Mercury in Dentistry: The Facts

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Continuing Education Units: 2 hours


Disclaimer: Participants must always be aware of the hazards of using limited knowledge in integrating new techniques or procedures into their practice. Only sound evidence-based dentistry should be used in patient therapy.

There has been considerable debate over the use of mercury as a component in dental amalgam restorations. Numerous governmental and private studies continue to show amalgam, when properly handled, to be safe to both the patient and dental team. This course addresses not only patient and environmental safety, but also the occupational safety issues for the dental team. The intent of this course is to provide the dental professional with currently available information about mercury hygiene.

Conflict of Interest Disclosure Statement

- Jen Blake is a member of the dentalcare.com Advisory Board.

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Overview
In the dental workplace mercury is encountered in amalgam restorative material. Although mercury is a naturally occurring substance, it is a toxic substance and can cause harmful effects at unsafe levels. The proper handling of mercury in the dental office is therefore an important occupational safety issue for the dental team. There has been considerable debate over the use of mercury as a component in dental amalgam restorations. Numerous governmental and private studies continue to show amalgam, when properly handled, to be safe to both the patient and dental team. Most of this debate concerns the safety of the material as it pertains to the patient. This course addresses not only patient and environmental safety, but also the occupational safety issues for the dental team.

The intent of this course is to provide the dental professional with currently available information about mercury hygiene. Those aspects beyond the scope of this course can be found in the references cited and in the “Suggested Readings.”

Learning Objectives
Upon the completion of this course, the dental professional will be able to:
• Explain the current position of dental organizations and governmental agencies on dental amalgam.
• List several sources of mercury contamination.
• Identify some of the factors that affect the concentration of mercury vapor in the air.
• Distinguish between mercurial poisoning and mercurial hypersensitivity.
• Name several symptoms of mercury toxicity.
• Summarize the recommendations for proper mercury hygiene.
• Describe the function of amalgam separators.
• Clarify the facts of dental amalgam use.
• Discuss the pros and cons of dental amalgam restorations with co-workers and patients.

Course Contents
• Glossary
• History
  • Characteristics
  • Use in Dentistry
• Types of Mercury
• Vaporization
• Health Hazards
• Non-occupational Exposure
• Occupational Exposure in Dentistry
• Sources of Mercury Exposure
  • Elemental Mercury
  • The Amalgam Work Station
  • The Amalgamator
  • Amalgam Capsules
  • Scrap Amalgam
• Evacuation System (Trap Waste)
• Vacuum Pump Filter
• Amalgam Separators
• Sterilization
• Amalgam Restoration Removal
• Waste Disposal
• Precautions for Safe Handling
• Policy Statements/Reports
  • United Nations Minamata Convention on Mercury
  • Food and Drug Administration
  • FDI World Dental Federation
  • World Health Organization
  • European Commission - Health and Consumer Protection
  • American Dental Association
History
Mercury (chemical symbol Hg) is a naturally occurring substance that is found in the earth’s crust. Volcanoes are among the largest natural sources of mercury. The high temperatures of the volcano vaporize the mercury from the earth's crust and send it into the atmosphere. Many industrial sources also contribute significant amounts of mercury vapor into the air. In consequence, all living organisms are subject to a certain degree of mercury exposure. This is called environmental exposure.

Less than 1% of mercury released into the environment comes from amalgam. This amount compares to 53% that is emitted from combustion of fuels for energy production and 34% from the combustion of waste. It is estimated that mercury released into the environment from dental offices accounts for between 0.04 and 0.2% of total worldwide mercury pollution from all sources.
Characteristics
Mercury has many unique characteristics that have long made it a valuable raw material for industry. It is the only heavy metal that is liquid at room temperature. It has uniform volume expansion over a wide range of temperatures, making it invaluable in thermometers and other measuring instruments. It is an excellent conductor of electricity and is used in batteries, fluorescent lights, and other electronics. It can also be found in some cleaning supplies, photographic equipment, and some disinfectants. The ease with which it combines with most other metals to form a durable amalgam has made it a proven restorative material in dentistry.

Mercury has long been recognized as a highly toxic heavy metal. For that reason, the increasing popularity of mercury in industry has brought concern about the amount of human exposure to mercury, both occupationally and non-occupationally, and the effects of mercury on the environment.

Federal and state authorities have lobbied since 2002 for bans on medical mercury thermometers. In some states the sale of home use mercury thermometers is illegal. The Environmental Protection Agency (EPA), the National Institute of Standards and Technology, and environmental and industry groups are targeting industrial users of mercury thermometers. Better options for home use include electronic (digital reading), tympanic (ear canal), liquid crystal forehead bands, and disposable dot matrix strips.

Mercury has also been used in the sphygmomanometer, the device used to measure blood pressure, for more than 100 years. However, the realization of the toxic effects of mercury has also led to replacing them with other devices, such as aneroid sphygmomanometers or with automated blood pressure monitors. An abundance of such devices, operated at the arm or wrist, has been marketed during the last few years. This newer technology is actually easier to use and more accurate than mercury based sphygmomanometers. Offices making such a change should consult packaging to ensure manufacturer quality and correct operability by the dental team.
Use in Dentistry

In dentistry, the use of crude amalgam can be traced back to China in 659 AD. When the concept of dental amalgam was initially introduced to the West in the mid-1800s, there was much controversy surrounding its use. In fact, the American Society of Dental Surgeons originally condemned the use of amalgam by its members. Later in that century, studies conducted by Dr. G. V. Black, did much to alleviate the original concerns of the profession at that time. Eventually, its use was accepted and it became the preferred material for restorative dentistry. In recent years, as awareness of mercury toxicity increased and became a matter of concern to regulatory agencies, information began to surface suggesting that not only the dental patient, but the dental team as well, might be at risk of mercury toxicity.

