Engineering Controls

As old fillings are drilled out, the mercury vapor diffuses through the air and the particulate cloud spreads radially around the operatory environment. With as much exposure as this generates, we must look for methods that will reduce the dispersion of mercury around the room, and reduce the mercury exposure to everyone present. Methods that can be used to reduce a toxic exposure in the workplace are referred to as “engineering controls.”

Engineering controls should include: the use of water spray, high volume evacuation, a "clean-up" suction tip, a supplemental vacuum air mover, room air filtering, and surface cleaning.

Water Spray & High-volume Evacuation

**Water Spray**

Many common dental techniques can serve to reduce the dispersion of mercury vapor and amalgam particulate in the clinic environment. Use of water spray is standard operating procedure in most dental settings. Having the assistant rinse the field constantly as the old filling is being removed reduces the buildup of volatile particles.

**High-volume Evacuation**

The use of high-volume evacuation is also standard operating procedure in most dental settings. However, it is important to consider how the vacuum equipment is vented. Many installations have the vacuum pump vented to the space inside, as in a utility closet, or under a cabinet. This arrangement blows the exhaust air right back into the workplace, and exposes the whole office environment to the mercury removed from the fillings. Instead, the vacuum system must be arranged to be vented outside the building.
"Clean-up" Suction Tip

The "clean-up" suction tip has an enclosure that surrounds the tooth being worked on, to reduce spatter and spread of particles around the field when drilling out an old amalgam filling. It is available commercially and from the IAOMT store.

Supplemental Vacuum Air Mover

As we shall see, mercury-laden debris and vapor scatters in the operative area beyond the reach of our surgical suction. One way that dentists have used to reduce office-environment contamination is to use a supplemental vacuum air mover to remove the aerosol from the surgical area.

Machines like the one illustrated are available on the dental supply market. Alternatively, some offices have used a typical household central vacuum system that is vented to the outside as their method for moving contaminated air out of the operatory environment.
Room Air-Filtering
Mercury vapor and amalgam particulate that gets dispersed widely throughout the operatory may be cleaned up to some extent by room air-filtering, either with a standard charcoal-based room air filter, or with an air filter supplemented by a negative ion generator.

Standard

Surface Cleaning
This also brings up the subject of surface cleaning in the room. The same considerations we make for surface disinfection-hard surfaces that can be scrubbed, seamless flooring, and no carpets-can be extended to allow for cleaning up the fine haze of mercury that settles on floors and countertops.
Mercury Dispersion

How much mercury really gets spread around when we drill out an old filling? A team of investigators affiliated with IAOMT set out to answer this question.

Dispersion of Particulate

Using the manikin model in a clinical setting, fillings containing 1000 milligrams of mercury were drilled out, with all the engineering controls (mentioned in the Engineering Controls section of the course) in place. Cotton 2x2 gauze pads, placed at various distances from the operative field, were analyzed for mercury that settled on them in the form of particulates.

Even with all the engineering controls in place, amalgam particulate containing 30 milligrams of mercury was deposited in a radius of 30 centimeters from the operative field. The industrial hygiene specialist who performed the chemical analysis remarked that he had never seen such an enormous quantity of mercury in any other workplace environment!
Dispersion of Vapor

Mercury, measured as vapor alone, can spike to levels approaching occupational safety limits even when we use water spray and high volume evacuation.

An IAOMT sponsored experiment took place in a dental school technique lab, where amalgam fillings were placed in a dentiform manikin, and then removed under three conditions: using water spray and suction, suction only with no water, and no suction or water spray. Twenty five amalgam fillings were removed in each group, and the mercury vapor was measured at the distance of the operator’s nose.

The experiment showed that when drilling out amalgam fillings using water spray and suction, we are able to stay just under the occupational safety limit for mercury vapor, 25 micrograms per cubic meter of air. With no water spray, and, certainly with neither water nor suction, the vapor levels spike tremendously.

