International Academy of Oral Medicine and Toxicology (IAOMT) Position Statement against Dental Mercury Amalgam Fillings for Medical and Dental Practitioners, Dental Students, Dental Patients, and Policy Makers

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INTRODUCTION

**Position Statement Objectives:**¹

1) To end the use of dental mercury amalgam fillings. Many other mercurial medical devices and mercury-containing substances have been removed from use, including mercurial wound disinfectants, mercurial diuretics, mercury thermometers, and mercurial veterinary substances. In this era when the public is advised to be concerned about mercury exposure through fish consumption, dental mercury amalgam fillings should also be eliminated, especially because they are the predominant source of non-industrial mercury exposure in the general population.

2) To assist medical professionals and patients as a whole in understanding the scope of mercury in dental mercury amalgam fillings. The risk of illness or injury associated with the use of dental mercury presents an unreasonable, direct, and substantial danger to the health of dental patients, dental personnel, and the fetuses and children of dental patients and dental personnel.

3) To establish the health benefits of mercury-free, mercury-safe, and biological dentistry.

4) To educate dental and medical professionals, dental students, patients, and policy makers about safe removal of dental mercury amalgam fillings while raising the standards of scientific biocompatibility in dental practice.

**Regulations Overview:**

According to the [United States Food and Drug Administration](https://www.fda.gov) (FDA), “Dental amalgam is a mixture of metals, consisting of liquid (elemental) mercury and a powdered alloy composed of silver, tin, and copper. Approximately 50% of dental amalgam is elemental mercury by weight. The chemical properties of elemental mercury allow it to react with and bind together the silver/copper/tin alloy particles to form an amalgam. Dental amalgam fillings are also known as ‘silver fillings’ because of their silver-like appearance. Despite the name, ‘silver fillings’ do contain elemental mercury.”²

Millions of dentists around the world routinely use dental mercury amalgam to repair decayed teeth, but controversy has surrounded the use of mercury in dentistry since the 1800’s, when the neurotoxin was first widely introduced as a filling material. The American Society of Dental Surgeons, the predecessor to the American Dental Association, [made its members pledge not to use mercury because of its known toxicity.³](https://www.fda.gov) and in more recent years, government officials, scientists, dentists, consumers, and many others have raised serious concerns about the risks dental mercury poses to humans and to the environment at large.

**Global Regulations:**

- [Norway](https://www.fda.gov) banned dental amalgam in 2008.⁴
- [Sweden](https://www.fda.gov) banned the use of dental amalgam for almost all purposes in 2009.⁵
- [Denmark, Estonia, Finland, and Italy](https://www.fda.gov) use it for less than 5% of tooth restorations.⁶
- [Japan and Switzerland](https://www.fda.gov) have also restricted or almost banned dental amalgam.⁷
- [France](https://www.fda.gov) has recommended that alternative mercury-free dental materials be used for pregnant women, and [Austria, Canada, Finland, and Germany](https://www.fda.gov) have purposely reduced the use of dental amalgam fillings for pregnant women, children, and/or in patients with kidney problems.⁸
The United Nations Environment Programme’s Intercessional Negotiating Committee agreed upon the text of a global, legally-binding mercury treaty in January 2013, and over 100 nations have since signed the “Minamata Convention on Mercury.” The United States was the first country to give its support for ratification of the international agreement, and Annex A, Part II, includes the following initiatives with regards to dental mercury amalgam:  

(i) Setting national objectives aiming at dental caries prevention and health promotion, thereby minimizing the need for dental restoration;  
(ii) Setting national objectives aiming at minimizing its use;  
(iii) Promoting the use of cost-effective and clinically effective mercury-free alternatives for dental restoration;  
(iv) Promoting research and development of quality mercury-free materials for dental restoration;  
(v) Encouraging representative professional organizations and dental schools to educate and train dental professionals and students on the use of mercury-free dental restoration alternatives and on promoting best management practices;  
(vi) Discouraging insurance policies and programmes that favour dental amalgam use over mercury-free dental restoration;  
(vii) Encouraging insurance policies and programmes that favour the use of quality alternatives to dental amalgam for dental restoration;  
(viii) Restricting the use of dental amalgam to its encapsulated form;  
(ix) Promoting the use of best environmental practices in dental facilities to reduce releases of mercury and mercury compounds to water and land.

U.S. Regulations--States:  

In the United States, brochures have been created to educate patients about their choices for dental fillings in California, Connecticut, Maine, and Vermont. The brochures, some of which are legally required to be presented to dental patients, contain information about the release of mercury vapor from dental mercury amalgam fillings and concerns related to dental mercury amalgam usage, as well as information about mercury pollution to the environment caused by dental mercury.

U.S. Regulations--Occupational Safety and Health Administration (OSHA):  

Employee exposure to mercury is regulated in the United States by the 1970 Occupational Safety and Health Act and Workers’ Rights Handbooks from the United States Department of Labor’s Occupational Safety and Health Administration (OSHA), which establish that all employees have the right to know about the chemicals in their work environment. OSHA’s Hazard Communication Standard (HCS) states: “All employers with hazardous chemicals in their workplaces must have labels and safety data sheets [SDS] for their exposed workers, and train them to handle the chemicals appropriately. The training for employees must also include information on the hazards of the chemicals in their work area and the measures to be used to protect themselves.” Employers must also evaluate workplaces for allowable airborne concentrations, and they are supposed to keep a 30-year record of employee exposures and medical records. Employees have the right to access this information, and more on workers’ rights in regards to chemical exposures can be learned at https://www.osha.gov/Publications/pub3110text.html.
The purpose of the safety data sheets (SDS, formerly known as material safety data sheets, or MSDS) required by OSHA is to protect workers by supplying them with the most crucial facts about the hazardous materials at their jobsite, such as the physical properties of the material, proper storage and handling techniques, known health risks and essential emergency procedures. Thus, manufacturers of amalgam fillings must create these information sheets, and excerpts from just a few of the SDSs for dental amalgam includes compelling evidence about the known dangers of using mercury in fillings:

- **SDI; Permite; Lojic +; GS-80, GS-80 Spherical; F400; Ultracaps +; Ultracaps S; SDI Admix; SDI Spherical and New Ultrafine,- Capsules; Australia, Brazil, Ireland, and the USA; 2015:**
  - Hazard Identification/California Prop 65 Warning: “This product contains mercury, a chemical known to the State of California to cause birth defects or other reproductive harm.”
  - First Aid Measures: “May cause respiratory disorders including inflammation and fluid retention. Inhalation of mercury vapours at high concentration can cause dyspnea, coughing, fever, severe nausea, vomiting, excess salivation, kidney damage with renal shutdown.”
  - Toxicological Information/Chronic Health Effects: “Inhalation of mercury vapours, dusts or organic vapours, or skin absorption or mercury over long periods can cause mercurialism. Symptoms include tremors, inflammation of mouth and gums, excessive salivation, stomatitis, blue lines on gums, pain and numbness in extremities, weight loss, mental depression, and nervousness. Exposure may aggravate kidney disorders, chronic respiratory disease and nervous system disorders. May cause damage to blood, kidneys, liver, brain, peripheral nervous system, central nervous system.”