However, to date, no scientific studies have found mercury in dental restorations to be a public health risk. Amalgams have been used to restore the teeth in tens of millions of Americans annually. Although many groups have tried to use scare tactics with the public, a study conducted by the Centers for Disease Control and Prevention showed most consumers have little to no concern and relied on their health care provider for advice.

Types of Mercury

Mercury exists in three forms: as the element, in organic compounds, and in inorganic compounds. In dentistry, elemental mercury is used; most of the occupational exposure results from the inhalation of the vapor that arises from elemental mercury. Mercury vapor is a particularly dangerous poison. It is a colorless, odorless, and tasteless gas and its presence often goes undetected. In addition to being inhaled, mercury can enter the body through ingestion, contact with the eyes, and absorption through the skin. Inorganic and organic mercury is not believed to be a significant concern in the dental treatment room, however, it does merit some discussion.

Organic mercury is mercury combined with carbon. A specific type of organic mercury is methylmercury. Organic mercury is many times more toxic than elemental mercury. Inorganic mercury is composed of mercury compounds that contain non-carbon substances. Chlorine, oxygen, or sulfur may all be components of inorganic mercury.

In dealing with patient concerns about mercury, it is important to understand that a “normal body burden” of mercury exists. This means that everyone is exposed to a certain amount of mercury. To a large extent, the amalgam controversy is deepened by the lack of general understanding of this normal body burden of mercury. It is acknowledged and accepted that small amounts of mercury vapor are inhaled from dental amalgam. However, this exposure is only a diminutive part of the daily exposure that all humans take in from the air they breathe and the food they eat. Furthermore, the mercury in food generally is methylmercury (organic) and as discussed above, has higher toxicity than elemental mercury. That is not to deny the propriety of concern for mercury intake from dental amalgam. It simply points out that a “normal” amount of mercury is absorbed by the body with no apparent ill consequences. (The topic of patient exposure from amalgam is given additional attention under the heading “Non-occupational exposure”.)

Vaporization

To prevent the occurrence of harmful effects of mercury toxicity, it is important to understand the concept of vaporization. Mercury in the atmosphere easily evaporates into a vapor and travels quickly through the air. Some will land in our oceans and lakes, which in turn is consumed by the fish we eat. Elemental mercury vaporizes readily at room temperature into an invisible, odorless, and tasteless gas. Two main factors affect the rate of mercury vaporization. The first factor is temperature. Higher temperatures will result in a greater rate of vaporization. In other words, the warmer the air or surface where mercury contamination exists, the greater the rate of mercury vaporization and therefore the greater the concentration of mercury vapor in the air.

The second factor is the surface area of the exposed mercury, i.e., the number of mercury beads formed. The greater the number of beads, the greater the rate of vaporization, because more beads have more total surface area from which the mercury can vaporize. Therefore, in the dental office, the presence of many tiny mercury
particles is a factor in the overall concentration of mercury vapor in the air. A closely related and additional factor with respect to mercury vapor concentration is air circulation. The greater the volume of circulating air, the lower the concentration of mercury vapor in the air.\textsuperscript{11}

**Health Hazards**

Overexposure to mercury can occur from either acute or chronic exposure. Acute exposure refers to a high dose over a short period of time.

Chronic exposure refers to low doses over a long period of time. Because most dental team members work 30 to 40 hours per week and the majority of dental offices are within acceptable limits, as set by the US Federal Food and Drug Administration (FDA) for mercury vapor concentrations in the ambient air, the primary concern to the dental team is with chronic mercury poisoning. Symptoms of overexposure include: tremors, emotional changes, insomnia, neuromuscular changes, headaches, disturbances in sensations, changes in nerve responses, and deficits in cognitive functions. At extremely high concentrations there may be kidney involvement, respiratory failure, and even death.\textsuperscript{12}

Mercury toxicity is very unpredictable, with wide variations in individual responses. Frequently, early signs of chronic mercury poisoning may not be recognized immediately because they resemble many common ailments with similar symptoms.

It is important to distinguish between mercury poisoning and mercury hypersensitivity. Anti-amalgam literature contains reports of patients who have been relieved of a variety of ailments after having their amalgam restorations removed. Several studies conducted by the U.S. federal government and other organizations have not found this to be the case.\textsuperscript{7} However, it is possible that these patients were highly sensitive or allergic to mercury or the other metal components of amalgam and that sensitivity was increased by their amalgam restorations. If that is the case, the number of patients affected by such hypersensitivity is quite small and the reaction is not unique to amalgam restorations. A **minute number of patients are sensitive to a variety of dental materials, not just amalgam.**

Mercurial hypersensitivity will usually elicit an immediate response, generally within the first 24 hours after placement of the amalgam. The reaction can be treated by allowing the allergy to run its course or by removal of the amalgam restoration. These are extremely rare and have no risk factors. In dentistry, a few cases have reported the development of contact or irritant stomatitis.\textsuperscript{17}

**Non-occupational Exposure**

Notice has been taken of recent reports from anti-amalgam organizations implicating dental amalgam with adverse health effects. Such reports have generated considerable public controversy concerning the safety of amalgam with respect to its predominant use in dental patients as a restorative material. Amalgam has undergone more testing than any other restorative material now used. Prudence dictates minimization of exposure to every type of toxic substance. However, there is no scientifically-accepted research to indicate that the use of dental amalgam causes any undue health risk to the dental patient.\textsuperscript{7}

