

DON'T LET IT GO TO YOUR HEAD: Phasing Out Mercury Tooth Fillings



Mercury Policy Project/Tides Center

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Policy Project**

Executive Summary

There are many important reasons to phase out mercury in dentistry—ranging from releases into wastewater, landfills, farmers' fields and more direct releases from dental clinics, human wastes and cremation—to reducing exposure and mercury levels in the fish we eat. Two years ago, the Vermont Legislature mandated requirements for dental clinics to adopt best management practices and install amalgam separators. But the job is not finished. Due to continuing unsafe mercury levels, the Department of Health maintains strict consumption advisories for many fresh water fish found in our lakes, rivers and streams.

Today, dental amalgam is the number one continuing use of mercury in the state, and most of that mercury will ultimately wind up polluting Vermont's environment. Yet there has been little public attention focused thus far on the environmental impact of dental amalgams from the human body. While mercury releases from human wastes and cremation may be an uncomfortable topic, most people understand that if they have mercury in their teeth, it will eventually be released into the environment.

A growing number of Vermont agencies, officials and committees now believe that dental mercury is a serious environmental problem, and are beginning to raise concerns—and make recommendations. The Department of Health's Dental Program has expressed concerns "about the environmental burden of mercury" and the Air Pollution Control Division recently recommended that, "the use of dental amalgam in Vermont be

banned or rapidly phased out."¹ In addition, the Northeast Waste Management Officials Association, which Vermont participates in, also believes that "many reasons exist for dentists to reduce the use and release of mercury from dental facilities."

For the first time in its "2007 Annual Report to the Governor, General Assembly and Citizens of the State of Vermont," the Advisory Committee on Mercury Pollution stated its support for "an eventual phase-out of mercury-containing dental amalgam...and recommends that the Legislature consider this" in order "to virtually eliminate the release of anthropogenic mercury in

Vermont... In addition, the Committee recommends that the Legislature consider legislation to not allow

placement of dental amalgams in pregnant women and children under 18 years of age."

In addition, dentists polled nationwide also recognize the environmental concerns from the use of mercury amalgam. While most dentists still use amalgam and think that it is safe, a majority will eventually stop using mercury tooth fillings for "environmental/waste disposal" reasons, according to a national survey of dentists.

Therefore, to protect Vermonters and their environment, it is critical for all users to reduce, and wherever possible eliminate their use of mercury where there are viable and cost effective alternatives. In fairness, this should apply to dental clinics just as much as to hospitals and industries that use mercury or mercury-added products.

Introduction

For over 150 years, mercury-containing fillings (often called “silver” or “amalgam”) have been used extensively to fill dental cavities. Four metals—mercury, silver, copper and tin—primarily comprise amalgam, with mercury being approximately 50 percent by weight.² While use of mercury-free dental fillings³ is becoming more prevalent, most dentists in the United States still use mercury-containing amalgam.⁴

amalgam. In 2002, the publication *Dental Products Report* conducted a survey of 600 general dentists regarding the safety and future of mercury-amalgam fillings. Of those polled, 71% stated that their overall use of amalgam had decreased. The findings of a second survey in 2005 indicated that the top two tooth filling choices replacing amalgam are “flowable composites” (81%) and “hybrid composites”(69%) followed by amalgam (67%).⁷ Over half (53%) of those surveyed agreed that “Dentists will eventually stop using amalgam due to

Rating amalgam's future/safety

Please indicate whether you agree or disagree with each of the following statements:

	Strongly agree	Agree	Disagree	Strongly disagree
Dentists will eventually stop using amalgam due to environmental/waste disposal concerns.	12%	41%	39%	8%
Amalgam restorations may pose a potential health risk to patients.	5%	19%	49%	27%
There is credible scientific evidence that proves amalgam poses a health risk to patients.	4%	8%	47%	41%
Amalgam should be legislated out of existence.	5%	7%	36%	52%

Source: September 2002 DPR amalgam survey

Mercury use in health, consumer, and industrial products has declined precipitously in all products over the past thirty years. But in dentistry, this decline has been slight, such that dental fillings jumped from 2 percent of all mercury products two decades ago to over 20 percent in 2001.⁵ That dentistry still uses a health care product containing mercury is increasingly an anomaly among health care professionals. Organizations ranging from the American Public Health Association and the American Hospital Association have agreed to “virtually eliminate” all mercury waste.⁶ While mercury use is declining or being eliminated in other health care products, the continued use of dental mercury warrants further attention.

