MERCURY USE: DENTISTS

Dental amalgam is an alloy that results from the trituration of powdered silver, tin and copper which hardens quickly to a solid phase. Dental amalgams have been used as the main restorative in teeth for more than 150 years; it is a popular restorative material because it can be easily manipulated and is relatively inexpensive.

Amalgam wastes are generated from amalgam abrasion, from the placement or replacement of fillings, and from cremation. The Western Lake Superior Sanitary District has estimated that dentists emit 0.1 grams of mercury per day per dentist. The approximate 1,650 dental offices in the metropolitan Seattle, Washington area contribute an estimated 14 percent of the mercury in that system. San Francisco has estimated that 12 percent of the mercury contributed to that city's system comes from dental offices. (directly from the concern over mercury and wastewater, journal of MDA) It has been estimated that approximately 4 percent of the mercury entering the Lake Superior ecosystem is from amalgam wastes.

Alternatives to mercury-amalgam fillings exist, but are not appropriate in all cases or for all patients. Until acceptable alternatives exist for every situation, mercury will continue to be used widely in dental practices. It is imperative that dentists handle the mercury in their office carefully to prevent releases of mercury to the environment.

There are specific steps dentists can take to reduce their mercury releases. They may consider the use of precapsulated amalgam alloy instead of the use of bulk liquid mercury; the precapsulated amalgam can lessen the overall amount of mercury being used and decrease spills. Dentists may also consider the use of chair side traps to capture their waste mercury-amalgam and can recycle this waste.

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ABOUT THIS HANDOUT

This is one chapter of the "Wisconsin Mercury SourceBook." The Sourcebook was written as a guide for communities to help identify and reduce the purposeful use of mercury. The SourceBook contains background information on mercury contamination and provides a seven-step outline for drafting a mercury reduction plan.

This handout is one of the nineteen sectors that were highlighted in the SourceBook as a potential contributor of mercury in any given community.

What you will find in this handout:

- ★ Information on mercury-containing products and that are unique to the agriculture industry
- ★ Action ideas that describe pollution prevention, recycling, and management practices for a mercury reduction plan for a business in this sector. This provides a good overview of the types of mercury-containing products and alternatives that may exist in your sector.
- ★ Current mercury projects in the agriculture industry

For more information, please contact:

WHY SHOULD I BE CONCERNED ABOUT MERCURY?

Some of you may remember playing with mercury when you were a child. Its silvery white shimmer was entrancing, and the ability of its glistening mass to split and come back together again was magical. But scientists are now beginning to realize that there is another side to mercury's wily nature. In fact, it is some of mercury's most elemental qualities that make it a difficult substance to handle.

Mercury is a common element that is found naturally in a free state or mixed in ores. It also may be present in rocks or released during volcanic activity. However, most of the mercury that enters the environment in Wisconsin comes from human uses.

Because mercury is very dense, expands and contracts evenly with temperature changes, and has high electrical conductivity, it has been used in thousands of industrial, agricultural, medical, and household applications.

It is estimated that half of the anthropogenic mercury releases in Wisconsin are the result of the purposeful use of mercury. The other half of mercury emissions originate from energy production.

Major uses of mercury include dental amalgams, tilt switches, thermometers, lamps, pigments, batteries, reagents, and barometers. When these products are thrown in the trash or flushed down a drain, the mercury doesn't go away.

The good news is that the majority of products that use mercury purposefully have acceptable alternatives. For example, electric vacuum gages, expansion or aneroid monitors are good alternatives to mercury blood pressure monitors. Mechanical switches, magnetic dry reed switches, and optic sensors can replace mercury tilt switches.

Replacing mercury-laden products with less toxic alternatives is referred to as *source reduction*. Source reduction allows us to eliminate the use of mercury in certain waste streams. This is especially beneficial considering the volatile nature of mercury, because mercury can so easily transfer from air to soil to water.

Practicing source reduction in combination with recycling the mercury already in the waste stream can have a significant impact on reducing mercury levels in the environment.

HEALTH EFFECTS OF ELEMENTAL MERCURY

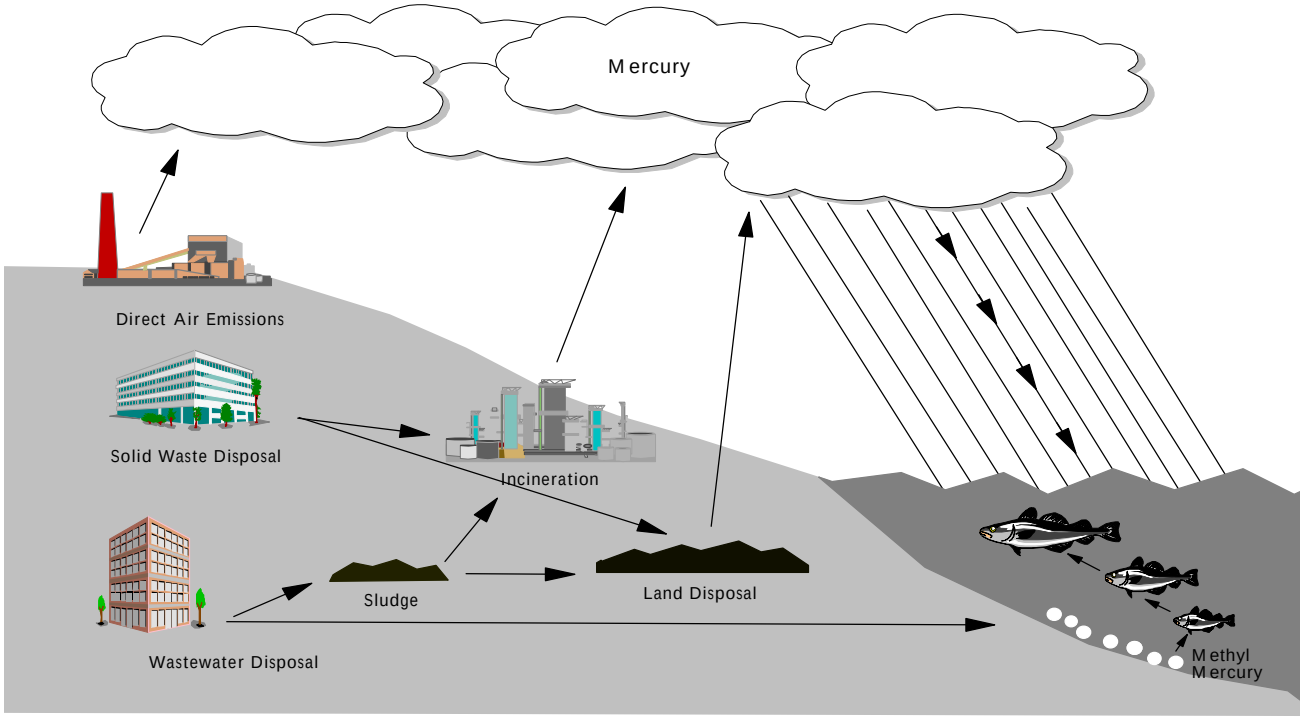
The toxicity of mercury has long been known to humans. Hat makers during the 19th century developed symptoms of shaking and slurring of speech from exposure to large amounts of inorganic mercury, which was used to give a metallic sheen to felt hats. This gave rise to the term "mad as a hatter."

The hat makers were suffering from neurological damage from the inhalation of mercury fumes. Exposure to elemental mercury vapors can cause acute respiratory problems, which are followed by neurologic disturbances and general systemic effects. Acute exposure to inorganic mercury by ingestion may also cause gastrointestinal disturbances and may effect the kidneys.

SO WHAT'S THE BIG DEAL?

Mercury is a bioaccumulative, persistent, toxic substance that threatens the health of humans and wildlife throughout North America. The USEPA, Environment Canada, the International Joint Commission, the Commission for Environmental Cooperation and many state and provincial governments have identified mercury as one of the most critical pollutants for significant elimination and/or reduction.

Mercury Transport and Bioaccumulation



Mercury can enter the environment from a number of paths. For example, if a mercury-containing item is thrown into the garbage, the mercury may be released into the atmosphere from landfill vapors or leachate, or the mercury may vaporize if the trash is incinerated. If mercury is flushed through a wastewater system, the mercury will likely adhere to the wastewater sludge, where it has the potential to volatilize and be deposited elsewhere. Mercury can enter the atmosphere through these various means because it evaporates easily. It then travels through the atmosphere in a vaporized state.

Once mercury is deposited into lakes and streams, bacteria convert some of the mercury into an organic form called *methylmercury*. This is the form of mercury that humans and other animals ingest when they eat some types of fish. Methylmercury is particularly dangerous because it *bioaccumulates* in the environment. Bioaccumulation occurs when the methylmercury in fish tissue concentrates as larger fish eat smaller fish. A 22-inch Northern Pike weighing two pounds can have a mercury concentration as much as 225,000 times as high as the surrounding water.

These concentrations are significant when one considers the potential toxic effects of methylmercury. Methylmercury interferes with the nervous system of the human body and can result in a decreased ability to walk, talk, see, and hear. In extreme examples, high levels of methylmercury consumption has resulted in coma or death.

Many animals that eat fish also accumulate methylmercury. Mink, otters, and loons in Wisconsin have been found to have high levels of mercury in their tissue. Mercury can interfere with an animal's ability to reproduce, and lead to weight loss, or early death.

Fish Consumption Advisories

There are currently 260 lakes and more than 350 miles of rivers in Wisconsin that have fish consumption advisories because of mercury. Approximately 1 out every 3 sites that is tested is listed on the advisory; no sites have ever been removed. Forty-eight states now issue fish consumption advisories to protect human health. Most of these warnings are related to mercury contamination.

CAPTURING AMALGAM AND MERCURY WASTES

Because mercury amalgam fillings are the material of choice for many fillings, it is important to capture and dispose of this waste safely and effectively. There are several filtration devices available to capture amalgam at the source of generation. These include "low tech" devices such as sieves and strainers, and "high-tech" devices such as sedimentation columns, centrifuges, and complete capture units. *(M2P2)*

There are a range of options available for handling amalgam wastes. The board of trustees of the ADA have identified the following *(1994 supplement to annual reports and resolutions)*:

- lowest tech: filters (secondary screens with finer mesh sizes, if technically practical)
- low tech: holding tanks (if prototypes are made commercially available)
- high tech: separators (the commercially available models, e.g., from Europe)
- higher tech: electrical and chemical approaches (which could address all of the discharge and not just the particulate)
- amalgam alternatives (would still need to address removals of existing amalgams)
- closed systems (if feasible)

Research by the University of Illinois, Chicago has shown that 60% of the mercury from a dental practice is captured on commonly used chair-side traps. The remaining portion settles out rapidly; less than 1 percent remains in the water after settling for 24 hours. Therefore, the recycling of amalgam captured on disposable trays is an effective way of keeping mercury out of the environment. The Western Lake Superior Sanitary District (WLSSD) reports that the cost of recycling chair side traps is approximately $3.50 per pound, probably less than $20 per year per practice. Recycling the amalgam is much less restrictive than managing waste as a RCRA hazardous waste.

Facts About Mercury Amalgam

from DWSD

- ✔ Amalgam has been used extensively as tooth-filling material for more than 150 years
- ✔ The toxic effects of silver/mercury dental fillings have been discussed and debated in professional circles since mercury's introduction into dentistry in 1819
- ✔ Components of dental amalgam are: mercury, powdered metals, silver, copper, zinc, and tin
- ✔ In the past 50 years, about 75% of all direct restorations placed were of amalgam
- ✔ Amalgam waste is created when fillings are removed or replaced
- ✔ Particles of removed old amalgam restorations, smaller than the filter size hole, are normally lost to the sewer unless the dentist has a high efficiency filtration or separation device in place
- ✔ Dentists estimate that 27% of old amalgam restorations are lost to the sewer system

PROCEDURES FOR COLLECTING MERCURY AND MERCURY AMALGAMS

From the Michigan Dental Association, "HHR Update," March 1996 + WLSSD handout

In order to reduce the amount of mercury from amalgam particles entering the sewer system or landfill, it is recommended that you use an amalgam trap.