- **Kerr Corporation; Tytin FC ™; USA; 2014:**
  - First Aid Measures/Inhalation: “Adverse symptoms may include the following: reduced fetal weight, increase in fetal deaths, skeletal malformations, salivation, metallic taste, eye irritation, respiratory tract irritation, coughing, pulmonary edema, wheezing and breathing difficulties, headache, fever, nausea or vomiting, diarrhea, abdominal cramps and pain, muscle weakness / pain, mental confusion or disorientation.”
  - First Aid Measures/Skin Contact: “Adverse symptoms may include the following: reduced fetal weight, increase in fetal deaths, skeletal malformations.”
  - First Aid Measures/Ingestion: “Adverse symptoms may include the following: reduced fetal weight, increase in fetal deaths, skeletal malformations.”

- **Henry Schein; SDS acc. to OSHA HCS; Stratosphere, Ionosphere, Troposphere; USA; 2014:**
  - Hazard Identification/Classification: “Very toxic, Very toxic by inhalation, Toxic, May cause harm to the unborn child, Toxic: danger of serious damage to health by prolonged exposure through inhalation.”
  - Disposal Consideration: “Must not be disposed of together with household garbage. Do not allow product to reach sewage system.”
  - Toxicological Information: “Avoid exposure of mercury to pregnant person.”
U.S. Regulations--U.S. Food and Drug Administration (FDA):

In September of 2006, a joint panel of FDA scientific experts rejected an FDA White Paper’s assurances of the safety of dental mercury amalgam.\(^24\)

On July 28, 2008, the IAOMT submitted a public comment to FDA\(^25\) demanding dental mercury amalgam be classified in conformance with the mandate of the Medical Device Amendments of 1976.\(^26\) Nearly a year later, the IAOMT also filed a Citizen’s Petition to further influence FDA policy-making on amalgam. A few days after that, on July 28, 2009, FDA announced it was classifying dental mercury amalgam for the first time in Class II without requiring any significant special controls.\(^27\)

FDA’s Final Rule on this issue was published on August 4, 2009,\(^28\) and an FDA warning for dental mercury amalgam use in developing children and pregnant women (fetuses)\(^29\) was soon removed from the FDA website.

FDA also published an Addendum in support of its Final Rule,\(^30\) which attempted to address the recommendations of the joint panels that convened in September 2006 when they rejected the proclamations of dental mercury amalgam safety set forth in the FDA’s White Paper on amalgam fillings.\(^31\)

Following the issuance of the FDA’s Final Rule, the IAOMT sponsored a Petition for Reconsideration in 2009 which identified over 25 errors committed by FDA in its discussion of risk assessment principles.\(^32\)

Based on the IAOMT petition, the FDA scheduled a meeting of the Dental Products Panel of the Medical Devices Advisory Committee in December 2010. At the meeting, Dr. Suresh Kotagal, a pediatric neurologist at the Mayo Clinic announced: “…I think that there is really no place for mercury in children.”\(^33\) The 2010 Dental Products Panel encouraged the FDA to consider limiting dental mercury amalgam use in pregnant women and children and to consider labeling that would warn consumers about the risks of this mercury-containing product.\(^34\)

In spite of this meeting and international legislative actions, the U.S. Food and Drug Administration (FDA) currently “considers dental amalgam fillings safe for adults and children ages 6 and above.”\(^35\) However, details in the FDA’s public statements about dental mercury amalgam on its website have changed over the years, including information about its potentially harmful impact on pregnant women, fetuses, and children under the age of six. Importantly, there are no enforced FDA regulations for this susceptible population or any other population.

Due in part to concerns about this lack of protection, the IAOMT filed a lawsuit in 2014 against the FDA over its classification of dental mercury amalgam.\(^36\) As part of the case, the IAOMT secured an internal document from the FDA that had proposed restricting dental mercury amalgam use in pregnant and nursing women and children under the age of six, as well as individuals with mercury allergies and pre-existing kidney or neurological disease.\(^37\) Yet, allegedly for administrative reasons, the FDA communication (dated January 2012) was never released to the public.
IAOMT’s Position on Regulations:

Founded in 1984, the International Academy of Oral Medicine and Toxicology (IAOMT) is a worldwide organization of dentists, physicians, and research professionals devoted to the examination, compilation, and dissemination of scientific information about the biocompatibility of oral/dental materials. The fundamental mission of the IAOMT is to promote the health of the public. In this regard, the IAOMT continually reviews, composes, and shares analytical research and educational materials related to the biocompatibility of oral/dental materials.

Thus, this position statement was formulated by conducting a PubMed literature search, hand-searching an IAOMT collection of published literature, analyzing the available scientific data, reviewing personal experiences of IAOMT members in clinical settings, synthesizing expert opinions, funding relevant research to explore various aspects of dental mercury amalgam and non-amalgam alternate dental materials, and evaluating information about the issue provided by governmental authorities, health organizations, and environmental groups from around the world.

Additionally, this position statement clearly outlines significant quantities of reputable research and challenges the safety of dental mercury amalgam fillings by applying two cornerstones of public health policy: 1) risk assessment and 2) the precautionary principle.

1) **Risk assessment** has been defined by the FDA as follows: “Risk assessment consists of identifying and characterizing the nature, frequency, and severity of the risks associated with the use of a product. Risk assessment occurs throughout a product’s lifecycle, from the early identification of a potential product, through the premarketing development process, and after approval during marketing. Premarketing risk assessment represents the first step in this process prior to marketing.”

Risk assessment expert Dr. G. Mark Richardson was invited by the FDA to present the results of a major risk assessment analysis of dental mercury amalgam fillings at the 2010 FDA Dental Products Panel meeting. Dr. Richardson’s work, which established that millions of Americans exceed the intake of mercury vapor considered “safe” by the U.S. Environmental Protection Agency (EPA) due to the presence of dental mercury amalgam fillings, was published shortly thereafter. FDA’s report about the 2010 meeting noted: “The Panel deliberated on the exposure to mercury from dental amalgam, reference exposure levels, human clinical studies and the strength and weaknesses of the available evidence.”

Additionally, a conscientious and ethical deliberation of the data and analysis should include a second cornerstone of public health policy known as the precautionary principle.

2) In June 1992, the United Nations Environment Programme ratified the Rio Declaration on Environment and Development which, among other principles, established the precautionary approach among UNEP member states. In particular, Principle 15 states: “In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific
certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”

Further to the Rio Declaration, in January 1998, at an international conference involving scientists, lawyers, policy makers, and environmentalists from the United States, Canada and Europe, a formalized statement was signed and became known as the “Wingspread Statement on the Precautionary Principle.”

In it, the following advice is given: “When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. In this context the proponent of an activity, rather than the public, should bear the burden of proof.”

Based on scientific evidence, concepts of risk assessment, and the precautionary principle, it is our position that dental mercury amalgam fillings should not be used in dentistry. It should also be noted here that the IAOMT is concerned that dental mercury amalgam fillings are following the same delayed route to safety regulations as occurred with cigarettes and lead-based paint.

**SUGGESTED ACTION BY MEDICAL AND DENTAL PRACTITIONERS AND PATIENTS:***

**INTERVENTIONS**

**Summary of Interventions:**

1. The main ingredient for mercury amalgam fillings is mercury, approximately 50% by weight. Therefore, the appropriate terminology is “dental mercury amalgam fillings.”
2. Dental mercury amalgam fillings should not be used in dentistry.
3. The detrimental impact of mercury on fetuses, pregnant women, women of childbearing age, children, patients experiencing health issues, and dental workers mandate that special protection be provided to these populations with regards to dental mercury amalgam fillings.
4. Removal of existing dental mercury amalgam fillings requires safety measures for dentists, dental staff, dental students, and patients.

