

Chemical Forms of Mercury

The form of mercury that is used in dental amalgam is the elemental metallic form that is liquid or gaseous at room temperature.

Hg⁰

Elemental, metallic mercury (used in dental amalgam) vapor atoms have no charge, so are lipophilic, and are able to easily cross biological membranes, including the blood-brain barrier.

Elemental mercury, metal form, either liquid or vapor

- 80% uptake in the lungs
- Crosses the BBB (Blood-Brain Barrier)
- Moderate uptake in the intestines

Hg²⁺

Oxidized, inorganic mercury atoms, with a 2+ charge, cannot cross biological membranes.

Inorganic mercury salt, formed by oxidation of mercury

- poor uptake in the intestines
- poor mobility
- does not cross BBB
- causes inflammation in the gut

MeHg

Methyl mercury is the most common form of organic mercury in the environment, and in the human diet. Levels of methyl mercury have been rising in recent decades in the environment and in seafood, due to the mercury released from burning coal for electrical power. Methyl mercury that we ingest from the diet is easily absorbed in the intestines, and is widely distributed throughout the body.

Methyl Mercury

- Formed by bacterial synthesis in the environment, taken up by fish, predominant form in dietary exposure
- Formed by bacteria in our mouth and gut from metallic Hg exposure
- 95% uptake in the intestines, good mobility, crosses BBB, as MeHg-cysteine which uses the methionine transporter

EtHg

Ethyl mercury, in the form of the antibacterial preservative thimerosal, has been the reason for much of the controversy over vaccines, although most of it has now been removed from most of the vaccines given to infants. It was once thought to be safe, because the mercury levels found in blood after thimerosal exposure would clear rapidly. But now we know that it clears rapidly not because it's excreted, but because it's quickly deposited in all body tissues.

Ethyl Mercury

- Synthetic form, in thimerosal (EtHg salicylate)
- Used as an antimicrobial preservative in vaccines
- 100% absorbable, crosses BBB rapidly
- Rapidly cleared from the blood as it deposits in body tissues

Toxicity of Mercury

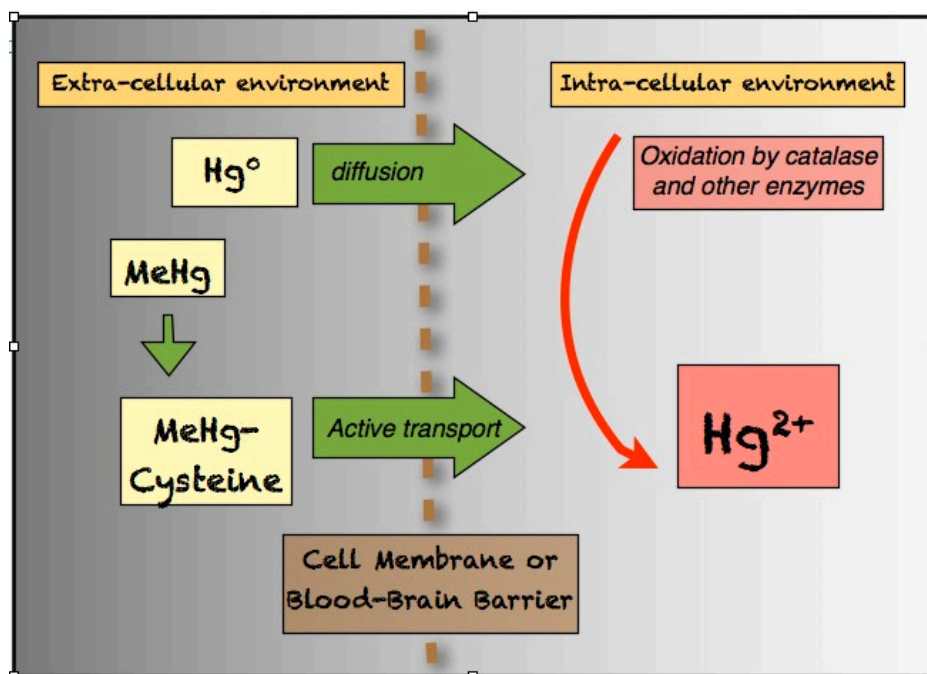
Mercury has been called the most toxic non-radioactive element in nature. Toxicology and toxic risk assessment science have never found a safe level of exposure, no threshold below which mercury is not harmful.

The toxicity of Mercury is far reaching inside our cells, in our retention of its toxicity, our overall health, including a daunting array of symptoms, and its effects on mothers and children.

Inside the Cell

Once inside the cell, both metallic and organic mercury will be oxidized by catalase and other common enzymes to the inorganic mercuric form, mercury 2+, the final toxic species.

Inorganic mercury, in the form of charged ions, does not pass through cell membranes, and gets stuck inside the cell. Once that happens, it can only be eliminated by the active processes of cellular excretion.



Retention Toxicity

It's impossible to say how long mercury stays in the body after exposure, because each tissue responds differently. The half-life of elimination varies from tissue to tissue.

