

# THE TOXIC EFFECTS OF THE MERCURY IN DENTAL AMALGAM FILLINGS ON THE ENVIRONMENT AND HUMAN HEALTH

A FACT SHEET PREPARED BY

The International Academy of Oral Medicine and Toxicology

[www.iaomt.org](http://www.iaomt.org)

*“For medical reasons, amalgam should be eliminated in dental care as soon as possible. As a result, one of our largest sources of mercury in the environment can be eliminated.”<sup>1</sup>*

*--Dr. Maths Berlin, the Dental Material Commission of Sweden, 2003*

## **About IAOMT**

Representing a network of dental, medical, and research professionals with members in North America and affiliated chapters in over fourteen other countries, the International Academy of Oral Medicine and Toxicology (IAOMT) has been researching the damage dental mercury inflicts on the environment and humans since the non-profit organization was created in 1984.

## **Brief Overview of Mercury Used in Dentistry**

Millions of dentists around the world routinely use dental amalgam as a filling material to repair decayed teeth. Often referred to as “silver” fillings, amalgam fillings actually consist of 45-55% metallic mercury.<sup>2</sup>

According to the United States Environmental Protection Agency (EPA), there are currently over 1,000 tons of mercury in the mouths of Americans, which is more than half of all the mercury being used in the U.S. today.<sup>3</sup> Also according to the EPA, dentistry accounts for 14% of the U.S. domestic usage of mercury annually.<sup>4</sup>

Controversy has surrounded the use of mercury in dentistry since the 1800’s, when the neurotoxin was first widely introduced as a filling material. The American Society of Dental Surgeons, the predecessor to the American Dental Association, made its members pledge not to use mercury because of its known toxicity,<sup>5</sup> and in more recent years, government officials, scientists, dentists, consumers, and many others have raised serious concerns about the threats dental mercury poses to humans and to the environment at large.

Today, authorities including the United Nations Environmental Programme (UNEP), the United States Food and Drug Administration (FDA), and the European Commission (EC) are actively assessing health risks associated with dental amalgam.<sup>6 7 8</sup>

However, the governments of Norway, Sweden, and Denmark have already banned the use of mercury fillings in dentistry,<sup>9</sup> Germany and Canada have limited their use for pregnant women,<sup>10 11</sup> and France, Finland, and Austria have recommended that alternative dental materials be used for pregnant women.<sup>12</sup>

Meanwhile, scientific studies continue to demonstrate the harm that mercury in dentistry inflicts upon each one of us and our environment.

## **Dental Amalgam Pollutes the Environment in a Variety of Ways:**

*A 2002 report from the New York Academy of Sciences found that 40-60% of the mercury in New York/New Jersey harbor is a result of discharges from dental offices.<sup>13</sup>*

### **1) Wastewater from Dental Offices**

According to the EPA, dental offices were found to have been the source of 50% of all mercury pollution entering publically-owned treatment works in 2003.<sup>14</sup>

Studies in the United States, Canada, and other countries have also shown that dental offices play a significant role in causing mercury to enter the environment.<sup>15</sup> In the United States, the dental industry is the third largest user of mercury, accounting for over 45 tons of mercury per year,<sup>16</sup> and the discharge per dentist ranges from 270 to 484 milligrams per day.<sup>17 18</sup>

Because wastewater treatment facilities are designed to process human waste, not heavy metals, the mercury from dental discharges is separated out into sludge, or biosolids.<sup>19</sup> These biosolids are usually incinerated or used as fertilizer, with the mercury content again being directly emitted into the environment.<sup>20</sup>

*"If the average fecal excretion was applied to the entire Swedish population, a total emission of 150 kg/yr (330 lb/year) can be estimated.*

*This is roughly comparable to the yearly mercury leakage from a modern chloralkali plant."<sup>21</sup>*