**Detail of Interventions:**

1) The main ingredient for mercury amalgam fillings is mercury, approximately 50% by weight. Therefore, the appropriate terminology is “dental mercury amalgam fillings.”

All dental amalgam restorations contain approximately 50% mercury, and reports and research are consistent that these fillings emit mercury vapors.

Thus, while these restorations are commonly referred to as “silver fillings,” “dental amalgam,” and/or “amalgam fillings,” the public is often unaware that amalgam refers to the combination of other metals with mercury. A 2014 Zogby poll established that 57% of Americans did not know that mercury is the main ingredient in amalgam fillings and that 63% thought the commonplace practice of referring to mercury amalgams as “silver fillings” was misleading.
It would be more appropriate therefore to recognize them as “dental mercury amalgam fillings,” “mercury silver fillings,” or “mercury fillings.” Terminology recognizing the main ingredient of mercury is needed so that medical and dental practitioners, dental students, patients, and policy makers are aware that mercury is the main ingredient in this medical device. As such, this document refers to these tooth restorations as “dental mercury amalgam fillings.”

Additionally, an understanding of the terminology associated with dentists that aim to end the use of dental mercury amalgam fillings and define how they practice is helpful to medical professionals and patients. These terms are commonly used, and dentists often choose one or several of these terms to describe their practice:

- “Mercury-free” is a term with a wide-range of implications, but it typically refers to dental practices that do not place dental mercury amalgam fillings.
- “Mercury-safe” typically refers to dental practices that use safety measures to limit or prevent mercury exposure, such as in the case of removing previously existing dental mercury amalgam fillings and replacing them with non-mercury alternatives.
- “Biological” or “Biocompatible” dentistry typically refers to dental practices that utilize mercury-free and mercury-safe dentistry while also considering the impact of dental conditions, devices, and treatments on oral and systemic health, including the biocompatibility of dental materials and techniques.

2) Dental mercury amalgam fillings should not be used in dentistry.

Exposure to mercury, even in minute amounts, is known to be toxic and poses significant risks to human health. A 2005 World Health Organization report warned of mercury: “It may cause harmful effects to the nervous, digestive, respiratory, immune systems and to the kidneys, besides causing lung damage. Adverse health effects from mercury exposure can be: tremors, impaired vision and hearing, paralysis, insomnia, emotional instability, developmental deficits during fetal development, and attention deficit and developmental delays during childhood. Recent studies suggest that mercury may have no threshold below which some adverse effects do not occur.”

Scientific research demonstrates that dental mercury amalgam exposes dental professionals, dental staff, dental patients, and fetuses to releases of mercury vapor, mercury-containing particulate, and/or other forms of mercury contamination. Dental mercury amalgam is therefore not a suitable material for dental restorations.

Furthermore, mercury vapor is known to be released from dental mercury amalgam fillings at higher rates during brushing, cleaning, clenching of teeth, chewing, etc., and mercury is also known to be released during the placement, replacement, and removal of dental mercury amalgam fillings. A series of studies demonstrate that urinary mercury concentrations consistently increase as the number of amalgam fillings increases. In these studies, the average urine mercury content is consistently greater in groups with amalgam fillings than in those without, and urine mercury content consistently increases as the number of dental mercury amalgam fillings increases.
Numerous studies have also demonstrated that the mercury exposure or concentration increases in the following tissues and situations:

- Due to chewing, brushing, and/or bruxism
- In exhaled or intra-oral air of persons with amalgam fillings
- In saliva of persons with amalgam fillings
- In blood of persons with amalgam fillings
- In various organs and tissues of amalgam bearers, including the kidney, liver, pituitary gland, thyroid, and brain or parts thereof
- In feces of amalgam bearers
- In amniotic fluid, cord blood, placenta, and various fetal tissues including liver, kidney and brain, in association with maternal amalgam load
- In saliva of persons with amalgam fillings
- In various tissues and organs of amalgam bearers, including the kidney, liver, pituitary gland, thyroid, and brain or parts thereof
- In blood of persons with amalgam fillings
- In saliva of persons with amalgam fillings
- In feces of amalgam bearers
- In amniotic fluid, cord blood, placenta, and various fetal tissues including liver, kidney and brain, in association with maternal amalgam load
- In colostrum and breast milk in association with maternal amalgam load

Scientific evidence confirms that in most individuals with dental mercury amalgam fillings, mercury exposure exceeds the Reference Exposure Level (REL). [REL is a term used to denote the exposure level defined by national and international regulatory agencies at which there is an expectation of no negative health outcomes within the population.]

Also, reports from the World Health Organization (WHO) and Canada’s federal department of health (Health Canada) conclude that mercury vapor from dental amalgam is the greatest source of human exposure to mercury in non-industrial settings.

Additionally, in research published in 2011, Dr. G. Mark Richardson reported that more than 67 million Americans aged two years and older exceed the intake of mercury vapor considered “safe” by the U.S. EPA due to the presence of dental mercury amalgam fillings, whereas over 122 million Americans exceed the intake of mercury vapor considered “safe” by the California EPA due to their dental mercury amalgam fillings.

3) The detrimental impact of mercury on fetuses, pregnant women, women of childbearing age, children, patients experiencing health issues, and dental workers mandate that special protection be given to these populations with regards to dental mercury amalgam fillings.

Mercury’s damaging influence on the developing brain and neurological system makes dental mercury amalgam fillings an inappropriate material for use in children, pregnant women, and women of childbearing age. In fact, research has repeatedly shown the potential for significant impacts to pregnant women, fetuses, and children as a result of dental mercury.

Additionally, physicians and dentists should, where patients are suffering from pathological states and/or disease of unclear causation, consider in their differential diagnosis whether exposure to mercury released from dental mercury amalgam fillings might be a contributing or exacerbating factor in such adverse health conditions. This is because dental mercury amalgam has been associated with a wide-range of adverse health conditions.

It should also be remembered that reactions to mercury exposures vary from person to person, including exposures to dental mercury.
Finally, dentists, dental staff, and dental students are exposed to mercury at a greater rate than their patients. Severe exposures from past practices include hand-squeezing of fresh amalgam, where drops of liquid mercury could run over the dentist’s hands and contaminate the entire office. Dangerous levels of mercury are still generated in the dental workplace, and research has clearly identified that exposure to these mercury levels can cause ill-health to dental workers and dental students. Another area that has received much attention is the possibility of reproductive hazards to female dental personnel, including menstrual cycle disorders, fertility issues, and pregnancy risks.

Dental workers require protection from mercury exposures when working with dental mercury amalgam, and a variety of studies have specifically called for protective measures to be taken in the dental office as a means of limiting mercury releases.

4) Removing dental mercury amalgam fillings requires safety measures for dentists, dental staff, and patients.

Chronic (low dose, long-term) exposure to mercury for dentists, dental staff, dental students, and dental patients does not exist when alternative materials are used for dental fillings. However, there is a high risk of acute (high dose, short-term) mercury exposure to dentists, dental staff, dental students, and dental patients when dental mercury amalgam fillings are drilled out. Essentially, an unsafe amalgam removal process releases mercury vapor and particles that can be harmful to the patient, the dentist, the dental staff, and the environment. Obviously, the danger to the patient is increased since mercury is being released directly into the mouth and lungs.

