Elevated Mercury Investigation

Important Notice:
*All public health recommendations for routine investigations are based on "Control of Communicable Diseases Manual, 21th edition, 2022" (CCDM) unless otherwise stated. Use the CCDM as the primary resource for case investigations that meet routine follow up. In cases of complicated situations or unique issues not addressed by this manual, please refer to the Administrative Rules of Montana (ARM) Chapter **37.114** or contact the designated subject matter expert in the Office of Epidemiology and Scientific Support at the Montana DPHHS for further clarification.*

PROTOCOL CHECKLIST

- ☐ Confirm diagnosis, see case definition (see section 3.3 and 4.1)
- ☐ Review background information on elevated mercury (see section 2)
- ☐ Contact provider to determine plan to re-test mercury level
- ☐ Notify state health department of case by entering available information into the Montana Infectious Disease Information System (MIDIS), if available, within the time frame for the specific disease per (ARM) **37.114.204** (see section 1.3)
- ☐ Review for use, specific technical assistance guidance documents (See the CDEpi Resources Page)
- ☐ Interview patient/guardian, cover the following:
  - ☐ Review health consequences of an elevated mercury facts with patient/guardian (see section 2.2)
  - ☐ Ask about exposures to relevant risk factors to determine the risk of exposure for other household members (see section 4.3)
  - ☐ Educate patient/ guardian on mercury exposure prevention (see section 6)
  - ☐ Implement Control Measures (see section 5.1)
  - ☐ Address patient's/guardian's questions or concerns
  - ☐ Determine answers to "condition specific" questions at the end of each MIDIS investigation and the Follow Up Exposure Questionnaire on Mercury
- ☐ Fax the Exposure Questionnaire on Mercury to DPHHS 1-800-616-7460
- ☐ Follow-up on special situations (see section 5, review references and additional information or contact the Epidemiology and Scientific Support Bureau at 406-202-8866
- ☐ Attach any additional lab reports to case investigation in MIDIS
- ☐ When done with MIDIS investigation, close the investigation.

1 DISEASE REPORTING

1.1 Provider notification to Public Health Authorities

Any person, including, but not limited to a physician, dentist, nurse, medical examiner, other health care practitioner, administrator of a health care facility or laboratory, public or private school administrator, or laboratory professional who knows or has reason to believe that a case exists of a reportable disease or condition defined in the Administrative Rules of Montana (ARM) **37.114.203** must immediately report to the local health officer.

For more information on analysis and specimen collection, please contact the laboratory conducting the test.

1.2 Local Health Department Follow-up Responsibilities

Immediately after being notified of a case of a reportable condition, a local health officer must investigate per (ARM) **37.114.546**. See section 4.3 below.

1.3 Local Health Department Reporting to State Public Health Authorities

- Elemental, organic, and inorganic mercury in blood $\geq$ 10 µg/L,
- Creatinine elemental mercury in urine $\geq$ 10 µg/L, and
- Total mercury in urine $\geq$ 10 µg/L.

Mercury tests must be reported to DPHHS within seven days regardless of the person's age.

2 THE DISEASE AND ITS EPIDEMIOLOGY

2.1 Public Health Significance in Montana

DPHHS added elevated mercury in blood and urine to the reportable diseases list in 2020. Currently, little is known about the public health significance of mercury exposure in Montana.

Mercury poisoning results from exposure to mercury or mercury compounds, and the toxic effects of mercury depend on the chemical form and the route of exposure.

- Elemental mercury is released into air from burning coal and other fossil fuels. Elemental mercury is/was also used in gold and silver mining, thermometers, blood pressure cuffs, barometers, fluorescent light bulbs, dental fillings, and electrical switches.
- Inorganic mercury compounds are found in button batteries, chemistry labs, folk remedies, and some disinfectants.

Elemental mercury vaporizes in air, so the primary exposure route may be inhalation of mercury vapors. The primary exposure routes to inorganic mercury solids may be ingestion or dermal contact.

Biological systems convert elemental and inorganic mercury to methylmercury which bioconcentrates in fish, birds of prey, and other top predators. The major route of human exposure to methylmercury is largely through eating contaminated local sport fish, seafood, and wildlife which have been exposed to mercury through ingestion of contaminated lower organisms. Montana Fish, Wildlife, and Parks lists known environmental sources of methylmercury in sport fish by water body, in their fish consumption guidelines.

