

Dental Amalgam: Public Health and the Environment
ISSUE SUMMARY
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Current scientific research and major national and international health organizations support the use of dental amalgam as a safe and effective restorative material for dental patients. Long-term studies also demonstrate that amalgam can be safely handled by dentists and other dental health care workers in occupational settings. Available studies on amalgam's environmental impacts, primarily those impacts associated with dental office wastewater discharges, indicate no likely potential for any significant environmental harm, but definitive studies are not available. Environmental agencies, however, continue to press all industries to reduce or eliminate mercury discharges.

Dental amalgam has been the subject of attention by regulators because it contains elemental mercury as a major component, and mercury in certain forms has toxic properties. The mercury in amalgam, however, is contained within a very stable, durable alloy with other metals (silver, copper, tin, zinc, and others) and so is not available for release into the body or the environment in any significant amounts. In addition, the mercury in dental amalgam is elemental mercury, the least potentially harmful of all forms of mercury. Mercury is ubiquitous in the environment and it cannot be destroyed. One of the most harmful forms of mercury is methyl mercury, the form typically found in fish.

Theories associating mercury in dental amalgam with serious illness have been sensationalized while scientific facts are ignored. Mercury toxicity is determined by various factors: the form of mercury, route and duration of exposure, and dose. Measuring devices have improved over time and now allow very low levels of mercury to be detected, but no cause-and-effect relationship has been established between the mercury in dental amalgam and any systemic illnesses in either patients or dental health care workers.

The impact of dental amalgam on environmental health continues to be examined. Under certain conditions, mercury that has been released into the environment can be converted to methyl mercury, a form of mercury that is more toxic than elemental or inorganic mercury. Federal, state, and local environmental agencies regulate for levels of "total mercury" because of mercury's changeability. We do not know that dental amalgam in the environment is a significant source of methyl mercury. There is a lack of definitive research in this area. Nonetheless, it is prudent for dentistry to take steps to reduce the release of amalgam waste or any potentially harmful materials to the environment because dentistry's role as a public health profession naturally includes environmental stewardship. We encourage and support constructive dialogue with individuals and organizations that further public health and environmental quality goals.

Dental amalgam use is declining as more patients and dentists choose newer, more natural-looking, tooth-colored restorative materials. If current trends continue, newer materials eventually may replace conventional dental amalgam entirely. But for now, dentists and patients still value amalgam as the superior choice among restorative materials in numerous instances, and the CDA and ADA are therefore committed to protecting the patient-doctor decision to select this durable and effective material among the safe options available for restoring decayed teeth.

Supporting Documentation

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studies also demonstrate that amalgam can be safely handled by dentists and other dental health care workers in occupational settings.

In December 2004, the third comprehensive review in 12 years of the safety of dental amalgam was completed by the Life Sciences Research Office (LSRO) at the request of the federal Trans-agency Working Group on the Health Effects of Dental Amalgam. This ad hoc body was created in 1994 and is composed of representatives from the National Institutes of Dental and Craniofacial Research of the National Institutes of Health, the Center for Devices and Radiological Health of the U.S. Food and Drug Administration, the Centers for Disease Control and Prevention, and the Office of the Chief Dental Officer of the Public Health Service. The final report, titled "Review and Analysis of the Literature on the Potential Adverse Health Effects of Dental Amalgam," concluded that there is insufficient evidence to draw a link between serious adverse health consequences and dental amalgam. This scientific body has been rendering independent scientific opinions and evaluations for nearly half a century, and this report summarized a massive evaluation of peer-reviewed amalgam literature from 1996 to 2003. It can be obtained through www.lsro.org

The two prior comprehensive reviews completed by the Working Group on the Health Effects of Dental Amalgam were reported with similar findings of safety in 1993 and 1997. The World Health Organization (1997) comprehensively reviewed the scientific research on the safety of amalgam, and concluded that it is a safe and effective restorative option. There is no evidence linking mercury in amalgam with any serious illness or systemic disease in dental patients.