While many dentists continue to use and support the use of amalgam, most recognize concerns about the environmental impacts of

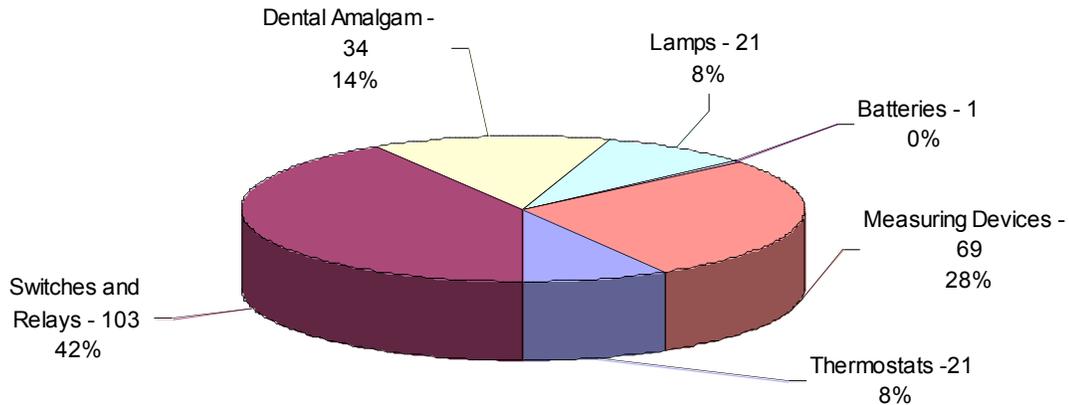
environmental/waste disposal concerns.”⁸

Yet for reasons ranging from health, environmental and liability concerns to patient preferences (including cosmetic reasons), a large and growing number of dentists have ceased placing mercury fillings in favor of alternative materials. The percentage of general dentists still placing mercury amalgam has declined to 68 percent.⁹ Indeed, the number of “mercury-free” dentists who pledge not to place amalgam in their patients, has increased in each informal survey over the past twenty years¹⁰ and three national dental societies have been created whose mission includes promoting mercury-free dentistry.¹¹

While amalgam use has been declining, federal studies show that the dental sector is the third largest user of mercury in the

United States.¹² In 2004, the Environmental Protection Agency (EPA) estimated that dental clinics use 34 tons of mercury annually, 14% of the total annual mercury consumption in the U.S.

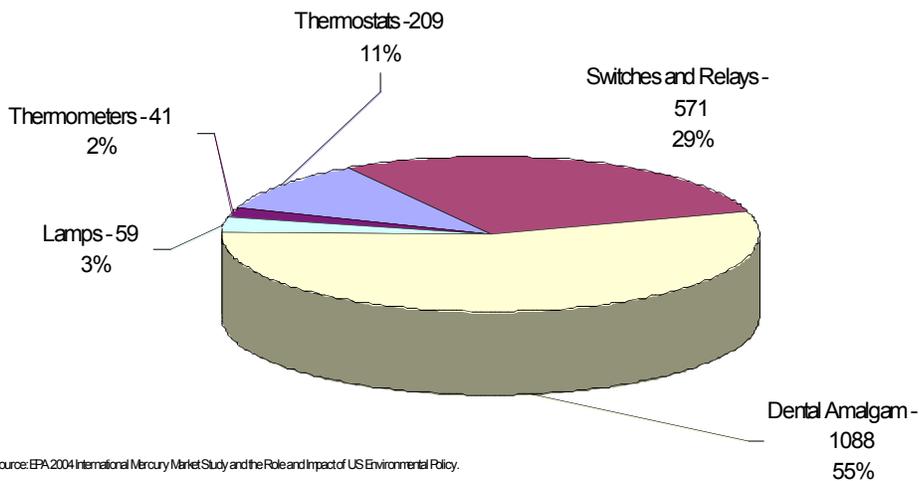
Mercury amalgam remains a significant source of dangerous mercury pollution that reaches the water and air via sewage treatment plants, crematoria and other mechanisms. Dental mercury takes many routes to the air, land and water. Until the



Source: EPA 2004 International Mercury Market Study and the Role and Impact of US Environmental Policy.

Approximately 100 million amalgams are placed in patients' teeth each year by 175,000 U.S. dentists.¹³ This annual mercury input has added up over time. It is estimated that there are currently over 1,000 tons of mercury in the mouths of U.S. residents—more than half of all mercury currently in use in all products.¹⁴

recent mandate requiring installation of amalgam separators in Vermont, one major route was simply down the drain. But even with separators installed, some amalgam will still pass through into the environment, depending upon how well the units are installed and maintained.¹⁵ But other pathways remain, including the following:



Source: EPA 2004 International Mercury Market Study and the Role and Impact of US Environmental Policy.

