury when they were young and no harmful health effects had resulted. MDCH had an opportunity to respond to the growing body of erroneous information via a Lansing State Journal columnist who reprinted most of the letter the department sent to respond to those who thought mercury was harmless.

Discussion

MDCH frequently receives requests to assist with elemental mercury spills and is prepared to help in several ways. Staff can quickly fax or email procedural guidance to the caller which includes information on addressing small or large spills, sample press releases, sample letters to parents, patients and employees. Our response can include bringing in and coordinating the resources of other agencies such as the Agency for Toxic Substances & Disease Registry (ATSDR) in Atlanta, Georgia, the U.S. EPA Emergency Response Branch in Chicago, Illinois, and the Michigan-based Poison Control Centers. We are also able to give guidance on containing the spill, managing the cleanup, and evaluating the need for biological sampling of exposed and potentially exposed people. We have assisted local health departments in drafting letters to home and business owners after the event for insurance coverage purposes.

The main routes of exposure for elemental mercury are ingestion, dermal absorption and inhalation of mercury vapors. Of the three, inhalation is the most hazardous route, particularly to children and women of childbearing age.

Inhalation of high levels of elemental mercury can cause permanent neurological damage and kidney impairment. ATSDR recommends that breathing zone mercury levels not exceed 1,000 ng/m^3 for long term exposures as would be likely in a residence (1). This recommended level is based on both animal studies and human epidemiology studies that describe the health effects of inhalation of mercury-contaminated air. Workers who were exposed to mercury vapors in an occupational setting exhibited hand tremors, increases in memory disturbances, and slight subjective and objective evidence of autonomic nervous system dysfunction. The ATSDR minimal risk level (MRL) for mercury in air was derived from the lowest observed adverse effect level (LOAEL) from this study of 26,000 nanograms of mercury per cubic meter of air (ng/m^3). Because workers were only exposed during working hours, the LOAEL was adjusted to account for continuous exposure. The resulting value was divided by an uncertainty factor of 10 to protect sensitive human subgroups and by a factor of 3 because a LOAEL was used rather than a no observed adverse effect level (NOAEL). The resulting MRL is 0.2 micrograms per cubic meter (ug/m^3) or 200 ng/m^3. An MRL is defined as an estimate of the daily exposure level to a hazardous substance that is likely to be without appreciable risk of adverse, non-cancer health effects. **The ATSDR recommended value for residential setting of 1000 ng/m^3 is an action level that if exceeded would prompt the need for further cleanup or other remedial action.** The initial screening of the school determined that the mercury contamination was located at several places in the classroom and particularly near two student's desks. The contractors screened student lockers and removed and put in overpack drums any of the contents of lockers that showed over 1,000 ng/m^3. A contaminated mop head, which was indicative of an inadequate clean-up attempt, was found and isolated.

MDCH recommended that, after a thorough clean-up and ventilation of the affected school areas, the acceptable level for reuse of the classroom should be less than 3,000 ng/m^3 in the breathing zone. This recommendation was based on the absence of visible beads of mercury or Lumex identified "hot spots." School officials decided to be more protective and directed the environmental contractors to achieve the residential recommendation of less than 1,000 ng/m^3 in the breathing zone. Following clean-up, ventilation and removal of contaminated materials, the clearance testing found levels in room 105 to be in the 700 to 800 ng/m^3 range.

Addressing the Unique Vulnerabilities of Children

Children may be at greater risk than adults from certain kinds of exposure to hazardous substances at sites of environmental contamination. They engage in activities such as playing outdoors and hand-to-mouth behaviors that increase their exposure to hazardous substances. They are shorter than an adult, which means they breathe dust, soil, and vapors close to the ground. Their lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. The developing body systems of children can sustain permanent damage if toxic exposures are high enough during critical growth stages.