2.2 Clinical Description of Illness

The route of exposure and efficiency of absorption depends on the form of mercury. Elemental mercury vapor is well absorbed through the lungs, but absorption of elemental mercury is negligible through the gastrointestinal tract. Oral absorption of inorganic mercury compounds is poor to moderate depending on the precise form. Oral absorption of organic methylmercury is nearly complete. Once absorbed, mercury is distributed primarily to the central nervous system and the kidneys. Elimination is through the urine and feces. The half-life of elemental and inorganic mercury in the blood is 40–60 days, and the half-life of organic mercury in the blood is about 70 days.

Mercury levels can be measured in both blood and urine. Either form of measurement can be used to assess exposures to elemental and inorganic forms of mercury, although individuals with a history of exposure may have elevated urine levels without elevated blood levels. Tests for mercury in whole blood is the preferred test for exposure to organic mercury, (methylmercury as it occurs in fish) since this form of mercury is excreted primarily in the feces rather than in the urine. It is important to choose the appropriate test depending on the suspected source of exposure.

Signs and symptoms of mercury toxicity vary with the form of mercury and route of exposure.

Elemental mercury: The human health effects of exposure to low environmental levels of elemental mercury are unknown. Inhaling very high elemental mercury vapor concentrations can quickly cause severe lung damage. Acute toxicity might result in fever, fatigue, and clinical signs of pneumonitis (fluid in the lungs due to metals exposure). Symptoms for extended exposures to lower elemental mercury vapor concentrations may include swollen bleeding gums, a bad cough, difficulty breathing, vomiting, and a metallic taste in the mouth.

Inorganic mercury compounds: Inhalation of high concentrations of mercury vapor or salts causes cough and shortness of breath. Inflammation of the oral cavity and gastrointestinal complaints occur shortly after exposure, followed by a chemical pneumonitis. When ingested in large amounts, some inorganic mercury compounds can be very irritating and corrosive to the digestive system. Acute symptoms might include burning in the stomach or throat, profuse vomiting and diarrhea that is often bloody, followed by hypovolemic shock, kidney failure and possibly death. For repeated low levels of exposure, either incidentally ingested or applied to the skin over long periods of time (as can occur with mercury-containing skin lightening creams),

some inorganic mercury compounds can cause effects like what is seen with long term elemental mercury vapor exposure, including neurological disturbances, memory problems, skin rashes, and kidney abnormalities. Chronic exposure to inorganic mercury compounds primarily affects the nervous system. Neuropsychiatric manifestations include changes in personality, shyness, anxiety, memory loss and emotional lability. Tremor is an early sign of neurotoxicity. Initially the tremor is fine and occurs at rest, progressing with further exposure to an intention tremor (action tremor) interrupted by coarse jerking movements. A sensory peripheral neuropathy with distal paresthesia is usually present. Other reported findings may include gingivitis, dental erosions and a bluish linear pigmentation on the teeth or gums.

Methyl or organic mercury: Methylmercury toxicity is associated with nervous system damage in adults and impaired neurological development in infants and children. Ingested mercury can undergo bioaccumulation in humans, leading to progressive increases in body burdens. Symptoms of delayed toxicity (greater than one month) are typical of organic mercury poisoning and usually involve the central nervous system. Sensory peripheral neuropathy (numbness or pain in certain parts of your skin) is common, and central nervous system effects can include personality changes, irritability, fatigue, uncontrollable shaking or tremor, inability to walk well from loss of full control of bodily movements, blindness and double-vision, and difficulties with memory and concentration. Hearing can be impaired. Renal effects include both tubular and glomerular (filter) damage. In the fetus, organic mercury disrupts the cytoarchitecture of the developing brain and has been associated with neuropsychological changes after birth.

Additional information on environmental mercury exposure, sources, health effects, and the national mercury biomonitoring program are described in the CDC ATSDR mercury toxicological profile.

3 CASE DEFINITION

3.1 Clinical Description

See Section 2.2.

3.2 Laboratory Criteria for Diagnosis

Confirmed

- Elemental, organic, and inorganic mercury in blood ≥ 10 µg/L,
- Creatinine adjusted elemental mercury in urine ≥ 10 µg/L, and
- Total mercury in urine ≥ 10 µg/L.

This definition was established by CDC's Emergency Preparedness and Response program in the event of a chemical emergency that has the potential for significant public health impacts.

3.3 Case Classification

Confirmed

• A clinically compatible illness in a person with laboratory evidence.