The New England’s Children Amalgam Trial (NECAT) concluded in a randomized trial of 534 six- to ten-year old children, there was no evidence that exposure to mercury from dental amalgam was associated with any adverse neuropsychological effects five years from placement.\textsuperscript{14}

A separate randomized trial was conducted by a joint research team from the University of Lisbon, Portugal and the University of Washington which included 507 children from eight to ten years of age. This trial concluded there were no statistical differences of neurobehavioral assessments between children receiving amalgam and composite restorations seven years after placement.\textsuperscript{15}

**Occupational Exposure in Dentistry**

Although still below the recommended amount, it is a fact that dental team members have higher concentrations of mercury in body fluids and tissues than the average population.\textsuperscript{6} Given the cumulative nature of mercury in the body and the serious health effects associated with mercury toxicity, it is very important that dental practices adhere to proper mercury handling practices and procedures. It is imperative to know and understand the sources of mercury...
because the mercury vapor level in the practice in which one works has been determined to be below a recommended limit. An exposure level of zero should be the ultimate goal. Any level above zero is an indication of a contaminating source.

Sources of Mercury Exposure
Let us consider in greater detail some of the specific sources of mercury contamination. As already noted, the ambient air concentration is the result of many factors. Simply because a particular source may emit a high concentration of mercury vapor does not necessarily equate with a high ambient mercury vapor level. Rather, each source contributes to overall mercury vapor levels in the air.

Elemental Mercury
Much exposure risk can be eliminated simply by refusing to use “open” elemental mercury. This step eliminates a lot of the traditional problems with respect to mercury contamination. By removing elemental mercury from the dental workplace, we eliminate possible spills; leakage or seepage from mercury bottles or dispensers and from reusable capsules; and contamination from the “squeeze cloth” approach. Most dental offices have already eliminated this risk. With the improvements in, and variety of, single use encapsulated amalgam and its reasonable cost there is no reason to continue to use elemental mercury.

Establishment of safe exposure limits is important. These concentrations are determined in accordance with the most recent scientific data in mind. Periodically, results of new studies and other information can lead to changes in these limits, making them either more or less stringent. The exact exposure level is a judgment, by the appropriate regulating bodies, that at this level and below very few people will experience any adverse effects. It is important to remember that individuals vary in sensitivity to all sorts of chemicals. Equally important is that opinions differ about the level that is “safe.” Not all countries, for example, have set the same levels for safe exposure to mercury vapor. The point is that one should not become complacent because the mercury vapor level in the practice in which one works has been determined to be below a recommended limit. An exposure level of zero should be the ultimate goal. Any level above zero is an indication of a contaminating source.

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The majority of recent studies show that most dental offices are well within prescribed occupational safety standards. In the United States, both the National Institute for Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration (OSHA) have set exposure limits for mercury vapor. The limits are based on a time-weighted average that assumes that workers are exposed eight hours a day and 40 hours per week. NIOSH has established a recommended exposure limit (REL) of mercury vapor levels in the air at 0.05mg/m$^3$. OSHA has set 0.1mg/m$^3$ as its permissible exposure limit (PEL). Studies conducted on dentists have shown their readings to be well below the national standards. These studies include occupational exposure as well as exposure from their own amalgam restorations.

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Amalgam Capsules
After trituration, opening an amalgam capsule releases mercury vapor. Remember that one of the factors of vaporization is the amount of air circulation. Obviously, very little air circulates inside the capsule. The vapor released does not automatically create high vapor levels in the ambient air being inhaled. The problem occurs when vapor settles on nearby surfaces, including hands, causing contamination to increase over time.

Disposable, precapsulated amalgam capsules are preferred. These capsules come in a variety of sizes to help reduce the excess of non-contact amalgam. One should open amalgam capsules at arm's length and reseal immediately after depositing the freshly triturated amalgam into the amalgam well.

Closed, empty capsules should be placed in wide-mouth airtight amalgam recycling containers and disposed of according to county/state regulations.

Scrap Amalgam
There are two types of scrap amalgam. Unused amalgam is referred to as non-contact amalgam. Any scrap amalgam that has come in contact with the patient, including extracted teeth that contain amalgam restorations, is referred to as contact amalgam. Some recyclers want the two types of scrap amalgam kept in separate containers. When bits of amalgam are unused or removed after placement, they will continue to emit small amounts of mercury vapor. Scrap amalgam should...
be collected in a wide-mouth, airtight plastic container. Do not store scrap amalgam under water. Some sources state it is acceptable to store under radiographic fixer solution, however many areas will not accept wet amalgam for recycling. The actual fixer solution itself may have recycling restrictions. The containers should be marked **Hazardous Amalgam Waste for Recycling**. Or, if separating the two types of waste, label them **Non-contact Hazardous Amalgam Waste for Recycling** and **Contact Amalgam Waste for Recycling**.¹⁹

**Evacuation System (Trap Waste)**

This system is subject to mercury vapor contamination from the scrap amalgam that is flushed through it and collected in the trap. Never use the high volume evacuator to get rid of unused, non-contact scrap amalgam. This material should be placed into the **non-contact waste recycling container**. When the system is in use, the frequent flushing of water keeps mercury vapor contamination to a minimum. Both the trap basket and the trap cover are susceptible to mercury buildup and vapor release. When the evacuation trap is being emptied or removed, higher concentrations of mercury vapor can be released into the surrounding air. Empty the contents into the **contact waste recycling container**. If you used a disposable tray, then the whole tray should go into the **contact waste recycling container**. Do not use bleach or bleach containing cleaners to flush waterlines. Bleach can dissolve amalgam and push the mercury into the publicly owned treatment works.