All portions of this giant reservoir that are not captured and managed end up in the environment.

Solid Waste Scrap amalgam is often discarded into the trash. Mercury sent to an

incinerator vaporizes when heated and is emitted to the air through the smokestack, or captured in fly ash and deposited in a landfill. Mercury that is sent to a landfill may enter groundwater, contaminate underlying soils, vaporize and dissipate to the atmosphere, or be sent to a wastewater treatment plant with the landfill leachate. Also, mercury may be emitted from the landfill with methane gas.¹⁶

Biomedical Waste/Incineration Waste dental mercury is often disposed of into the biomedical waste container. A survey found that 25 to 30 percent of dentists place their contact amalgam wastes into biomedical “red bags” that are often incinerated.¹⁷ “Red-bag” waste is usually sent to a medical waste incinerator, or sterilized at high temperatures with pressurized steam (autoclaved) and then sent to a landfill. In either process, the mercury vaporizes when heated and can be released into the atmosphere.

Dental Mercury Releases from Human Waste Amalgam has been determined to be the primary source of mercury in human waste.¹⁸ Mercury fillings continually volatilize, releasing small amounts of mercury into the body. Some of this mercury passes through the digestive system. As a result, human wastes are second only to direct releases from dental offices, as contributors of dental mercury to waste water treatment plants.¹⁹ Most municipal wastewater treatment systems are not designed to treat hazardous waste or reduce mercury releases to the environment. Consequently, mercury that enters most sewage systems will be discharged to the environment either through the sludge or wastewater. Sludge is the solid material remaining after wastewater treatment. Mercury can be released to the environment when sludge is incinerated, landfilled, spread on agricultural fields as a fertilizer, or pelletized and sold as lawn fertilizers. Conditions at certain points within the

wastewater treatment process may promote the conversion of elemental mercury into the more toxic methylmercury. Methylmercury is highly soluble and more able to pass through the facility to the receiving lake, river, or salt-water body.

Mercury Releases from Dental Clinic’s Traps, Drains, and Sewer Pipes Following years of use, the plumbing in dental offices and associated sewer pipes can acquire a significant buildup of dental mercury. This mercury often slowly dissolves and continues to be released into the wastewater stream for years – even after amalgam separators are installed – unless pipes are replaced or cleaned out.^{20,21}

Direct Air Releases from Dental Clinics The continuing use of dental amalgam contributes mercury to the atmosphere each year in the United States. On a national basis, this air contains as much as one ton of mercury annually.²²

Dental Mercury Releases from Cremation Dental amalgam is a significant and growing source of mercury pollution when human bodies are cremated. This source is expected to more than double over the next 20 years, due to the increasing number of people cremated with greater amounts of mercury in their teeth, and the significant projected increases in cremations. In Connecticut, for example, cremations rose from 25.7% of people who died in 1998 to 32% in 2003. By 2010, it is expected to rise to more than 42%. In 2003, an estimated 2.5 tons of mercury was emitted from crematoria nationwide, based upon the 1998 Northeastern States Mercury Study which estimated that each person cremated had an average of 2.9 grams of mercury. Crematoria in Vermont, as elsewhere, lack pollution control technology to capture mercury vapors. For this reason, the Vermont Air Pollution Division recently

recommended that amalgam “should either be immediately banned or rapidly phased out.”²³

Reuse of Recycled Dental Mercury As an increasing number of Vermont dentists collect amalgam waste for recycling, the mercury that gets sent off eventually is sold into commerce, either domestically or internationally. Most of this mercury will eventually be released into the local environment, and contribute to the global atmospheric burden. It’s likely that some of this mercury will ultimately make its way back into the fish we eat.

Exposure Concerns from Dental Mercury Amalgam

Mercury is a heavy metal that exists in several forms, all of them toxic to humans and the environment. A World Health Organization (WHO) scientific panel concluded that “a safe level of mercury exposure below which no adverse effects occur has never been established.”²⁴ Once released to the environment from a variety of sources—including dental clinics and human waste—mercury persists in the environment, where it is converted into a form called methylmercury. Methylmercury accumulates in the bodies of fish and wildlife, so that people, larger fish and other animals at the top of the food chain tend to accumulate the most methylmercury.

