

Health Consultation

EL CAMINO MIDDLE SCHOOL MERCURY SPILL
LOMPOC, SANTA BARBARA COUNTY, CALIFORNIA

OCTOBER 4, 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

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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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PUBLIC HEALTH CONSULTATION

**El Camino Middle School Mercury Spill
Lompoc, Santa Barbara County, California**

**Prepared by
California Department of Health Services
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry**

Background and Statement of Issues

The California Department of Health Services (CDHS) was contacted on July 3, 2005, by the Santa Barbara County Hazardous Materials Division regarding a mercury spill in El Camino Middle School located in Lompoc, Santa Barbara County, California. Staff from Occupational Health Branch and Environmental Health Investigations Branch (EHIB) of CDHS provided timely assistance via telephone and letter to the county (the letter is attached as an appendix). The EHIB staff is funded through a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). In this health consultation, CDHS summarizes the technical assistance that was provided.

Summary of Events and Nature of Request

On June 8, 2005, a student brought a 35 millimeter (mm) film canister full of mercury to share on the last day of school (personal communication, Dan Napier, July 20, 2005). During play, an unknown quantity of the mercury spilled in three rooms (a fourth room is adjacent to one of the rooms where it was spilled) (1). The janitor tried to clean the mercury by vacuuming it.

When CDHS was initially contacted, the school district had hired an industrial hygienist familiar with mercury spill cleanup. They had closed off the contaminated rooms including the heating and ventilation system and had covered the vacuum cleaner. The industrial hygienist measured 15 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) of mercury in the four rooms, with some areas having levels above $20 \mu\text{g}/\text{m}^3$ (1). Underneath the plastic covering the vacuum cleaner, the concentration of mercury was over $300 \mu\text{g}/\text{m}^3$.

The industrial hygienist placed all soft materials (anything that could not be wetted and scrubbed without deforming or absorbing water) in lined containers (1). They were going to transport the soft material to a landfill that accepts mercury-contaminated material, but the teachers did not want some of the material disposed. CDHS was initially asked whether or not it was necessary to dispose of the material.

At the time CDHS was contacted, the industrial hygienist planned to clean all hard surfaces with a mercury stabilizing chemical, then re-monitor in the four rooms. At that point, Santa Barbara County asked CDHS what the clearance monitoring readings should be to release the rooms for reuse (Personal communication, Paul McCaw, July 1, 2005). Santa Barbara County also inquired whether it was necessary to conduct wipe sampling.

Mercury Health Guidance Levels

In order to recommend a clearance concentration, CDHS reviewed several agencies health-based guidance values, specifically the U.S. Environmental Protection Agency (USEPA) Reference Concentration (RfC), ATSDR Minimal Risk Levels (MRLs), and the California Office of Environmental Health Hazard Assessment (OEHHA) Reference Exposure Levels (RELs). The calculation of the health guidance values assumes that there is a threshold level for effects. Health guidance values are calculated to be safe exposure concentrations for defined exposure

durations. Exposure to chemicals at or below the chronic health guidance values for a lifetime, or the acute health guidance value for an hour should not result in adverse health effects to the general public, including sensitive subpopulations.

Protective uncertainty factors have been included in health guidance values to limit the probability of anyone experiencing an effect, in addition to limiting the severity of any possible effect. However, as the exposure concentration increases above the health guidance value, the risk of experiencing an adverse effect increases.

Chronic Exposure Values: Mercury (Elemental)

The USEPA's Integrated Risk Integration System (IRIS) database (2001) specifies a RfC for chronic exposure to mercury vapor of $0.3 \mu\text{g}/\text{m}^3$ (2). An RfC is an exposure concentration which is not expected to result in adverse health effects in most people, including sensitive subpopulations, exposed via all routes over a lifetime. The mercury RfC is based on multiple studies of occupational exposures. Most studies were conducted by studying employees in chlor-alkali plants who were exposed to mercury vapor. The critical effects seen were hand tremors, increases in memory disturbances, and slight subjective and objective evidence of autonomic nervous system dysfunction. The lowest-observed-adverse-effect levels (LOAELs) in the occupational studies converge at $25 \mu\text{g}/\text{m}^3$. Adjusted to a 24-hour, 7-day-per-week exposure, the $\text{LOAEL}_{\text{adj}} = 9.0 \mu\text{g}/\text{m}^3$. An uncertainty factor of 30 was applied to the $\text{LOAEL}_{\text{adj}}$ to reduce the RfC to a level which is assumed to be associated with no adverse effects. The uncertainty factor includes a factor of 10 for human variation in sensitivity, and a factor of 3 for lack of studies on the reproductive and developmental effects of elemental mercury. Therefore, it is presumed that exposure below the RfC will incur no adverse effect.