Children who breathe metallic mercury vapors may develop a disorder known as acrodynia, or "pinks disease." The symptoms of this disorder include severe leg cramps, irritability; and abnormal redness of the skin, followed by peeling of the skin of the hands, nose, and soles of the feet. Itching, swelling, fever; fast heart rate, elevated blood pressure, excessive salivation or sweating, rashes, fretfulness, sleeplessness, and / or weakness may also be present. This disorder may also occur in teenagers and adults. Exposure to mercury vapors is more dangerous for children than for adults, because inhaled mercury vapors easily pass into the brain and nervous system of young children and may interfere with the development process. Exposure to high levels of mercury vapor can also cause lung, stomach, and intestinal damage. Death due to respiratory failure can result in cases of extreme exposures (3).

Though the ages of the children who attended the affected classes at Hayes Middle School were older than the 6 year old and younger age most vulnerable to mercury toxicity, the possibility of younger children being exposed by mercury that was carried or tracked out of the building was a concern until all the sampling had been completed. School and health officials estimated that a total of 21 students had the opportunity to be exposed to mercury vapor in the affected areas. All of them were encouraged to have blood tests for mercury via communication with their parents. Of the 9 students who followed through on the biologic sampling, results showed 7 had levels below the detection limit of 1 microgram per liter (ug/L) and 2 had 3 ug/L. None received any further medical attention since the exposure had been terminated.

Conclusions

The following conclusions were made at the time of MDCH's initial notification and shortly afterward:

The Hayes Middle School event was considered an Urgent Health Hazard because of the number of students who had been in the classes where mercury was handled and spilled. Mercury transported from the classroom on the clothing and personal belongings of students and the science teacher to vehicles and residences where others might experience chronic exposure was a great concern.

Due to the remediation, no current health hazard exists due to this mercury spill event.

Recommendations

The following recommendations were made by MDCH during the investigation:

1. Secure the elemental mercury that was used in the classroom demonstrations and discontinue any future demonstrtions.
2. Characterize the degree and extent of mercury contamination (The District Health Department environmental health staff were poised to respond.)
3. Isolate the highly contaminated areas and keep anyone other than investigators and remedial workers out of the atmosphere. If the amount of mercury found

required it, engage the services of professional environmental contractors to carry out remedial activities rather than try to have school janitorial staff attempt it.
4. Interview teacher and students to determine the events, and identify additional areas that may need investigation.
5. Offer to arrange blood tests for mercury for students and others who may have been exposed.
6. Refer students, parents, staff, and physicians with questions to MDCH as necessary.

Public Health Action Plan

All Action plan items were implemented during the course of the investigation or shortly afterwards.

The MDCH provided verbal consultation and referral to the school administrators, local health staff, and parents.

MDCH notified the Barry-Eaton District Health Department and assisted their lead role in the response.

MDCH recommended a clearance level for the post-clean-up based on ATSDR guidance.

MDCH provided a mercury vapor analyzer for use in the characterization of the site.

MDCH provided health education information to the local health agency, the school administrators, teachers, students, their parents, and the readership of the Lansing State Journal.

MDCH will be available to address any public health questions or concerns regarding this contamination event. Please contact the Michigan Department of Community Health, Division of Environmental and Occupational Epidemiology at 1-800- 648-6942.

References

- ATSDR (Agency for Toxic Substances and Disease Registry). 2000. Suggested Action Levels for Indoor Mercury Vapors in Homes or Businesses with Indoor Gas Regulators.

- ATSDR (Agency for Toxic Substances and Disease Registry). 1999. Toxicological Profile for Mercury, Update.

- Mercury Exposure Incident Report, Barry-Eaton District Health Department,, November 29, 2001

- Lansing State Journal, John Schneider column, 1/18/02

PREPARERS OF THE REPORT

Michigan Department of Community Health
Division of Environmental and Occupational Epidemiology

Brendan Boyle, M.P.A., Health Assessor

Linda D. Larsen, Ph.D., Toxicologist

ATSDR Regional Representative

Mark Johnson
Regional Services, Region V
Office of the Assistant Administrator

ATSDR Technical Project Officer

Alan Yarbrough
Division of Health Assessment and Consultation
Superfund Site Assessment Branch

CERTIFICATION

This Hayes Middle School Health Consultation was prepared by the Michigan Department of Community Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun.

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Technical Project Officer, SPS, SSAB, DHAC, ATSDR

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

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Chief, State Program Section, SSAB, DHAC, ATSDR