Disposable Traps

Information from WLSSD

Recycling facilities recover mercury from amalgam or amalgam traps for recycling. The following techniques will properly collect, store, and transport the chair-side traps to a recycler. Following these simple procedures, you can reduce the amount of mercury released to the environment.

① Flush the vacuum system with line solution before changing the chair side trap. The best method is to flush the line the last thing before you go home, and then change the trap first thing the next morning.

② Use barrier techniques such as gloves, glasses, and mask when handling the chair side trap. Choose utility gloves intended for cleaning and handling wastes for this procedure.

③ Do not place gloves*, plastic bags, or paper towels into the recycling container. These add the volume of waste created and cause problems with recycling equipment. Unless saturated with blood, dispose of gloves, plastic bags, and paper towels in the garbage.

④ **A. Chair-Side Traps**

Place the trap in widemouth plastic container. Label the container: Amalgam for recycling. Keep the container covered.

Only traps on chairs used for amalgam placement or removal need special handling. Place traps from chairs dedicated to hygiene in regular garbage.

B. **Vacuum Pump Traps**

Reusable Traps: Empty the trap's contents into a widemouth plastic container. Keep the container covered.

Disposable Traps: Replace the cover after use. Place the trap in the original box for shipment to a recycler.

Label the containers: **Amalgam for Recycling.**

** Please note: "AMALGAWAY" is currently the only company that will take the gloved disposable amalgam trap. To contact the "AMALGAWAY" mail disposal system contact: AMALGAWAY, 10085 Allisonville Road, Suite 201, Fishers, IN 46038. Or call AMALGAWAY 1-800-267-1467.*

Reusable Amalgam Traps

First, disinfect the trap for 24 hours using a minimum amount of disinfectant. Then, remove all visible amalgam and store it in an airtight container, labeled "WASTE AMALGAM." The disinfected trap can then be reused. Recycle the waste amalgam as outlined for the scrap amalgam.

Secondary Filters on the Vacuum Pump

Change these filters at least once a month, or more frequently if needed. DO NOT dispose of the filters as regulated medical waste. Place facial tissue or towels inside to absorb the liquid.

Scrap Amalgam

Excess amalgam remaining at the end of a procedure should be stored in an air-tight container labeled "SCRAP AMALGAM." The American Dental Association recommends that the scrap amalgam container be stored under a small amount of photographic fixer. Most reclaimers/recyclers will only accept dry amalgam, so you may need to decant off the fixer and blot the amalgam dry with a paper towel.

Bulk Mercury

The Detroit Water and Sewerage Department has estimated that approximately 10-15% of the dentists in their area use bulk mercury and bulk amalgam alloy for their amalgam restorations. This correlates with information from the federal Food and Drug Administration Dental Products Panel, which estimates that 8 to 10% of dental mercury an amalgam alloys are sold to dentists in bulk form. *(DWSD task force for mercury min from dental facilities, summary of June 13, 1995 meeting)*

Since 1984, the American Dental Associations's Council on Dental Materials, Instruments and Equipment, as part of its dental mercury hygiene recommendations, has recommend that dentists discontinue the use of bulk dental mercury and bulk amalgam alloy and that they only use precapsulated amalgam alloy in their practices. The use of these pre-mixed capsules decreases the potential of occupational exposure to mercury by eliminating the possibility of bulk mercury spills and leaky dispensers, and can lessen the overall amount of mercury being used.

The 1994 American Dental Association house of Delegates and the 1995 Michigan Dental Association House of Delegates passed a resolution recommending that dentists eliminate the use of bulk mercury and bulk amalgam alloy. The MDEQ (???) has set up a bulk mercury collection program for their dental offices and this project has been met with great success. They offered three options for the collection of bulk mercury from dentists: 1) mail -in programs 2) drop-off locations 3) infectious waste haulers take-back program. We hope to implement a similar program here in Wisconsin.

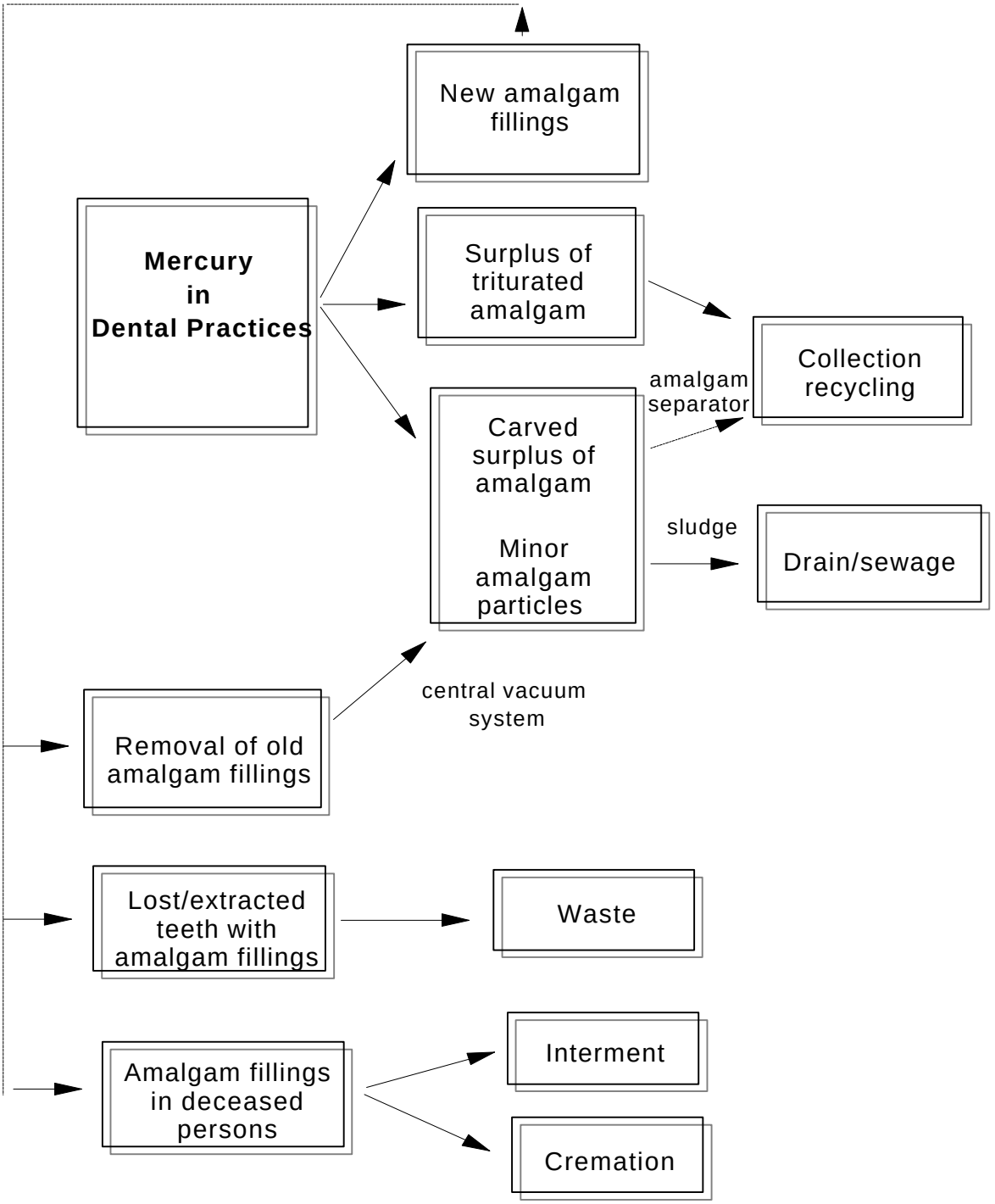
Amalgam Capsules

Used, empty amalgam capsules have been determined to be non-hazardous, based on toxicity test results. Empty amalgam capsules can be disposed of with all other office solid waste in the garbage.

Dispose of Your Waste Amalgam and Filters Properly

The Western Lake Superior Sanitary District audits have shown that 80% of the traps used by dentists are improperly disposed of by placement in the garbage or in medical waste bags. Care should be taken when handling waste amalgam or waste mercury - used filters should NEVER be placed in the garbage or in a medical waste red bag.

Mercury Cycle in Dentistry



from Horsted-Bindslev et al., 1991

Keeping Mercury Out of Medical Waste Incinerators

If your amalgam waste or filters are placed in your medical waste red bags, the amalgam will be sent to a Medical Waste Incinerator (MWI). There are approximately 5,000 MWIs distributed evenly throughout the United States. MWIs are a large source of mercury to the environment. There is up to 50 times more mercury in medical waste than in general municipal waste, and the amount of mercury emitted from general medical incinerators averages more then 60 times that from pathological incinerators. In Wisconsin, MWIs are responsible for approximately 25 percent of air emissions in Wisconsin that are associated with the purposeful use of mercury.

Mercury is a very volatile metal that evaporates easily. When a mercury-containing product finds its way into a medical waste red bag and is incinerated, the mercury becomes gaseous and exits through smokestacks into the air. The mercury then settles on land and in water where it can be changed into its organic form, methylmercury. Fish bioconcentrate the mercury to such levels that it can harm wildlife and can be a potential human health risk. It is very important to educate employees about the dangers of putting amalgam wastes in the red medical waste bags to prevent this contamination.

Keeping Mercury Out of the Solid Waste Stream

If your waste amalgam is placed in the garbage, it could potentially be incinerated, and the mercury will volatilize and enter the atmosphere as described above. If the solid waste is sent to a landfill, the mercury may volatilize out with the methane gas that is released from the landfill.

Keeping Mercury Out of the WasteWater Stream

Mercury amalgam that is not captured by a trap in your office will travel to your local wastewater treatment plant. Once mercury enters the wastewater treatment plant, most of it concentrates in wastewater biosolids during treatment. Since most treatment plants dispose of generated solids by land spreading, mercury enters the terrestrial environment by this process. Some of this mercury spread on land may, over time, be volatilized to the atmosphere. This mercury may then be deposited into lakes and streams, methylated, and ingested by fish, eventually reaching wildlife and humans.

Sewer Pipes

Mercury was used extensively in medical settings in the past. Often times the mercury may have found its way into the pipes of a dental facility when items were broken, disposed of, or spilled. This mercury can settle at a low point such as a sump or trap and remain in the pipes of a dental facility for many years. Often the slow dissolution of the mercury in a sump, trap, or pipe is enough to cause violations of wastewater discharge standards even after poor management practices have been eliminated. Hot spots in a dental facility's piping may appear where equipment maintenance areas were located. Whenever traps or sumps are moved or cleaned, the solid contents should be treated as a hazardous waste unless proven otherwise. For more information, please see the excerpts from the MWRA/ MASCO Infrastructure Subcommittee Maintenance Guidebook that appear in the "Resources" section of this sourcebook.

AMALGAM RECYCLERS

Acme Scrap Iron and Metal
7588 N. Syvania Avenue
Sturtevant, WI 53177
(414) 835-2662

Amalgaway
10085 Allisonville Road, Suite 203
Fishers, IN 46038
(800) 267-1467

Dental Recycling North America
PO Box 1069
Hackensack, NJ 07601
(800) 360-1001

D.F. Goldsmith
909 Pitner Avenue
Evanston, IL 60602
(708) 869-7800

Made Ltd.
Rt. 1 Box 127a
Hillman, MN 56338
(612) 277-3981

Maguire and Strickland Refining Co.
1290 81st Avenue NE
Minneapolis, MN 55432
(800) 486-2858

Mercury Refining Company, Inc.
1218 Central Ave.
Albany, NY 12205
(518) 459 -0820

Recyclights Inc.
401 West 86th Street
Bloomington, MN 55420
(800) 831-2852

Mercury Waste Solutions, Inc.
21211 Durand Avenue
Union Grove, WI 53182
(414) 878-2599

MERCURY RECYCLERS

Bethleham Apparatus
890 Front Street
Hellertown, PA 18055
(215) 838-7034

Garfield Refining
810 East Cayuga
Philadelphia, PA 19124
(800) 523-0968 ext. 300

Inmetco
PO Box 720
Elwood City, PA 16117
(412) 758-5515

Mercury Refining Company
790 Wateruliet-Shaker Rd.
Latham, NY 12110
(800) 833-3505

Mercury Waste Solutions, Inc.
21211 Durand Avenue
Union Grove, WI 53182
(414) 878-2599

STAR PROGRAM: DETROIT

From the Journal of the Michigan Dental Association, April/May 1995

The Detroit Water and Sewerage Department (DWSD) is a large municipal utility that supplies both drinking water and wastewater treatment services to millions of individuals and industries in southeastern Michigan. The DWSD has initiated a pilot program for dental facilities which seeks to reduce or eliminate mercury use and improve disposal practices within dental offices. The pilot program has multiple objectives:

- to identify mercury usage and disposal practices among dentists
- to quantify the amount of mercury entering the sewage system from this source
- to identify and encourage the use of mercury-free alternatives and other suitable technologies within the field
- to develop materials and other outreach initiatives specifically designed for the dental profession.