OEHHA has adopted a REL for chronic inhalation exposure to mercury that is based on the same studies used to develop the IRIS RfC (3). However, instead of using a cumulative uncertainty factor of 30, which was used by the USEPA, OEHHA adopted an uncertainty factor of 100. This is based on a factor of 10 for the uncertainty of using a LOAEL exposure instead of a no-observed-adverse-effect level (NOAEL) when calculating the REL, and a factor of 10 for human intraspecies variability. The California REL for mercury (elemental and inorganic) is $0.09 \mu\text{g}/\text{m}^3$ (3).

ATSDR has a health-based MRL for mercury of $0.2 \mu\text{g}/\text{m}^3$ (4). This MRL is calculated from the same data that was used to calculate the IRIS RfC. However, the MRL calculation assumes that in an occupational exposure 1/3 of the daily inhaled air each working day is contaminated, whereas the RfC assumes that 1/2 of the daily inhaled air each working day is contaminated air.

Acute Exposure Values: Mercury (Elemental)

California OEHHA has developed an acute REL for mercury vapor based on developmental effects in the offspring of exposed rats (3). Central nervous system effects in pups were noted following exposure of dams to 1.8 milligrams per cubic meter (mg/m^3) for 1 hour per day during gestation. A cumulative uncertainty factor of 1,000 is attached to this REL because 1) it is based on a LOAEL (10X), 2) the primary study was an animal study (10X), and 3) human response to all chemicals is variable (10X). The OEHHA acute REL for mercury vapor is $1.8 \mu\text{g}/\text{m}^3$, with a critical endpoint of reproductive or developmental effects (3).

Discussion

Mercury levels were elevated in four school rooms at the El Camino Middle School after the mercury spill that occurred on June 8, 2005. The mercury spill was worsened by the initial vacuuming of the spill but subsequent actions such as the closing off of the rooms, bagging of the soft material, and washing of the hard surfaces were effective in reducing exposure.

Per USEPA's guidance material, CDHS recommended that all soft material be disposed. This was conveyed by email on July 5, 2005.

In picking an acceptable clearance level, CDHS considered 1) the amount of time children and teachers spend in school, 2) background levels of mercury in indoor air, and 3) the increased sensitivity of children to mercury's effects.

1. Children typically spend 8 hours per day, 5 days a week, 36 weeks per year at the school, whereas teachers may spend 9 hours per day, 5 days per week, 38 weeks per year at the school. These exposures result in about 20 percent (or $1/5^{\text{th}}$) of the "continuous" exposure for a lifetime (high end residential) that is assumed when setting a chronic health guidance value.
2. There is a very limited indoor air data from structures with no known mercury source (spill, latex paint, etc). A survey of five homes which had no known spills of mercury ranged from 0.005 to $0.031 \mu\text{g}/\text{m}^3$ (5). One study measured mercury in 16 homes that had not recently been painted, the levels ranged from non detect to $0.3 \mu\text{g}/\text{m}^3$ (6).
3. Children and fetuses have been demonstrated to be sensitive to some mercuric compounds, including methyl mercury (4). However, increased sensitivity to elemental mercury has not been studied closely and has not been demonstrated. Nevertheless, the brain is the target organ for toxicity from metallic mercury, and in developing children this effect is even more dangerous.

It may be that the RfC or MRL is not protective enough, given that the basis for the underlying value is a LOAEL. While the California chronic mercury REL does provide this additional protection, practical application of the mercury REL at contaminated sites may be problematic because personal exposure to mercury from other sources, including dental amalgams, latex

paint, etc., may be in the range of the REL. Further, as described above, the amount of exposure (time at school) is not as great as that which is assumed when calculating the health guidance values.

Multiplying the REL by five to account for the less time spent at the school would arrive at a value of $0.45 \mu\text{g}/\text{m}^3$; however, this level seems to be elevated above typical background levels. Thus, CDHS recommends that the USEPA criterion ($0.3 \mu\text{g}/\text{m}^3$) be used. If the maximum concentration in ambient air is kept below $0.3 \mu\text{g}/\text{m}^3$, exposure to mercury vapor in this school should not affect health.