Anyone eating fish contaminated with methylmercury is at risk from its potential to damage the brain, heart and other organ systems. It’s thought, however, that young children and developing fetuses are at the greatest risk from exposure to methylmercury. EPA scientists estimate that around 410,000 children—or one newborn in ten—are born at risk of neurological harm

each year in the U.S. as a result of maternal exposure to methylmercury.²⁵

Dental amalgam contains elemental mercury, rather than methylmercury. Experts from the WHO²⁶, as well as several U.S. federal health and research agencies,²⁷ agree that dental amalgam is the largest source of human exposure to mercury.²⁸ In addition to direct exposure, amalgam disposal can increase the load of mercury to both the local and global environment, as well as the levels of exposure to methylmercury through the fish that Americans eat.²⁹

The main route of exposure to mercury from dental amalgam is through inhalation of elemental mercury vapor.³⁰ Approximately 80 percent of inhaled mercury vapor is absorbed by the lungs.³¹ U.S. Government studies indicate that inhaled elemental mercury is converted to inorganic mercury in the body³² and that mercury from amalgam is passed to babies via the placenta and through breast milk.³³

As much as 50 percent of the mercury in dental fillings can be vaporized after 5 years, and 80 percent after 20 years.³⁴ Depending on the number of fillings and other factors, the average daily absorbed dose of mercury from mercury-containing fillings is between 3 and 17 micrograms.³⁵ Common habits such as chewing gum,³⁶ drinking of hot liquids, tooth brushing, and grinding of teeth greatly increase the amount of mercury vapor released and thus individual exposure to a highly absorbable form of mercury and total body burden.^{37 38}

Most Vermonters Left in the Dark that “Silver Fillings” Contain Mercury

Like many Americans, most Vermonters aren’t aware that dental fillings contain mercury. Last year, Zogby International conducted a national telephone survey and

region-specific interactive survey in California and New England on consumer attitudes on dental fillings and mercury. What follows is a summary of the poll's results. The margin of error is +/- 2.9 percentage points, with margins of error higher in sub-group. The major findings of this national poll are as follows:

1. Question: One of the materials used by dentists to fill cavities is amalgam. Amalgam fillings contain several metals. Do you know what the primary metal in amalgam is?

Table 1.

	Nationwide	California	New England
Mercury	24	40	35
Silver	12	23	22
Zinc	8	4	6
Gold	2	1	0
Not sure	54	32	37

Most Americans (76 percent) don't know mercury is the primary component of amalgam fillings

2. Question: Do you think your dentist should be required to inform you about the various types of mercury and non-mercury fillings available before filling a cavity?

Table 2.

	Nationwide	California	New England
Yes	92	94	87
No	6	3	6
Not sure	2	3	7

Americans overwhelmingly (92 percent) want to be informed of their options with respect

to mercury and non-mercury dental filling materials prior to treatment

3. Question: Which of the following would you be more likely to choose given the option – higher cost fillings that contain no mercury or lower cost fillings that are about 50% mercury?

Table 3.

	Nationwide	California	New England
Higher cost/no mercury	77	80	76
Lower cost/with mercury	13	6	8
Not sure	11	14	16

The majority (77 percent) of Americans would choose higher cost fillings that do not contain mercury if given the choice

4. Question: How much of a problem do you think mercury pollution causes in the environment, on a scale with 1 being not at all serious and 5 being very serious?

Table 4.

	Nationwide	California	New England
1 Not at all serious	5	4	4
2	11	8	9
Less serious (1+2)	16	12	13
3	22	19	23
4	19	24	29
5 Very serious	28	33	25
More serious (4+5)	47	57	54
Not sure	16	13	10

Close to half (47 percent) of all Americans think mercury pollution poses a serious problem for the environment

5. Question: Would you support or oppose a ban on putting dental mercury fillings in pregnant women or children?

Support	69%
Oppose	9
Not sure	22

More than two-thirds (69 percent nationally) of New Englanders would support a ban on mercury amalgam fillings for pregnant women and children. (Asked in New England only)

In summary, the poll results indicate that most Vermonters don't know that mercury is the largest single component of amalgam fillings. On the other hand, close to half of all Americans think mercury pollution poses a serious problem for the environment. Therefore, it is not surprising that Americans overwhelmingly want the freedom to choose between mercury and mercury-free dental fillings and to be informed about this choice prior to treatment. Given the choice, the poll indicates that the vast majority of Americans – and Vermonters – would choose higher cost fillings that do not contain mercury.