*--Skare and Enqvist, 1992*

### **2) Human Waste**

Research has shown that the average person with amalgam excretes approximately .1 mg of mercury per day in his/her feces.<sup>22</sup> In the United States, this amounts to over eight tons of mercury per year eventually being flushed out to sewers, streams, and lakes.<sup>23</sup>

*"In Sweden, scientists have estimated that as much as 620 pounds of dental amalgam mercury are released into the atmosphere each year from cremation."<sup>24</sup>*

*--The Institute of Environmental Medicine, Sweden, 1992*

### **3) Cremation**

Cremation of bodies with amalgam fillings adds to air emissions and deposition onto land and waterways. A Swiss study confirmed that cremation released over 65 kilograms of mercury per year as emissions, often exceeding site air mercury standards.<sup>25</sup> In 1991, cremation of 320,372 bodies added an estimated 2,800 pounds of mercury into the atmosphere in the United States.<sup>26</sup>

*"Hg vapor release to the atmosphere from dental vacuums can be substantial and can exceed human exposure levels."<sup>27</sup>*

*--Stone, Cohen, and Debban, Naval Institute for Dental and Biomedical Research, 2007*

### **4) Mercury Vapor**

In offices with air/water separator tanks as part of the central vacuum system, mercury vapor has been found in air vented to the outside of the dental office.<sup>28 29</sup> Dr. Paul G. Rubin of IAOMT explains, "[M]ercury-containing material is discharged into waste streams via the dental office vacuum-pump system. This system also discharges large quantities of air, either into the atmosphere exterior to the office building or into the sewer system, depending on the type of equipment used."<sup>30</sup>

Furthermore, mercury vapor is continuously emitted from amalgam fillings,<sup>31</sup> which means that people are directly exposed to the mercury in their mouths. The output of mercury vapor can be intensified by the number of fillings present and other activities associated with the human mouth, such as

chewing, teeth-grinding, and the consumption of hot liquids.<sup>32 33</sup>

**Dental Amalgam Harms Humans in a Variety of Ways:**

*“There is really no place for mercury in children.”<sup>34</sup>*

*--Dr. Suresh Kotagal, FDA Dental Products Panel, December 2010*

**1) Pregnant Women and Children**

International legislation has already warned of the clear and present danger that the mercury in dental amalgam fillings poses to pregnant women and children: as stated earlier in this document, the governments of Norway, Sweden, and Denmark have banned the use of mercury fillings in dentistry,<sup>35</sup> while Germany and Canada have limited their use for pregnant women,<sup>36 37</sup> and France, Finland, and Austria have recommended that alternative dental materials be used for pregnant women.<sup>38</sup>

Additionally, 19 members of the United States Congress wrote a letter to the FDA in 2009 to express their concern about mercury used in amalgam fillings, with a focus on potential dangers to pregnant women and children,<sup>39</sup> and when Representative Diane Watson of California introduced the *Mercury Filling Disclosure and Prohibition Act* (H.R. 2101), she explained, “It is, in fact, children who are at greatest risk from these fillings.”<sup>40</sup>

Scientific studies proving the devastating impact of mercury on pregnant woman and children are abundant, which is why pregnant women and children are advised not to eat certain types of seafood that might contain methylmercury.<sup>41 42 43</sup>

The dangers of fetal and infant exposure to mercury via maternal dental amalgam have likewise been scientifically established.<sup>44 45 46 47 48 49 50 51 52 53 54 55</sup>

Although two studies (commonly referred to as the “New England Children’s Amalgam Trial”<sup>56</sup> and the “Casa Pia Children’s Amalgam Trial”<sup>57</sup>) have repeatedly been referenced to defend the use of amalgam in children, researchers and commentators have demonstrated that these studies failed to take essential factors such as long-term effects, genetic predisposition, detection of smaller effects, and measurement errors into account.<sup>58 59 60 61 62 63 64</sup>