Note the logarithmic scale on the Y-axis.

Of course, this study does not account for the presence and persistence of the mercury particulates that we generate along with the vapors. Also, we shouldn’t forget that occupational safety limits do not apply to our patients, who should not be subjected to industrial levels of mercury exposure.

Note: Occupational exposure limits do not apply to dental patients!

Citation: Warwick, et al. Journal of Occupational Medicine and Toxicology 2013, 8:27
Effects of Engineering Controls

Another manikin-based amalgam drilling experiment looked at the incremental effects of each of the recommended engineering controls, on the level of mercury vapor at the position of the assistant’s nose. Starting out with all controls in place, they first removed the negative ion air cleaner, then the clean-up suction tip, then the vacuum air mover.

At this point, the level of mercury vapor was still just under the exposure limit published by a US government agency, the ATSDR. When the water spray and, finally, the suction were removed, the levels of mercury vapor shot up dramatically.

Note the logarithmic scale on the Y-axis.
Patient Protection Protocols

Our obligation as dentists is to prevent our patients from breathing, swallowing, and having skin contact with the mercury-laden debris that's generated when we remove their old amalgam fillings. We know that taking such care by using simple, basic, physical-barrier techniques will substantially reduce the exposure the patient receives. Employing these protective measures, we proceed with our new restorative procedures once we know the risk of mercury exposure is past.

Which amalgam fillings do we recommend these procedures for? All of them! This basic set of suggestions includes:

**Draping the Patient**

Drape the patient to prevent skin exposure to particulates. Following is a quick, simple draping procedure:

- Provide an outside air source, eye protection, and saliva ejector

- Then a cut-out patient napkin
Learning Aid
Safe Removal of Amalgam Fillings

- Finally, the rubber dam

- Very simple draping: a damp paper towel, no skin uncovered

Which drape material? Tyvek® hazmat-type material proved too porous. Common polyethylene-backed patient bibs performed better:
Providing an Outside Air Source

Provide an outside air source to prevent the patient from inhaling the mercury laden aerosol that is generated by drilling on amalgam. The easiest method for the typical dental office is to use a nitrous nose hood. Some use a positive pressure air source, such as clean compressed air and an inexpensive oxygen hood.

It is not about providing oxygen, but about providing mercury free air. Nasal cannulas will not exclude the ambient air in the operative area.

Using a Rubber Dental Dam and a Saliva Ejector

Use a rubber dam (properly applied) to prevent debris from getting down the throat. There is disagreement as to whether a rubber dam is truly necessary, or if other strategies like throat packing, "Isolite®" type suction devices, or Clean-Up suction tips alone are sufficient. There are no published studies of this question, but a consensus of clinical experience would indicate that the rubber dam is the single most valuable protective barrier.

Which Rubber Dam?

In a two-chamber test of mercury vapor perfusion, the non-latex material proved to be a much better vapor barrier than latex:

Place a saliva ejector behind the dam to collect any vapor that penetrates.

Providing Water Spray, Evacuation, and Irrigation

Use copious water spray and high volume evacuation (HVE) to remove debris continuously. The “Clean-Up” suction tip reduces spatter, while constant irrigation improves collection of debris.
Learning Aid
Safe Removal of Amalgam Fillings

Cutting and Chunking
"Cut and chunk" means to remove amalgam in as large pieces as possible to reduce the generation of fine particles.

Rinsing and Removing
Rinse the field thoroughly after the amalgam is gone. Be sure to clean behind the rubber dam clamp where cut debris can hide. Remove the dam and drapes, rinse the patient’s mouth thoroughly, inspecting for visible debris.

Providing a Mercury Scavenging Mouth Rinse
Provide a mercury-scavenging mouth rinse to pick up any dissolved mercury from the patient’s saliva. Such a mouth rinse can be made by mixing a capsule of activated charcoal or N-acetyl cysteine into a cup of water. Both are easily obtainable as dietary supplements.
Reports of Mercury Exposure In Dental Workers

The other side of the amalgam mercury exposure problem involves the dentist and dental staff, who can frequently be exposed to high levels of mercury on the job.