Another study (Factor-Litvak, 2002) of 550 adults, ages 30-49, concluded, "In a sample of healthy working adults, mercury exposure derived from dental amalgam restorations was not associated with any detectable deficits in cognitive or fine motor functioning." Continuing clinical studies to determine whether dental amalgam has any demonstrable adverse effects on children began in 1997 are expected to be completed in 2006. These studies are supported by the National Institutes of Health, which has the authority to terminate the studies immediately if at any point the study subjects show any sign that amalgam causes harm.

Organizations that have issued statements supporting continued use of dental amalgam include the following entities:

- American Academy of Pediatrics
- National Council Against Health Fraud
- U.S. Food and Drug Administration
- U.S. Public Health Service
- U.S. Centers for Disease Control and Prevention
- World Health Organization
- World Dental Federation.

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In 2002, an ADA-sponsored environmental assessment found 78 percent of amalgam waste could be captured through dental office adherence to best management practices. Wastewater treatment plants' high mercury-capture efficiency further raises the amount captured to almost 92 percent. The assessment also showed that mercury in dental office wastewater is less than

0.7 percent of the total amount of mercury from all industries and sources to the environment that may be converted to methyl mercury.

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Mercury exists in three forms: elemental, inorganic, and organic. Elemental is the least harmful of the three. Dental amalgam is created when elemental mercury is mixed with an alloy powder comprised of silver, tin, copper, and sometimes zinc, palladium or indium. Mercury accounts for close to one-half the weight of dental amalgam. Mercury forms a very strong bond with other metals in dental amalgam to create a stable alloy.

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In the early 1990s, the media aired or published sensational stories about the supposed harm mercury from dental amalgam can cause. Both the 60 Minutes and Newsweek stories led people to believe that the presence of mercury in the body was a definite indication that they could be suffering from serious illness. Such media attention prompted public health officials to take additional actions to assure the public that dental amalgam is indeed safe.

The Alzheimer's Association, the Autism Society of America, and the National Multiple Sclerosis Society have issued statements pointing to the lack of scientific evidence to support theories that link dental amalgam with these illnesses. It should be pointed out that science has not yet determined the causal factors for these three conditions.

Studies on the effects of dental amalgam on patient health and on dental health care workers have been closely reviewed for inclusion in reports generated by the U.S. Public Health Service. "Dental Amalgam: A Scientific Review and Recommended Public Health Service Strategy for Research, Education and Regulation

<http://web.health.gov/environment/amalgam1/ct.htm> was published in January 1993
"Dental Amalgam and Alternative Restorative Materials"

<http://web.health.gov/environment/amalgam2/Contents.html> was published in October 1997. The latter report also summarizes information presented at two workshops and meetings of international health organizations. Current scientific literature has not substantiated any link between mercury in dental amalgam and any neurologic, renal or developmental health effects.

USPHS experts in 1997 reviewed those publications and reports that purportedly support such links. The reviewers winnowed the submission of approximately 175 articles to 57 articles that were of adequate research quality or had been included in the 1993 review. Most of the remaining 57 articles had short-comings, such as not accounting for other exposures to

mercury or not providing an adequate description of methodology. The reviewers concluded that the data presented, in the aggregate, did not demonstrate that mercury in dental amalgam causes any serious negative health effects.

USPHS also has published an updated Toxicological Profile for Mercury (1999) that reviews the most current published scientific research on all forms of mercury and corresponding health effects determined by form, dose and route of exposure. The entire report can be accessed on the internet at <http://atsdr1.atsdr.cdc.gov/toxprofiles/tp46.html>. Reading the Public Health Statement is recommended. "More on Health Effects and Dental Amalgam" can be found on pages 293- 301. Occupational exposure in dentistry is discussed on pages 451-452. Studies examining the health effects of mercury in dental amalgam are mentioned throughout the Toxicological Profile.