Awareness of Mercury Exposure Risks in Dentistry

While consumer knowledge about risks associated with mercury in mercury-containing fillings is low, the dental profession is well-informed. Starting in 1997, the second largest U.S. amalgam manufacturer, Dentsply, advised dentists against placing mercury-containing fillings in pregnant women or children. Although these warnings were subsequently withdrawn, they are still in place in other countries.³⁹ The largest U.S. manufacturer, Kerr, warns

dentists in its Materials Safety Data Sheet that, “The health authorities of the various countries, including Canada, Germany, France, the United Kingdom, Norway and Austria have recommended against the placement or removal of an amalgam in certain individuals such as pregnant and nursing women and persons with impaired kidney function.”⁴⁰

Dentists are so well-advised about the toxicity of mercury amalgam use that they may not sue the manufacturers for neurological damage caused by constant workplace exposure to amalgam.⁴¹ Dentists not only receive warnings from manufacturers, but also receive the following recommendations from the ADA's Dental Mercury Hygiene Recommendations:

- Use care when handling amalgam.
- Avoid skin contact with mercury or freshly mixed amalgam.
- Recap single-use capsules after use.
- Store them in a closed container.
- Work in well-ventilated work areas, with fresh air exchanges and outside exhaust.
- Periodically check the dental operatory atmosphere for mercury vapor.
- Remove professional clothing before leaving the workplace.⁴²
- Clearly, then, the ADA is well aware of human exposure concerns related to mercury-containing filling materials.

While neither the ADA, state dental societies nor federal authorities have acted to reduce overall mercury amalgam use, Sweden, Germany, Denmark, Norway, Finland, Austria, and Canada⁴³ have all sought to reduce or phase out mercury use by dentists - especially in pregnant women, children and those with impaired kidney functions. Health Canada, Canada's federal health agency, has advised a precautionary approach whereby pregnant women, children under six, and persons with kidney problems should never

receive mercury amalgam fillings.⁴⁴ The U.S. Agency for Toxic Substances and Disease Registry advises “...pregnant women, children under the age of 6 (especially up to the age of 3), people with impaired kidney function, and people with hypersensitive immune responses to metals...” to “...discuss your medical condition with your dentist prior to any dental restoration work.”⁴⁵

New FDA Expert Panel Questions Safety of Mercury Amalgam

Recent findings at the national level do not give amalgams a clean bill of health either. In September 2006, a federal expert advisory panel charged with reviewing an FDA white paper regarding the potential adverse health risks associated with exposure to mercury in dental amalgam did not give FDA the answers they appeared to be seeking. To the question whether the draft FDA white paper “objectively and clearly presented the current state of knowledge about the exposure and health effects related to dental amalgam,” the panel voted “no” by a 13-7 margin. And to the question whether the FDA paper’s conclusions were “reasonable” the panel also voted “no” by a 13-7 margin. Some of the reasons cited by the majority were that no conclusions could be drawn because “the evidence was often contradictory and that conclusions based on a limited search should not be made.”⁴⁶

Among the recommendations by committee members to FDA were the following:

- Consider informed consent for patients receiving amalgam
- Consider labeling changes restricting its use in pregnant women and children
- Consider the relevancy of the “precautionary principle.”

Governments and Associations Support Phasing Out Mercury Amalgam

For both health and environmental reasons, many governments and associations have recommended phasing out mercury use. As discussed earlier, the Vermont Air Pollution Division supports banning amalgam. The Northeast Waste Management Officials Association (NEWMOA), which Vermont officials participate in, also believe that many reasons for dentists to reduce the use of dental mercury, including the following:

- Reduced risks of exposure to mercury’s toxic effects for patients, dental employees and dentists
- Reduced impact on public health from dental mercury’s environmental release
- Reduced impact on the environment, including risks to wildlife that eat contaminated fish
- Reduced liability, since dentists can remove any liability associated with the use of mercury by going mercury-free as other dentists have done
- Reduced concerns about meeting wastewater requirements
- Enhanced public image when dentists “choose to go mercury-free”⁴⁷

NEWMOA conducted a literature and web survey in 2003 as part of its Mercury Initiative “for the purpose of identifying, collecting and analyzing available data on dental amalgam test results to determine if the mercury concentrations exceeded the federal hazardous waste Resource Conservation and Recovery Act (RCRA) limit of 0.2 milligrams per liter (mg/L). While the data showed much variability, in all but one of the studies the amalgam scrap and/or wastes exceeded the RCRA federal hazardous waste limit at least 20% of the time, with some of the samples found to be ten times the RCRA limit.”⁴⁸

In addition, several countries are leading the way to phasing out dental mercury, demonstrating that its continued use is not necessary. In Norway and Sweden, dental amalgam use is discouraged by the government due to health and environmental reasons. In Sweden, dental amalgam use represents less than five percent of fillings.⁴⁹ According to the Danish Statutory Order on Mercury, amalgam fillings are only allowed in molar teeth, and this last remaining use is being reexamined.⁵⁰

Conclusion

In summary, phasing out the use of mercury in dentistry in Vermont will result in reduced emissions from crematoria, and will have the additional benefit of reducing mercury in dental wastewater, sludge and the environment. Alternatives to mercury

amalgams are available and are becoming increasingly acceptable to dentists and demanded by patients.⁵¹

Amalgam use and release by the dental establishment is a significant and persistent source of mercury pollution in Vermont. Therefore, we strongly support the recommendations by the Advisory Committee on Mercury Pollution to the Legislature which would phase out most uses of amalgam by 2011, ban amalgam placement in pregnant women and children, and require those selling mercury in amalgam to report on quantities sold into the state each year. Supporting environmentally sound replacements for amalgam fillings is consistent with the state's goal to "virtually eliminate" all uses of mercury where there are viable, cost effective alternatives available.

