REPORT TO THE BOARDS OF HEALTH

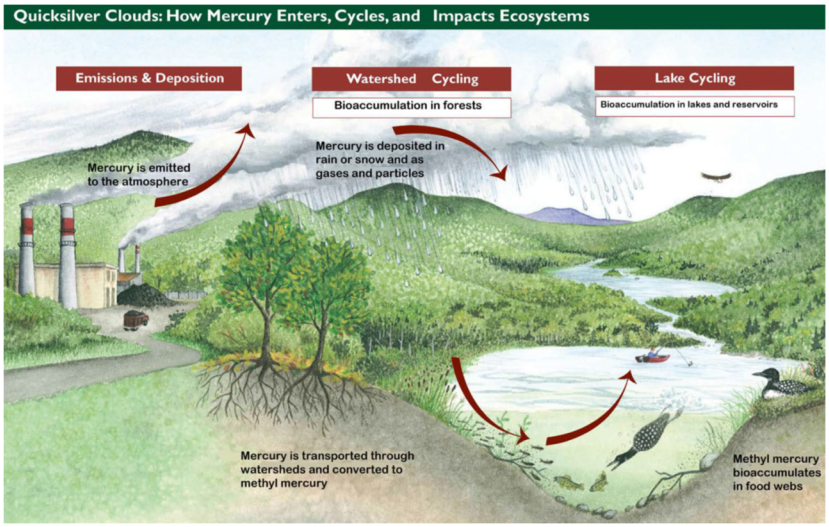
Jennifer Morse, MD, MPH, FAAFP, Medical Director

Mid-Michigan District Health Department, Wednesday, December 18, 2019
Central Michigan District Health Department, Wednesday, December 18, 2019
District Health Department #10, Friday, December 20, 2019

Mercury

Mercury is a heavy liquid metal. Though we now know it has toxic properties, its many useful qualities have led to its use by humans for thousands of years. It has been used as a bright red pigment for paint, an aphrodisiac, contraceptive, sedative, laxative, treatment for syphilis, and detonator for explosives. It has been used in light bulbs, batteries, barometers, thermometers, thermostats, counter weights of clocks, and blood-pressure meters. In the 1800s, mercury was used to cure felt hats, exposing hat makers to mercury vapors for prolonged periods of time. This led to mercury poisoning characterized by severe and uncontrollable muscular tremors and twitching limbs, distorted vision, confused speech, hallucinations, and other psychotic symptoms. It is claimed this is where the term "mad as a hatter" comes from. A variety of other symptoms can occur from chronic mercury exposure such as kidney failure, excessive salivation, rash, sweating, or gingivitis. When small children are exposed, acrodynia ("pink disease") can occur, with body rash, swelling of arms and legs, irritated feelings in palms and soles, peeling of skin, irritability, sensitivity to light, fever, insomnia, and sweating. Acute poisoning, usually from inhaling large amounts of mercury vapor, can cause fatal lung irritation. Clinical signs of mercury poisoning appear when blood levels increase to 100 ug/L after methyl mercury poisoning. If a fetus is exposed to levels around 85 ug/L, there is a 5% increased risk of abnormal mental development.

Elemental mercury is released into the air when fossil fuels, such as coal, are burned. It is also released during the burning of solid waste and during smelting and mining. This mercury leaves the atmosphere and is deposited to the land and water. In the water, it is metabolized by microorganisms to create an organic form called methyl mercury. This methyl mercury accumulates in bigger and bigger fish and becomes our main source of mercury exposure. Fish tested from 63 inland locations in Michigan were all found to be contaminated with mercury, ranging from 0.013 to 5.5 ppm (or 13 to 5500 ug/kg or 5.9 to 2494.76 mcg/pound). Concentrations in Coho and Lake trout from Lake Michigan have been found to contain 20.6 to 139 ug/kg (or 9.34 to 63.05 ug/pound). Most commercial fish and seafood contain mercury as well.



Driscoll, C.T., D. Evers, K.F. Lambert, N. Kamman, T. Holsen, Y-J. Han, C. Chen, W. Goodale, T. Butler, T. Clair, and R. Munson. Mercury Matters: Linking Mercury Science with Public Policy in the Northeastern United States. Hubbard Brook Research Foundation. 2007. Science Links Publication. Vol. 1, no. 3.