The DWSD has compiled a survey of over 2,000 dentists and conducted site surveys as well. They have also convened a task force that will explore ways of reducing mercury pollution from dental facilities, make recommendations for future legislation, regulation, and enforcement, and develop prevention strategies.

ALTERNATIVES TO MERCURY AMALGAM FILLINGS

(from M2P2)

Alternatives to mercury amalgam include gold, ceramic, porcelain, polymers, composites and glass ionomers. The cold silver and gallium techniques are among the most promising currently in the developmental phase.

However, while alternatives exist for mercury amalgam, they have limited uses. Some of the variables effecting the choice of material are the location of the defect in the tooth, the extensiveness of the defect, the location of the afflicted tooth in the mouth, the amount of stress placed on the filling, and the probability for contact with moisture during placement of the filling material. Amalgam use is favored over composite resins by differences in strength durability, ease-of-placement, an the lower cost between mercury amalgam and alternatives. Amalgams resist dissolution and wear better, require a less precise technique during placement, and are lower in cost. However, 0.6 percent of the population may have some risk to mercury amalgams due to a mercury sensitivity. (research from canadian dental association on dental amalgam, published in journal of american dental association, Vol 122, August 1991, pg. 54)

Mercury use by the dental profession decreases each year due to fluorides, sealant use, improved oral hygiene practices and dietary modifications. This results in fewer fillings removed from patients. In fact, in the United States, from 1979 to 1990, a 38 percent reduction in the use of dental amalgam for restorative procedures has been observed. Some people are predicting that technological advances will allow amalgam substitutes to become competitive and replace amalgam fillings in the next couple of decades. However, because a large segment of the population currently has mercury amalgam fillings, the proper handling of this waste will be a relevant issue for some time to come.

Dental Amalgam Use and Alternatives

Adopted from Dental Amalgam: A Scientific Review and Recommended Public Health Service Strategy for Research, Education, and Regulation, Dept. HHS, January 1993. As appeared in Mercury Pollution Prevention In Michigan, April, 1996

Critical Parameters in Evaluating Posterior Restorative Materials	Amalgam	Composite	Glass Ionomer	Gold Foil	Gold Alloy (Cast)	Metal-Ceramic Crowns
Median Longevity Estimate	8 to 12 years	6 to 8 years	No data1: 5 years predicted	No data: 10 to 15 years estimated	12 to 18 years	12 to 18 years
Relative Surface Wear	Wears slightly faster than enamel	Excessive wear in stress-bearing situations	Excessive wear in stress-bearing situations	Excessive wear in stress-bearing situations	Wears similar to enamel	Porcelain surface may wear opposing tooth
Resistance to Fracture	Fair to excellent	Poor to excellent	Poor	Fair to good	Excellent	Excellent
Marginal Integrity (leakage)	fair to excellent (self-sealing through corrosion products)	Poor to excellent (polymerizatio shrinkage can cause poor margins)	Poor to excellent	Poor to excellent	Fair to good (depends on fit and type of buting agent used)	Poor to excellent (depends on fit and type of buting agent used)
Conservation of Tooth Structure	Good	Excellent	Excellent if initial restoration, not if replacement	Good	Poor	Poor
Esthetics	Poor	Excellent	Good	Poor	Poor	Excellent
Indications:						
Age range	All ages	All ages	All ages	Adult	Adult	Adult
Occlusal Stress	Moderate stress	Low-stress bearing	Adult-class V and low-stress primary teeth	Class III and V and Crown repair	High-stress areas	High-stress areas
Extent of caries	Incipient to moderate size cavity	Incipient to moderate size cavity	Class I and II child incipient to moderate size cavity	Incipient to moderate size cavity	Severe tooth destruction	Severe tooth destruction or aesthetic considerations
Cost to patient2	1X	1.5X	1.4X	4X	3X + gold	8X

1 Longevity estimates reflect from published studies, however, under different clinical situations many restorations will last longer. For materials that have emerged in the last decade and gold foil, estimates are speculative.

2 Relative cost to patient, in relation to amalgam (1X). There may also be considerable geographic variation.

WHAT ABOUT THE HEALTH EFFECTS OF MERCURY-AMALGAM FILLINGS?

The focus of this analysis revolves around the proper disposal of amalgam filling waste, and not the potential health effects of its use as a restorative material. However, because this issue frequently comes up when discussing the use of mercury amalgams, we have provided a brief discussion of the issue and a list of paper abstracts on the subject. (The abstracts appear in the appendix.)

In general, the american dental community regards mercury-amalgam fillings as safe. The U.S. Public Health Service issued a report in 1993 stating that there is no health reason not to use amalgam, except in the extremely rare case of the patient who is allergic to a component of amalgam. This stance has been echoed by the Food and Drug Administration, the National Institutes of Health Technology Assessment Conference, and the National Institutes of Dental Research, all who support dental amalgam as a safe and effective restorative material.

Nonetheless, the issue is certainly under debate. There are two sections of articles included in the appendix about this issue.

What we can do as a State

Following Michigan's lead, Wisconsin can implement some practical initiatives to help reduce mercury entering waste water treatment plants from dental offices. Here are some ideas from the Michigan Dental Association and the Michigan Mercury Pollution Prevention Task Force:

- Encourage the development and use of mercury amalgam alternatives
- Recommend the elimination of bulk mercury and bulk amalgam alloy; recommend the use of precapsulated amalgam alloy only
- Participate in a bulk mercury collection program
- Develop and distribute a pamphlet on amalgam waste reduction and recycling
- Provide a Health and Hazard Regulation Traveling Seminar on all phases of mercury hygiene in dental offices. (These seminars are part of a continuing education program that is mandatory for all Michigan licensed dentists.)
- Include articles in Dental Association Journals
- Speak at local dental society meetings
- Research particle size distribution on the latest in amalgam separators
- Form a Dental Task Force on Mercury Minimization

DENTAL USE OF AMALGAM: ACTIVITIES IN OTHER COUNTRIES

Info from John Gilkeson

Canada

Canadian Ministry of Health has a web site. Access this site through http://hpb1.hwc.ca/datahpb/dataehd/ Then click on "English." When you get the next screen, click on "Medical Devices." Next screen, click on "Research and Surveillance." The "Health Canada Position Statement on Dental Amalgams" and "The Safety of Dental Amalgams" provide a summary of Health Canada's take on the issue and of a recent Health Canada-sponsored study of amalgam safety.

This study that found that for the average Canadian, 50 percent of daily exposure to mercury (50 percent of the amount absorbed by the body) is attributable to releases from amalgam fillings. That makes amalgam the most significant single source of mercury exposure for the average Canadian. [Please note: The summary of the report doesn't distinguish between forms of mercury—exposures to methylmercury in fish may still cause greater health risk.] However, the report concluded that exposures at this level do not cause illness in the general population, although a small percentage of the population has allergic hypersensitivity to mercury that could be triggered by exposure through amalgam.

The study also developed a tolerable daily intake (TDI) value for mercury (something that Health Canada does not endorse). This is a level of mercury exposure considered to be safe—with a safety factor of 100. Most people's exposure are below this TDI, although people who have seven or more amalgam fillings would have exposures in excess of the TDI. Because of the safety factor, it is still unlikely that such people are at risk of health effects.

Health Canada's position statement says that neither a ban on amalgam nor removal of sound amalgam fillings from healthy patients is justified. However, it recommends use of non-mercury materials in the primary teeth of children, when "suitable," and recommends against the using amalgam with pregnant women (due to exposures during the filling procedure) and with patients who have impaired kidney function.

Sweden

Recently obtained information from Sweden indicates that use of amalgams in children has been discontinued and use in adults is to be discontinued as of Jan. 1, 1997. This decision has been made on the basis that there is simply too much mercury in the environment already, and amalgam use is halted like nearly all other uses. They have stayed away from the health issue because it is contentious and currently unresolved, due to the lack of research that can be agreed to resolve the question.

OTHER MERCURY-CONTAINING PRODUCTS THAT MAY BE FOUND IN A DENTAL OFFICE

Mercury Product Focus: Detergents and Cleaners

The Massachusetts Water Resources Authority (MWRA), in conjunction with MASCO (a consortium of Longwood Medical and Academic Area Institutions), has been working with their area hospitals and academic institutions to identify and address the problem of mercury contamination in hospital and medical waste streams. As part of this process, the MWRA group also worked to identify "other sources" of mercury contaminants. These are common products, such as bleach, alcohol, laboratory lids, not otherwise thought to be of significant importance or concern, that might contain low levels of mercury. Thus far, a total of 118 products has been identified by this team. This information is applicable in a variety of settings.

Included among their findings:

- At least four (4) cleaners, nine (9) soaps, embedding tissues and other miscellaneous items such as photoprocessing fixer and developer solutions each contain significant levels of mercury.

"Other Sources of Mercury"

Information from the Massachusetts Water Resources Authority/MASCO

Product	Mercury Content (ppb)
Ajax Powder	0.17
Comet Cleaner	0.15
Lysol Direct	<0.011
Soft Scrub	<0.013
Kodak Fixer	6.9; 3.7
Kodak Developer	2.65; 6.0
Alconox Soap	0.004 mg/kg 0.005 mg/kg <0.0025 mg/kg
Derma Scrub	<5.0 <2.5
Dove Soap	0.0027
Ivory Dishwashing Liquid	0.061
Joy Dishwashing Liquid	<0.01
Murphy's Oil Soap	<0.012
Soft Cide Soap (Baxter)	8.1
Sparkleen Detergent	0.0086
Sunlight Dishwashing Detergent	<0.011

Mercury Product Focus: Lamps

- ✔ fluorescent
  - general purpose straight, U-bent, circline, compact
  - high output
- ✔ germicidal lamps
  - cold cathode
  - hot cathode
  - slimline
- ✔ metal halide
- ✔ high pressure sodium

There are a number of electric lamps that use mercury as an intrinsic part of their functioning. These lamps include fluorescent, mercury vapor, metal halide, and high pressure sodium lamps. These lamps may be used indoors or outdoors in heat lamps, film projection, photography, dental exams, photochemistry, water purification, or street lighting.

Fluorescent lamps contain mercury in a vapor form. The electric current of the lamp "excites" the mercury atoms, which then give off invisible ultraviolet light. The ultraviolet light then "excites" a powdery phosphorus coating inside the tube that emits visible light. The mercury that is contained in these lamps is emitted into the atmosphere when the lamps are broken, disposed of in landfills, or incinerated.

Fluorescent lamps are still a good option. They last longer and cost less to run than incandescent lights because they use up to 50 percent less electricity. This energy savings helps reduce mercury emissions because small amounts of mercury are present in coal that is burned in power plants. The less energy we use, the less mercury will be released into the environment when coal is burned.