Probable

• A clinically compatible illness in a person with a high index of suspicion (patient's exposure history regarding location and time).

Or

• A clinically compatible illness in a person with and epidemiologic link to a case with laboratory evidence.

Suspected

• A case in which a potentially exposed person is being evaluated by health-care workers or public health officials for poisoning by a particular chemical agent, but no specific credible threat exists.

4 ROUTINE CASE INVESTIGATION

In accordance with (ARM) **37.114.314** conduct an epidemiologic investigation to determine the source and possible mercury exposure risks. Determine the information necessary to complete the investigation in MIDIS (See CD Epi Mercury Exposure Questionnaire).

4.1 Confirm the Diagnosis

Review the laboratory results to confirm the diagnosis. Clinical signs and symptoms are not necessary to confirm elevated urine mercury levels. See sections 3.2 and 3.3.

4.2 Laboratory Requirements

See Sections 1.2 and 1.3.

4.3 Case Investigation

The public health recommendations for this investigation guideline are based on the ARMs and CDC/ATSDR rather than the CCDM.

Specific Control Measures

Per ARM **37.114.546**, "The health officer must gather information about the circumstances and nature of the exposure using forms developed by the department (See CD Epi Exposure Questionnaire). For elemental, organic, and inorganic mercury in blood or urine at or above the reference value (See Section 3. Case Definitions), the local health officer must ensure that the following actions are performed. The health officer or health-care provider must provide:

(a) Counseling about health consequences of mercury poisoning;

(b) Information about ways to eliminate mercury exposure; and

(c) Referral of the case and household members potentially at risk of exposure to a health-care provider for additional follow-up and blood or urine mercury testing as appropriate.

4.4 Contact Investigation

Because environmental/occupational mercury exposures might affect entire families, it should be noted in any individual investigation whether there are additional family members at risk of exposure to mercury. If so, those family members should be evaluated for elevated blood or urine mercury levels as appropriate. This applies particularly to pregnant women and young children.

4.5 Environmental and Occupational Evaluation

See Sections 1.2 and 4.3(b). Conduct an environmental and occupational evaluation if an ongoing source of exposure is suspected (See CD Epi Exposure Questionnaire).

5 CONTROL MEASURES

In accordance with (ARM) **37.114.501 and 37.114.546**, utilize the control measures (prevention tips) indicated in Section 6.2 for this disease. Contact the DPHHS Epidemiology and Scientific Support Bureau for consultation and questions at 406-202-8866.

5.1 Case Management

See Section 1.2.

5.2 Contact Management

See Section 4.4.

5.3 Environmental and Occupational Measures

An environmental and occupational evaluation is appropriate if an ongoing source of exposure is not identified or if more than one case is associated with a venue, such as an occupational setting.

- For cases with a very high mercury level, medical management protocols can be found here: https://wwwn.cdc.gov/TSP/MMG/MMGDetails.aspx?mmgid=106&toxid=24
- A more exhaustive list of potential sources of mercury poisoning in children can be found in this article entitled “Mercury Exposure and Children’s Health” under the section “Environmental Sources of Exposure”: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3096006/

Depending on the situation, the Department of Labor and Industry (DLI) may assist with environmental investigations of public entities and the Occupational Safety and Health Administration (OSHA) may assist with private and federal entities. The Billings MT OSHA contact is Art Hazen at 406-247-7494. A public entity is defined as any state or local government or any department, agency, special purpose district, or other instrumentality of one or more state or local governments. Contact the DLI with any questions about public entities at 406-444-6543.

The employee should work with their employer to complete a First Report of Injury. The employer is then required to submit the form to the company’s worker’s compensation insurer.

The insurer will determine whether the injury or occupational disease is work-related and compensable. However, if the employee has issues working with their employer to receive compensation, they can contact the DLI at 406-444-6543 or visit their website for more information and resources http://erd.dli.mt.gov/work-comp-claims.

The employer should consult OSHA directive on inorganic mercury and related compounds - for detailed information on occupational mercury exposure, including medical surveillance.

There are many ways to minimize mercury exposure in the workplace:

- Ensure proper handling of hazardous materials and meticulous attention to workplace hygiene;
- Use of proper ventilation and respiratory protection in all operations that use mercury compounds;
- Special attention and training to maintenance workers who are responsible for the handling and disposal of mercury compounds to prevent inadvertent workplace contamination.