Thimerosal, also known as thiomersal, is an organic mercury compound that is metabolized to ethylmercury and thiosalicylate. If eaten, it is cleared from the body much more quickly than methyl mercury. Until 1999, thimerosal

was used as a preservative in numerous licensed vaccines in the United States. It is required that a preservative be added to multi-dose vials of vaccines to prevent bacterial or fungal contamination. In the late 1990s, there was increasing controversy about thimerosal in vaccines being linked to autism and other neurodevelopmental disorders in children. Despite no evidence to support this claim, the U.S. Public Health Service recommended thimerosal be removed from pediatric vaccines. Due to this recommendation, every childhood vaccine (except multi-dose influenza vaccine) that had an expiration date later than 2003 has not contained thimerosal.

In 2004, the National Academy of Sciences Institute of Medicine (now known as the National Academy of Medicine) reviewed a large body of evidence that found no support of a relationship between thimerosal-containing vaccines and autism. The European Medicines Agency also found no evidence of harm. Denmark eliminated thimerosal from vaccines in 1991, and actually saw increased rates of autism beginning several years later. Since thimerosal has been removed from childhood vaccines in the United States, autism prevalence has increased here as well; supporting that thimerosal is not related to the cause of autism.

Other possible causes of mercury exposure are inhalation of fumes. This can happen after an accidental spill or misuse of mercury (young person playing with elemental mercury, adults using it to recover gold or silver from jewelry, etc.) Mercury vapor is invisible, has no odor, and is readily absorbed by the lungs when inhaled. These things all make it very dangerous. Though the use of mercury has been discontinued in most products, many still have it in their homes. Dial thermostats, old thermometers, grandfather clocks, barometers, or old blood pressure cuffs are just a few things we may have in homes that contain mercury. Many find jars of mercury in attics and basements of loved one's home or as they move into a new home. It is very important that this old mercury be handled properly. If mercury spills in your home, do not vacuum or sweep it up. Get all the people and pets out of the room; open doors and windows to allow ventilation of the vapor. Cover the area with plastic if possible and call for more advice (see www.mi.gov/mercury).

Blood Total Mercury (2003 – 2016)

Geometric mean and selected percentiles of blood concentrations (in µg/L) for the U.S. population from the National Health and Nutrition Examination Survey (NHANES)

Categories (Survey Years)	**Geometric Mean** in µg/L
Age 1-5 years (2011 - 2012)	0.262
Age 6-11 years (2011 - 2012)	0.330
Age 12-19 years (2015 - 2016)	0.395
Age 20+ years (2015 - 2016)	0.810
Total population (2015 - 2016)	0.678

Table 5-12. Estimated Average Daily Intake and Retention of Total Mercury and Mercury Compounds in the General Population

Source of exposure	Elemental mercury vapor	Inorganic mercury compounds	Methylmercury
Air	0.030 (0.024)	0.002 (0.001)	0.008 (0.0064)
Food			
Fish	0	0.600 (0.042)	2.4 (2.3)
Non-fish	0	3.6 (0.25)	0
Drinking water	0	0.050 (0.0035)	0
Dental amalgams	3.8–21 (3–17)	0	0
Total	3.9–21 (3–17)	4.3 (0.3)	2.41 (2.31)

Note: Values given are the estimated average daily intake (in µg/day) for adults in the general population who are not occupationally exposed to mercury; the figures in parentheses represent the estimated amount retained in the body of an adult.

Source: WHO 1990, 1991

Thimerosal Content of Available FDA-Approved Seasonal Influenza Vaccines		
Vaccine	**Tradename (Manufacturer)**	**Thimerosal Status Concentration**(Mercury)**
Trivalent Influenza Vaccine	Afluria (multi-dose presentation) Seqirus Pty Ltd	0.01% (24.5 mcg/0.5 mL dose)
	Fluvirin (multi-dose presentation) Seqirus Vaccines Ltd	0.01% (25 mcg/0.5 mL dose)
	Fluvirin (single-dose presentation) Seqirus Vaccines Ltd	Trace (<1 mcg/0.5mL dose) [1]