New Low Mercury Fluorescent Lamp

Phillips Electronics has developed a long-life fluorescent that contains so little mercury it is no longer considered a hazardous waste. "Typically fluorescent lamps have an overabundance of mercury because mercury loses its effectiveness due to physical and chemical reactions. So manufacturers put in an overdose of mercury to compensate for these reactions," said George Preston, a scientist at Philips Lighting Co. Currently, a four-foot lamp contains about 22.8 milligrams of mercury, down from 38.4 milligrams in 1990. Philips's new lamp contains less than 10 milligrams of mercury. The new lamp, named ALTO™, relies on a "buffering mechanism" that blocks the physical and chemical reactions that cause the mercury to lose its effectiveness over time. The lamp also uses a new form of phosphorus patented by Philips.

- From "Philips Unveils a Fluorescent Lamp With Less Mercury and a Long Life," Wall Street Journal, June 9, 1995

Recycling Your Fluorescent Lamps

Several Wisconsin companies are in the business of recycling fluorescent lamps and incandescent bulbs. The copper coils, and aluminum or brass end pieces are smelted and reused as raw materials for non-food products. The glass can be purified and used to make fiberglass. The mercury is distilled from the phosphor powder and reused in new lamps and thermometers.

State hazardous waste regulations prohibit businesses from disposing of waste lamps and light bulbs in sanitary landfills if those lamps and bulbs contain levels of heavy metals that exceed hazardous waste limits. For information on the storage, collection, and transport of fluorescent lamps, please see the informational handout, "Recycling Your Fluorescent Lamps," in the "Resources" section of this sourcebook.

Types of Bulbs and Lamps that Contain Mercury

- **Fluorescent Lamps -** the tube-style were first used as overhead lighting in offices, now they also come in compact globe shapes for a variety of home and office uses
- **Mercury Vapor Lamps -** the first high intensity discharge (HID) lamps with blue-white light, originally used as farmyard lights
- **Metal Halide Lamps -** newer, more efficient HID lights found in homes and offices
- **High-Pressure Sodium Vapor Lamps -** white-yellow HID lights used for street lamps and outdoor security lighting
- **Neon Lamps -** brightly colored lamps typically used in advertising; most colors contain mercury except red, orange, and pink

- From the Wisconsin Recycling Markets Directory

Mercury Product Focus: Switches

Tilt switches

- ✔ silent light switches (single pole and three way; discontinued in 1991)
- ✔ fire alarm box switch
- ✔ temperature control (mounted on bimetal coil or attached to bulb device)
- ✔ thermostats
  - · room temperature control
  - · refrigerators

Another source of mercury that dental facilities may encounter is mercury switches. A small electrical switch may contain 3,500 milligrams of mercury; industrial switches may contain as much as eight pounds of mercury. Mercury is used in temperature-sensitive switches and in mechanical switches. The mechanical (tilt) switches are activated by a change from a vertical to a horizontal position. These are used in products like thermostats and silent switches. Mercury-containing tilt-switches may also be present in or under the lids of clothes washers and chest freezers - they stop the spin cycle or turn on a light. Mercury tilt switches are also found in motion-sensitive and position sensitive safety switches in clothes irons or space heaters. If a mechanical switch is not visible in these items, a mercury switch is probably being used.

Mercury tilt switches have been used in thermostats for more than 40 years. According to Honeywell, Inc., a major manufacturer of thermostats, more than 50 million mercury-containing thermostats have been sold since the 1950s for use in homes and offices. Mercury in these thermostats provide accurate and reliable temperature control, require little maintenance, and do not need a power source. However, each mercury switch in a thermostat contains about 3 grams of mercury. (There may be one or more of these switches in a single thermostat, each switch in a sealed glass bulb.) Alternatives to these products include electronic thermostats, which can be programmed to set room temperatures at predetermined times. *(blue brochure: the waste connection)*

Float control switches may be used in septic tank and sump pumps to turn the equipment on and off when water is at a certain level. Often, these switches are visible. Temperature-sensitive switches may be used in thermostats. Yet another type of mercury switch, the plunger or displacement relay, is used in high current, high voltage applications that could include lighting, resistance heating, or power supply switching *(M2P2)*.

Reduction Works!

Honeywell Corporation has been running a free take-back program in Minnesota to collect any brand of used mercury-containing thermostat through either a reverse distribution system or a recycle by-mail system.

Honeywell works with heating, ventilating, and air-conditioning (HVAC) wholesalers who sell their products. Honeywell has one license (called a network license) for all the wholesalers who are participating as a consolidation point for the thermostats. HVAC wholesalers contact their Honeywell customer service representatives to order containers for used thermostats, and Honeywell sends the wholesaler a plastic container with an attached lid that holds 100 thermostats.

Homeowners who replace their own thermostats without contractor assistance or with contractors who are not currently participating in the Honeywell program may recycle their thermostats through the free recycle-by-mail system. These individuals can call a toll-free number to receive a free postage paid thermostat mailer.

Mercury Switches in Electrical Applications

Source: Michigan Mercury Pollution Prevention Task Force, 1996

Switch	Quantity of Mercury	Available Alternatives
Tilt Switch		
· Thermostats	3,000 - 6,000 mg	Electronic type and snap switches
· Float Control (septic tank and sump pumps)	?	Magnetic dry reed switch, optic sensor, or mechanical switch
· Freezer Light	2,000 mg	Mechanical switch
· Washing Machine (power shut off)	2,000 mg	Mechanical switch
· Silent Switches (light switches prior to 1991)	2,600 mg	Mechanical switch
Thermo-Electrical Applications		
· Accustat ("mercury in glass thermostat," a calibrated device resembling a thermometer is used to provide precise temperature control for specialized applications)	~ 1,000 mg	?
· Flame Sensor (used in residential and commercial gas ranges, mercury is in capillary tube when heated mercury vaporizes and opens gas valve or operates switch. Used for both electrical or mechanical output.)	2,500 mg	Hot surface ignition system for devices or products that have electrical connections.

MERCURY SPILLS

As a dentist, you will probably continue to encounter mercury for some time to come. Therefore, it is essential to handle mercury, especially bulk mercury, safely. Small droplets of spilled mercury may lodge in cracks and sinks, mix with dust, accumulate on work surfaces, and adhere to knit fabrics, shoe soles, watches, gold, and other jewelry. This allows for mercury to potentially be transported to other locations, homes, or businesses.

The Costs of Mercury Spills

Mercury spills can be expensive for a number of reasons. Here are some examples:

The Cost of Clean-up

- A mercury-containing sphygmomanometer broken on a carpeted floor at Butterworth Hospital cost $2000 to clean up.

Labor costs

- It took Riverside Hospital 8 to 16 hours to clean up a mercury spill (the mercury had fallen in tile crevices).

Facility Down-Time

- The room in which a mercury spill occurs will be unavailable for use until the site is decontaminated. Riverside Hospital found that their room was out of service for at least one day.

Equipment Loss

- A mercury-containing switch in an oven in a University of Michigan Hospital cafeteria exploded. It cost $3500 to clean up the spill. The oven, a $25,000 piece of equipment, was irreparably damaged.

Training Time

- Continuing to use mercury containing items can be expensive for your facility because of the needed staff training for spill response plans. However, if you are still using mercury-containing products, don't neglect this important step! An improperly handled spill can end up costing even more to decontaminate.

Handle Mercury Safely!

- ✔ Use mercury only in uncarpeted, well-ventilated areas. Provide troughs on smooth surfaced tables and benches to collect mercury spills. Reserve the room for mercury use only; restrict traffic in the area.
- ✔ Ask workers to remove all watches and other jewelry - especially gold jewelry since mercury readily combines with gold - and have them wear a mercury vapor respirator and protective clothing: gloves, disposable gowns, and shoe coverings.
- ✔ Prohibit smoking, eating, and drinking in the area.
- ✔ Train all workers to understand the properties and hazards of mercury and to carry out safe handling procedures and specific policies related to mercury disposal.
- ✔ Clean and calibrate all mercury-containing equipment according to the manufacturer's recommended handling procedures and the formal procedures posed by your communications or safety program supervisors.
- ✔ Ask your safety supply vendor for a mercury vacuum sweeper and spill cleanup kit. Having the right equipment on hand will limit the amount of mercury released into the atmosphere.

- From "The Case Against Mercury: Rx for Pollution Prevention," The Terrane Institute

ACTION IDEAS FOR DENTISTS TO CONSIDER

- ✔ Eliminate the use of bulk mercury and bulk amalgam alloy in your practice; use precapsulated amalgam alloy only

- ✔ Use a chair-side trap or other capture device to collect your waste amalgam. Educate staff on how to effectively use the equipment .

- ✔ Recycle the waste amalgam you collect in your traps. Never throw it in the garbage or in the medical waste red bags!

- ✔ Continue to educate yourself and your colleagues about amalgam alternatives

- ✔ Continue to use fluorescent lamps! Even though fluorescent lamps contain mercury, they are a good choice because they use much less energy than regular bulbs.

- ✔ Establish a lamp recycling program for your business. Try not to break these lamps because some of the mercury will escape into the air.

- ✔ When remodeling or replacing old equipment, replace thermostats containing mercury switches with thermostats containing electronic type and snap switches, and replace “silent” light switches with mechanical light switches.

- ✔ Clean or flush the traps, sumps, and pipes in your sewer lines to rid your facility of historical uses of mercury. See excerpts from the MWRA/MASCO Infrastructure Subcommittee Maintenance Guidebook that appear in the “Resources” section of this sourcebook for more information.

SAMPLE PROCLAMATION

Your dental clinic may wish to formally declare your commitment to mercury reduction. You may use the proclamation below, or adopt it to suit your needs.

WHEREAS mercury is an elemental substance, that once released into the environment, easily and rapidly changes forms to several organic and inorganic states that transfer from soil to air to water and back again;

WHEREAS the organic form of mercury, methylmercury, bioaccumulates in aquatic ecosystems to magnify concentrations in animal tissue in increasing degrees up to 250,000 times;

WHEREAS methylmercury, the most toxic form of mercury, can affect the reproductive efforts of top predators in aquatic environments such as loons, otters, mink, and panthers;

WHEREAS the neurotoxic effects of high levels of methylmercury poisoning in humans has been established, and low-level doses of methylmercury consumption can potentially effect human health, especially that of a fetus;

WHEREAS elemental mercury is a highly toxic substance which can vaporize easily and cause both acute and chronic health effects including severe respiratory irritation and damage to the central nervous system;

WHEREAS mercury has been identified internationally as a toxic substance of concern, and mercury contamination has led to fish consumption advisories for more than 235 lakes and 350 miles of rivers in Wisconsin;

WHEREAS the majority of mercury entering Wisconsin comes from anthropogenic sources, and one-quarter of these emissions are the result of the purposeful use of mercury;

WHEREAS mercury is used widely in consumer and industrial products, where, in most cases, alternative, mercury-free products are available;

WHEREAS pollution prevention or product substitution is a progressive approach to protecting the environment that eliminates or minimizes the generation of mercury-bearing waste, making it one of the most favorable strategies for maintaining a clean environment;

WHEREAS pollution prevention for mercury can help environmental conditions, as well as protect the health and safety of workers;

WHEREAS recognizing mercury minimization as an active opportunity to improve the environment of Wisconsin and the environment of our business, we, the undersigned, do hereby declare our business to be a mercury minimization participant;

WE commit to research the following mercury minimization opportunities in our facility and implement those we find most feasible:

- Continue education about amalgam alternatives
- Use a chair-side trap or other capture device to collect waste amalgam. Educate staff on how to use effectively use the equipment .
- Recycle the waste amalgam collected in the traps.
- Eliminate the use of bulk mercury and bulk amalgam alloy; use precapsulated amalgam alloy only
- Recycle any bulk mercury still at facility
- Use safe, non-mercury cleaners and degreasers in labs, housekeeping departments, and maintenance areas
- Replace mercury-containing thermostats and switches with mercury-free alternatives when remodeling or replacing old equipment
- Recycle fluorescent lamps
- Establish effective spill response measures to ensure the mercury already in your facility is handled in a safe and proper manner.