Furthermore, the most up-to-date science continues to expose the havoc that the mercury in dental amalgam fillings wreaks upon pregnant women and children. A study published in the April 2011 edition of *Environmental Monitoring and Assessment* notes, “As we showed, the number of amalgam filled teeth in breast-feeding mothers strongly influences the mercury level in their milk. Take it into consideration that maternal milk is the only source of nutrition during the first few months after birth.”<sup>65</sup> Another recent study published in *Science of the Total Environment* cautions, “Changes in dental practices involving amalgam, especially for children, are highly recommended in order to avoid unnecessary exposure to Hg.”<sup>66</sup>

Meanwhile, mercury has been found to be a factor in autism,<sup>67 68 69 70 71 72 73 74 75 76</sup> and as such dental amalgam fillings (maternal) have been directly linked to autism as well.<sup>77 78 79 80 81</sup>

*“Dental amalgam fillings are the primary source of mercury exposure for the general population (Skare, 1995; Health Canada, 1997).”<sup>82</sup>*

*--Cited in paper published under the joint sponsorship of the United Nations Environment Programme, the International Labour Organization, and the World Health Organization*

**2) The General Population**

An extensive number of international research studies thoroughly document the human health risks

associated with the use of dental amalgam. Scientific data from reputable scientists all over the world has investigated how the mercury in amalgam fillings can relate to dysfunction of the immune system,<sup>83 84 85 86 87 88 89 90</sup> multiple sclerosis,<sup>91 92 93 94 95 96</sup> kidney ailments,<sup>97 98 99 100 101</sup> chronic fatigue syndrome,<sup>102 103 104 105</sup> allergies,<sup>106 107 108 109</sup> reproductive issues,<sup>110 111 112</sup> cardiovascular problems,<sup>113 114</sup> absorption of heavy metals in the brain,<sup>115 116</sup> Lou Gehrig's disease,<sup>117 118</sup> Alzheimer's disease,<sup>119 120</sup> antibiotic resistance,<sup>121 122</sup> hearing loss,<sup>123</sup> and a myriad of other health problems.<sup>124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139</sup>

*“Provide pre-placement and periodic medical exams for those regularly exposed to mercury with emphasis directed to CNS-central nervous system, skin, lungs, liver, kidneys, and G.I. tract.”<sup>140</sup>*

*--Material Safety Data Sheet (MSDS), Safe Handling and Use Section,  
provided with dental amalgam product by Original D Wykle*

### **3) Dentists and Dental Personnel**

Dentists and their staffs are occupationally exposed to constant levels of mercury released from dental amalgam on a routine basis, and thus, researchers have also raised concerns about the safety of dental personnel who work with amalgam.<sup>141 142 143 144 145 146 147 148 149 150 151 152 153 154 155</sup>

*“...we urge you to consider the many ill effects of mercury amalgam...  
Even though dental amalgam is the predominant source of human exposure to mercury,  
it is not regulated by the FDA.”<sup>156</sup>*

*--Letter to the FDA from 19 Members of Congress, 2009*

### **4) Additional Considerations about Dental Amalgam and Human Health**

#### Reference Exposure Levels

After Health Canada was sued by a group of consumer activists over safety of medical devices, they hired Dr. G. Mark Richardson to make recommendations about dental amalgam. Dr. Richardson presented a chart summarizing seventeen separate estimates of mercury exposure due to amalgam in adults. If the US Agency for Toxic Substances and Disease Registry (ATSDR) minimal risk level (MRL) for non-occupational exposure of  $.014 \mu\text{g Hg}^0/\text{m}^3$  in air standard is used, even one amalgam filling would expose the individual to more mercury than would be allowed by Dr. Richardson's proposed tolerable daily intake.<sup>157</sup>

In new research published this year, Dr. Richardson reports that more than 67 million Americans aged 2 years and older exceed the intake of mercury vapor considered “safe” by the U.S. EPA due to the presence of dental amalgam fillings, whereas over 122 million Americans exceed the intake of mercury vapor considered “safe” by the California EPA due to their amalgam fillings.<sup>158</sup>