**Vacuum Pump Filter**

Filters should be changed according to the manufacturer’s directions. You should always recycle the filter when possible. Remove the filter and hold the filter over a container that can catch any spills. Remove as much liquid as possible without dumping any of the amalgam waste. The liquid can be rinsed down the drain. Never rinse the amalgam particles over a drain. The lid should be put back on the filter and placed in a sealed box labeled, **Contact Waste Recycling Container**.¹⁹

**Amalgam Separators**

Amalgam Separators are used to separate amalgam particles from dental office waste water before it is discharged into publicly owned treatment works (POTWs). The International Organization for Standardization (ISO) standard for amalgam separators requires at least 95% amalgam removal efficiency. There are various systems available that meet and/or exceed this requirement. Factors to consider before a dental office installs an amalgam separator include: the office’s need to meet established regulatory requirements for mercury discharge; the office’s plumbing configuration; physical space needed for the installation; maintenance procedures; disposal of collected amalgam waste; and related costs involved.

The 2007 American Dental Association (ADA) House of Delegates voted to recommend the voluntary use of amalgam separators as an option to reduce the amount of amalgam entering waste water treatment plants. The ADA, EPA, and the National Association of Clean Water Agencies (NACWA) have entered into a memorandum of understanding (MOU) concerning the voluntary use of separators. The EPA has issued a proposed amalgam separator standard and is expected to have the rule finalized by September 2015. At that time, it will be mandatory for all dental offices that release amalgam into POTWs to have an amalgam separator with at least 95% efficiency. There are already laws in place in some states and localities...
that make it mandatory for dental offices using amalgam to have an amalgam separator. Each dental office must check its state and local laws.

Sterilization
Heat generated in sterilization of instruments used in the placement and removal of amalgam causes mercury vaporization. This is not a surprise, as heat is among the forces already noted which can cause vaporization. The sterilizer will emit mercury vapor after the door is opened at the end of the cycle. Proper cleaning of instruments before sterilization diminishes this source of mercury vaporization.

Heating instruments that have been used in placement or removal of amalgam can also cause mercury to vaporize. It is important to plan sterilization procedures to avoid release of mercury into the ambient air. Place the heat sterilizer in an area where air circulation is high and, ideally, where an exhaust fan can remove the contaminated air. Before sterilizing, place instruments contaminated with mercury in sterilizable bags. When opening the autoclave after a sterilization cycle, be aware that mercury vapor may be released. Therefore, open at arm’s length due to heat and Hg vapors.

Amalgam Restoration Removal
Another source of contamination stems from the removal of amalgam restorations. The drilling action creates amalgam dust and friction causes heat, thus releasing mercury vapor. Both the dust and the vapor can be inhaled. Furthermore, small particles are suctioned into the evacuation system to be collected in the evacuation trap. The primary contributor to contamination from removal of restorations is amalgam dust. This contaminant settles on a variety of surfaces, including the personal protective equipment of dental staff, the patient, the dental chair and the floor areas immediately adjacent to the dental chair.

Use of high volume evacuation and water spray reduces the level of mercury dust and vapor created when amalgam restorations are removed. When exposure to mercury vapors is expected, as in the case of removing an old amalgam restoration, the use of an N95 respirator mask can be worn by the dental team to further reduce the risk of Hg vapor inhalation. When cleared by the
Waste Disposal
Amalgam should not be rinsed down the drain, disposed of in the garbage, placed in red biohazard bags, or into sharp containers. The good news is that amalgam can be safely recycled, which in turn helps to prevent the release of mercury into the environment. During the recycling process mercury is recovered from amalgam through a distillation process and reused in new products.

Contact an amalgam waste recycler that complies with ANSI/ADA Specification No. 109 with an EPA or state license to ensure you are following correct procedures for recycling amalgam waste and elemental mercury in your geographic location. There may be special requirements for collecting, storage and transporting of amalgam waste in your vicinity. Some recyclers require you to separate contact and non-contact amalgam waste. Some have pick up services, others want it shipped to them. Some provide packages for storage, others require disinfection of amalgam waste. Some may even pay for clean non-contact amalgam.

Check with your local or state regulatory agency for a licensed recycler in your area. The ADA has compiled a national list of recyclers, which can be accessed on its website (www.ada.org).

Precautions for Safe Handling
• Understand the causes of mercury vaporization.
• Know the sources of mercury contamination.
• Discontinue the use of elemental mercury and mercury dispensers. This eliminates the possibility of a large spill. By eliminating this possibility, you eliminate the greatest threat to unsafe exposure levels.
• Ensure that all staff members are informed about and trained in the importance of safe handling procedures for mercury and related amalgam materials.
• Establish and post a routine for safe handling procedures and a monitoring system to verify that the procedures are being followed. Eliminate all direct contact with or handling of mercury, amalgam, or debris contaminated with mercury. Always wear good quality gloves.
• Flooring in dental operatories where amalgam is used should be smooth single sheet vinyl or similar surface with no joints and should extend three to six inches up the walls. Carpeting is virtually impossible to decontaminate once penetrated by mercury.
• Limit the area susceptible to contamination by setting up an amalgam work station where all amalgam-related work is performed.  Design work areas where amalgam is used to have sufficient air exchange or ventilation.
• Do not use vacuum cleaners in areas where mercury is used. Ordinary vacuum cleaners will volatilize any mercury contaminated items picked up and exhaust mercury back into the ambient air.
• Keep mercury and amalgam materials away from heat sources.
• Keep mercury and amalgam materials in plastic labeled containers with secure lids and on stable surfaces to avoid spills.
• Do not throw scrap amalgam or excess mercury into drains, sinks or waste receptacles. This practice is detrimental both to the office environment and the ecological environment.
• Do not allow patients to rinse in sinks which bypasses the traps and separators.
• Periodic monitoring of the contamination levels in the office and the blood and urinary mercury levels of dental personnel should be provided.
• Be familiar with state and local regulations concerning mercury. They may be more stringent than the federal regulations.
• Establish a recycling office policy.