There are levels of increasing protection for limiting exposure during mercury-related dental procedures. Depending on the level of protection, health risks will vary. The challenge is training dentists from around the globe to use effective engineering controls and personal protective equipment as they remove the thousands of tons of mercury currently stored in the mouths of patients with dental mercury amalgam fillings. An additional challenge is training U.S. dentists to properly comply with both the current OSHA standards and the EPA standards.

Utilizing the most up-to-date science and research, the IAOMT has developed extensive safety recommendations for removal of existing dental mercury amalgam fillings, including detailed protective measures that are to be utilized for the procedure. The IAOMT’s innovative recommendations build upon traditional safe amalgam removal techniques such as the use of masks, water irrigation, and high volume suction by supplementing these conventional strategies with a number of additional protective measures, the need for which have only recently been identified in scientific research. The IAOMT’s Safe Mercury Amalgam Removal Technique (SMART) is described in more detail on pages 12-13 below.
OUTCOMES CONSIDERED

Individual Response:

First, it should be noted that mercury influences each individual differently based on a wide-range of co-existing factors.\textsuperscript{351} For example, other health conditions (specified throughout this document), the number of amalgam fillings in the mouth,\textsuperscript{352} 353 354 355 356 357 358 359 360 361 362 363 364 gender,\textsuperscript{365} 366 367 368 369 370 genetic predisposition,\textsuperscript{371} 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 dental plaque,\textsuperscript{389} selenium levels,\textsuperscript{390} exposure to lead,\textsuperscript{391} 392 393 394 consumption of milk\textsuperscript{395} 396 or alcohol,\textsuperscript{397} methylmercury levels from fish consumption,\textsuperscript{398} the potential for mercury from dental amalgam fillings to be transformed into methylmercury within the human body,\textsuperscript{399} 400 401 402 403 404 and other circumstances\textsuperscript{405} 406 can play a role in each person’s unique response to mercury.

In the same way that individual response influences reactions to mercury exposures, individual response also varies from patient to patient upon amalgam removal. That being said, research does support the fact that many patients benefit from having their amalgams removed and replaced with an alternative material. A few examples of conditions reportedly improved and/or cured as a result of removing dental metal allergens include amyotrophic lateral sclerosis,\textsuperscript{407} chronic fatigue syndrome,\textsuperscript{408} dermatitis,\textsuperscript{409} fibromyalgia,\textsuperscript{410} multiple sclerosis,\textsuperscript{411} oral lichen planus,\textsuperscript{412} 413 414 oral lichenoid lesion,\textsuperscript{415} 416 417 orofacial granulomatosis,\textsuperscript{418} and other symptoms.\textsuperscript{419} In addition to the recovery situations mentioned above related to dental allergies, research has likewise documented the reduction of other health issues after the removal of mercury amalgam fillings.\textsuperscript{420} 421 422 423 424 425 426 427 428 429 430

Amalgam Removal:

However, an outcome of dental mercury amalgam removal is acute exposure to mercury vapor and particulate for dentists, dental staff, dental students, and dental patients,\textsuperscript{431} 432 433 434 435 436 437 especially endangering pregnant women, lactating women, women of childbearing age, fetuses, children, and other sensitive populations.

Other than primary exposures during dental mercury amalgam removal, secondary exposures in less obvious areas of the dental office are emerging as additional sources of chronic mercury exposures. Some of these peripheral exposures include the following:

- mercury exposure to staff, patients, and visitors in other parts of the office not directly involved in the removal process
- environmental mercury exposure caused by the waste from removal and storage of amalgam, especially because the ADA’s “\underline{Best Management Practices for Amalgam Waste}”\textsuperscript{439} is voluntary
- storage and disposal of workplace protective clothing and instruments used during procedures involving dental mercury amalgam
- mercury vapor exposure from sterilization of instruments used on dental mercury amalgam fillings
- mercury vapor and particulate on the clothing, and under/around the dentist, staff, dental students, and patients in the immediate removal area
- mercury particulate that is carried home in hair, on shoes, and other clothing from the dental office
To assist in mitigating the potential negative outcomes of both primary and secondary mercury exposure during amalgam removal, the IAOMT has developed new safety recommendations for removal of existing dental mercury amalgam fillings to protect dental professionals, students, staff members, patients, and others from mercury exposure.440

More specifically, the IAOMT’s Safe Mercury Amalgam Removal Technique (SMART) includes the following practices, which are cited here with scientific research supporting each step of the technique:

An amalgam separator must be properly installed, utilized, and maintained to collect mercury amalgam waste so that it is not released into the effluent from the dental office.441 442 443 444 445 446 447 448 449 450 451 452

Each room where mercury fillings are removed must have adequate filtration in place,453 454 455 which requires a high-volume air filtration system (such as an at source oral aerosol vacuum) capable of removing mercury vapor and amalgam particles generated during the removal of one or more mercury fillings.456 457 458

If possible, windows should be opened to reduce the mercury concentration in the air.459 460 461 462 463

The patient will be given a slurry of charcoal, chlorella, or similar adsorbent to rinse and swallow before the procedure (unless the patient declines or there are other contraindications making this clinically inappropriate).464 465 466 467

Protective gowns and covers for the dentist, dental personnel, and the patient must be in place.468 All present in the room must be protected because substantial quantities of particles generated during the procedure will elude collection by suction devices.469 It has been demonstrated that these particles can be spread from the patient’s mouth to the patient’s knee, and to the chest, shoulder, and neck of the dentist and dental assistant.470

Non-latex nitrile gloves must be utilized by the dentist and all dental personnel in the room.471 472 473 474 475

Face shields and hair/head coverings are to be utilized by the dentist and all dental personnel in the room.476 477

Either a properly-sealed, respiratory grade mask rated to capture mercury or a positive pressure, properly-sealed mask providing air or oxygen must be worn by the dentist and all dental personnel in the room.478 479 480 481 482 483

In order to protect the patient’s skin and clothing, a full body, impermeable barrier, as well as a full head/face/neck barrier under/around the dam, need to be utilized.482 483
External air or oxygen delivered via a nasal mask for the patient also needs to be utilized to assure the patient does not inhale any mercury vapor or amalgam particulate during the procedure. A nasal cannula is an acceptable alternative for this purpose as long as the patient’s nose is completely covered with an impermeable barrier.

A dental dam that is made with non-latex nitrile material must be placed and properly sealed in the patient’s mouth.

A saliva ejector must be placed under the dental dam to reduce mercury exposure to the patient.

During amalgam filling removal, the dentist must utilize an at source oral aerosol vacuum in close proximity to the operating field (i.e., two to four inches from the patient’s mouth) to mitigate mercury exposure.

High speed evacuation produces better capture when fitted with a Clean Up device, which is not mandatory but is preferred.

Copious amounts of water to reduce heat and a conventional high speed evacuation device to capture mercury discharges are required to reduce ambient mercury levels.

The amalgam needs to be sectioned into chunks and removed in as large of pieces as possible, using a small diameter carbide drill.

Once the removal process is complete, the patient’s mouth should be thoroughly flushed with water and then rinsed out with a slurry of charcoal, chlorella or similar adsorbent.

Dentists must comply with federal, state, and local regulations addressing the proper handling, cleaning, and/or disposal of mercury-contaminated components, clothing, equipment, surfaces of the room, and flooring in the dental office.