ENDNOTES

¹ "2007 Annual Report to the Governor, General Assembly and Citizens of the State of Vermont," Advisory Committee on Mercury Pollution, January 2007, p.11

² "Environmental and Toxicological Concerns of Dental Amalgam and Mercury," MVS Solutions, Inc., 2003; <http://www.mvssolutions.com/mercury.pdf> (p.22-25).

³ In 2001, the Maine State Legislature passed a law telling the Maine Bureau of Health to make a brochure about the advantages and disadvantages to human health and the environment of using mercury amalgam fillings in dental work;

http://janus.state.me.us/legis/ros/lom/LOM120th/8Pub351-400/Pub351-400-72.htm#P11191_797452. Also now available is the following: "Fillings: The Choices You Have/Mercury Amalgam and Other Filling Materials," A Patient Education/Information Brochure Prepared by the Maine Department of Human Services, Bureau of Health, 2002; <http://www.maine.gov/dhhs/boh/files/odh/AmalBrochFinal2.doc>, and "Mercury-free Dental Fillings: Phase out of amalgam in Sweden," Swedish KEMI, 2005; http://www.kemi.se/upload/Trycksaker/Pdf/PM/PM9_05.pdf.

⁴ Clinical Research Associates Newsletter, vol 29, Issue 10, 1005 Provo, UT; <http://www.cranews.com/>

⁵ "Environmental and Toxicological Concerns of Dental Amalgam and Mercury," MVS Solutions, Inc., 2003; <http://www.mvssolutions.com/mercury.pdf> (p.18).

⁶ On June 24, 1998, the American Hospital Association and the United States Environmental Protection Agency signed a landmark agreement for the "Virtual Elimination of Mercury Waste" from Hospitals; <http://www.epa.gov/glnpo/toxteam/ahamou.htm>.

⁷ "Materials matter: Dental Products Report exclusive 2005 Materials Survey to general dentists," Dental Products Report, 2005; http://www.dentalproducts.net/xml/display_printer_friendly.asp?file=3202&type=textonly

⁸ "Amalgam Economic, durable, debatable," by Gail Weisman, Dental Products Report, Dec 2002; <http://www.dentalproducts.net/xml/display.asp?file=1361>

⁹ Clinical Research Associates Newsletter, Vol. 29, Issue 10, 1005 Provo, UT; <http://www.cranews.com/>.

¹⁰ CRA Newsletter readers survey, December 2001; 3,865 responses: 73% place amalgam, 27% do not. Percentages of dentists no longer amalgam tripled from 1985 to 1995, and tripled again from 1995 to 2001: It was 3% in 1985, 9% in 1995, and 27% in 2001.

