INTRODUCTION

Mercury (Latin: *hydrargyrum*, Hg, meaning water and silver) is an element with the melting point -38.83 °C and boiling point 356.73 °C.¹ Mercury has a narrow range of its liquid state among metals,³ and its atomic number is 80.² This element is naturally found in the earth’s crust around 80 μg/Kg. It has been distributed throughout the environment by natural processes such as volcanic activity, fires, movement of rivers, lakes, oceanic up-welling and biological processes.⁵ Most of the mercury production nowadays takes place in Spain, Kyrgyzstan, China and Tajikistan.⁶ Mercury is extracted from ore cinnabar (occurring in red crystals or masses) which is mercury sulphide and mainly found in rocks that are associated with volcanic activity. Generally mercury is released by heating the ore which causes sulphur to react with oxygen and is lost as sulphur dioxide gas leaving behind the metallic mercury.⁷

\[
\text{HgS} + \text{O}_2 \rightarrow \text{Hg} + \text{SO}_2
\]

Mercury is a naturally occurring element that may exist in elemental, inorganic or organic forms in various oxidation states.⁸ When it has a zero oxidation means Hg⁰ exists as vapours or as liquid metal state, mercurous state is a state where Hg²⁺ exists as an inorganic salt whereas mercuric state Hg³⁺ may form either inorganic salts or organo-mercury compounds.⁹

**Table-1: Types of mercury and their sources of exposure**¹⁰

<table>
<thead>
<tr>
<th>Type of Mercury</th>
<th>Source of exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elemental</td>
<td>Dental amalgam, alkaline batteries, barometer, chloralkali plant, jewellery making, neon light, paint, paper, sphygmomanometer, thermometer, weighed nasogastric tube, accidental spillage of mercury containing devices, latex paint</td>
</tr>
<tr>
<td>Inorganic</td>
<td>Antiseptics, bleaching creams, calomel teething powders, diuretics, felt hat industry, laxatives, stool fixatives</td>
</tr>
<tr>
<td>Organic</td>
<td>Food fish, fungicides, insecticides, grains and seeds, treated liver stock feeding on treated grains, processed woods, plastics, paper, vaccines containing thimerosal</td>
</tr>
</tbody>
</table>

**Inorganic mercury compound:** This form of mercury has been used topically in a variety of therapeutics.¹¹ These compounds have been used for many years in different numerous products, including various medications, germicidal soaps, teething powders and skin creams, and many of these products are still in use.¹² Calomel or mercurous chloride has traditionally been used as a diuretic, topical disinfectant and laxatives.¹³ It is also known as sweet mercury and was used in infant teething powders as well as an analgesic.¹⁴ Mercuric chloride also acts as a corrosive sublimate for treatment of syphilis¹⁵ whereas mercuric oxide or ammoniated mercury can be used in the treatment of psoriasis.¹⁶ Inorganic mercury creams and ointments have been used for centuries as antiseptics and to treat impetigo, lice and some inflammatory skin diseases. Some manufactures have advertised them as skin lighteners¹⁷ but the women of childbearing age who use mercury based skin lighteners may place their unborn foetus at risk for neurological, nephrological and dermatological disorders.¹⁸ Some of the mercury based skin whiteners contain mercury salts which may inhibit the melanin formation by competing with copper in tyrosinase.¹⁹ Inorganic mercurial preparations may induces fatigue, insomnia, weight loss, paresthesias of the feet and hands, erythema, pruritus, excessive perspiration and hypersalivation, progressive weakness in the extremities, renal tubular dysfunction and neuropsychiatric disorders.²⁰

**Organic Mercury Compound:** Thimerosal is an organic mercury containing compound that is 49.55% mercury by weight, and initially metabolised to ethylmercury compounds and thiosalicylate.²¹ Thimerosal is an antibacterial and antifungal agent, has been used as antiseptic and preservative in different formulations including paints, topical medications, contact lens, cleaners and cosmetics since the 1930s.²² Ethyl mercury in the form of thimerosal has been used as a topical antiseptic for children, including diphtheria
mercury release from dental amalgam restorations are occupational exposure to humans are shown in Table 2. Different studies have shown that the mercury amalgam fillings release anywhere from 1–29 µg/day; 3 times the limit. The rates of mercury release from dental amalgam restorations are dependent upon several factors including the number of amalgam restorations in the mouth, the composition of dental amalgam (high vs low copper dental amalgam), the location of the amalgam restoration also play an important role (occlusal vs non-occlusal teeth), including the amalgam surface area. Some scientists agree that dental amalgam fillings leach out the mercury into the mouth and according to FDA studies showed that this may be as low as 1–3 µg/day or as high as 27 µg/day. The safety limits for fish and seafood are 2.3 µg/day and the other foods are 0.3 µg/day whereas air or water values are negligible respectively.

Mercury toxicity has been a cause of concern for the researchers and the health safety organisations for many years. It is said that mercury toxicity from different exposure may cause some serious illnesses and may be responsible to effect on the different organ of a body. Toxic dose and effects on a different organ of a body are shown in Table-3.