During the opening and maintenance of suction traps in operatories or on the main suction unit, dental staff should utilize the appropriate personal protection equipment described above.

**Alternatives to Amalgams:**

Obviously, once amalgams have been removed, they must be replaced with a different dental filling material. Alternatives to amalgam include composite resin, glass ionomer, porcelain, and gold, among other options. Most consumers choose direct composite fillings because the white coloring matches the tooth better and the cost is considered moderate. In support of this fact, a 2007 poll showed that just less than half of dentists in the U.S. are using dental mercury amalgam.
In the past, a common argument against composite fillings was that they were not as durable as amalgam. However, recent studies have debunked this claim. Researchers of a study which was published in 2016 and conducted on over 76,000 patients for over ten years found that posterior amalgam fillings had a higher annual failure rate than composites.\textsuperscript{526} Two separate studies published in 2013 found that composite fillings performed as well as amalgam when comparing failure rates\textsuperscript{527} and replacement filling rates.\textsuperscript{528} Other research has offered similar findings: a study published in 2015 documented “good clinical performance” of composite resins over a 30-year evaluation,\textsuperscript{529} a meta-analysis published in 2014 noted “good survival” of posterior resin composite restorations,\textsuperscript{530} a study published in 2012 showed certain types of composite materials last as long as amalgam,\textsuperscript{531} and a study published in 2011 found “good clinical performance” of composites over a 22-year period.\textsuperscript{532}

Composite fillings have also been criticized because some of them contain the controversial material bisphenol-A (BPA). Dentists have a variety of opinions about the safety of BPA and other types of bisphenol, such as Bis-GMA and Bis-DMA. Patients who are concerned about bisphenol-containing dental material often choose to speak with their dentists about using a material that does not contain the ingredient. For example, a product named Admira Fusion\textsuperscript{533}/Admira Fusion X-tra\textsuperscript{534} released in January 2016 by the dental company VOCO is being touted as “the first purely ceramic-based restorative material”\textsuperscript{535} and does not contain Bis-GMA or BPA before or after it has been cured.

Another option for dental patients concerned about which mercury-free alternative to use as a filling material is to do their own research and/or take a dental biocompatibility test. If biological testing is used, a patient’s blood sample is sent to a laboratory where the serum is evaluated for the presence of IgG and IgM antibodies to the chemical ingredients used in dental products.\textsuperscript{536} The patient is then provided with a detailed list of which name-brand dental materials are safe for their use and which ones could result in a reaction. Two labs that currently offer this service are Biocomp Laboratories\textsuperscript{537} and Clifford Consulting and Research.\textsuperscript{538}

Composites and all replacement materials should also be assessed for safety and biocompatibility with special consideration for all populations and all known risk factors.\textsuperscript{539}

**Susceptible Populations:**

In conclusion, the following populations could substantially reduce the risk of harm from mercury exposure by taking the suggested measures:

1) Minimization of exposure to dental mercury, vapor, and particulate for

- All dental professionals, dental staff (including hygienists), and dental students who work with dental mercury amalgam
- All patients with existing dental mercury amalgam fillings
- All patients requiring the cleaning and/or removal of dental mercury amalgam fillings

2) Avoidance of dental mercury amalgam fillings for

- All patients requiring new dental fillings
• Pregnant or lactating women
• Women of childbearing age
• Fetuses
• Children
• Patients genetically predisposed to mercury toxicity
• Patients with
  o Allergies, especially allergy to mercury
  o Alzheimer’s disease
  o Amyotrophic lateral sclerosis (Lou Gehrig’s disease)
  o Antibiotic resistance
  o Autism spectrum disorders
  o Autoimmune disorders/immunodeficiency
  o Cardiovascular problems
  o Chronic fatigue syndrome
  o Complaints of unclear causation
  o Hearing loss
  o Kidney disease
  o Micromercurialism
  o Multiple sclerosis
  o Oral lichenoid reaction and oral lichen planus
  o Parkinson’s disease
  o Periodontal disease
  o Psychological issues such as depression and anxiety
  o Reproductive dysfunction
  o Suicidal ideations
  o Symptoms of chronic mercury poisoning
  o Thyroiditis
• Patients undergoing chelation treatment or other detoxification treatments

MAJOR RECOMMENDATIONS

Recommendations:

1) Dental mercury amalgam fillings should not be used in dentistry.

2) Furthermore, safety precautions should be taken when working with and/or removing previously existing dental mercury amalgam fillings so as not to expose dentists, dental staff, dental students, dental patients, and their fetuses and breast-feeding children to mercury.

3) Moreover, based on scientific evidence, the practice of mercury-free dentistry [dentistry that does not place any new mercury amalgam fillings] and mercury-safe dentistry [dentistry that utilizes protective measures when removing existing mercury amalgam fillings] as a means of improving public health should especially be considered for the following reasons:
WORKPLACE EXPOSURE:
- Dentists, dental professionals, dental staff, and dental students are occupationally and chronically exposed to mercury released from dental mercury amalgam, and researchers and clinicians have raised concerns about the safety of dental personnel and students who work with dental mercury amalgam.
- This includes mercury released during hygiene, cleaning, and polishing procedures.
- This includes mercury released during removal of old mercury amalgam fillings and replacement with new ones.
- Scientific data indicates that female dental personnel are uniquely impacted by occupational exposure to mercury.

PATIENT EXPOSURE:
- Mercury vapor is continuously emitted from dental mercury amalgam fillings, and particulate can also be discharged from dental mercury amalgam fillings, which means that people are directly exposed to mercury as a result of their dental mercury amalgam fillings.
- The output of mercury is intensified by the number of fillings present and other activities such as chewing, teeth-grinding, brushing, dental treatments and procedures, and the consumption of hot liquids.
- This includes mercury released during hygiene, cleaning, and polishing procedures.
- This includes mercury released during placement of new restorations and removal of old ones.
- Ergo, men, women, and children patients are all at risk from the hazards of mercury released from dental mercury amalgam fillings.

GENETIC PREDISPOSITION:
- Mercury exposure from dental mercury amalgam particularly threatens individuals with genetic variants that can impact their response to mercury exposures such as those with CPOX4, APOE(3,4), and BDNF polymorphisms.
- Recent research has identified a genetic predisposition to neurological impacts by mercury exposure from dental amalgam in male children with the polymorphism CPOX4.