_____
Facility

_____ _____
Name Date Signed

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"Wisconsin Recycling Markets Directory," Wisconsin DNR, May 1995

Current Mercury Work – Dentists

Specific Outreach/Research	
Project:	*Lake Superior Pollution Prevention Pilot*
Description:	A focus area of dentist and hospital outreach and product education/collection was targeted for 1996 projects
Agencies working on this project:	WDNR
Project:	*MercAlert*
Description:	Mercury education and waste reduction program, focusing on dentists and the general public
Agencies working on this project:	WLSSD
Project:	*Targeted Initiative: Dentists*
Description:	Outreach effort and study of recycling/disposal procedures; best management practice document
Agencies working on this project:	WLSSD
Project:	*Lake Superior Implementation Plan Team*
Description:	A focus area of dentist and hospital outreach was targeted for 1996 projects
Agencies working on this project:	MPCA/OEA WDNR
Project:	*Study of Dentist Mercury Use and Alternatives*
Description:	A section of the M^2P^2 Task Force examined sources and alternatives for mercury use in dental settings. Includes a table of amalgam alternatives, collection of bulk mercury from dentist offices, and research
Agencies working on this project:	MDEQ
Project:	*Mercury Minimization from Dental Facilities*
Description:	As part of Detroit's Mercury Minimization Program, DWSD is establishing collaborative voluntary efforts with the ADA, the MDA, and the Detroit District Dental Society. Task Force of 20 members. Bulk mercury collection.
Agencies working on this project:	Detroit Water and Sewerage Department

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ABSTRACT: " Altogether 1462 women aged 38, 46, 50, 54 and 60 yr were examined in 1968/69 in a combined medical and dental population study in Gothenburg, Sweden. Number of tooth surfaces restored with amalgam fillings was assessed. The examination was repeated in 1980/81 including a new dental examination. The results from a number of biochemical analyses of blood, serum and urine were analyzed for a possible statistical relationship to number of dental amalgam fillings. As emphasis has been put in the literature on special influence from amalgam on kidney function and on the immunological system, special attention was paid to variables which might reflect these functions in our analyses. When potential confounders were taken into consideration, no significant correlations remained which seemed to be of clinical importance. Specifically, amalgam fillings were not found to be associated with impairment of the kidney function or the immunological status."

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ABSTRACT: "In the past years increasing attention has been paid to possible adverse health effects associated to mercury exposure from dental amalgam fillings. To evaluate possible health effects from amalgam fillings, dental status, registered by specially trained nurses, was obtained from 587 male and female twins included in the ongoing Swedish Adoption/Twin Study of Aging (SATSA). Data on physical and mental health were collected and memory function tested. Mean age was 66 years (SD 9, range 46-89). In the entire material, 25 % of the individuals had no own teeth and in the group with own teeth the median number of teeth surfaces filled with dental amalgam was 15 (range 0-65). Analyses of associations between dental amalgam and a number of scales estimating somatic and mental health and memory functions were performed both using the entire group and after excluding individuals with less than 12 teeth. Regardless of the sample no negative effects on physical or mental health were found from amount of dental amalgam. On the contrary, a positive correlation between performance in the memory tests and number of teeth surfaces filled with dental amalgam was found. After controlling for age, gender, education and number of remaining teeth this association generally disappeared. When using a co-twin control design with twin pairs discordant for amalgam exposure, no negative health effects associated with dental amalgam were detected. This study does not indicate any negative effects from dental amalgam on physical or mental health or memory functions in the general population over 50 years of age."

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were less sensitive for the overall battery of tests. The reported effects were detected among dentists with a mean urinary Hg level of 36 micrograms/l, which lies between the proposed biologic thresholds of 25 and 50 micrograms Hg/creatinine, suggesting the need for a more comprehensive study to determine the threshold of adverse biologic effects."

Ellingsen DG, Nordhagen HP & Thomassen Y. Urinary Selenium Excretion in Workers with Low Exposure to Mercury Vapour. J Appl Toxicol 15(1):33-36 (1995)

ABSTRACT: "Urinary selenium excretion was studied in 21 mercury vapour (Hg0)-exposed workers involved in the demolition of a chloralkali plant. The subjects had no known previous occupational exposure to mercury. Their mean pre-exposure urinary mercury concentration, determined on average 1.2 days prior to the exposure, was 0.8 nmol/mmol creatinine (range 0.3-1.9). Their last mean urinary mercury concentration, determined on average after 51.4 days (range 19-103) of exposure, was 4.8 nmol/mmol creatinine (range 1.2-10.0). The exposure ceased on average 4.1 days after the last determined urinary mercury concentration. The corresponding concentrations of urinary selenium decreased from an average of 39.1 nmol/mmol creatinine (range 13.9-89.5) to 29.0 nmol/mmol creatinine (range 10.1-52.9) (P=0.002). This finding may indicate that even a low to moderate work-related exposure to Hg0 may reduce the urinary selenium concentration in humans in a manner that is not yet fully known"

Enestrom S & Hultman P. Does Amalgam Affect the Immune System? A Controversial Issue. Int Arch Allergy Immunol 106:180-203 (1995)

ABSTRACT: "Although in use for more than 150 years, dental amalgam has been questioned more or less vigorously as a dental restoration material due to its alleged health hazards. Humans are exposed to mercury and the other main dental amalgam metals (Ag, Sn, Cu, Zn) via vapour, corrosion products in swallowed saliva, and direct absorption into the blood from the oral cavity. Dental amalgam fillings are the most important source of mercury exposure in the general population. Local, and in some instances, systemic hypersensitivity reactions to dental amalgam metals, especially mercury, occur at a low frequency among amalgam bearers. Experimental and clinical data strongly indicate that these and other subclinical systemic adverse immunological reactions to dental amalgam metals in humans will be linked to certain MHC genotypes, and affect only a small number of the exposed individuals. These individuals will be very difficult to detect in a mixed population of suspectible and resistant individuals, including persons with alleged symptoms due to dental amalgam fillings, where many of the individuals are likely to suffer from conditions with no proven immunological background such as multiple chemical sensitivity syndrome. Intensified studies should be performed to identify such susceptible MHC genotypes, taking advantage of the reported cases of more heavily metal-exposed humans with systemic autoimmune reactions. Further studies will also be needed to ascertain whether the combined exposure to the metals in dental amalgam may lower the threshold for adverse immunological reactions, since recent studies have shown that the metals in alloy, especially silver, may induce autoimmunity in genetically susceptible mice."

End of abstract. A quote follows:

> *"... Very recent results (Hultman et al., in prep) in genetically suspectible rats implanted with conventional dental amalgam fillings in 4 teeth revealed a stimulation of B cells, measured as a significant increase in serum IgE, followed by systemic immune complex deposits..."*

Eti S, Weisman R, Hoffman R & Reidenberg. Slight Renal Effect of Mercury from Amalgam Fillings. Pharm & Toxicol 76:47-49 (1995)

ABSTRACT: "The current study was to answer the question: Is enough mercury absorbed from dental amalgam fillings to produce renal damage? One hundered healthy adults (18-44 years old) filled out health questionnaries and voided urine samples. Urine mercury concentration and N-acetyl-beta-glukosaminidase

(NAG) were measured. Subjects were grouped into those having amalgam fillings (N=66) and those without (N=34). Median 95% Confidence Interval) urine mercury was 1 (1-2) and 0 (0-0.6) ng/ml ($P<0.01$) and median urine NAG was 23 (18-27) and 16 (11-18) units ($P<0.05$) in the two groups respectively. People with mercury amalgam fillings excreted slightly more mercury than people without them, and have a very small increase in urinary NAG excretion that is probably of no clinical significance. This dose of mercury absorbed from amalgam appears to be too little to be a health hazard for renal injury."

Fuortes LJ, Weismann DN, Graeff ML, Bale JF, Tannous R & Peters C. Immune trombocytopenia and elemental mercury poisoning. J Toxicol - Clin Toxicol 33(5):449-455 (1995)
ABSTRACT: " Three cases of severe mercury toxicity occurring within a family are reported. Two cases of thrombocytopenia occurred in this family and represent the second such report in the literature of an association between elemental mercury toxicity and thrombocytopenia. Three of the children presented with a combination of dermatologic and neurologic manifestations reminiscent of acrodynia or pink disease. Each of the four children in this family were treated with dimercaptosuccinic acid. The hazard of vacuuming spilled mercury and appropriate clean-up procedures are described."

Gonzalez-Ramirez D, Maiorino RM, Zuniga-Charles M, Xu Z, Hurlbut KM, Junco-Munoz P, Aposhian MM; Dart RC, Diaz Gama JH, Echeverria D et al. Sodium 2,3-dimercaptopropane-1-sulfonate challange test for mercury in humans: II. Urinary mercury, porphyrins and neurobehavioral changes of dental workers in Monterrey, Mexico. J Pharmacol Exp Ther 272(1):264-274 (1995)
ABSTRACT: "The sodium salt of 2,3-dimercaptopropane-1-sulfonic acid (DMPS) challange test (300 mg p.o. after an 11-hr fast) was given in Monterrey, Mexico to dental and non-dental personnel. Urine samples were collected and analyzed for total mercury. The mean mercury urinary excretion (+/- S.E.) for 6 hr before and 6 hr after DMPS administration for 10 dental technicians, who formulate amalgam, was 4.84 micrograms +/- 0.742 and 424.0 micrograms +/- 84.9; for 5 dentists, who use amalgam in their practice, 3.28 micrograms +/- 1.11 and 162.0 micrograms +/- 51.2; and for 13 nondental personnel, 0.783 microgram +/- 0.189 and 27.3 micrograms +/- 3.19. The urinary coproporphyrin levels before DMPS administration, which are indicative of renal mercury content, were quantitatively associated with the urinary mercury levels among the three study groups after DMPS administration. This was not so if the urinary mercury level before DMPS administration was compared with the urinary coproporphyrin concentration. The urinary mercury level after DMPS administration is a better indicator of exposure and renal mercury burden than is the mercury level measured in the urine before DMPS is given. Regression analysis showed that the coefficient of urinary mercury was statistically and adversily associated with complex attention (switching task), the perceptual motor task (symbol-digit substitution), symptoms and mood. The easily performed DMPS-mercury challenge test is useful for monitoring dental personnel for mercury vapor exposure."

Gothe CJ, Odont CM & Nilsson CG. The environmental somatization syndrome. Psychosomatics 36(1):1-11 (1995)
ABSTRACT: "Patients with environmental somatization syndrome (ESS) believe that their symptoms are caused by exposure to tangible components of the external environment or by ergonomic stress at work. ESS is distinguishable by mental contagiousness and by the patients' focus on the external environment as cause of the illness. The presentation is often polysymptomatic, and epidemic outbreaks may appear. The patients usually refuse alternative explanations of their symptoms and discredit and reject any suggestion of a psychogenic etiology. It is important to distinguish between hygienic problems and ESS problems, particularly when poor and inadequate hygienic factors are present simultaneously with an ESS epidemic."

Grandjean P. Individual susceptibility in occupational and environmental toxicology. Toxicol Lett 77(1-3):105-108 (1995)

ABSTRACT: "By prudent interpretation of toxicological and epidemiological evidence, susceptibility could become a very useful notion, both in a scientific sense and for prevention of adverse effects. Based on presumed aetiology, susceptibility can often be separated into genetic, constitutional, and environmental categories, although some overlapping between these groups will be apparent. Inherited factors seem to be involved in determining many toxic effects of environmental chemicals, including carcinogenic responses, although some of the evidence is equivocal. Among constitutional factors, sex, age and pregnancy are major determinants of individual susceptibility. An individual's resistance toward chemical toxicity may also be affected by other environmental exposures, including those associated with diet and lifestyle. The mechanisms involved are only partially known but are likely to include both toxicokinetic and toxicodynamic interactions. Three major types can be recognised: (1) factors that increase the concentration of the biologically active substance at the active site; (2) factors that augment the reaction of the chemical substance with target molecules in the body, thereby initiating the response; and (3) factors that promote the sequence of events between the initial reaction and the final manifestation of an adverse health effect. Specifically, a decrease in the body's reserve capacity may not be readily observable and may only reveal itself as a weakening of the defence mechanisms. The causes of hypersusceptibility and its effects on toxic responses are little known and deserve to be explored systematically."