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- ¹¹ The International Academy of Oral Medicine and Toxicology; www.iaomt.org; the International Academy of Biological Dentistry and Medicine; www.iabdm.org, and the Holistic Dental Association; www.holisticdental.org.
- ¹² U.S. E.P.A., International Mercury Market Study and the Role and Impact of US Environmental Policy, 2004 (“Switches and Relays” = 42%; “Measuring Devices” = 28%; Dental Amalgam =14%; Thermostats = 8%.)
- ¹³ Water Environment Federation, “Controlling Dental Facility Discharges in Wastewater, Alexandria, VA,” 1999; King County Department of Natural Resources, “*Management of Hazardous Dental Wastes in King County, 1991 – 2000*,” Hazardous Waste Management Program, Water and Land Resources Division, 2000.
- ¹⁴ U.S. E.P.A., International Mercury Market Study and the Role and Impact of US Environmental Policy, 2004 (“Switches and Relays” = 42%; “Measuring Devices” = 28%; Dental Amalgam =14%; Thermostats = 8%.)
- ¹⁵ “High mercury emissions from dental clinics despite amalgam separators,” Hylander, I., Lindvall, D., Gahnberg, L.; *Science of the Total Environment* 362 (2006) 74-84
- ¹⁶ Raloff, Janet, “Mercury in Landfills,” *Science News*. 7 July 2001; v160, n1.
- ¹⁷ “Management of Hazardous Dental Wastes in King County, 1991 – 2000,” King County Department of Natural Resources, Hazardous Waste Management Program, Water and Land Resources Division, 2000.
- ¹⁸ O’Conner Environmental Assoc. Inc., “*Mass Balance of Dental Related Mercury Wastes in Canada, with a Discussion of Env’l Impacts and Alternative Dental Restorative Materials*,” Final report 10-5791, Prepared for: Office of Transboundary Air Issues and National Office of Pollution Prevention; Barron, T.; Mercury Headworks Analysis for 2000. Prepared for: Palo Alto RWQCP, 2001.
- ¹⁹ “*Mercury Source Control & Pollution Prevention Program Evaluation*,” Final Report, Prepared for American Metropolitan Sewerage Agencies by Larry Walker Associates, 2002
- ²⁰ Larsen, A.H. et al., “Mercury Discharge in Waste Water from Dental Clinics” *Water Air and Soil Pollution*, Jan 1996: 86(1-4): 93-99 ; & Rubin, P.G. et al, *Archives of Environmental Health*, Jul. 1996; 51(4):335-337; & A. Lindvall et al., “Mercury in the Dental Practice: Contamination of Ambient Air and Waste Water,” FDI World Dental Congress, Goteborg, Sweden, Aug 19, 1993.
- ²¹ “Quantification of mercury in sewer line pipes, wastewater and sediment from dental facility effluent discharge,” EnvironmentCanada, May 9, 2001.
- ²² Personal communication with Dr. Paul Rubin, DDS, FIAOMT, November 17, 2002
- ²³ Dec 15, 2006 Memorandum to Advisory Committee on Mercury Pollution from Richard A. Valentinetti, Director Air Pollution Control Division
- ²⁴ World Health Organization (WHO), 1991, Environmental Health Criteria 118, Inorganic Mercury, WHO, Geneva and L.T.Friberg, "Status Quo and perspectives of amalgam and other dental materials", International symposium proceedings, G.Thieme Verlag Struttgart, 1995.
- ²⁵ Mahaffey, K., “Methylmercury: Epidemiology Update,” U.S. Environmental Protection Agency, Washington, D.C., Fish Forum—San Diego – 2004; See: <http://www.epa.gov/waterscience/fish/forum/2004/presentations/monday/mahaffey.pdf>.
- ²⁶ World Health Organization, Environmental Health Criteria 118, Inorganic Mercury, WHO, Geneva, Switzerland, 1991.
- ²⁷ Toxicological Profile for Mercury, Agency for Toxic Substances and Disease Registry, US Public Health Service, 1999; Kingman A., et al, National Institute of Dental Research, “Mercury concentrations in urine and blood associated with amalgam exposure in the US military population,” *Dent Res.* 77(3);461-71, 1998; National Research Council, Toxicological Effects of Methylmercury, pp.41 and 304-332: Risk Characterization and Public Health Implications, National Academy Press, 2000.
- ²⁸ The U.S. Centers for Disease Control agrees that dental amalgam constitutes a major exposure to mercury (www.cdc.gov/exposurereport/), as does the U.S. Public Health Service (www.atsdr.cdc.gov/toxprofiles/phs46.html). Further, the Congressionally-mandated July 2000 National Academy of Sciences report states that “The major source of exposure to elemental Hg in the general population is due to Hg vapors released from dental amalgam.” (National Research Council, National Academy Press, 2101 Constitution Ave., N.W., Box 285, Washington, DC 20055; Library of Congress Card Number 00-108382).
- ²⁹ Mercury Study Report to Congress, US EPA, 1997.
- ³⁰ Mercury Study Report to Congress, Vol. IV, US EPA <http://www.epa.gov/ttn/oarpg/t3/reports/volume4.pdf>
- ³¹ Mercury Study Report to Congress, Vol. IV, US EPA <http://www.epa.gov/ttn/oarpg/t3/reports/volume4.pdf>. Toxicological Profile for Mercury, US ATSDR, 1999; p. 440; <http://www.atsdr.cdc.gov/toxprofiles/tp46-c5.pdf>.
- ³² National Research Council, Toxicological Effects of Methylmercury, Risk Characterization and Public Health Implications, National Academy Press, 2000.
- ³³ Toxicological Profile for Mercury, US ATSDR, 1999; p. 442; <http://www.atsdr.cdc.gov/toxprofiles/tp46-c5.pdf>.