#### Methylization of Mercury in the Human Body

Research has also already begun to explore how the mercury in amalgam and its vapor can be altered into methylmercury (commonly accepted to be the most toxic form of mercury) within the human body. Bacteria in soil and water can convert mercury into methylmercury, a form of the element sometimes consumed by fish and shellfish,<sup>159</sup> and as noted above, pregnant women and children are advised not to eat seafood that might contain methylmercury.<sup>160 161 162</sup>

Several studies have documented the ability of metallic mercury rooted in the human system (such as that from amalgam fillings) to be transformed into methylmercury in the mouth<sup>163 164 165</sup> and by specific strains of yeast and bacteria that dwell in the gut,<sup>166 167 168</sup> thus revealing that the problem already addressed in maritime environments is one which even more intimately impacts human health.

### Genetic Predisposition

The issue of genetic predisposition to mercury poisoning has also been noted in several studies.<sup>169</sup>  
170 171 172 173 174 175 One study specifies that roughly 25% of the U.S. population is polymorphic for a specific genotype associated with sensitivity to mercury toxicity,<sup>176</sup> which amounts to 78 million Americans today.

### Mercury allergies

In 1972, the North American Contact Dermatitis Group determined that 5 - 8% of the U.S. population demonstrates allergy to mercury by skin patch testing,<sup>177</sup> which would amount to approximately 21 million Americans today. Since dentists do not test their patients for mercury allergies prior to using amalgam, this would mean that millions of Americans are unknowingly allergic to the fillings in their mouths.

Other scientific research offers even more startling results. In one study, 180 subjects with amalgam fillings were patch tested, and 16.1% of those without allergic disease and 22.5% of those with allergic disease tested positive for mercury allergy. Of sixty subjects without amalgam fillings, none tested positive for mercury allergy.<sup>178</sup> In another study of 29 patients with oral lichen planus, 62% were positive for mercury allergy.<sup>179</sup> And at Baylor College of Dentistry, of 171 dental students patch tested, 32% were positive for mercury allergy. The percentage of positive tests correlated with the students' own amalgam scores and with the length of time they had been in dental school.<sup>180</sup>

### Co-existing Factors

Finally, it should be noted that mercury influences each individual differently based on a wide-range of co-existing factors. Thoughtful research has explored how the number of amalgam fillings in the mouth,<sup>181 182 183 184 185 186 187 188 189</sup> various routes of exposure from mercury fillings,<sup>190 191 192</sup> gender,<sup>193 194</sup> plaque,<sup>195</sup> consumption of selenium,<sup>196</sup> milk,<sup>197 198 199</sup> or alcohol,<sup>200 201 202</sup> and other circumstances<sup>203 204 205 206</sup> can play a role in each person's unique reaction to mercury.

*"Dental treatment without mercury is becoming the norm."<sup>207</sup>*

*--Carsten Lassen and Jakob Maag, Nordic Council of Ministers, INC1, June 2010*

### **Suggested Solutions to Mercury Risks Caused by Dental Amalgam**

Since some countries have successfully eliminated dental mercury, banning mercury from dentistry has already proven to be both feasible and economical.<sup>208</sup>

Various considerations should be part of any effort to end the use of mercury in dental amalgam:

#### **1) Amalgam Separators**

Amalgam separators can successfully reduce the amount of mercury discharge in wastewater from dental offices<sup>209 210</sup> and are essential in stopping mercury from entering the environment. However, it would be helpful to enforce maintenance requirements for amalgam separators, as the Royal College of Dental Surgeons has done in Ontario, Canada.<sup>211</sup> It should also be remembered that amalgam separators only contribute to solving the problem of dental mercury in wastewater and not the additional burdens placed by amalgam fillings on the environment and human health.