Why do dental authorities continue to claim that dentists who use mercury are no more unhealthy than the general population? How can they, when exposure limits are exceeded and the literature is full of reports of mercury related illnesses in dental workers who handle amalgam?

The 2012 paper of Duplinsky is especially revealing.

Occupational Exposure Limits

Most nations recognize an occupational exposure limit of either 25 or 50 micrograms of mercury per cubic meter of air, as an average over an 8 hour workday, and 100 micrograms as a top limit for momentary exposures.

Some typical mercury exposures that have been reported to occur in the dental operatory are shown in this table:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Mercury Exposure Limit</th>
</tr>
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<tbody>
<tr>
<td>Opening an amalgam capsule</td>
<td>400 μg/m³</td>
</tr>
<tr>
<td>Opening chair-side trap</td>
<td>600 μg/m³</td>
</tr>
<tr>
<td>Drilling with no water spray</td>
<td>1200 μg/m³</td>
</tr>
<tr>
<td>Polishing with prophylaxis paste</td>
<td>500 - 900 μg/m³</td>
</tr>
<tr>
<td>Drilling with water and suction</td>
<td>15-40 μg/m³</td>
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</table>

A Reference List of Reports

The literature is full of reports of mercury related illnesses in dental workers who handle amalgam. Following is a brief sample list of references.

Reports of Mercury in Dental Workers

The following all found higher levels of mercury in dental workers:


Duplinsky 2012

In this study, 396 dentists were carefully matched with 708 non-dentists, who were all part of the same health insurance group, so they all had the same access to care and prescription coverage. The dentists used many more prescriptions for conditions that are associated with mercury toxicity: 7.5 times the number of prescriptions to control neurological conditions, and significantly more drugs for respiratory and coronary diseases than non-dentists.


Neghab 2011

Dentists had increased skin hyperpigmentation, respiratory disorders, irregular pulse, hand tremors, spasms of the upper extremities, neuro-psych symptoms, tachycardia, painful chewing, thyroid enlargement, vague fears, and difficulty in writing.

Mutter 2011 and Moen 2008
In the studies, neurological issues such as memory loss, concentration issues, fatigue, and sleep disturbances related to working with mercury amalgam are discussed.

Lindbohm 2006
Found an increased risk of miscarriage.

Ritchie 2002
Reported renal and memory issues.

Langworth 1997
Showed increased CNS symptoms.
J Dent Res. 1997 Jul;76(7):1397-404

Rowland 1994
Uncovered assistants working with dental mercury had lower fertility.
Occupat Environ Med. 1994; 51:28-34.
Dental Worker Protection Protocols

Regulations and best practices that protect employees from exposure to pathogens, also apply to mercury exposure. Employee exposure is strictly regulated in the US. Employers must provide training in proper handling of toxic substances and methods for personal protection, and maintain records of that training.

Laws include a summary of employer responsibilities when employees are likely to encounter hazardous substances at work. In addition, we can employee personal barrier protection.

Regulations and Best Practices

In the United States, hazardous exposure to dental staff is regulated by the 1970 Occupational Health and Safety Act and the 1987 Right to Know Act. Under these laws it is the dentist's responsibility as an employer to inform employees about any hazardous materials they are to encounter at work.

In brief, the laws require employers to:

- Train employees on how to avoid or minimize exposures
- Offer informed consent at least as detailed as the Material Safety Data Sheet (MSDS)
- Practice work techniques that minimize toxic release
- Institute engineering controls to minimize toxic exposures
- Provide protective equipment to all exposed employees
- Monitor the facility contaminant levels
- Medically test employees for symptoms related to exposure
- Maintain records of all of the above in their Hazards Communication Notebook for 30 years!