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- ³⁴ Pleva J, "Dental mercury - a public health hazard", *Rev Environ Health* 10(1):1-27 (1994); Pleva J, Mercury from dental amalgams: exposure and effects, *Int J Risk & Safety in Med*, 1992, 3: 1-22.
- ³⁵ "Concise International Chemical Assessment Document No. 50: Elemental mercury and inorganic mercury compounds: Human health aspects (www.who.int/pcs/cicad/summaries/cicad_50.html), September 2002, based on the "Toxicological profile for mercury (update) published by the Agency for Toxic Substances and Disease Registry of the US Department of Health and Human Services (ATSDR), 1999.
- ³⁶ Toxicological Profile for Mercury, US ATSDR, 1999; p. 440; <http://www.atsdr.cdc.gov/toxprofiles/tp46-c5.pdf>
- ³⁷ Vimy MJ, Lorscheider FL: Serial measurements of intra-oral air mercury; Estimation of daily dose from dental amalgam. *J Dent Res* 64(8):1072-5, 1985.
- ³⁸ Vimy MJ, Luft AJ, Lorscheider FL, Estimation of Mercury Body Burden from Dental Amalgam Computer Simulation of a Metabolic Compartment Model *J. Dent. Res* 1986 65(12):1415-1419, December, 1986.
- ³⁹ The warning from amalgam manufacturer Dentsply/Caulk (38 W. Clarke Ave, Milford, DE 19963-0359) states: "The use of amalgam is contraindicated in children 6 and under..." and "...In expectant mothers." The term "contraindicated," also called contra-indicated, means, according to Webster's on-line dictionary, "...to make (a treatment or procedure) inadvisable."
- ⁴⁰ The Kerr warning reads: "The health authorities of the various countries, including Canada, Germany, France, the United Kingdom, Norway and Austria have recommended against the placement or removal of an amalgam in certain individuals such as pregnant and nursing women and persons with impaired kidney function."
- ⁴¹ *Barnes v. Kerr Corp.*, 418 F.3d 583 (6th Cir. 2005).
- ⁴² "Dental Mercury Hygiene Recommendations," *JADA*, Vol. 134, pp. 1498-99. (2003) http://www.ada.org/prof/resources/pubs/jada/reports/report_mercury.pdf.
- ⁴³ Swedish National Dept. of Health, Mercury Amalgam Review Panel, 1987; *Heavy Metal Bulletin*, Dec 2000, Vol 6, Issue 3.
- ⁴⁴ An FDA Consumer Update (December 31, 2002) informs consumers that Canada limits the use of mercury amalgam in pregnant women; <http://dsp-psd.pwgsc.gc.ca/Collection/H49-105-1996E.pdf>.
- ⁴⁵ Public Health Statement, US ATSDR, p.7, downloaded from website Feb 7, 2006; <http://www.atsdr.cdc.gov/toxprofiles/tp46-c1.pdf>
- ⁴⁶ Joint Meeting of the Dental Products Panel (CDRH) and the Peripheral and Central Nervous Systems Drugs Advisory Committee (CDER) – September 6-7, 2006 (Summary); <http://www.fda.gov/cdrh/meetings/090606-summary.html>
- ⁴⁷ "Mercury-Dental: Reasons for Change," P2Rx Topic Hub, NEWMOA, <http://www.newmoa.org/prevention/topichub/subsection.cfm?hub=103&subsec=3&nav=3&CFID=3295991&CFTOKEN=66776082>, accessed Jan.21, 2007
- ⁴⁸ "TCLP Analysis of Waste Dental Amalgam," NEWMOA, <http://www.newmoa.org/prevention/mercury/tclp.pdf>, accessed Jan.21, 2007
- ⁴⁹ "Impact of a General Ban on Mercury in Norway," The Norwegian Pollution Control Authority, Dec 2006; http://sft.no/nyheter/dokumenter/0701_impact_ban_products.pdf and "Mercury--investigation of a general ban," KEMI Report No 4/04; Swedish National Chemicals Inspectorate; 2004 http://www.kemi.se/upload/Trycksaker/Pdf/Rapporter/Rapport4_04.pdf
- Mercury-free Dental Fillings, Phase-out of amalgam in Sweden, KEMI Report Nr 9/05; Swedish National Chemicals Inspectorate; 2005; http://www.who.int/ifcs/documents/forums/forum5/pm9_05.pdf
- ⁵⁰ Personal conversation with Ms. Mette Halberstadt, Dental Authority, Danish National Board of Health, Copenhagen, Denmark, June 21, 2006 meeting
- ⁵¹ NJ Mercury Task Force Report; December 2001; <http://www.state.nj.us/dep/dsr/Vol3-chapter2.pdf>. For information on NJ Mercury Task force, see: http://www.state.nj.us/dep/dsr/mercury_task_force.htm