Policy Statements/Reports
Following are policy statements and/or reports from various professional organizations and governmental agencies.
Late in 2010 the FDA convened the Dental Products Panel to make recommendations based on petitions received by the FDA after its 2009 ruling. After two days of testimonies for and against the use of dental amalgam, especially in pregnant women and children under the age of six, the panel concluded that the FDA should continue to examine all scientifically sound studies related to this issue.\textsuperscript{23,24}

FDI World Dental Federation
The FDI World Dental Federation is in the process of updating its 2009 Resolution on Dental Amalgam. The Federation was actively involved in the United Nations Minamata Convention on Mercury and agrees with the treaty’s upcom.

Food and Drug Administration
In 2002, the U.S. FDA and other organizations of the U.S. Public Health Service (USPHS) that continue to investigate the safety of dental amalgams released a consumer update stating that there is “no valid scientific evidence has shown that amalgams cause harm to patients with dental restorations, except in the rare case of allergy.”

The FDA in 2009 classified encapsulated dental amalgam as a Class II Medical Device. Gold and composite restoration materials are also Class II devices. This is the first time that dental amalgam has been given a medical device classification. Previously the mercury and alloy components of amalgam had separate classifications. This classification includes product labeling requirements that include:

- A warning against the use of dental amalgam in patients with mercury allergy;
- A warning that dental professionals use adequate ventilation when handling dental amalgam; and
- A statement discussing the scientific evidence on the benefits and risk of dental amalgam, including the risks of inhaled mercury vapor. (This will help dentists and patients make informed decisions about the use of dental amalgam.)

This ruling from the FDA was published on July 28, 2009. The reaffirmation reads, “While elemental mercury has been associated with adverse health effects at high exposures, the levels released by dental amalgam fillings are not high enough to cause harm in patients.”\textsuperscript{25}

World Health Organization
In 2009 WHO in cooperation with the United Nations Environment Program (UNEP) organized a “Consultation” on “Future Use of Materials for Dental Restorations.” The conclusion from this meeting was in the absence of an ideal alternative, dental amalgam remains a dental restorative material of choice and is still the mainstay of restorative dentistry around the world.\textsuperscript{26}

European Commission - Health and Consumer Protection

Its abstract concludes:

We conclude that dental health can be adequately ensured by both types of material. All the materials are considered safe to use and they are all associated with very low rates of local adverse effects with no evidence of systemic disease. There is, obviously, a greater level of aesthetic appeal with those alternatives that are tooth colored compared to the metallic amalgam. Furthermore, these alternatives allow the use of minimally interventional adhesive techniques. These clinical trends themselves ensure that there will continue to be a sustained reduction in the use of dental amalgams in clinical practice across the European Union.\textsuperscript{27}
American Dental Association

Negotiated Rulemaking Process Regarding a National Pretreatment Standard for Dental Office Wastewater (2010:602)

Resolved, that the appropriate agencies of the ADA engage the United States Environmental Protection Agency in a negotiated rulemaking process regarding a national pretreatment standard for dental office wastewater, and be it further

Resolved, that the following principles guide the Association’s position in any negotiations with the United States Environmental Protection Agency:

1. Any regulation should require covered dental offices to comply with best management practices patterned on the ADA’s best management practices (BMPs), including the installation of International Organization for Standardization (ISO) compliant amalgam separators equally effective:
2. Any regulation should defer to existing state or local law or regulation requiring separators so that the regulation would not require replacement of existing separators compliant with existing applicable law;
3. Any regulation should exempt dental practices that place or remove no or de minimis amounts of amalgams;
4. Any regulation should include an effective date or phase-in period of sufficient length to permit affected dentists a reasonable opportunity to comply;
5. Any regulation should provide for a reasonable opportunity for covered dentists to repair or replace defective separators without being deemed in violation of the regulation;
6. Any regulation should minimize the administrative burden on covered dental offices by (e.g.) primarily relying upon self-certification (subject to verification or random inspection) and not requiring dental-office-specific permits;
7. Any regulation should not include a local numerical limit set by the local publicly owned treatment works (POTW);
8. Any regulation should not require wastewater monitoring at the dental office, although monitoring of the separators to assure proper operation may be required;
9. Any regulation should provide that compliance with it shall satisfy the requirements of the Clean Water Act unless a more stringent local requirement is needed.