WOMEN AND CHILDREN:
- Fetal and infant exposure to mercury is known to have potentially serious health consequences, and the number of maternal amalgam fillings has been associated with mercury levels in cord blood, in the placenta, in the kidneys and liver of fetuses; in fetal hair, and in the brain and kidneys of infants.
• Mercury is excreted in breast milk of mothers with dental mercury amalgam fillings, and the mercury concentration in breast milk increases as the number of amalgam fillings in the mother increases.\textsuperscript{674 675 676 677}

• Additional research has likewise examined the potential dangers that dental amalgam mercury poses to pregnant women, their fetuses, and infants.\textsuperscript{678 679 680 681 682 683 684 685 686 687}

• Children are also at-risk for health impairments linked to dental amalgam mercury fillings.\textsuperscript{688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704}

○ ADDITIONAL AT-RISK POPULATIONS:

  - The mercury in dental mercury amalgam fillings can exacerbate and/or contribute to all of the conditions stated below, as well as a myriad of other health problems:
    - Patients with
      - Allergies\textsuperscript{705 706 707}
      - Alzheimer’s disease\textsuperscript{708 709 710}
      - Amyotrophic lateral sclerosis (Lou Gehrig’s disease)\textsuperscript{711}
      - Antibiotic resistance\textsuperscript{712 713 714 715}
      - Autism spectrum disorders\textsuperscript{716 717 718}
      - Autoimmune disorders/immunodeficiency\textsuperscript{719 720 721 722 723 724 725 726 727 728}
      - Cardiovascular problems\textsuperscript{729 730 731}
      - Chronic fatigue syndrome\textsuperscript{732 733 734 735}
      - Complaints of unclear causation\textsuperscript{736 737 738 739 740 741}
      - Hearing loss\textsuperscript{742}
      - Kidney disease\textsuperscript{743 744 745 746 747 748 749 750}
      - Micromercurialism\textsuperscript{751}
      - Multiple sclerosis\textsuperscript{752 753 754 755}
      - Oral lichenoid reaction\textsuperscript{756 757 758 759 760 761 762} and oral lichen planus\textsuperscript{763 764 765}
      - Parkinson’s disease\textsuperscript{766 767 768}
      - Periodontal disease\textsuperscript{769 770}
      - Psychological issues such as depression and anxiety\textsuperscript{771 772 773 774 775 776}
      - Reproductive dysfunction\textsuperscript{777 778}
      - Suicidal ideations\textsuperscript{779 780}
      - Symptoms of chronic mercury poisoning\textsuperscript{781}
      - Thyroiditis\textsuperscript{782 783}
    - Patients undergoing chelation treatment or other detoxification treatments

○ ALLERGY TO MERCURY:

  - This is a completely separate health issue from toxicity.
  - Based on statistics from the North American Contact Dermatitis Group,\textsuperscript{784} it is estimated that approximately 21 million Americans are allergic to mercury. However, this figure could be even higher because recent studies and reports tend to agree that metal allergies are on the rise.\textsuperscript{785 786}
Most patients are not tested for dental metal allergies, but, according to statistics in scientific research, millions of patients are allergic or sensitive to the dental mercury amalgam fillings in their mouths because of the mercury or the other components. In addition to research that demonstrates this is a pertinent issue, a number of patients with health conditions linked to dental metal allergies have improved or recovered from their ailments after removal of their fillings.

Studies also establish that exposure to dental mercury amalgam fillings correlates with higher prevalence of mercury allergies.

**Additional Data Supporting Recommendations:**

The data on the following pages provide additional information about the hazards of dental mercury amalgam fillings and mercury exposure presented in these recommendations:

**TABLE/CHART #1:** This chart shows that dental mercury amalgam is the major route of mercury exposure for the general public.

**Sources of Human Mercury Exposure (World Health Organization [WHO], 1991)**

*Note: In 1991, the WHO Environmental Health Criteria 118 concluded that “[e]stimated average daily intake and retention” from dental amalgam was 3.8-21 (3-17) ug/day. In the 2003 Executive Summary of this document, WHO stated: “Dental amalgam constitutes a potentially significant source of exposure to elemental mercury, with estimates of daily intake from amalgam restorations ranging from 1 to 27 ug/day.” [Emphasis added]*
**TABLE/CHART #2:** This is a list of common symptoms of elemental mercury vapor inhalation to be considered by practitioners when evaluating the possible side effects of dental mercury amalgam:

<table>
<thead>
<tr>
<th>Acrodynia or similar symptoms such as emotional instability, loss of appetite, general weakness, and skin changes (Magos and Clarkson, 2006)</th>
<th>Anorexia (Bernhoft, 2011)</th>
<th>Cardiovascular problems/ labile pulse [frequent changes in heart rate/tachycardia [abnormally rapid heartbeat] (Klassen, 2008)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive/neurological impairments/memory loss/decrease in mental function/difficulties with verbal and visual processing (Echeverria et al., 1998; Clarkson and Magos, 2006; Magos and Clarkson, 2006; Syversen and Kaur, 2012; USEPA, 2016)</td>
<td>Delusions/delirium/hallucination (Bernhoft, 2011; Syversen and Kaur, 2012)</td>
<td>Dermatological conditions/ dermatographism [skin condition characterized by raised red marks]/dermatitis (Bernhoft, 2011; Klassen, 2008)</td>
</tr>
<tr>
<td>Endocrine disruption/enlargement of thyroid (Bernhoft, 2011; Klassen, 2008)</td>
<td>Erethism [symptoms such as irritability, abnormal responses to stimulation, and emotional instability] (Bernhoft, 2011; Clarkson et al., 2003; Clarkson and Magos, 2006; Magos and Clarkson, 2006)</td>
<td>Fatigue (Bernhoft, 2011; Echeverria et al., 1998)</td>
</tr>
<tr>
<td>Headaches (USEPA, 2016)</td>
<td>Hearing loss (Rothwell and Boyd, 2008)</td>
<td>Immune system impairments</td>
</tr>
<tr>
<td>Insomnia (USEPA, 2016)</td>
<td>Nerve response changes/peripheral neuropathy/decreased coordination/ decreased motor function/ polyneuropathy/neuromuscular changes such as weakness, muscle atrophy, and twitching (Bernhoft, 2012; Clarkson et al., 2003; Clarkson and Magos, 2006; Echeverria et al., 1998; USEPA, 2016)</td>
<td>Oral manifestations/ gingivitis/metallic taste/oral lichenoid lesions/stomatitis/salivation (Bernhoft, 2011; Camisa et al., 1999; Clarkson et al., 2003; Clarkson and Magos, 2006; Klassen, 2008; Magos and Clarkson, 2006)</td>
</tr>
<tr>
<td>Psychological issues/mood changes related to anger, depression, excitability, irritability, mood swings, and nervousness (Echeverria et al., 1998; Klassen, 2008; Magos and Clarkson, 2006; USEPA, 2016)</td>
<td>Renal [kidney] problems/ proteinuria/nephrotic syndrome (Bernhoft, 2011; Clarkson et al., 2003; Clarkson and Magos, 2006; Klassen, 2008; USEPA, 2016; Syversen and Kaur, 2012)</td>
<td>Respiratory problems/ bronchial irritation/bronchitis/cough/ dyspnea [breathing difficulties]/ pneumonitis/respiratory failure (Bernhoft, 2011; Clarkson et al., 2003; Echeverria et al., 1998; Klassen, 2008; Magos and Clarkson, 2006; Syversen and Kaur, 2012; USEPA, 2016)</td>
</tr>
</tbody>
</table>
EVALUATION OF SUGGESTED ACTION:

POTENTIAL BENEFITS

By minimizing mercury exposure from dental mercury amalgam fillings or completely avoiding the use of dental mercury amalgam fillings, an individual’s total body burden of mercury is beneficially reduced.