Child Health Considerations

CDHS and ATSDR recognize that infants and children may be more sensitive than adults to environmental exposures. For exposures related to mercury vapor, children's increased sensitivity is related to children having greater exposures to environmental toxicants than adults because pound for pound of body weight, children breathe more air than adults. Also, children grow and develop rapidly, thus could sustain permanent damage if toxic exposures occur during critical growth stages. Because children depend on adults for risk identification and management decisions, CDHS and ATSDR are committed to evaluating their special interests at hazardous waste sites. CDHS considered children and pregnant women in evaluating the mercury spill at the school. The health guidance values established by USEPA, ATSDR, and the State of California are protective of sensitive individuals, including children (2-4).

Conclusion

Exposure to the mercury spilled in the three rooms at the El Camino Middle School posed a public health hazard (category B). The school district recognized this hazard and followed the recommendations made by CDHS of cleaning the four rooms, thus allowing safe reentry and use of the rooms. Currently, there is no public health hazard.

Recommendations

1. CDHS recommended bagging and properly disposing of all soft material from the four school rooms.
2. CDHS recommended that mercury air concentrations indoors be $0.3 \mu\text{g}/\text{m}^3$ or lower to clear the room for reuse. This level should be measured using an instrument that can achieve this level of detection, i.e., not a Jerome meter. The Lumex meter that has been used by the industrial hygienist hired by the school district has very low detection limits and is appropriate for the clearance sampling.
3. The monitoring should take place 1) when there is controlled ventilation (e.g., no open doors or windows) and no air exchange with the outdoor air, 2) when indoor ambient air is greater than 75°F , and 3) within the breathing zone over an extended period of time. Based on the chemical properties of mercury, monitoring conducted in the manner described is the method of choice to clear the rooms for reentry. Wipe samples are not needed.

Public Health Action Plan

The Public Health Action Plan is a summary of the activities taken to mitigate exposure from the mercury spilled at the El Camino Middle School.

Actions Completed

1. The Santa Barbara School District hired an industrial hygienist familiar with mercury spill cleanup.
2. The Santa Barbara School District contacted the Santa Barbara County hazardous Materials Unit to assist them with oversight of the cleanup.
3. The Santa Barbara County Hazardous Materials Unit contacted CDHS for technical assistance of the cleanup.
4. The industrial hygienist followed appropriate cleanup protocols and used an instrument sensitive enough to monitor for mercury after the cleanup.
5. CDHS provided advice on the clearance concentration for mercury as well as appropriate steps to take during the post cleanup monitoring.
6. The industrial hygienist confirmed levels in the four rooms were below the clearance concentration provided by CDHS (7).

References

1. Napier D. California Department of Health Services, Environmental Health Investigations Branch. Remediation plan, Lompoc Unified School District, Lompoc, California. Richmond (CA): 2005 Jun.
2. U.S. Environmental Protection Agency. Integrated Risk Information System (IRIS). Available at: <http://www.epa.gov/iris/index.html>. Last updated: 2005 May 03. Last accessed: 2005 Jul 01.
3. California Office of Environmental Health Hazard Assessment. Chronic reference exposure levels. Available at: http://www.oehha.org/air/chronic_rels/AllChrels.html. Last updated: 2005 Feb. Last accessed: 2005 Jul.
4. Agency for Toxic Substances and Disease Registry. Toxicological profile for mercury. Atlanta: U.S. Department of Health and Human Services; 1999 Mar.
5. Agency for Toxic Substances and Disease Registry. Mercury exposure in a residential community, Florida. Morbidity and Mortality Weekly Report 1994;44(23):436-37.
6. Beusterien KM, Etzel RA, Agocs MM. Indoor air mercury concentrations following application of interior latex paint. Arch Environ Contam Toxicol 1991;21:62-64.
7. DNA Industrial Hygiene. Letter from Dan Napier, CIH, to James Bakos, Lompoc School District, regarding the El Camino Middle School mercury spill. July 18, 2005. Available to the public at: California Department of Health Services, Environmental Health Investigations Branch, Richmond, California.

Preparers of Report

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Certification

This health consultation, Mercury Spill at the El Camino Middle School, Lompoc, California, was prepared by the California Department of Health Services 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 initiated. Editorial review was completed by the cooperative agreement partner.