#### **2) Alternatives to Amalgam as a Filling Material**

Many consumers choose composite fillings because the coloring matches the tooth better, and the American Dental Association (ADA) explains that the cost for a composite filling is moderate.<sup>212</sup> The ADA also offers ionomers, indirect restorative dental materials, all porcelain (ceramic) dental materials, gold alloys, and indirect composites, among other alternatives to amalgam.<sup>213</sup>

Although a poll showed that just less than half of dentists are using amalgam in the U.S. today,<sup>214</sup> a recent survey published in the *Journal of the American Dental Association* offers statistics demonstrating that mercury fillings are still being used routinely on ethnic minority groups, including 53.4% of Black/African Americans and 72.9% of American Indians/Alaska Natives/Asians/Pacific Islanders.<sup>215</sup>

Additionally, a study about new recruits to the U.S. Navy and Marines, also published in the *Journal of the American Dental Association*, notes that while the use of resin composite among dentists is increasing, “Our data show that dental amalgam remains the predominant material in use, accounting for more than 75 percent of all posterior restorations among new recruits.”<sup>216</sup>

### **3) Safe Removal of Existing Amalgam Fillings**

Unsafe removal of amalgam fillings can cause more mercury-related health problems to patients because mercury vapor is released in greater quantities as a result of drilling. IAOMT funds and studies international research about the safety of dental materials and has created a safe protocol for taking mercury fillings out of patients’ mouths.<sup>217</sup>

### **4) Educating Dentists**

While some dentists have already stopped using amalgam, others will require training in mercury-free dentistry. Since Norway, Sweden, and Denmark have banned dental mercury, their dental schools shed light upon how to make a transition away from amalgam.

### **5) Economic Perspective**

In a report entitled “The Economics of Dental Amalgam Regulation,” the authors note that amalgam use is already declining and that restrictions on mercury are inevitable.<sup>218</sup> The authors conclude, “We can then make the case that the overall health care expenditures necessary to deal with diseases and conditions, known or unknown, arising from the continued installation of amalgam could far exceed the relatively manageable cost increases to the consumer for the alternatives... This is not to mention the cost to the U.S. economy of lost work time owing to concomitant illness and disability.”<sup>219</sup>

...

An international timeline to ban dental mercury would save people and the environment, while also fostering a cooperative global effort.

*"Mercury is among the most dangerous environmental toxins.  
Satisfactory alternatives to mercury in products are available,  
and it is therefore fitting to introduce a ban."*<sup>220</sup>

*--Erik Solheim, Norway's Minister of Environment and Development, 2007*

<sup>1</sup> Dr. Maths Berlin. "Mercury in Dental Materials—an updated risk analysis in environmental medical terms." *An Overview of Scientific Literature published in 1997 to 2002*. (The Dental Material Commission, Sweden).

<sup>2</sup> World Health Organization. *Mercury in Health Care*. (Geneva, Switzerland: policy paper, August 2005), 1. [http://www.who.int/water\\_sanitation\\_health/medicalwaste/mercurypolpaper.pdf](http://www.who.int/water_sanitation_health/medicalwaste/mercurypolpaper.pdf)

<sup>3</sup> United States Environmental Protection Agency. *International Mercury Market Study and the Role and Impact of US Environmental Policy*. 2004.

<sup>4</sup> *Ibid.*

<sup>5</sup> Health Canada. *The Safety of Dental Amalgam*. 1996. [http://www.hc-sc.gc.ca/dhp-mps/alt\\_formats/hpfb-dgpsa/pdf/md-im/dent\\_amalgam-eng.pdf](http://www.hc-sc.gc.ca/dhp-mps/alt_formats/hpfb-dgpsa/pdf/md-im/dent_amalgam-eng.pdf)

<sup>6</sup> United Nations Environmental Programme. *Reducing the Risk from Mercury*. <http://www.unep.org/hazardoussubstances/Mercury/tabid/434/language/en-US/Default.aspx>