Minimizing or eliminating mercury exposure can potentially result in improvement and/or decreased risk of disease/illness/health impairments for

- All dental professionals, dental staff (including hygienists), and dental students who work with dental mercury amalgam
- All patients with existing dental mercury amalgam fillings
- All patients requiring the cleaning and/or replacement of dental mercury amalgam fillings
- All patients requiring new dental fillings
- Pregnant or lactating women
- Women of childbearing age
- Fetuses
- Children
- Patients genetically predisposed to mercury toxicity
- Patients with
  - Allergies
  - Alzheimer’s disease
  - Amyotrophic lateral sclerosis (Lou Gehrig’s disease)
  - Antibiotic resistance
  - Autism spectrum disorders
  - Autoimmune disorders/immunodeficiency
  - Cardiovascular problems
  - Chronic fatigue syndrome
  - Complaints of unclear causation
  - Hearing loss
  - Kidney disease
  - Micromercurialism
  - Multiple sclerosis
  - Oral lichenoid reaction and oral lichen planus
  - Parkinson’s disease
  - Periodontal disease
  - Psychological issues such as depression and anxiety
  - Reproductive dysfunction
  - Suicidal ideations
  - Symptoms of chronic mercury poisoning
  - Thyroiditis
- Patients undergoing chelation treatment or other detoxification treatments
As far as considering the costs of implementing these recommendations, in a report entitled “The Economics of Dental Amalgam Regulation,” the authors noted that amalgam use is already declining and that restrictions on mercury are inevitable. The authors concluded, “We can then make the case that the overall health care expenditures necessary to deal with diseases and conditions, known or unknown, arising from the continued installation of amalgam could far exceed the relatively manageable cost increases to the consumer for the alternatives…This is not to mention the cost to the U.S. economy of lost work time owing to concomitant illness and disability.”

Additionally, the IAOMT co-released a 2012 report from Concorde of Brussels, Belgium, which noted: “In order to obtain a useful perspective on the ‘external’ costs to society that are not included in the fees a dental patient pays the practitioner, we have examined 1) the costs of keeping dental mercury releases from being released into the environment, and 2) when dental mercury is no longer released into the environment, the various benefits accrued to human health and society. …[W]hichever analytical approach one chooses, even when using conservative assumptions, and even allowing for the uncertainties inherent in much of the cost data, it is clear that the real cost of using amalgam far outweighs the cost of using mercury-free composite, not to mention an even cheaper alternative such as ART.”

Yet, from a consumer standpoint, some insurance companies only cover the cost of dental mercury amalgam fillings, which means that oftentimes patients have to pay additional fees for alternative materials and techniques. However, the United Nations Environmental Programme (UNEP)’s 2013 “Minamata Convention on Mercury,” signed by over 100 nations including the U.S., specifically discourages insurance policies and programs favoring dental mercury amalgam use over mercury-free dental restoration.

Since some countries have successfully eliminated dental mercury amalgam, ending the use of mercury in dentistry has already proven to be both feasible and economical. For example, Carsten Lassen and Jakob Maag, of the Nordic Council of Ministers, shared the following observation with a committee of the United Nations in 2010: “Dental treatment without mercury is becoming the norm.”

**POTENTIAL HARMS**

1) There is a risk of additional mercury exposure to dentists, dental staff, hygienists, dental students, and patients from current unsafe procedures involving mercury amalgam fillings, especially if treatment, hygiene routines, removal, and/or replacement of fillings are conducted without taking appropriate protective measures.

2) As such, special consideration of any dental work involving amalgam mercury fillings should be given to
   - All dental professionals, dental staff (including hygienists), and dental students who work with dental mercury amalgam
   - All patients with existing dental mercury amalgam fillings
   - All patients requiring the cleaning and/or removal of dental mercury amalgam fillings
   - All patients requiring new dental fillings
Pregnant or lactating women
Women of childbearing age
Fetuses
Children
Patients genetically predisposed to mercury toxicity
Patients with
  o Allergies
  o Alzheimer’s disease
  o Amyotrophic lateral sclerosis (Lou Gehrig’s disease)
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  o Psychological issues such as depression and anxiety
  o Reproductive dysfunction
  o Suicidal ideations
  o Symptoms of chronic mercury poisoning
  o Thyroiditis
Patients undergoing chelation treatment or other detoxification treatments

3) Alternative dental restorative materials should likewise be assessed for safety and biocompatibility, especially on an individual basis.

4) Some insurance companies only cover the cost of dental mercury amalgam fillings which means that oftentimes consumers have to pay additional fees for alternative materials and techniques.832

Furthermore, whereas amalgams are used for 45% of all direct dental restorations worldwide,833 articles published in the Journal of the American Dental Association have established that these mercury fillings are used on 51.0% of White/Caucasian Americans, on 53.4% of Black/African Americans, on 72.9% of American Indians/Alaska Natives/Asians/Pacific Islanders,834 and on more than 75% of posterior restorations for new recruits to the U.S. Navy and Marines.835

However, the United Nations Environmental Programme’s 2013 “Minamata Convention on Mercury,” signed by over 100 nations including the United States, specifically discourages insurance policies and programs favoring dental mercury amalgam use over mercury-free dental restoration.836
CONTRAINDICATIONS

1) Dentists, dental staff, and dental students working with mercury amalgam fillings during procedures such as cleaning, hygiene, and/or replacement are significantly exposed, along with their patients, fetuses, and breast-feeding children to mercury. Safety measures, when used, diminish but do not totally eliminate exposure.

2) Removal of dental mercury amalgam fillings without appropriate protection causes significant mercury exposure to dentists, dental staff, dental students, and patients, especially women of childbearing age, pregnant or lactating women, fetuses, children, and other sensitive populations.

3) Due to mercury releases, polishing, placement, removal, or any disruption of a dental mercury amalgam filling should not be done by dental personnel who are pregnant or lactating and should not be conducted upon patients who are pregnant or lactating.

4) Alternative dental restorative materials should likewise be assessed for safety and biocompatibility, especially on an individual basis.

QUALIFYING STATEMENTS

Whereas the American Dental Association (ADA), the United States Food and Drug Administration (FDA), and other groups have endorsed the use of dental mercury amalgam, numerous peer-reviewed, scientific studies report risks associated with dental mercury amalgam fillings. In fact, over 200 scientific articles produced by a literature search on PubMed (collected by the U.S. National Library of Medicine National Institutes of Health) and a hand-search of IAOMT documents (collected by the International Academy of Oral Medicine and Toxicology) have been cited as evidence for this document.

The PubMed literature search was conducted online at the PubMed database from September 16, 2013 to March 6, 2014. The purpose of the research was to answer the following question: “Are there risks associated with dental mercury?” The PubMed search term used was “dental mercury risk,” and clinical trials and reviews were included in the search. The search was conducted from March 6, 2014 to as far back as PubMed provided results (1972), and the PubMed search resulted in 280 sources.

All PubMed sources were categorized into risk, no risk, or ambiguous categories. Articles were excluded from the final results of the search if they were not in English, they were not relevant (i.e. not significantly about dental mercury amalgam), they were an erratum, they were a comment on a different article, and/or if the abstract and study could not be found. Thus, 124 articles were excluded. Many of the articles that could not be located were not peer-reviewed and appeared in trade journals or journals of localized dental groups. Based on the 156 articles that were included, the PubMed search yielded 86 articles (55.1%) suggesting risk, 55 articles (35.3%) suggesting no risk, and 15 articles (9.6%) deemed as ambiguous.

An IAOMT hand-search of documents was conducted to supplement the PubMed search. The hand-search was originally conducted from September 16, 2013 to March 6, 2014, but it was updated from December 1, 2015 to December 23, 2015, as a means to produce this 2016 revision.
of the position statement. Over 700 documents about this issue are currently on file in the IAOMT’s Library, which has documents dating from 1926 to present day. Of these hundreds of sources, those used for this article were limited to the scientific and regulatory documents most relevant to dental mercury amalgam health risks.