Dental Office Wastewater Policy (2003:387)

Resolved, that the Association strongly encourages dentists to adhere to best management practices and supports other voluntary efforts by dentists to reduce amalgam discharges in dental office wastewater, and be it further

Resolved, that the Association encourages constituent and component societies to enter into collaborative arrangements with regional, state or local wastewater authorities to address their concerns about amalgam in dental office wastewater, and be it further

Resolved, that the appropriate agencies of the Association continue to disseminate information to the constituent and component societies to help them address concerns of regional, state or local wastewater authorities about amalgam in dental office wastewater, and be it further

Resolved, that the appropriate agencies of the Association continue to investigate products and services that will help dentists effectively reduce amalgam in dental office wastewater and keep the profession advised, and be it further

Resolved, that the Association include in its advocacy messages the importance of basing environmental regulations or guidance affecting dental offices on sound science, and be it further

Resolved, that the Association continue to identify and urge the Environmental Protection Agency to fund studies that accurately and appropriately identify whether amalgam wastewater discharge affects the environment, and be it further

Resolved, that to advocate to a patient or the public the removal of clinically serviceable dental amalgam restorations solely to substitute a material that does not contain mercury is unwarranted and violates the ADA Principles of Ethics and Code of Professional Conduct, and be it further

Resolved, that in those instances where state dental boards initiate proceedings on this question that the ADA cooperate in such proceedings by making available scientific personnel as expert witnesses.

2013 Current Policies

ADA Statement on Dental Amalgam
Dental amalgam is considered a safe, affordable and durable material that has been used to restore the teeth of more than 100 million Americans. It contains a mixture of metals such as silver, copper and tin, in addition to mercury, which binds these components into a hard, stable and safe substance. Dental amalgam has been studied and reviewed extensively, and has established a record of safety and effectiveness.

The FDI World Dental Federation and the World Health Organization concluded in a 1997 consensus statement: “No controlled studies have been published demonstrating systemic adverse effects from amalgam restorations.” Another conclusion of the report stated that, aside from rare instances of local side effects of allergic reactions, “the small amount of mercury released from amalgam restorations, especially during placement and removal, has not been shown to cause any ... adverse health effects.”

In 1998, the ADA’s Council on Scientific Affairs’ published its first major review of the scientific literature on dental amalgam which concluded that “based on available scientific information, amalgam continues to be a safe and effective restorative material.” The Council’s report also stated, “There currently appears to be no justification for discontinuing the use of dental amalgam.”
In an article published in the February 1999 issue of the Journal of the American Dental Association, researchers report finding “no significant association of Alzheimer’s Disease with the number, surface area or history of having dental amalgam restorations” and “no statistically significant differences in brain mercury levels between subjects with Alzheimer’s Disease and control subjects.”

A 2003 paper published in the New England Journal of Medicine states, “Patients who have questions about the potential relation between mercury and degenerative diseases can be assured that the available evidence shows no connection.”

In 2004, an expert panel reviewed the peer-reviewed, scientific literature published from 1996 to December 2003 on potential adverse human health effects caused by dental amalgam and published a report. The review was conducted by the Life Sciences Research Office (LSRO) and funded by the National Institutes of Dental and Craniofacial Research, National Institutes of Health and the Centers for Devices and Radiological Health, U.S. FDA. The resulting report states that, “The current data are insufficient to support an association between mercury release from dental amalgam and the various complaints that have been attributed to this restoration material. These complaints are broad and nonspecific compared to the well-defined set of effects that have been documented for occupational and accidental elemental mercury exposures. Individuals with dental amalgam-attributed complaints had neither elevated urinary mercury nor increased prevalence of hypersensitivity to dental amalgam or mercury when compared with controls.” The full report is available from LSRO (www.lsro.org). A summary of the review is published in Toxicological Reviews.

In 2006, the Journal of the American Medical Association (JAMA) and Environmental Health Perspectives published the results of two independent clinical trials designed to examine the effects of mercury release from amalgam on the central and peripheral nervous systems and kidney function. The authors concluded that “there were no statistically significant differences in adverse neuropsychological or renal effects observed over the 5-year period in children whose caries are restored using dental amalgam or composite materials,” and “children who received dental restorative treatment with amalgam did not, on average, have statistically significant differences in neurobehavioral assessments or in nerve conduction velocity when compared with children who received resin composite materials without amalgam. These findings, combined with the trend of higher treatment need later among those receiving composite, suggest that amalgam should remain a viable dental restorative option for children.”

In May 2008, a Scientific Committee of the European Commission addressed safety concerns for patients, professionals and the use of alternative restorative materials. The committee concluded that dental amalgams are effective and safe, both for patients and dental personnel and also noted that alternative materials are not without clinical limitations and toxicological hazards.

The ADA Council on Scientific Affairs prepared a comprehensive literature review (PDF) on amalgam safety that summarized the state of the evidence for amalgam safety (from January 2004 to June 2010). Based on the results of this review, the Council reaffirmed at its July 2009 meeting that the scientific evidence supports the position that amalgam is a valuable, viable and safe choice for dental patients.

On July 28, 2009, the U.S. FDA issued its final rule on encapsulated dental amalgam classifying amalgam and its component parts, elemental mercury and powder alloy, as a class II medical device. Previously there was no classification for encapsulated amalgam, and dental mercury (class I) and alloy (class II) were classified separately. This new regulation places encapsulated amalgam in the same class of devices as most other restorative materials, including composite and gold fillings. At the same
time, the FDA also reaffirmed the agency’s position that the material is a safe and effective restorative option for patients.

The CSA supports ongoing research on the safety of existing dental materials and in the development of new materials, and continues to believe that amalgam is a valuable, viable and safe choice for dental patients.³⁹

American Public Health Association

Proposed Recommendations Statement

Although the Review Committee of the APHA Oral Health Section acknowledges that the release of mercury into the environment can be harmful to the environment as well as both human and animal life and thus should be minimized and avoided whenever possible, it also recognizes that:

• The contribution of dental amalgam to harmful mercury in the environment is minimal and can be largely prevented through appropriate use of dental waste management techniques.