<sup>7</sup> United States Food and Drug Administration. *2010 Meeting of the Dental Products Panel*. December 14-15, 2010. <http://www.fda.gov/AdvisoryCommittees/CommitteesMeetingMaterials/MedicalDevices/MedicalDevicesAdvisoryCommittee/DentalProductsPanel/ucm235085>

<sup>8</sup> European Commission. *Dental Amalgams 9: What further information is needed on the environmental risks of dental amalgam?* Europa DG Health and Consumer Protection. <http://ec.europa.eu/health/opinions/en/dental-amalgam/l-2/9-research-needed.htm#0>

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<sup>11</sup> Health Canada. *The Safety of Dental Amalgam*. 1996. [http://www.hc-sc.gc.ca/dhp-mps/alt\\_formats/hpfb-dgpsa/pdf/md-im/dent\\_amalgam-eng.pdf](http://www.hc-sc.gc.ca/dhp-mps/alt_formats/hpfb-dgpsa/pdf/md-im/dent_amalgam-eng.pdf)

<sup>12</sup> Health and Environment Alliance. *Mercury and Dental Amalgams*. (Brussels, Belgium: fact sheet, May 2007): 3. [http://www.env-health.org/IMG/pdf/HEA\\_009-07.pdf](http://www.env-health.org/IMG/pdf/HEA_009-07.pdf)

<sup>13</sup> New York Academy of Sciences. *Pollution Prevention and Management Strategies for Mercury in the NY/NJ Harbor*. June 2002. <http://www.nyas.org/Publications/Annals/Detail.aspx?cid=8454dd76-8998-4ee7-b7a2-5a97f68c790c>

<sup>14</sup> United States Environmental Protection Agency. *Mercury in Dental Amalgam*. August 5, 2011. <http://www.epa.gov/mercury/dentalamalgam.html>

<sup>15</sup> Arenholt-Bindslev, D., et al., *Mercury Levels and Discharge in Waste Water from Dental Clinics*, *Water Air Soil Pollution*, 86(1-4):93-9 (1996); AMSA, *Evaluation of Domestic Sources of Mercury* (Aug 2000); Metropolitan Council Environmental Services (MCES), *Controlling Dental Facility Discharges in Wastewater*, Twin Cities, Minnesota (1999); [www.pca.state.mn.us/publications/mercury-va-mces.pdf](http://www.pca.state.mn.us/publications/mercury-va-mces.pdf) ; Stone ME, et al., "Determination of methylmercury in dental-unit wastewater," *Dent Mater.*, 2003, 19(7):675-679; AMSA/U.S. EPA, *Mercury Source Control Program Evaluation*, Larry Walker Associates, Final Report (March 2002); *Dentist the Menace: The Uncontrolled Release of Dental Mercury in the Environment*, Mercury Policy Project and Healthcare Without Harm (June 2002). [www.mercurypolicy.org/new/documents/DentistTheMenace.pdf](http://www.mercurypolicy.org/new/documents/DentistTheMenace.pdf); Sustainable Hospitals Program, S.M. Jasindki, U.S. Bureau of Mines, *The Materials Flow of Mercury in the U.S.*, Information Circular; 9412 (1994); United Nations Environment Program, *Global Mercury Assessment-Appendix: Overview of Existing and Future National Actions*, April 25 2002 Draft; al-Shraideh, M., al-Wahadni, A., *The mercury burden in waste water released from dental clinics in Jordan*; *SADJ*, 57(6):213-5 (June 2002).

<sup>16</sup> *Ibid.*

<sup>17</sup> Arenholdt-Bindslev, D., Larsen, A.H. "Mercury Levels and Discharge in Waste Water from Dental Clinics." *Water, Air, Soil, Pollution*, 86(1-4):93-9, 1996. Abstract available at <http://www.springerlink.com/content/pp65v404t276p450/>

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