Guerrier P, Weber J-P, Cote R, Paul M & Rhainds M. The accelerated reduction and elimination of toxics in Canada: the case of mercury-containing medical instruments in Quebec hospital centres. Water, air, and soil pollution 80:1199-1202 (1995)

ABSTRACT: "In Canada, medical instruments containing mercury (Hg) are still widely used in hospitals. These are mostly thermometers and sphygmomanometers. Mercury present in these instruments does not itself consitute a risk of contamination since the metal is contained within a closed system. however, breakage, inadequate maintenance and disposal of such instruments can expose workers and the public to this toxic substance. In Quebec 80% of the 28 hospitals surveyed still use Hg sphygmomanometers and 45% Hg thermometers. Besides, 35% do not have any recovery procedures in case of spillage and most mercury spills are apparently not reported. Two main courses of action are recommended: the gradual replacement of these medicla instruments by aneroid sphygmomanometers and electronic thermometers, and the establishment and communication, in form of a handbook, of guidelines to handle and dispose of mercury safely."

Gustafsson E. Swedish experiences of the ban on products containing mercury. Water, Air, and Soil Pollution 80:99-102 (1995)

ABSTRACT: "The Swedish Parliament has decided that the use of mercury (Hg) must cease. Risk reuction measures are to be carried out with and without the support of legislation. According to decisions taken in May 1994 the aim is, with a few exemptions, to end the use of Hg in processes and products by the year 2000. Special attention has been paid to products containing Hg. Most uses of Hg-containing measuring instruments and electrical components have successively been phased out in Sweden. It can be concluded that most such uses have reliable Hg-free alternatives."

Liang L I & Brooks RJ. Mercury reactions in the human mouth with dental amalgams. Water, Air, and Soil Pollution 80:103-107 (1995)

ABSTRACT: "This is a preliminary study of the reactions of mercury (Hg) in the human mouth with dental amalgams. It was conducted by analysing saliva samples from subjects with amalgam fillings and control subjects with no amalgams. Samples were collected both prior to and after cleaning the mouth. These samples were analyzed for elemental mercury (Hg0), inorganic mercury (Hg2+) and methylmercury (MeHg). We concluded that the concemntrations after cleaning represented the systemic concentrations. Hg2+ and MeHg

were found in all systemic samples from both subjects and controls, while Hg0 was found only in the samples from subjects with amalgams. In the control group, the concentrations found before and after cleaning the mouth were equivalent. In the amalgam group, concentrations of Hg2+ found before cleaning the mouth were 10 to 40 times higher than those found after cleaning, suggesting that the oxidation reaction of Hg0 into Hg2+ takes place. For MeHg, a similar but less pronounced pattern as Hg2+ was found, supporting methylation in the mouth."

Louwerse ES, Buchet J-P, Van Dijk MA, de Jong VJMB & Lauwerys RR. Urinary excretion of lead and mercury after oral administration of meso-2,3-dimercaptosuccinic acid in patients with motor neurone disease. Int Arch Occup Environ Health 67:135-138 (1995)
ABSTRACT: "Amyotrophic lateral slerosis (ALS) and spinal muscular atrophy (SMA) are progressive neurodegenerative disorders involving motor neurons. The aetiology of the non-familiar forms is still unknown but it has been suggested that long-term exposure may play a role in the pathogenesis of these diseases. In 53 patients suffering from ALS (n=42) and SMA (n=9) the oral administration of dimercaptosuccinic acid (DMSA, 20 mg/kg) did not result in a greater mobilization of lead and mercury from peripheral depots than in control subjects. Although it can not be excluded that the amount of lead or mercury excreted after DMSA administration may not be a reflection of the amount accumulated in the motor neurones, this study does not provide support for the hypothesis that heavy metals play a significant role in the occurrence of motor neurone diseases."

Maretta M, Marettov:a E, Skrob:anek P & Lede:c M. Effect of mercury on the seminiferous epithelium of the fowl testis. Acta Vet Hung 43(1):153-61 (1995)
ABSTRACT: " Phenylmercuric chloride was applied in three doses (5 ppm, 30 ppm Hg, and 30 ppm Hg + 4 ppm Se) via the food for 60 days. The effect of Hg with an without Se was studied histologically and the data of a shortened spermatogram were evaluated. Treatment with 30 ppm Hg resulted in hypospermia, occurrence of abnormally maturing spermatozoa, reduction of the volume of semen, and decrease in the number of spermatozoa. The dose of 5 ppm Hg only resulted in the appearance of abnormally developing cells and decreased sperm motility. The addition of Se maintained spermatogenesis and the values of semen on the control level."

McCann. Intravenous gamma globulin (IVIG) treatment of autoimmune kidney disease associated with mercury (Hg++) toxicity. J Allergy Clin Immunol 95(1)(Pt 2):145 Abstract 18 (1995)
ABSTRACT: "Tiny amounts of Hg++ (10(-6)) regulary induce in Brown-Norway rats, but not in outbred strains, autoimmune renal disease characterized by polyclonal activation of B-cells, hypergammaglobulinemia with antibodies against a variety of antigens as well as autoreactive T cells directed against Class II molecules. The same could occur in humans but only in those who are genetically susceptible. RS, a 31 yr old Finn, developed fatigue and recurrent infections (aseptic meningitis, pneumonia, sinusitis, pseudomonas pyelonephritis) beginning at age 9. He was heavily exposed to Hg++. Urine Hg = >800 ug/L. His illness exaberated following simultaneous removal of 21 large Hg-amalgam fillings along with chelation therapy (EDTA & DMPS). Over the next yr he had 70 lb wgt loss, gastroenteritis, monilial stomatitis, granulocytopenia and proteinuria. IgG=14.6 gm/L, CD8 lymphocytes= 50% CD4/CD8=0.9, CD8 HLADR=20u/L(N=>149). Antimyelin IgM antibody was pos. The only successful treatment was IVIG, 400 mg/kg/mo. Creatinine Cl, 60 ml/min increased to > 80 ml/min, proteinuria cleared and weight gain resumed. His illness resembled AIDS but repeated HIV testing was neg. This case suggests that traditional toxicological thinking in which symptoms should be dose related to total body Hg++ burden in all individuals in a group, needs to be changed to recognize genetic variability."

Molin M, Berglund JR & Mackert Jr. Kinetics of mercury in blood and urine after amalgam removal. J Dent Res 74:420 IADR Abstract 159 (1995)

ABSTRACT: "Even though a number of studies have not been able to reveal any correlation between subjective symptoms and amalgam load there still are speculations wether patients with subjective symptoms related by the patients themselves to their amalgam fillings could have a changed pattern of elimination of mercury. The aim of the present investigation was to study the elimination half-time of mercury in plasma. erythrocytes and urine over an extended period of time after amalgam removal in a group of 10 patients with subjective symptoms by the patients themselves reffered to their amalgam fillings and a group of 8 healthy subjects. The average number of occlusal and total amalgam surfaces in the patient group were 13.0 (range 4 - 20) and 44.4 (range 24 - 68), respectively. Corresponding figures in the control group were 12.9 (range 10 - 16) and 40.9 (range 24 - 63). The amalgam removal using rubberdam, water spray cutting and high volume vacuum evacuator, was carried out at one and the same time. Blood and urine samples were collected at two occasions before the amalgam removal, then blood was collected at thirthytwo occasions and urine at forthythree occasions during the following year. The mercury content wasanalysed by CVAAS technique. The measured P-, Ery- and U-Hg concentrations before amalgam removal were slightly higher in the control group 6.4+/-3.3 nmol/L, 19.4+/-6.6 nmol/L, and 2.7+/-1.3 nmol/mmol creatinine respectively than in the symptom group 5.6+/-1.8 nmol/L, 14.8+/-8.8 nmol/L, and 1.6+/-0.9 nmol/mmol creatinine respectively. The Hg-concentrations did not significantly increase in the two groups after amalgam removal. Six days after the removal the plasma mean concentrationwas significantly decreased at $p<0.05$ level and ten days after the decrease was at a permanent $p<0.005$ level. The mean Ery-Hg level was significantly decreased after eleven days ($p<0.05$) a level that remainedstabel for the rest of the year. The mean U-Hg level was significantly decreased one month after the removal and after six months the mean level was reduced with 80% compared to the initial level in bothgroups. The conclusion to be drawn from the present study is that the symptom group did not have a changed pattern of elimination of mercury compared to the healthy group."

Moszczy:nski P, S:owi:nski S, Rutkowski J, Bem S & Jakus-Stoga D. Lymphocytes, T and NK cells, in men occupationally exposed to mercury vapours. Int J Occup Med Environ Health 8(1):49-56 (1995)

ABSTRACT: " Lymphocytes, T-cells (CD3+), T-helper (CD4+) and T-suppressor (CD8+) as well as NK-cells (CD16+) counts were determined in the peripheral blood of 81 males occupationally exposed to metallic mercury vapours and of 36 non-exposed males using monoclonal antibodies in indirect immunofluorescence tests. Mean weighted mercury concentration in air accounted for 0.0028 mg x m-3. Urine mercury concentrations ranged from 0 to 240 micrograms x 1(-1) and concentrations in the blood varied from 0 to 30 micrograms x 1(-1). Stimulation of T-lymphocytes manifested by an increased number of T-cells, T-helper and T-suppressor was observed. Quantitative change in T-cells night be an immunological index of exposure to mercury vapours as indicated by a positive correlation between the exposure duration and the number of these cells."

Nakagawa R. Concentration of mercury in hair of diseased people in Japan. Chemosphere 30(1):135-140 (1995)

ABSTRACT: "The purpose of this investigation was to estimate the total hair mercury of diseased people (not including patients of mercury poisoning such as Minamata disease). Hair samples were collected from 133 diseased volunteers in Tokyo and the surrounding areas from Oct. 1992 to June 1993. The total mercury concentrations in the hair of ordinary diseased people (atopic dermatitis, asthma, dementia, cerebral infarct, osteoporosis, hypertension and diabetes) were from 2.08 ppm to 36.5 ppm. Those values were considerably higher than that of healthy people of the same age groups. However, the uptake routes and the metabolic mechanism of high hair mercury concentrations in diseased people are not clear."

Nuyts GD, Vanvlem E, Thys J, Deleersnijder D, Dhaese PC, Elseviers MM & Debroe ME. New Occupational Risk Factors for Chronic Renal Failure. Lancet 346(8966):7-11 (1995)
ABSTRACT: "Occupational pollutants may have a role in development of chronic renal failure (CRF). Most epidemiological studies have been cross-sectional, limited to certain renal diagnoses, or concentrated on early transient renal effects. In a case-control study, we examined the association between CRF and occupational exposure. Occupational histories of 272 men and women with CRF (of all types) were compared with those of 272 controls matched for age, sex, and region of residence. Exposures were assessed and degree and frequency were scored independently by three industrial hygienists unaware of case/control status, Significantly increased risk of CRF were found for exposure to lead (odds ratio 2.11 [95% CI 1.23-4.36]), copper (2.54 [1.16-5.53]), chromium (2.77 [1.21-6.33]), tin (3.72 [1.22-11.3]), mercury (5.13 [1.02-25.7]), welding fumes (2.06 [1.05-4.04]), silicon-containing compounds (2.51 [1.37-4.60]), grain dust (2.96 [1.24-7.04]), and oxygenated hydrocarbons (5.45 [1.84-16.2]). The frequencies of various occupational exposures were high among patients with diabetic nephropathy. This epidemiological study confirms previously identified risk factors and suggests that additional occupational exposures, for which there is some other experimental evidence, may be important in the development of CRF. The role of grain dust and the association between occupational exposure and diabetic nephropathy merit further investigation."