Staff Protection Barrier Techniques

The engineering controls we use to protect patients from dispersion of mercury vapor and particulates will also reduce exposures for the dentist and staff. In addition, we can use employee personal barrier protection, so the staff is protected from respiratory and skin exposure.

Personal barrier protection starts with the same materials we use to protect ourselves from pathogen exposure. This includes using: eye protection; face shields; and resistant clothing. And specifically for removing mercury fillings, we need mercury-rated respirators or some type of positive pressure breathing apparatus. As well we need to be aware of which gloves and clothing options are resistant to mercury vapor.

Protecting the Breathing Space

A positive-pressure breathing system can be used with a medical compressed air tank or clean compressed air from the office compressor.
Learning Aid
Safe Removal of Amalgam Fillings

Mercury Rated Respirators

H-2802
3M 6000
HALF-FACE

H-1471
3M 6000
FULL-FACE

3M mercury cartridge

Bureau of Mines approved respirator

Charcoal filter mask
**Protecting Against Skin Exposure**

Nitrile gloves resist mercury vapor much better than latex.

A sulfur-based hand cream can be used to scavenge mercury that passes through the gloves. It can also be rubbed on gloves and rubber dams to reduce mercury vapor perfusion.

Different protective gown materials resist mercury vapor perfusion to different degrees. Waterproof isolation gowns are the most resistant.
Dental workers should use their protective gear when opening chair side particle traps.

- Opening chair-side trap - 600 µg/m³
- Occupational limit for instantaneous exposure - 100 µg/m³

If all the gowns, drapes, gloves, rubber dams, etc. are disposable, this is how much waste one dentist can produce in one day. It is all mercury contaminated. Where should it be disposed?
Protection Checklist

Patient Protection
- Drape the patient
- Provide an outside air source
- Use a rubber dam and saliva ejector
- "Cut and Chunk" the amalgam out
- Use water spray, HVE, and constant irrigation
- Rinse the operative field and the mouth
- Provide a mercury-scavenging mouth rinse

Staff Protection
- Respirators or positive pressure air source
- Nitrile gloves
- Protective clothing
- Supplemental vacuum and room air-filter
- Toxic hazard training and monitoring
Amalgam Mercury Separation and Recycling from Dental Office Wastestream

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<th>Approval</th>
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<td>3/23/96</td>
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<td>3/97, 9/06</td>
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<td></td>
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Explaination of IAOMT position: This updated version is a must read for all IAOMT members both with and without a separator in their office. Make sure your patients know you have one.

Name of Scientific Review: Amalgam Mercury Separation and Recycling from Dental Office Wastestream

Alternative name(s) of Scientific Review: Mercury Separation of Office Wastewater

This Scientific Review is related to Dentistry

This Scientific Review is a Procedure & Equipment

Purpose of the Scientific Review: To summarize the current research on the effectiveness and value of amalgam separators for dental offices

Scientific Review History: Originally submitted 3/23/96 and approved 3/18/97

A brief description of the Scientific Review: A mercury filtration system to trap and/or filter out at least 95% of dental amalgam mercury from operatory wastewater before it enters the municipal waste system. The captured mercury should be appropriately recycled

A specific description of this Scientific Review: Beginning in about 1990, municipalities began to be concerned about increased levels of mercury entering the wastewater treatment system, and began to discover that a high percentage of this mercury was coming from dental offices. Since then, a number of studies have confirmed this problem. Devices have been developed ("amalgam separators") that can be installed in dental offices. They have been shown capable of removing 95% or more of mercury before discharging into the municipal wastewater system. Further studies have verified that, when separators are installed community-wide, the level of mercury entering the local POTW’s (wastewater treatment facilities) is significantly reduced. Many municipalities in North America are now requiring installation of amalgam separators in dental offices. The Environmental Committee of the IAOMT has gone on record as recommending all dentists install such amalgam separators.