### Table-2: Daily intake and retention (µg/day) of various types of mercury

<table>
<thead>
<tr>
<th>Source of exposure</th>
<th>Daily intake and retention (µg/day) of various types of mercury</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Elemental</td>
</tr>
<tr>
<td>Air</td>
<td>0.04–0.2</td>
</tr>
<tr>
<td>Dental amalgam</td>
<td>2.2–27 (1–21.6)</td>
</tr>
<tr>
<td>Food-Fish (100 g/week containing 0.2 mg Hg/Kg)</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
</tr>
<tr>
<td>Drinking Water</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>1.2–27 (1–22)</td>
</tr>
</tbody>
</table>

### Table-3: Effect of different types of mercury on human organs

<table>
<thead>
<tr>
<th>Human organ system</th>
<th>Toxic dose of different types of mercury</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Elemental</td>
</tr>
<tr>
<td>Neuromuscular and neurological</td>
<td>40–60 µg/L urine (Acute)</td>
</tr>
<tr>
<td>Kidney</td>
<td>&gt;5–10 µg/g creatinine urine (chronic)</td>
</tr>
<tr>
<td>Thyroid</td>
<td>15–30 µg/g creatinine urine (chronic)</td>
</tr>
</tbody>
</table>

The liquid form of mercury is not to be easily absorbed whereas the vapours can be metabolised. The symptoms may depend on the exposure of mercury poisoning whether is acute or chronic. Acute toxic effects are generally anticipated at levels of 50 µg Hg/L blood or 100 µg Hg/L urine, compared with normal (no effect) levels of up to 10 µg Hg/L blood or 10 µg Hg/L urine in humans. Acute toxicity may affect the different systems including the kidneys, GI tract, lungs, nervous and immune systems. Chronic exposure of humans to elemental or inorganic mercury, such as might be experienced in some occupational situations,
has been shown to result in persistent damage to the central nervous system and a wide range of effects including progressive anaemia, gastric disturbance, excessive salivation, metallic taste in the mouth and tenderness of the gums. The nervous system is known to be the most sensitive target organ and produced the neurological problems (such as tremor, insomnia, polyneuropathy, paresthesia, emotional ability, irritability, personality changes, headache, weakness, blurred vision, dysarthria, speech impairment, slowed mental response and unsteady gait) have been reported in adults. Pre- or postnatal exposure to high levels of MeHg may cause mental retardation, cerebral palsy, and seizures. Kidneys are particularly susceptible to mercury salts resulting in different pathological changes such as acute tubular necrosis and immunologic glomerulonephritis; this may also be responsible to cause arrhythmias and cardiomyopathy.

Quantitative data on different mercury concentrations in blood, urine and elemental mercury inhalation exposure, have already been established and including the early effects of mercury toxicity. The non-specific symptoms of micromercurialism are observed on long term exposures to elemental mercury, air concentrations of 50 µg/m³, or at 35 µg/L in blood, or 150 µg/L in urine. Overt neurotoxicity (tremor) occurs after long term inhalation of elemental mercury at concentrations 100–200 µg/m³ with resulting blood mercury concentrations of 70–140 µg/L and urinary mercury in the range of 300–600 µg/L. Different analysis methods are using to measure the mercury levels in the biological samples but the cold vapour atomic absorption spectrometric (CVAAS) analysis is the most common method used to measure mercury levels.

Mercury compounds tend to be much more toxic than the elemental mercury itself, and the organic compounds of mercury are often extremely toxic and may be responsible in causing brain and liver damage. The most dangerous mercury compound is dimethylmercury. Dimethylmercury is a volatile liquid organic mercury compound, and is used by a small number of chemistry laboratories as a reference materials, such as nuclear magnetic resonance spectroscopy. The lethal dose of dimethylmercury is approximately 400 mg of mercury (equivalent to a few drops, or about 5 mg/Kg of body weight) and is supertoxic. Since it is a highly toxic compound so the precautions should be taken in handling this compound because even a few µL spilled on the skin, or even a latex glove, can cause death. The acute lethal dose of mercuric chloride is approximately 1–4 g and the fatal dose in humans is approximately 100 mg organic mercury or 1 g mercury salt. Liquid metallic mercury is poorly absorbed from gastrointestinal tract and acute ingestion has been associated with poisoning only in the presence of normal gut mobility that markedly delays normal faecal elimination or after peritoneal contamination. The symptom of respiratory distress may be produced at 1.1–44 mg/m³ (equivalent urine levels of 169–520 µg/L), but the potential lethal dose of elemental mercury is well tolerated orally up to 240 g.

There are different organizations which are concerned with health effects and toxicity or allergy associated with exposure to mercury. They follow up the exposure and consumption according to standard limits to make sure not to exceed the safety limits. No such organizations are available in Pakistan. There is need to amend law for the safety and control.

REFERENCES