O'Carroll RE, Masterton G, Dougall N & Ebmeier KP. The neuropsychiatric sequelae of mercury poisoning. The mad hatter's disease revisited. Br J Psychiatry 167(1):95-98 (1995)
ABSTRACT: "BACKGROUND. the detailed effects of mercury poisoning on cognitive function, brain anatomy and regional brain function are largely unknown. We report a case of a 38-year-old man who was exposed to toxic levels of inorganic mercury. METHOD. Four years after exposure, the patient was assessed using magnetic resonance imaging (MRI), single-photon emission computerised tomography (SPECT) and detailed neuropsychological evaluation. RESULTS. The patient developed a myraid of physical and psychiatric complaints, including stomatitis, muscle spasm, tremor, skin rash and the psychiatric syndrome known as "erythism" (Mad Hatter's disease). Neuropsychological evaluation revealed marked and significant deficits of attention, concentration, particularly when under time pressure. The MRI scan was unremarkable; however, SPECT revealed hypermetabolism of the posterior cingulate cortex. CONCLUSIONS. Mercury poisoning appeared to result in a dysregulation of posterior cingulate cortex, which was associated with attention/concentration deficits and marked anxiety/agitation."

Oskarsson A, Palminger Hallen I & Sundberg J. Exposure to toxic elements via breast milk. Analyst 120(3):765-770 (1995)
ABSTRACT: "Breast milk is the ideal nutrient for the newborn, but unfortunately also a route of excretion for some toxic substances. Very little attention has been paid to breast milk as a source of exposure to toxic elements. The dose-dependent excretion in breast milk and the uptake in the neonate of inorganic mercury, methylmercury and lead were studied in an experimental model for rats and mice. The transfer of mercury from plasma to milk was found to be higher in darns exposed to inorganic mercury than to methylmercury. In contrast, the uptake of mercury from milk was higher in the sucklings of dams exposed to methylmercury than to inorganic mercury. Pre- acid postnatal exposure to methylmercury resulted in increased numbers and altered proportions of the thymocyte subpopulation and increased lymphocyte activities in the offspring of mice and also effects on the levels of noradrenaline and nerve growth factor in the developing brain of rats. Mercury in blood and breast milk in lactating women in Sweden was studied in relation to the exposure to mercury from fish and amalgam. Low levels were found; the mean levels were 0.6 ng g(-1) in milk and 2.3 ng g(-1) in blood. There was a statistically significant correlation between mercury levels in blood and milk, showing that milk levels were approximately 30% of the levels in blood. Inorganic mercury exposure from amalgam was reflected in blood and milk mercury levels. Recent exposure to methylmercury from consumption of fish was reflected in mercury levels in the blood but not in milk. A high lactational transfer of

lead was found in rats and mice. A linear correlation was found in the dams between lead in plasma and milk and between lead in milk and tissues of sucklings. It was also found that the bioavailability of lead in milk diets is dependent on the casein content of milk. Thus, lead in human milk with a low casein content was absorbed more rapidly and to a higher extent in the sucklings than lead in rat milk with a high casein content. The excretion of lead in milk was also studied in cows after an episode of lead intoxication. A curvilinear relationship between lead in blood and milk was found, with a sharp increase in lead levels in milk at blood lead levels above 200-300 mu g kg(-1). Lead levels in human breast milk and blood were studied in Sweden. The mean levels of lead were 0.8 mu g l(-1) in milk and 33 mu g l(-1) in blood. This can be compared with a reported mean value of 62 mu g l(-1) in milk from women living close to a smelter in Mexico. There was no correlation between lead levels in blood and milk in the Swedish study. However, significantly higher levels of lead in milk were found in women living close to a metal smelter as compared with women from a control area."

Perlingeiro RCR & Queiroz MLS. Measurement of the respiratory burst and chemotaxis in polymorphonuclear leukocytes from mercury-exposed workers. Human & Experim Toxicol 14:281-286 (1995)
ABSTRACT: "The chemotactic and nitroblue tetrazolium reducing activities of neutrophils from 48 mercury-exposed workers were examined and compared with those of non-exposed, age- and sex-matched individuals. At the time of testing, the exposed population had a mean (+/- s.d.) urinary mercury concentration of 24.0 +/- 20.1 ug/g creatinine and in 44 of these workers urinary mercury levels were below the accepted threshold level (TLV) of 50 ug/g creatinine. The two neutrophil functions were significantly reduced in the mercury-exposed workers compared with the controls. In 28 of these workers, chemotaxis was re-evaluated 6 months later. During the intervening 6 months, the level of hygiene was improved throughout the plant and urinary mercury concentrations were determined monthly in each worker. Des pite a significant reduction in urinary mercury concentrations, neutrophil migration did not return to within the normal range. These results suggest the "safe" level mercury exposure may lead to impairment of netrophil function."

Ritchie KA, MacDonald EB, Hammersley R, McGowan DA, Dale IM & Wesnes K. Psychomotor testing of dentists with chronic low level mercury exposure. J Dent Res 74:420 IADR Abstract 160 (1995)
ABSTRACT: "There is still widespread concern about possible ill effects of chronic low-level mercury exposure on dentists, staff and patients. 20 experienced general practioners (mean age 41), and 19 first year post-qualification dentists (mean age 23), were tested, as were a control group of 40 doctors, 20 "older" (mean age 46) and 20 "younger" (mean age 28). A computerised battery of psychomotor tests developed for drug studies by Cignitive Drug Research was used., along with a questionnaire on age, sex, alcohol consumption, regular medication, general health (supplemented by the 12-question version of the General Health Questionnaire), and some aspects of practice procedure, includingany recent mercury spillage. Their urine samples were analysed by cold atomic absorption spectroscopy and related to creatinine content as a measure of urine concentration. The robertson Institute for Biostatistics (University of Glasgow), analysed data from the 42 measurements from the 8 tests along with results of the questionnaire and of the urine testing. The median mercury / creatinine ratios (nmol/mmol) for older dentists were 3.65 (range 1.4 - 17.6), younger dentists 1.8 (0.7 - 16.6), older controls 0.95 (0.2-15), and younger controls 1.25 (0.5 - 6.1). Three older and one young dentist had levels above the 5 mg/mmol cretinine considered to be the normal background level. Older dentists scored faster Mean Reaction Times, (t-test, $p<0.02$) and poorer Mean Immediate, ($p<0.05$), and Mean Delayed, ($p<0.05$), Word Recall, than the other groups, but there were no differences in the tests of Number Vigilance, Choice Reaction Time, Spatial Memory, Memory Scanning, or Word Recognition. No differences were shown in GHQ responses. Older dentists had faster reaction times, perhaps due to occupational experience, but impaired memory retrieval, which could not be related to any confounding factors, and could be due to chronic low level mercury exposure. The CDR testing system is suitable for larger scale studies of effectc of mercury exposure on dentists."

Salonen JT , Sepp:anen K, Nyyss:onen K, Korpela H, Kauhanen J, Kantola M , Tuomilehto J, Esterbauer H, Tatzber F & Salonen R. Intake of mercury from fish, lipid peroxidation, and the risk of myocardial infarction and coronary, cardiovascular, and any death in eastern Finnish men. Circ 91(3):645-655 (1955)
ABSTRACT: " BACKGROUND: Even though previous studies have suggested an association between high fish intake and reduced coronary heart disease (CHD) mortality, men in Eastern Finland, who have a high fish intake, have an exceptionally high CHD mortality. We hypothesized that this paradox could be in part explained by high mercury content in fish. METHODS AND RESULTS: We studied the relation of the dietary intake of fish and mercury, as well as hair content and urinary excretion of mercury, to the risk of acute myocardial infarction (AMI) and death from CHD, cardiovascular disease (CVD), and any cause in 1833 men aged 42 to 60 years who were free of clinical CHD, stroke, claudication, and cancer. Of these, 73 experienced an AMI in 2 to 7 years. Of the 78 decreased men, 18 died of CHD and 24 died of CVD. Men who had consumed local nonfatty fish species had elevated hair mercury contents. In Cox models with the major cardiovascular risk factors as covariates, dietary intakes of fish and mercury were associated with significantly increased risk of AMI and death from CHD, CVD, and any death. Men in the highest tertile (> or = 2.0 micrograms/g) of hair mercury content had a 2.0-fold (95% confidence interval, 1.2 to 3.1; P = .005) age- and CHD-adjusted risk of AMI and a 2.9-fold (95% CI, 1.2 to 6.6; P = .014) adjusted risk of cardiovascular death compared with those with a lower hair mercury content. In a nested case-control subsample, the 24-hour urinary mercury excretion had a significant (P = .042) independent association with the risk of AMI. Both the hair and urinary mercury associated significantly with titers of immune complexes containing oxidized LDL. CONCLUSIONS: These data suggest that a high intake of mercury from nonfatty freshwater fish and the consequent accumulation of mercury in the body are associated with an excess risk of AMI as well as death from CHD, CVD, and any cause in Eastern Finnish men and this increased risk may be due to the promotion of lipid peroxidation by mercury."

Sato K, Kusaka Y, Yanagihara M , Ueda K, Mori T & Miyakoshi S. :An epidemiological study of factors relating to mercury sensitization: Arerugi 44(2):86-92 (1995) (In Japanese with Engl abstr)
ABSTRACT: "We investigated factors relating to mercury sensitization in 156 medical students (mean age 22.7 +/- 2.4, mean +/- S.D., male 113, female 43). Their allergic symptoms, lifestyles and family histories were studied by questionnaire. Patch tests were performed on them with HgCl2 (0.05%aq.), NiSO4 (5%aq.), PPD (2%pet.) and urushiol (0.01%pet.). Anti-dermatophagoides and anti-cryptomeria pollen IgE antibodies in serum were also measured. While the positive rates of urushiol, nickel and PPD were 11.1%, 5.1% and 2.6%, respectively, that of mercury was as high as 12.8%. Each allergen specific antibody positivity and past histories of allergic diseases were not associated with mercury sensitization (by the chi-square test). Mercury sensitized students had significantly more frequently experienced eczema caused by cosmetics, shampoos, soaps and haircreams (by the chi-square test, $p < 0.005$). They also had significantly more teeth treated with metals compared to the controls (one-tailed t-test, $p < 0.05$). And their urinary mercury concentrations were significantly higher than those of the controls (one-tailed t-test, $p < 0.05$). These findings suggest that mercury sensitization is associated with exposure to mercury in the living environment."

Saxe SR, Snowdow DA, Wekstein MW, Schmitt FA & Wekstein DR. Amalgam and Elderly Mental Function. J Dent Res 74:75 AADR Abstract 510 (1995)
ABSTRACT: "Dental amalgam restoration surfaces release mercury (Hg), a neurotox, when mildly abraded such as from chewing. Possible neuropsychological effects of such Hg relese have been alluded to but have not been well assessed. This study investigated whether a relationship exists between number and surface area of occlusal amalgam restorations and cognitive function in older women. Catholic sisters (nuns) (n=122) aged 75-102 years who lived in the same residential complex with an on-site dental office were given a selected battery of 8 standarized neuropsychological tests. Number and surface area of occlusal amalgams

were determined using bite registrations, an intra-oral video camera and a Kontron image analyzer computer system. Of the 122 sisters, 22 were dentate but had no amalgam (Grp. I) who were compared to 27 edentulous (Grp.II), 43 with 1 to 99 sq. mm of occlusal amalgam surface (Grp III) and 30 with 100 or greater sq. mm (Grp. IV). Age and education-adjusted differences in Word Recall outcome scores showed that compared to Grp. I, Grp. II was 1.3 (95% CI -0.3,2.9) p=0.12; Grp. III was 0.6 (Cl -1.0,2.2) p=0.43; Grp. IV was 1.1 (Cl -0.6,2.9) p=0.20. Remaining tests also showed no adverse effects in grps. II, III and IV. The older women studied showed no difference in mental function testing regardsless of the presence and extent of occlusal surface amalgam."