5.4 Special Circumstances / Mercury Spills / Mercury in Schools

See Section 4.3 and the ATSDR resource webpage "Don't mess with Mercury" on elemental mercury spills and health education resources.
https://www.atsdr.cdc.gov/dontmesswithmercury/index.html

6 ROUTINE PREVENTION

6.1 Immunization Recommendations

N/A

6.2 Prevention Recommendations

The best way to treat mercury poisoning is to have the patient avoid additional exposure. If the patient eats a lot of mercury-containing seafood (large top-predator fish, such as King Mackerel, marlin, orange roughy, shark, swordfish, tilefish, ahi tuna, and bigeye tuna), have them stop immediately. Montana's Fish Advisory also lists species and areas where consumption should be limited due to mercury content (fish consumption guidelines).

If toxicity is linked to the patient's environment or workplace, they might need to take steps to remove themselves from the area to prevent further effects of poisoning. The American Conference of Governmental Industrial Hygienists (ACGIH) biological exposure indices are for urine equal or greater than 35 micrograms per gram creatinine prior to a shift.

Patients with occupational exposure should use safety equipment as directed and talk with employer regarding proper use of equipment. Patients should wash their hands and change out of work clothes when finished with work. If elevated mercury levels persist, they should consider removal from source at work via re-assignment
https://www.osha.gov/SLTC/mercury/index.html.

If the patient's mercury levels reach a certain point, their doctor may do chelation therapy. Chelating agents are drugs that remove metal from organs and eliminate them from the body. Long term, the patient may need continuing treatment to manage the effects of mercury poisoning, such as neurological effects.

- Resources for Toxicological and Health Professionals, Emergency Responders, and Community Members can be found at the ATSDR Toxic Substances Portal, https://wwwn.cdc.gov/TSP/substances/ToxSubstance.aspx?toxid=24

Please see Section 5.3 above for additional means of preventing mercury exposure in the occupational setting.

7 ESCALATION/ACTIVATION OF EMERGENCY OPERATIONAL PLANNING

These investigation guidelines are designed to assist local health jurisdictions in the steps and actions needed to report, investigate, and control reported cases of mercury poisoning. Suppose individual case investigations or other reported cases link mercury to a cluster of cases by person, time, and place. In that case, local health jurisdictions need to contact DPHHS under the Administrative Rules of Montana 37.114.314 and 37.114.315 so DPHHS can consider emergency operational escalation or activation under the Communicable Disease Annex to the DPHHS Emergency Operation Plan.

8 ACKNOWLEDGEMENTS

Montana DPHHS would like to acknowledge the Colorado, Florida, and Washington State Departments of Health, and the Centers for Disease Control and Prevention (CDC) for developing the format and select content of this document.

9 REFERENCES AND ADDITIONAL INFORMATION

Important references:

ATSDR Medical Management Guidelines for Mercury Exposure
https://wwwn.cdc.gov/TSP/MMG/MMGDetails.aspx?mmgid=106&toxid=24

ATSDR Case Studies in Environmental Medicine (CSEM) Pediatric Mercury Toxicity
https://www.atsdr.cdc.gov/hec/csem/pediatric/docs/pediatric.pdf

CDC Mercury Website
https://emergency.cdc.gov/agent/mercury/mercelementalcasedef.asp

Health Advisory: DSHS Warns of Mercury Poisoning linked to Tainted Skin Creams
https://www.dshs.texas.gov/news/releases/2020/HealthAdvisory-20200109.aspx

Lewis, R. (2007). "Occupational Exposures: Metals. In: *Current Occupational and Environmental Medicine.* LaDou, J. editor. 4th Ed. (pp. 413-438). McGraw Hill Publishing.

Louisiana Department of Health & Hospitals, Section of Environmental Epidemiology & Toxicology Office of Public Health, Mercury Exposure and Toxicity
https://ldh.la.gov/assets/oph/Center-EH/envepi/Mercury_for_Health_Providers_Hg_Final.pdf

Mercury Exposure and Children's Health
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3096006/

Mercury Toxicity and Treatment: A Review of the Literature
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3253456/

Resources for Adult Cases:

NIOSH Mercury https://www.cdc.gov/niosh/topics/mercury/default.html

OSHA Directive on Inorganic Mercury and its Compounds
https://www.osha.gov/enforcement/directives/cpl-02-02-006

OSHA Mercury https://www.osha.gov/SLTC/mercury/index.html