• Banning the use of dental amalgam would have a strong economic impact, felt most severely in low-income countries with limited access to dental materials.

• A phase out of dental amalgam could have unintended negative public health consequences, as such an action would deprive dentists and patients of a restorative option that has a very long track record of safety and effectiveness while compelling them to choose an alternative that may be less effective in some situations. On the basis of the best available scientific evidence, the American Public Health Association recommends that dental professionals continue the use of dental amalgam as a restorative material and that schools and programs educating dental professionals place greater emphasis on education and training for all dental personnel regarding mercury hygiene. In addition, it is recommended that state regulatory agencies implement requirements for training regarding best management practices to minimize the release of mercury from dental amalgam into the environment. October 30, 2012. Policy Number LB-12-01.³⁰

The Association of State and Territorial Dental Directors

The Association of State and Territorial Dental Directors (ASTDD) is a national non-profit organization representing the directors and staff of state public health agency programs for oral health. It was organized in 1948 and is one of 17 affiliates of the Association of State and Territorial Health Officials (ASTHO). ASTDD formulates and promotes the establishment of national dental public health policy, assists state dental programs in the development and implementation of programs and policies for the prevention of oral diseases; builds awareness and strengthens dental public health professionals’ knowledge and skills by developing position papers and policy statements; provides information on oral health to health officials and policy makers, and conducts conferences for the dental public health community.

The ASTDD Membership consists of the chief dental public health officer (state dental director) of the state health department or equivalent agency, and the U.S. Territories. ASTDD also offers an Associate Membership which is open to any public agency, voluntary organization, tribal entity and/or health professionals employed or interested in dental public health.

Policy Statement

The Association of State and Territorial Dental Directors (ASTDD) supports and endorses the use of dental amalgam as a restorative material with proper disposal of waste amalgam. December 15, 2010.³¹

The Academy of General Dentistry

Resolved, that based on current scientific evidence, including the Food and Drug Administration’s February 2002 Consumer Update on Dental Amalgam, the Academy of General Dentistry maintains that amalgam is safe and effective as a dental restorative material (House of Delegates 2002).

American Dental Assistants Association

Whereas, Mercury is accepted by the practice of dentistry as a component of silver amalgam restorations; and

Whereas, Contamination by direct contact and the inhalation of mercury vapors is a possibility
when mercury is manipulated incorrectly in the dental office; and

**Whereas**, Safety standards on mercury hygiene have been promulgated for occupational workers (dental personnel) by the Occupational Safety and Health Administration (OSHA); therefore be it

**Resolved**, That the American Dental Assistants Association inform its Members and other dental personnel of recommended measures to avoid undue exposure of the personnel and the facility by mercury vapors and direct contact with mercury; and be it further

**Resolved**, That the ADAA, in cooperation with the American Dental Association and other health agencies, be fully supportive of mercury hygiene recommendations for the monitoring of safe practices in the use of mercury in dental treatment procedures.

**Future Plans**
Millions of private and public dollars are being spent to continue to study this issue. These studies are ongoing and require years to follow up to determine long range health effects. Included in these studies is research on new non-mercury restorative materials with the same advantages as dental amalgam.

**Conclusion**
While research, regulatory changes, and educational efforts are underway, the use of dental amalgams in the U.S. is declining. Dental schools are continuing to expand their curriculums to include posterior placement of resin-based composite restorations. Pediatric dentists, in particular, are using resin (plastic) FDA cleared tooth-colored materials that are bonded to the tooth. Many of these release fluoride and are mercury-free. Other reasons for the decline in amalgam use include increasing use of sealants and community fluoridation, an expanding selection of fluoride-containing dental products, improved oral hygiene practices, patient concern for esthetics, and greater access to dental care. With the improvement of alternative restorative materials over the past few years, dentists have increased their use of these products.

Nevertheless, mercury contamination continues to persist at some level in most dental offices. Given the serious consequences of mercury poisoning and the difficulty of determining the effects of mercury exposure on the body, it is essential that the dental team is aware of and practices proper mercury hygiene procedures.

The range of adverse health effects that have been reported to have been caused by mercury release from amalgam should not be disregarded but rather viewed in relation to many other considerations. Among these considerations are the risk factors of alternative restorative materials, the relative costs of alternative materials, the benefit of affordable oral health care versus the risk of dental caries and other oral diseases, and the concept of an acceptable level of exposure.

The debate over the safety of dental amalgam and its effect on the environment continues. However, the vast body of evidence on the topic suggests that amalgam is an acceptably safe material to be used on the public, especially in light of the benefit it provides.
Course Test Preview
To receive Continuing Education credit for this course, you must complete the online test. Please go to: www.dentalcare.com/en-US/dental-education/continuing-education/ce88/ce88-test.aspx

1. The position of the American Dental Association on the use of dental amalgam is best described as _______________.
   a. all amalgams should be removed
   b. based on current evidence, amalgam is a safe material for patient use and there is no cause for public concern about future or existing amalgam restorations
   c. mercury vapor is not released in any amount from dental amalgam and is therefore safe
   d. the use of amalgam is unsafe and should be phased out

2. A patient who develops or has an immediate reaction to an amalgam restoration must be allergic to mercury. No problems are associated with alternative restorative materials.
   a. The first statement is true. The second statement is false.
   b. The first statement is false. The second statement is true.
   c. Both statements are true.
   d. Both statements are false.