Skare I. Mass Balance and Systemic Uptake of Mercury Released from Dental Amalgam Fillings. Water, air, and soil pollution 80(1-4):59-67 (1995)
ABSTRACT: "The release of mercury (Hg) from dental amalgam fillings has been verified by several authors. In this study, the emission rate of Hg0-vapor from the oral cavity (O-Hg) and the urinary Hg-excretion rate (U-Hg) have been studied with 34 healthy individuals. In ten cases, the urinary excretions of silver (U-Ag) and the fecal excretions of Hg and Ag (F-Hg, F-Ag) were also monitored. All variables, except U-Ag, were significantly related to the load of amalgam. According to this study, an individual with a moderate lode of amalgam, i.e. 30 restored surfaces, is predicted to exhibit the following emission rates: O-Hg=22, U-Hg=3, F-Hg=60 and F-Ag=27 ug/d (d=24 hours), consistent with a gross mass balance for Hg of approximately 60 ug/d. The corresponding systemic uptake of Hg was estimated to 12 ug/d based on external data relating air Hg0-exposures to urinary Hg-excretions. The worst case individual showed a gross mass balance of 200 ug Hg/d connected to a systemic uptake of 70 ug Hg/d. These values were compared to the average intake of total-Hg by a Swedish diet (2 ug/d) and to the WHO's tolerable value for intake of total Hg by food (45 ug/d). Upscaled to the entire Swedish population (8 mill.), the data suggests a fecal/urinary emission to the environment of 100 kg Hg yearly originating from a population load of amalgam fillings containing 90,000 kg of Hg."

Smart ER, Macleod RI & Lawrence CM. Resolution of lichen planus following removal of amalgam restorations in patients with proven allergy to mercury salts: a pilot study. Br Dent J 178(3):108-112 (1995)
ABSTRACT: "Thirteen patients with symptomatic oral lichen planus had been shown by patch testing to be allergic to ammoniated mercuric chloride. Replacement of amalgam restorations in these patients effected an improvement in all but one case. In some cases the resolution of symptoms was dramatic following the replacement of one or two fillings. The authors feel that the removal of all amalgam fillings need not be necessary except in the most intractable case."

Soederstroem S, Fredriksson A, Dencker L & Ebendal T. The effect of mercury vapour on cholinergic neurons in the fetal brain: studies on the expression of nerve growth factor and its low- and high-affinity receptors. Developmental Brain Research 85(1):96-108 (1995)
ABSTRACT: "The effects of mercury vapour on the production of nerve growth factor during development have been examined. Pregnant rats were exposed to two different concentrations of mercury vapour during either embryonic days E6-E11 (early) or E13-E18 (late) in pregnancy, increasing the postnatal concentration of mercury in the brain from 1 ng/g tissue to 4 ng/g tissue (low-dose group) or 11 ng/g (high-dose group). The effect of this exposure in offspring was determined by looking at the NGF concentration at postnatal days 21 and 60 and comparing these levels to age-matched controls from sham-treated mothers. Changes in the expression of mRNA encoding NGF, the low- and hogh-affinity receptors for NGF (p75 and p140 trk, respectively) and choline acetyltransferase (ChAT) were also determined. When rats were exposed to high levels of mercury vapour during early embryonic development there was a significant (62%) increase in hippocampal NGF levels at P21 accompanied by a 50% decrease of NGF in the basal forebrain. The expression of NGF mRNA was found to be unaltered in the dentate gyrus. The expression of p75 mRNA was

significantly decreased to 39% of control levels in the diagonal band of Broca (DB) and to 50% in the medial septal nucleus (MS) whereas no alterations in the level of trk mRNA expression were detectable in the basal forebrain. ChAT mRNA was slightly decreased in the DB and MS, significantly in the striatum. These findings suggest that low levels of prenatal mercury vapour exposure can alter the levels of NGF and its receptors, indicating neuronal damage and distributed trophic regulations during development."

Stoz F, Aicham P, Janovic S, Steuer W & Mayer R. Ist ein generelles Amalgam-Verbot gerechtfertigt? Untersuchungen an M:uttern und ihren Neugeborenen. (Is a generalized amalgam ban justified? Studies of mothers and their newborn infants) Z Geburtshilfe Perinatol 199(1):35-41 (1995) (In German with Engl Abstr)
ABSTRACT: "To measure the Hg-contamination from amalgam as well as other exposures to mothers and their newborns 185 women with tooth filling surfaces from 0 to 780 mm2 were examined. The Hg-values of mother and child at a time showed a highly significant correlation with a median value from 0.4 resp. 0.5 microgram/Hg/l. Obviously, the placenta has a retention capability with up to 10 times higher Hg-values and a low positive correlation to the amalgam surfaces. There was no relationship between the blood values of the women and the children and the size of the surfaces of the amalgam fillings. Opposite to this a high consumption of fish led to higher Hg-values in the umbilical cord blood, this even in children with mothers without amalgam fillings. Other exposures through working conditions (i.e. dental assistant) or living environment did not lead to higher values. Symptoms of diseases such as headaches, allergies, eczemas appeared with those patients who had amalgam fillings as well as those in the group without amalgam fillings. All women gave birth to healthy children. With all necessary caution concerning contamination with heavy metals during pregnancy some of today's panic inducing portrayals do not seem justified."

Tandon L, Kasarskis EJ & Ehmann WD. Elemental imbalance studies by INAA on extraneural tissues from amyotrophic lateral sclerosis patients. J Radioanal Nuclear Chem 195(1):13-19 (1995)
ABSTRACT: "Human kidney and liver tissues were studied for generalized elemental imbalances in amyotrophic lateral sclerosis (ALS) by instrumental neutron activation analysis (INAA). Iron was significantly increased ($p < 0.05$) in ALS kidneys and Co and Fe(marginal, $p < 0.10$) were increased in ALS liver compared with their respective controls. Mercury values were almost two-fold higher for ALS kidney and 17% higher for ALS liver as compared with their respective controls. However, the Hg data exhibited large variations and ALS-control differences were not significant. Data from the present study are discussed with reference to the role of metallothioneins (MT) in ALS, and a possible linkage between a free radical mediated mechanism and degeneration of cells in ALS is also explored."

Tibbling L, Thuomas K-A, Lenkei R & Stejskal V. Immunological and brain MRI changes in patients with suspected metal intoxication. Int J Occup Med Toxicol 4(2):285-294 (1995)
ABSTRACT: " Thirty-four patients with CNS and systemic symptoms suggestive of intoxication from dental amalgam were examined with magnetic resonance imaging (MRI) of the brain (n=32) and with a Memory Lymphocyte Immuno Stimulation Assay, MELISA, (n=17). Lymphocyte phenotype was analysed with flow cytometry (FC) in 22 of the patients. One hundred twenty age-matched patients without CNS symptoms served as controls for the MRI study, seventy-seven healthy subjects with dental amalgam fillings served as controls for the MELISA test, and seventy-five clinically healthy subjects were controls for lymphocyte phenotype determination. Pathological MRI findings were found in 81 % of the patients, most of them with signs of degeneration in the basal ganglia, but in none of the controls. The lymphocyte phenotype determination was pathological in 58 %. The MELISA showed pathological findings in 88 % of which 60 % with immune reactions to mercuric chloride. 62 % of the patients had some kind of atopic disease. 35 % suffered from levothyroxine-treated hypothyreosis. A high rate of immunopathies and objective signs of immunological reactions in the majority of the patients with MRI changes in the brain suggests that immunological mechanisms may play an important role in the development of the lesions."

Tulinius AV. Mercury-dental amalgam fillings and intellectual abilities in Inuit school children in Greenland. Arct Med Res 54(2):78-81 (1995)
ABSTRACT: "The hair mercury concentration of 125 Greenland pupils aged 12 to 17 was recorded and compared with the pupils' marks in selected school subjects. Mercury values ranged from 0.2 to 15.9 microgram per gram (ug/g) and 20% of the pupils had more than 6 ug/g. There was no correlation between a high mercury concentration score and poor results in school. Correlation of the number of dental amalgam fillings with mercury concentration showed a weak but no significant relation. Eating habis were significantly correlated with mercury concentration. Girls had a significantly higher number of amalgam fillings than boys, and had a significantly higher mercury concentration. Modern Inuit and the mummified Qilaqitsoq Inuit from the 15th century had largely identical levels of mercury in the hair irrespective of today's higher exposure to global environmental contamination. This is believed to result from a change in eating habits away from the traditional Greenland food towards a more continental diet."

Warfvinge K, Hansson H & Hultman P. Systemic autoimmunity due to mercury vapor exposure in genetically susceptible mice: dose-response studies. Toxicol Appl Pharmacol 132(2):299-309 (1995)
ABSTRACT: "Six groups of genetically mercury-suspectible female SJL/N (H-2(5)) mice were exposed to mercury vapor at a concentration of 0.3-1.0 mg Hg/m3 air for 0.5-19 hr/day 5 days a week for 10 weeks. The absorbed doses calculated to be between 75 and 2365 ug Hg/week/kg body wt (ug Hg/week/kg). The correlation between the dose and the concentration of Hg in Kidney, spleen, and thymus was significant ($p < 0.0001$; Spearman's rank correlation test). The lowest observed adverse effect level (LOAEL) for serum IgG antinuclear antibodies (ANoA) was 170 ug Hg/week/kg, corresponding to a renal mercury concentration of 4.0+/-0.76 ug Hg/g wet wt. The correlation between the absorbed dose and the ANoA titer was highly significant ($p < 0,0001$; Spearmen's rank correlation test), and all mice were ANoA-positive at a dose of 480 ug Hg/week/kg. High-titer ANoA targeted the nucleolar 34-kDa protein fibrillarin. The LOAEL for B-cell stimulation, measured as an increase in serum IgG2a and IgG1 concentrations, was 360 ug Hg/week/kg, but the increase was fivefold higher and also included IgE at a dose of 690 to 2365 ug Hg/week/kg. The serum Ig concentrations peaked after 2-4 weeks and then slowly declined but, except for IgE, remained significantly increased during the entire exposure time. Glomerular, mesangial IgG immune complex (IC) deposits, accompanied by systemic vessel wall IC deposits, were first detected at a dose of 480 ug Hg/week/kg, The mesangium also showed increased titers of IgM IC deposits and complement factor C3c. The correlation between the absorbed dose, and the individual titer of IgG, IgM, and C3c, was highly significant ($p < 0.0001$; Spearmen's rank correlation test). In conclusion, mercury vapor efficiently induced an autoimmune syndrome in genetically suceptible mice, and the LOAEL for adverse effects varied in the order ANoA < B-cell stimulation < IC deposits. Comparing the body burden of mercury in mice at the LOAEL for autoantibodies with the body burden in populations of occupationally exposed humans suggests that the safety margin may be narrow for genetically suspectible individuals."

Zaichick VYe, Tsyb AF & Vtyurin BM. Trace elements and thyroid cancer. Analyst 120(3):817-821 (1995)
ABSTRACT: "To evaluate the importance of trace amounts of elements in thyroid cancer etiology and diagnostics, instrumental neutron activation analysis has been used to estimate Ag, Co, Cr, Fe, Hg, I,Rb, Sb, Sc, Se, and Zn concentrations in malignant and benign thyroid nodules as well as in apparently intact paranodular thyroid tissue. Resected material from 135 patients was obtained from operations. Forty-five cancer cases were diagnosed and the rest were of benign nodules. The thyroid glands of 65 people, 53 male and 12 female, who died and unexpected death or committed suicide, were used as a control group. Trace element contents of the International Atomic Energy Agency reference material H-4 (animal muscle) were analysed simultaneously with the thyroid tissue in order to evaluate the accuracy of the obtained data. No dependence of trace element

contents on sex and age (14-80 years) was found for normal thyroids. In paranodular tissue, the Ag, Co, Hg, I and Rb contents were much higher for malignant and benign nodules than they were for the standard. There was also a slight deficiency of Se in the nodules compared with the standard. This result supports the hypothesis that the direct toxic heavy metal influence on thyrocytes plays a major role in thyroid cancer etiology, provided that an adequate level of the defence mechanisms is absent. Iodine concentrations are 15 times lower, on average, in malignant compared with benign nodules. It is also shown that the radio between the iodine concentration in nodular and paranodular tissue can be used for in vivo thyroid cancer diagnostics."