"The general population is most commonly exposed to mercury from two sources: (1) eating fish and marine mammals (e.g., whales, seals) that may contain methyl mercury in their tissues or (2) from the release of elemental mercury from the dental amalgam used in fillings. It is not known how much of the elemental mercury released from dental amalgam is inhaled as a mercury vapor, how much is breathed out, how much is swallowed in a liquid form, or how much is converted into a mercuric salt that is either swallowed or directly absorbed into the oral mucosa. Exposure to mercury however, does not necessarily mean that adverse health effects will result. Health effects depend upon the amount of exposures, the form of mercury, and the route of exposure. Each form and route leads to different effects, and these are discussed in detail in this chapter." (pp 29-30)

"The (U.S. Public Health Service) (1993) report also strongly recommends educating the public on the risks and benefits of dental amalgam. To prevent misleading or unduly alarming the public, the layperson should be informed that the presence of metallic mercury in dental amalgams is, in itself, not sufficient to produce an adverse health effect. Toxic levels of mercury must first be released from the filling, absorbed into the body, and transported to target tissues where adverse effects are produced. What constitutes a "toxic level" from an amalgam exposure has been the focus of recent research. Uncertainty continues concerning the presence or absence of a threshold for adverse effects from low level chronic exposure to mercury. The above mentioned inadequacies in study size, the measures used for effects, the reproducibility of the results, and the subjective nature of some of the low level effects have precluded a consensus in the scientific community on the safety of mercury amalgam. In the absence of clearly defined toxicity from low level exposures, one approach has been to focus upon determining exposure levels from mercury amalgam, and whether these levels exceed recommended guidelines or regulations. Since these guidelines and regulations (including the MRL) are themselves extrapolated from the hazardous effects literature, there is some circularity in the argument that exposures of mercury from amalgam that exceed guidelines like the MRL (or other standard) "support" the position that mercury amalgams pose a health risk. This aspect of the controversy will only be satisfactorily resolved with better toxicity and pharmacokinetic data for chronic low level mercury exposure from amalgams." (pp 294-295)

In November 2002 ADA representatives testified in Congress about the ADA Health Foundation's compilation of data on the occupational health of dentists. At its annual health screenings, ADAHF measured dentists' mean urinary mercury levels during 1975-83 and again during 1984-2001. Results show that dentist urinary mercury levels are well below established limits for occupational exposure. Dentist urinary mercury levels have fallen since 1975, until they

now approach those of the general population. This is largely due to better mercury hygiene methods promoted by the ADA, such as the use of precapsulated amalgam. ADA investigators also have studied a possible correlation between kidney dysfunction and urinary mercury levels, but found none. (Source: ADA Testimony to Government Reform Committee, U.S. House of Representatives, November 2002, www.ada.org/prof/resources/positions/statements/amalgam.asp)

At the 2003 American Association of Dental Research meeting, ADA scientists reported dentists' mean urinary mercury concentration in 1984 was 11.1 ug/l declining to 4.3 ug/l by 2001 with a range of 2.9 to 11.1 ug/l. ADA scientists also reported that from 1992-2001 the proportion of dentists with urinary mercury above 20ug/l dropped from 3.6% to 0.6%. The mean urinary mercury level of non-occupationally exposed individuals is about 4.0 ug/l (USPHS 1998). (Source: Chou, H-N, et al., "Urinary Mercury Levels In Dentists, 1984-2001," AADR 2003 Abstract No. 1456. Search 2003 AADR abstracts at <http://iadr.confex.com/iadr/2003SanAnton/techprogram/>)

(For reference, the American Conference of Industrial Hygienists (ACGIH) recommends that a urine level of 35 ug/gram of creatinine should not be exceeded.)

The impact of dental amalgam on environmental health is being examined. Under certain conditions mercury that has been released into the environment can be converted to methyl mercury, a form of mercury that is more toxic than elemental or inorganic mercury.