3. The dental professional is at greatest risk of overexposure to mercury from _______________.
   a. absorption through direct or indirect skin contact
   b. ingestion of metallic mercury
   c. inhalation of mercury vapor or mercury particles
   d. contact with organic mercury compounds

4. Mercury vapor is invisible, odorless and tasteless. The lower the temperature, the greater the rate of vaporization.
   a. The first statement is true. The second statement is false.
   b. The first statement is false. The second statement is true.
   c. Both statements are true.
   d. Both statements are false.

5. Humans are exposed to mercury from _______________.
   a. industrial sources
   b. dental amalgams
   c. natural sources
   d. dietary intake
   e. All of the above.

6. The type of mercury of concern in dentistry is/are _______________.
   a. organic
   b. elemental
   c. inorganic
   d. All of the above.

7. The amount of mercury exposure to the dental team during an average day, with good mercury hygiene, is _______________.
   a. not a health risk
   b. a potential health risk
   c. a definite health risk
8. Unused scrap amalgam is referred to as ______________ amalgam.
   a. non-contact
   b. contact
   c. None of the above.

9. Mercurial hypersensitivity can best be described as ________________.
   a. a disease process
   b. mercury poisoning
   c. an allergic reaction
   d. mercury toxicity

10. Most people who have mercurial hypersensitivity develop symptoms within _____________.
    a. 2 weeks
    b. 6 months
    c. 24 hours
    d. 2 years

11. Some important factors to consider when assessing ambient air concentrations of mercury are ________________.
    a. temperature, quantity of mercury particles, air circulation
    b. temperature, type of amalgam capsule, air circulation
    c. temperature only
    d. air circulation only

12. Symptoms of mercury poisoning are not easily recognized because they are often confused with other common illnesses. Vacuum pump filters should be disposed of in a red biohazard bag.
    a. The first statement is true. The second statement is false.
    b. The first statement is false. The second statement is true.
    c. Both statements are true.
    d. Both statements are false.

13. The best type of flooring in a dental operatory is ________________.
    a. tile
    b. high quality wood
    c. carpet
    d. seamless vinyl

14. The high speed evacuator is the best way to get rid of non-contact amalgam. Stored scrap amalgam should be kept in a glass container.
    a. The first statement is true. The second statement is false.
    b. The first statement is false. The second statement is true.
    c. Both statements are true.
    d. Both statements are false.

15. Some common symptoms of mercury toxicity are ________________.
    a. tremors
    b. insomnia
    c. emotional changes
    d. headaches
    e. All of the above.
16. **Mercury is _______________.**  
   a. a poor conductor of electricity  
   b. a natural substance  
   c. only toxic when mixed with other substances  
   d. a light metal, liquid at room temperature

17. **The International Organization for Standardization standard for amalgam separators requires at least ________________ percent amalgam removal efficiency.**  
   a. 80  
   b. 95  
   c. 100  
   d. None of the above.

18. **After an amalgam capsule has been used it remains a potential source of mercury vapor. Dental personnel have higher concentrations of mercury in body fluids and tissues than the average population.**  
   a. The first statement is true. The second statement is false.  
   b. The first statement is false. The second statement is true.  
   c. Both statements are true.  
   d. Both statements are false.

19. **Non-contact amalgam waste includes each of the following EXCEPT ________________.**  
   a. amalgam particles removed during carving  
   b. unused mixed capsule  
   c. amalgam left over after tooth is filled  
   d. used amalgam capsule

20. **The dental sterilizer will emit mercury vapor _________________.**  
   a. during the processing period  
   b. when the door is opened after sterilization  
   c. during processing after it has reached the proper temperature  
   d. None of the above.
References

Suggested Readings
- American Dental Association. ADA Guidelines on Amalgam Accumulations in Dental Office Plumbing.
- American Dental Association. 2007 survey of current issues in dentistry: employee termination and embezzlement.
- NIOSH Pocket Guide to Chemical Hazards.
About the Author

Jennifer K. Blake, CDA, EFDA, MADAA

Jen Blake graduated from Indiana University School of Dentistry’s Dental Assisting Program in Fort Wayne, Indiana and received her certificate in expanded functions from Indiana University School of Dentistry in Indianapolis.

Her career started as a chairside assistant. After receiving her expanded functions training, Ms. Blake became a faculty member at the Indiana University School of Dentistry TEAM Clinic working with senior dental students teaching them how to work with expanded assistants in a private practice simulated environment. Jen went on to become an instructor at Professional Careers Institute, an ADA Accredited Dental Assisting Program in Indianapolis, Indiana, and later served as their Program Administrator and Placement Counselor. She is also a past Editorial Director for The Dental Assistant Journal.

A member of the American Dental Assistants Association since she was a student, Jen has served all positions in the Indianapolis Dental Assistants Society, Indiana Dental Assistants Association, Sixth District Trustee, Vice President and President-elect to the American Dental Assistants Association and served as ADAA President from 1997-1998. She is also a past member of the Indiana State Department of Health Radiological Technology Certification Committee.

Jen is certified by the Dental Assisting National Board, licensed in Indiana in limited dental radiography, holds certificates in Coronal Polishing and Caries Prevention Procedures from Indiana University School of Dentistry Continuing Education, and is a Master of the American Dental Assistants Association.

Ms. Blake served as the ADAA Director of Education and Professional Relations for 15 years and is currently the Vice President of Corporate Relations for the ADAA Foundation. Ms. Blake volunteers her time assisting chairside at the Kingsway Community Care Center in Indianapolis, IN.

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