Thimerosal Content of Available FDA-Approved Seasonal Influenza Vaccines		
Quadrivalent Influenza Vaccine	Afluria Quadrivalent (multi-dose presentation) Seqirus Pty Ltd	0.01% (24.5 mcg/0.5 mL dose)
	FluLaval Quadrivalent (multi-dose presentation) vID Biomedical Corporation of Quebec	0.01% (25 mcg/0.5 mL dose)[2]
	Fluzone Quadrivalent (multi-dose presentation) Sanofi Pasteur Inc.	0.01% (12.5 mcg/0.25 mL dose, 25 mcg/0.5 mL dose)[3]
Japanese Encephalitis	JE-Vax (Single dose vial) Sanofi Pasteur	0.0007%
Meningococcal	Menomune-ACYW135 (Diluent for Multi-dose) Sanofi Pasteur	0.01% (24.5 mcg/0.5 mL dose)
Tetanus and Diphtheria Toxoids adsorbed	Td (Single dose vial) MassBiologics	* (≤0.3 mcg/0.5 mL dose*)

**Thimerosal is approximately 50% mercury (Hg) by weight. A 0.01% solution (1 part per 10,000) of thimerosal contains 50 µg (micrograms) of Hg per 1 mL dose or 25 µg of Hg per 0.5 mL dose.

[1] The term "trace" has been taken in this context to mean 1 microgram of mercury per dose or less

[2] Individuals 6 months of age and older receive a full-dose of vaccine, i.e., 0.5 mL

[3] Children 6 months of age to less than 3 years of age receive a half-dose of vaccine, i.e., 0.25 mL; children 3 years of age and older receive 0.5 mL dose

* This product should be considered equivalent to thimerosal-free products. This vaccine may contain trace amounts (<0.3 mcg) of mercury left after postproduction thimerosal removal; these amounts have no biological effect. JAMA 1999; 282(18) and JAMA 2000; 283(16).

Healthy Living Recommendations

1. Pregnant and nursing woman as well as young children should be aware of the safe fish guidelines to limit exposure to mercury.
2. Remove all sources of mercury in your home to prevent accidental spills.
3. Know the facts: There has never been evidence that thimerosal, a preservative used in multi-dose vaccines, causes autism or other neurological illness. As a precaution, it was removed from nearly every vaccine prior to 2003.

Resources

1. How to Replace a Mercury Thermostat https://www.thermostat-recycle.org/hvac/how_to_replace_a_thermostat
2. Sign up to collect mercury thermostats for recycling https://www.thermostat-recycle.org/signup/
3. Mercury Spills and other information www.mi.gov/mercury
4. Advice about Fish (all), FDA https://www.fda.gov/media/102331/download
5. Michigan Eat Safe Fish www.mi.gov/eatsafefish

References

- Czaika, E., Bethanie, E. (2013). History of Mercury Use in Products and Processes. Mercury Science and Policy at MIT. https://mercurypolicy.scripts.mit.edu/blog/?p=367
- Plotkin
- Ball, L. K., Ball, R., & Pratt, R. D. (2001). An Assessment of Thimerosal Use in Childhood Vaccines. Pediatrics, 107(5), 1147-1154.
- Toxicological Profile for Mercury March 1999 https://www.atsdr.cdc.gov/toxprofiles/TP.asp?id=115&tid=24
- FDA https://www.fda.gov/vaccines-blood-biologics/safety-availability-biologics/thimerosal-and-vaccines#cstat
- Vaccine Safety Johns Hopkins Bloomberg School of Public Health http://www.vaccinesafety.edu/thi-table.htm
- Fourth National Report on Human Exposure to Environmental Chemicals, Updated Tables, January 2019 https://www.cdc.gov/exposurereport/pdf/FourthReport_UpdatedTables_Volume1_Jan2019-508.pdf
- Michigan Department of Environmental Quality Fish Contamination Monitoring Report: A Summary of Edible Portion Sampling Effort and Analytical Results with Recommendations for Updates to the Michigan Department of Community Health Eat Safe Fish Guide. December 2014 https://www.michigan.gov/documents/deq/wrd-swas-fcmp-2014report_493073_7.pdf
- Results of the Lake Michigan Mass Balance Study: February 2004. https://www.epa.gov/sites/production/files/2015-08/documents/lmmbhg.pdf.
- All maps from Reference #5