Mercury does not degrade, but it can change from one form to another and migrate in the environment. Research shows that under certain conditions in the aquatic environment, microorganisms can convert some forms of mercury to methyl mercury. Fish and other aquatic organisms can absorb methyl mercury, and because fish cannot eliminate methyl mercury from their tissue, methyl mercury can bioaccumulate up the food chain. Regular consumption of fish with methyl mercury in high enough concentrations can cause harm to both wildlife and humans.

We do not know that dental amalgam in the environment is a significant source of methyl mercury. There is a lack of definitive research in this area.

Mercury in amalgam forms a strong bond with the other metals that make up dental amalgam. High temperatures and certain chemicals, such as those used in EPA wastewater laboratory analyses, can separate mercury from the other metals in amalgam. However, most of the amalgam in dental wastewater remains bonded in particulate form, is heavy, and is mostly captured by traps and filters in the dental office and in the grit chamber at wastewater treatment plants. It is rarely subject to conditions that dissolve amalgam bonds. A laboratory test that simulated the sewer system environment to examine the disposition of amalgam in wastewater did not detect soluble mercury. More definitive research studies could be done, but the cost would be millions of dollars. The largest sources of mercury in the environment nationally are incineration of municipal and medical waste and combustion of fossil fuels. In California, mercury occurs naturally in the cinnabar deposits around the San Francisco Bay area. Another large source is legacy-mining wastes from the state's gold mines, where mercury was used to extract gold from ore.

Nevertheless, dentistry's role as a public health profession naturally includes environmental stewardship. It is prudent for dentistry to take steps to reduce the release of amalgam waste or any potentially harmful materials to the environment.

Most sanitation agencies are interested in first initiating an educational outreach program to

dental communities. A typical outreach program will focus on the implementation of “best management practices” (BMPs) for dental office waste. CDA recommends dental offices implement the BMPs listed below.

Wastewater regulations differ from community to community. CDA’s approach is to address each situation on a case-by-case basis. Local discharge limits for mercury, treatment plant permit conditions and limits, local regulations, resources, and priorities vary among the local sanitation agencies. Some agencies have proposed and implemented wastewater discharge permit programs. CDA maintains open communication with local sanitation agencies and strongly encourages local dental societies to meet with local agencies when contacted.

Best Management Practices (BMPs)

- Do not rinse amalgam-containing traps, filters, or containers in the sink.*
- Do not place amalgam, elemental mercury, broken or unusable amalgam capsules, extracted teeth with amalgam, or amalgam-containing traps and filters with medical waste or regular solid waste.*
- Recycle, or manage as hazardous waste, amalgam, elemental mercury, broken or unusable amalgam capsules, extracted teeth with amalgam, amalgam-containing waste from traps and keep amalgam waste in an air-tight container*
- Separate excess contact dental amalgam that is retrieved during placement with gauze and place in an appropriate container.
- Use chair side traps to capture dental amalgam.
- Change, or clean, chair side traps frequently. Flush the vacuum system before changing the filters. *
- Change vacuum pump filters and screens at least monthly or as directed by the manufacturer.
- Check the p-trap under your sink for the presence of any amalgam-containing waste. If amalgam or mercury is detected, place waste water and amalgam debris in an airtight, container and dispose of as a hazardous waste.
- Eliminate all use of bulk elemental mercury and use only precapsulated dental amalgam for amalgam restorations.
- Limit the amount of amalgam triturated to the closest amount necessary for the restoration. Keep a variety of amalgam capsule sizes on hand to ensure almost all triturated amalgam is used.
- Train staff that handles or may handle mercury-containing material in its proper use and disposal. **
- Consider the use of amalgam removal technologies, such as sedimentation systems or amalgam separators, if you practice in an area where mercury in wastewater discharges is a serious concern.
- Eliminate the usage of bleach for disinfection of water lines as this can cause leaching of mercury from any amalgam residues in the lines.

* *Mandatory* per California Code of Regulations, Title 22

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