Even more specifically, sources for this paper were found by searching the IAOMT Library for scientific evidence of health risks from dental mercury exposures to the general population, pregnant women, fetuses, children, dental professionals, and those individuals who are genetically predisposed, who have an allergy to mercury, or who suffer from health conditions that have been potentially linked to mercury by scientific research. These health conditions include Alzheimer’s disease, amyotrophic lateral sclerosis (Lou Gehrig’s disease), antibiotic resistance, autism spectrum disorders, autoimmune disorders/immunodeficiency, cardiovascular problems, chronic fatigue syndrome, hearing loss, kidney disease, multiple sclerosis, oral lichenoid reaction and oral lichen planus, Parkinson’s disease, periodontal disease, and reproductive dysfunction.

The over 200 articles from the PubMed and IAOMT searches demonstrating risk have been used as sources for this document since they serve as evidence of the known hazards of dental mercury amalgam.

However, it should be noted that there were also a number of scientific studies suggesting dental amalgam does not pose a health risk, dental amalgam is safe, releases of mercury from dental amalgam are within acceptable exposure levels, and/or there is insignificant data to prove its hazards. For example, our PubMed literature search yielded 55 sources finding or suggesting “no risk.” Below is an abridged list of some of theses sources, which suggested “no risk” for the following populations and scenarios:

- Children\textsuperscript{837} 838 839 840
- General health/general population and/or exposure levels\textsuperscript{841} 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864
- Pregnancy\textsuperscript{865} 866 867 868 869
- Occupational\textsuperscript{870} 871 872 873 874 875 876 877 878 879 880
- Other: Alzheimer’s disease,\textsuperscript{881} antibiotic resistance,\textsuperscript{882} autism,\textsuperscript{883} 884 885 886 fatigue,\textsuperscript{886} immune system,\textsuperscript{887} 888 kidney function,\textsuperscript{889} 890 891 892 multiple sclerosis,\textsuperscript{893} 894 895 896 Parkinson’s disease

It merits consideration that the technology of studying mercury’s impact on human health has evolved over the past several decades, and some studies advocating the safety of dental mercury amalgam failed to take into account genetic factors, susceptible populations, metal allergies, and other variables that are now known to impact each person’s response to mercury.\textsuperscript{897}

Another area of concern in relation to research about dental mercury amalgam is agreeing upon the definition of “risk.” To illustrate this point, a number of scientific articles claim that dental mercury amalgam is safe for the “general population.” Yet, given the current knowledge that sensitivities, biological predispositions, and a gamut of other conditions influence an individual’s reaction to mercury exposure,\textsuperscript{898} the concept of accurately applying safety to the “general
population” becomes highly subjective. This also applies to evaluating dental mercury amalgam risks for specific health conditions such as Alzheimer’s disease, autism, or multiple sclerosis. Further issues with defining “risk” for dental mercury amalgam arise when considering the impact these restorations might have on an individual for a short amount of time versus long-term exposure, especially since many individuals have these fillings in their mouths for many years of their lives.899 In particular, research has shown that an individual accumulates a chronic dose of mercury ranging from “0.2 to 0.4 μg/day per amalgam-filled tooth surface, or 0.5 to 1 μg/day/amalgam-filled tooth, depending on age and other factors.”900 As detailed in other sections of this document, how each person processes mercury exposure is dependent on a wide-range of circumstances. Practicing mercury-free dentistry [dentistry that does not place any new mercury amalgam fillings] and mercury-safe dentistry [dentistry that utilizes protective measures when removing existing mercury amalgam fillings] undoubtedly reduces the danger of chronic mercury exposure to dentists, their staff, dental students, and patients. This is especially important considering that mercury exposures also occur from non-dental sources. For example, the issue of amalgam fillings contributing to human mercury exposures from fish consumption was reported in 2013 by the European Food Safety Authority’s Panel on Contaminants in the Food Chain (CONTAM). The EFSA Panel described the increased mercury danger from the combination of fish and dental amalgam: “The estimated exposure to inorganic mercury in Europe from the diet alone does not exceed the TWI [tolerable weekly intake]. Inhaled elemental mercury vapour from dental amalgam, which after absorption is converted to inorganic mercury, is an additional source that is likely to increase the internal inorganic mercury exposure; thus the TWI [tolerable weekly intake] might be exceeded.”901 Additionally, it is essential to acknowledge that there are various escalating levels of protection techniques for limiting mercury exposure during mercury-related dental procedures. Depending on the technique/s chosen, different results are reached in personal and patient protection levels from exposure. The more thorough the protection, the more complex and costly the technique, and as such, financial, cultural, and professional decisions are part of the process as to the level of protection ultimately used. Overall, it is apparent that dental mercury amalgam and all dental restorative materials should be assessed for safety and biocompatibility with special consideration for all populations and all known risk factors.902

**DESCRIPTION OF IMPLEMENTING SUGGESTED ACTION AND RESOURCES:**

Most consumers direct choose composite fillings because the coloring matches the tooth better, and a [2007 poll](#) showed that just less than half dentists are using dental mercury amalgam in the U.S.903 In fact, research has confirmed that resin composites or compomers are used for 55% of direct dental restorations worldwide.904
Thus, many dentists have already stopped using dental mercury amalgam; however, many of these dentists and others still require training in mercury-free dentistry [dentistry that does not place any new mercury amalgam fillings]. Since other countries have banned or strictly limited dental mercury amalgam, their dental schools and industry practices shed light upon how to make a complete transition away from dental mercury amalgam.

Yet, it must also be recognized again that since all dentists still must remove dental mercury amalgam fillings, dentists and dental students require training in mercury-safe dentistry [dentistry that utilizes protective measures when removing existing mercury amalgam fillings]. Essentially, properly applied protection techniques can minimize mercury exposure to dental workers, dental students, patients, fetuses, and other susceptible and sensitive populations.

The IAOMT has developed free dental education resources detailing implementation strategies for mercury-free dentistry [dentistry that does not place any new mercury amalgam fillings] and mercury-safe dentistry [dentistry that utilizes protective measures when removing existing mercury amalgam fillings], including information for dentists, physicians, health professionals, patients, and the general public. These resources include the following:

- Dental mercury education videos: [https://iaomt.org/free-online-learning/](https://iaomt.org/free-online-learning/)
- More resources available at [www.iaomt.org](http://www.iaomt.org)

**DISCLAIMER:**

Legally, it must be noted here that the IAOMT has used scientific evidence, expert opinion, and its professional judgment in assessing this information and formulating these recommendations. No other warranty or representation, expressed or implied, as to the interpretation, analysis, and/or efficacy of the information is intended in this position statement. The views expressed in this publication do not necessarily reflect the views of the IAOMT, its Executive Council, Scientific Advisory Board, administration, membership, employees, contractors, etc. This report is based solely on the information the IAOMT has obtained to date, and updates should be expected. Furthermore, as with all guidelines, the potential for exceptions to the recommendations based upon individual findings and health history must likewise be recognized.

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Amanda Just: MS; Program Director of the IAOMT; Dental consumer who has shared her writings about the impact of dental amalgam mercury fillings with the United Nations Environment Programme, the U.S. Department of State, the U.S. Food and Drug Administration, and various NGOs; Master of Science in Education from University of New Haven; Bachelor of Arts in History from the College of William and Mary.

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amalgam restorations in patients allergic to mercury compounds.


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