Tammie McRae, M.S.
Technical Project Officer, Cooperative Agreement Team
Division of Public Health Assessment and Consultation
ATSDR

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

Alan Yarbrough
Cooperative Agreement Team Leader
Division of Public Health Assessment and Consultation
ATSDR

Appendix

Letter from CDHS to Santa Barbara County Hazardous Materials Unit



California
Department of
Health Services

SANDRA SHEWRY
Director

State of California—Health and Human Services Agency
Department of Health Services



ARNOLD SCHWARZENEGGER
Governor

July 14, 2005

Ms. Kate Sulka
Hazardous Materials Supervisor
Santa Barbara County Fire Department
Hazardous Materials Unit
195 W. Highway 246, #102
Buellton, CA 93427

Dear Ms. Sulka:

On July 1, 2005, the California Department of Health Services (CDHS) was asked by your department, the Santa Barbara County Fire Department, for assistance with a mercury spill that occurred at the El Camino Middle School in Lompoc. Staff from the Occupational Health Branch initially responded to some of your questions. This letter specifically addresses the question of an acceptable level of mercury in air to be achieved after cleanup. The Environmental Health Investigations Branch staff responding to your request are funded under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR).

It is our understanding that on June 8, approximately 2 ounces of mercury were brought to El Camino Middle School and played with in four school rooms. About half the amount (1 ounce) was spilled. A janitor then vacuumed the mercury to try and clean it up. The janitor then put the vacuum bag into a sealed container, the rooms were sealed, and the ventilation shut off.

The school district contacted the county on June 9, 2005. Soon thereafter, an industrial hygienist hired by the school district measured a maximum concentration of 15 micrograms per meter cubed ($\mu\text{g}/\text{m}^3$) in one of the rooms with areas as high as 20 $\mu\text{g}/\text{m}^3$. Measurements near 300 $\mu\text{g}/\text{m}^3$ were found around the covered equipment where the mercury had been spilled.

Preliminary cleanup of the mercury spill began on June 23, 2005, and a formal work plan for cleanup methods was approved on June 30, 2005 and may be completed by July 14, 2005. Air testing is to occur on July 15, 2005.

CDHS recommends that mercury air concentrations indoors be 0.3 $\mu\text{g}/\text{m}^3$ or lower to clear the room for reuse. This level should be measured using an instrument that can

achieve this level of detection, i.e., not a Jerome meter. The Lumex meter that has been used by the industrial hygienist that the school district hired has very low detection limits and is appropriate for the clearance sampling.

The monitoring should take place when there is controlled ventilation (e.g., no open doors or windows) and no air exchange with the outdoor air, when indoor ambient air is greater than 75 °F and within the breathing zone over an extended period of time. Based on the chemical properties of mercury, monitoring conducted in the manner described is the method of choice to clear the rooms for reentry. Wipe samples are not needed.

The clearance concentration of 0.3 $\mu\text{g}/\text{m}^3$ is based on a review of several health based health guidance values: U.S. Environmental Protection Agency (USEPA) Reference Concentration (RfC), ATSDR Minimal Risk Levels (MRL), and the California Reference Exposure Levels (REL). The calculation of the health guidance values assumes that there is a threshold level for effects. Health guidance values are calculated to be safe exposure concentrations for defined exposure durations. Exposure to chemicals at or below the chronic health guidance values for a lifetime, or the acute health guidance value for an hour should not result in adverse health effects to the general public, including sensitive subpopulations.

Protective uncertainty factors have been included in health guidance values to limit the probability of anyone experiencing an effect, in addition to limiting the severity of any possible effect. However, as the exposure concentration increases above the health guidance value, the risk of experiencing an adverse effect increases.

Chronic exposure values: mercury (elemental)

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The California Office of Environmental Health Hazard Assessment (OEHHA) has adopted a REL for chronic inhalation exposure to mercury which is based on the same studies used to develop the IRIS RfC. However, instead of using a cumulative uncertainty factor of 30, which was used by the USEPA, OEHHA adopted an uncertainty factor of 100. This is based on a factor of 10 for the uncertainty of using a LOAEL exposure instead of a no-observed-adverse-effect concentration (NOAEL) when calculating the REL, and a factor of 10 for human intraspecies variability. The California REL for mercury (elemental and inorganic) is $0.09 \mu\text{g}/\text{m}^3$ (CA OEHHA, 2001).