Again, it depends upon the chemical species of mercury, the route of exposure and the time course of exposure. An acute exposure, like a meal of high mercury swordfish, will create an elevated blood mercury level that dissipates within days to weeks.

Acute exposure in blood, $T_{1/2} = 30$ days

Long term low level exposure, like that created by a daily occupational exposure, or by the presence of amalgam fillings in the mouth, leads to a slow accumulation of mercury in all tissues of the body, including the kidneys, brain, endocrine glands, and the digestive tract. Mercury is a "bio-accumulative" toxin.

Chronic exposure to brain, $T_{1/2} = 30$ years

An individual person's susceptibility to mercury toxicity depends on the many complex biochemical factors determining his or her ability to excrete the toxic element. As the tissue levels slowly go up, unpredictable toxic thresholds can be reached and toxic reactions begin to occur. This is what we mean by the concept of retention toxicity.

Overall Health

With its strong affinity for sulfur, mercury tends to bind to the sulfur amino acids that form the active sites of enzymes, making those enzymes inactive and non-functional. This has consequences at the level of overall health. When mercury binds to an enzyme, the enzyme no longer functions.

99% of enzymes have sulfur groups at the active site

For example, mercury is known to bind to the energy producing enzymes of the electron transport chain inside mitochondria, and degrade a cell's ability to produce ATP. This can happen all over the body – affecting the muscles, the nervous system, the oxygen carrying capacity of the blood. This is why one of the best-known symptoms of mercury toxicity is fatigue.

Another prominent group of enzymes inactivated by mercury is the complex responsible for cellular excretion, the phase II conjugation enzymes. The result is that mercury poisons the cell's, and the body's, ability to excrete mercury. Mercury creates its own retention by inactivating excretory enzymes.

Array of Symptoms

The material safety data sheets for any materials containing mercury, including dental amalgam, list a daunting array of symptoms that have been associated with mercury toxicity.

toxic severity: mercury > cadmium > arsenic > thallium > lead

Citation: Sharma, J Comp Pathology 1981

From the Micromedex® Poisindex Management for Elemental Mercury

(Micromedex® Poisindex Managements are the basic reference source used by poison control centers)

Chronic mercury poisoning (mercurialism) usually results from inhalation of elemental mercury vapor or particles. Evidence of chronic poisoning may occur within weeks of an extreme acute exposure or may develop insidiously over many years.



Chronic Inhalation

Chronic inhalation leads to the classic triad of:

- Neuropsychiatric disturbances (e.g., personality changes, hallucinations, delirium, insomnia, irritability, fatigue, memory loss, erethism)
- Tremor (fine intention tremor of fingers that progresses to choreiform movements of limbs)
- Gingivostomatitis-teeth may become loose due to gum inflammation

Neurological Effects

Neurological effects are chiefly associated with chronic elemental mercury exposure. Effects include personality changes, tremors, headache, short term memory loss, decreased appetite, shyness, insomnia, emotional instability, paresthesias, sensory and motor nerve conduction delays, seizures, and weakness.

Psychiatric Effects

Psychiatric effects chiefly occur with chronic mercury exposure. Effects include insomnia, emotional instability, shyness, depression, anger, irritability, aggressiveness, nervousness, loss of self-confidence and/or impatience.

Renal Dysfunction

Renal dysfunction has been reported.

Effects on Mothers and Children

Maternal mercury exposure impacts the fetus. Both the Environmental Protection Agency and National Academy of Science state that between 8 and 10% of American women have mercury levels that would render any child they gave birth to at risk for neurological disorders. It is estimated that more than 300,000 newborns each year may have increased risk of learning disabilities associated with in-utero exposure to mercury. Mercury impairs neurological development.

Mercury is implicated in autism, ADHD, learning disabilities

Discussions of this widespread concern about mercury in pregnant women center mostly around methyl mercury exposure from fish. What they leave out is the fact that the presence of mercury dental fillings in the mother's mouth correlates strongly with the levels of mercury in fetal tissue, cord blood, and breast milk.

the number of fillings correlates with mercury levels in maternal and fetal tissues

Citation: US HHS website, US EPA 2004

From the IAOMT Position Statement

Chronic mercury exposure is implicated in the genesis of many diseases. (Please see the [Position Statement](#) for the complete list of references. See also the Stock 1926 article [The Dangerousness of Mercury Vapor](#)):

- Allergies, especially allergy to mercury
- Alzheimer's disease
- Amyotrophic Lateral Sclerosis (Lou Gehrig's disease)
- Antibiotic resistance
- Autism Spectrum Disorders
- Autoimmune disorders/Immunodeficiency
- Cardiovascular problems
- Chronic Fatigue Syndrome
- Complaints of unclear causation
- Hearing loss
- Kidney disease
- Micromercurialism
- Multiple sclerosis
- Oral lichenoid reaction and oral lichen planus
- Parkinson's disease
- Periodontal disease
- Reproductive dysfunction