ATSDR has a health-based MRL for mercury of $0.2 \mu\text{g}/\text{m}^3$ (ATSDR, 1999). This MRL is calculated from the same data that was used to calculate the IRIS RfC. However, the MRL calculation assumes that in an occupational exposure 1/3 of the daily inhaled air each working day is contaminated, whereas the RfC assumes that 1/2 of the working daily inhalation is contaminated.

Acute exposure values: mercury (elemental)

California OEHHA has developed an acute REL for mercury vapor based on developmental effects in the offspring of exposed rats. Central nervous system effects in pups were noted following exposure of dams to $1.8 \text{ mg}/\text{m}^3$ for 1 hour per day during gestation. A cumulative uncertainty factor of 1,000 is attached to this REL because: it is based on a LOAEL (10X); the primary study was an animal study (10X); and human response to all chemicals is variable (10X). The OEHHA acute REL for mercury vapor is $1.8 \mu\text{g}/\text{m}^3$, with a critical endpoint of reproductive or developmental effects (CA OEHHA, 2001).

In picking an acceptable clearance level, CDHS considered the amount of time children and teachers, background levels of mercury in indoor air, and the increased sensitivity of children to mercury's effects.

- Children typically spend 8 hours per day, 5 days a week, 36 weeks per year at the school; whereas teachers may spend 9 hours per day, 5 days per week, 38 weeks per year at the school. These exposures result in about 20% (or 1/5th) of the "continuous" exposure for a lifetime (high end residential) that is assumed when setting a chronic health guidance value.
 - There is a very limited indoor air data from structures where no known mercury source (spill, latex paint, etc). A survey of 5 homes which had no known spills of mercury ranged from 0.005 to $0.031 \mu\text{g}/\text{m}^3$. One study measured mercury in 16 homes that had not recently been painted, the levels ranged from non detect to $0.3 \mu\text{g}/\text{m}^3$ (Beusterien et al 1991).
 - Children and fetuses have been demonstrated to be sensitive to some mercuric compounds including methyl mercury (ATSDR 1999). However, increased sensitivity to elemental mercury has not been studied closely and has not been demonstrated.
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Ms. Kate Sulka

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July 14, 2005

- Nevertheless, the brain is the target organ for toxicity from metallic mercury, and in developing children this effect is even more dangerous.

It may be that the RfC or MRL is not protective enough given that the basis for the underlying value is a LOAEL. While the California chronic mercury REL does provide this additional protection, practical application of the mercury REL at contaminated sites may be problematic for the following reasons: since personal exposure to mercury from other sources, including dental amalgams and latex paint, etc., may be in the range of the REL. Further, as described above, exposure time at a school is not as great that which is assumed when calculating the health guidance values.

Multiplying the REL by 5 to account for the less time spent at the school would arrive at a value of $0.45 \mu\text{g}/\text{m}^3$. However, this level seems to be elevated above typical background levels, thus CDHS recommends that the USEPA criterion ($0.3 \mu\text{g}/\text{m}^3$) be used. If the maximum concentration in ambient air is kept below $0.3 \mu\text{g}/\text{m}^3$, exposure to mercury vapor in this school should not affect health.

Please contact me if additional assistance is needed.

Sincerely,



Marilyn C. Underwood, Ph.D.
Chief, Site Assessment Section
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July 14, 2005

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Date October 7, 2005

From Division of Health Assessment and Consultation, ATSDR

Subject Health Consultation
El Camino Middle School Mercury Spill

To Susan Muza
Senior Regional Representative, ATSDR, Region IX

Enclosed please find three copies of the October 4, 2005, Health Consultation on the following site prepared by the California Department of Health Services under Cooperative Agreement with the Agency for Toxic Substances and Disease Registry.

EL CAMINO MIDDLE SCHOOL MERCURY SPILL
LOMPOC, SANTA BARBARA COUNTY, CALIFORNIA

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Please address correspondence to the Agency for Toxic Substances and Disease Registry (ATSDR) Records Center, Attn: El Camino Middle School Mercury Spill Site, 1600 Clifton Road, NE (E60), Atlanta, Georgia 30333.

Aaron Borrelli
Manager, Records Center

Enclosures

cc: B. Rogers R. Gillig L. Daniel W. Cibulas, Jr.
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