Manufacturer(s): Here is a list of most of the known current suppliers of amalgam separators:
- AB Dental Trends
- Air Techniques, Inc.
- BioSym Medical Corp.
- Dental Recycling North America (DRNA)
- Hygenitek, Inc.
- R&D Services, Inc.
- Rebec
- Solmetex

Scientific Literature: The appendix lists many of the supportive studies on the problem of mercury contamination of dental office wastewater and the effectiveness of installation of amalgam separators.

Legal Aspects of this Scientific Review: Regulation of wastewater contamination is largely up to local municipalities. King County, Washington State, was one of the first to mandate that dental offices install amalgam separators. It is now mandated...
statewide in Washington and in many other municipalities in North America. The list is growing, and I don’t have a comprehensive list of all such municipalities. A growing number of municipalities are concerned about this problem and struggling with ways to “certify” equipment that is on the market, recommend manufacturers to dental offices and dental associations, and agree on a uniform method of testing the effectiveness of these units. Most are finding that “voluntary compliance” agreements with local dentists and dental societies are failures and that some form of mandatory compliance is required.

Applicant Name: Paul G. Rubin, DDS, MIAOMT
Office Phone: 206 367-4712

Mailing Address: 9730 3rd Ave, NE, Suite 2052
Office FAX: 206 367-4971

City: Seattle
Home Phone: 425 827-1927

State of Province: WA
Zip code: 98115
Home FAX:

Country: USA
e-mail: drpaul@drpaulrubin.com

IAOMT Member #: 065
IAOMT Chapter: North American

Appendix:
Submitted by Paul G. Rubin, DDS, FIAOMT
June 21, 2006


Opening amalgam capsule

The friction process creates the varicose bullets, but other processes follow, including the elemental mercury, thousands of nanograms (ng/ml) of mercury vapor are released upon opening the capsule.

Vaporization after insertion

The freshly mixed amalgam is poured into an amalgam well, where it continues to off-gas hundreds of nanograms (ng/ml) of mercury vapor.

Machining amalgam

The freshly made amalgam continues to volatilize hundreds of nanograms (ng/ml) of mercury vapor as it is pressed and packed into the tooth.

Cleaning out traps and filters

Amalgam waste accumulates in the chairside trap and other filters. If戈置fined into the air when opened.

Disposal of hazardous waste

Dental offices with amalgam removal equipment need to follow the regulations for hazardous waste.

Peeling amalgam

Dental offices must follow the proper procedures for removing amalgam from the mouth.

Removing amalgam - Rapport

A dentist’s drill spits at about 400,000 rpm. When in motion, the amalgam is immediately multiparticulate generating thousands of nanograms (ng/ml) of mercury vapor.

Removing amalgam - Portocol

When the air is directly struck with the amalgam 8 nanograms of mercury are released into the atmosphere. These minute particles pass through nose and mouth and are inhaled and absorbed into the body.

Contaminated equipment, surfaces, clothes and skin

The particles from an amalgam removal or replacement contaminated equipment, lands on surface areas and the clothes and skin of staff and patients.

Air suction units

Used during placement, polishing and removing, air suction units are commonly worn in the dental office, drawing on additional exposure to mercury. When the release of mercury from an suction units vented outside are combined, they are greater than the sum is a page.

Reusing dental instruments

During the sterilization process of dental instruments crumbs contaminated with mercury tens of thousands of nanograms (ng/ml) of mercury vapor are generated. This mercury vapor is released into the clinical atmosphere.

Occupational safety limits

The Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for mercury vapor is 150 micrograms per cubic meter (mg/m³) of air as a ceiling level.

A worker’s exposure to mercury vapor shall not exceed this ceiling level. Market of the exposure above the OSHA PEL.

Potentially exposure to the following:

Dental Staff  Patients  Environment

Some amalgam manufacturers recommend special mercury vapor control in the doctors’ office and during pregnancies.

The ADA recommends using capsules to be stored in an air-tight container and collected in a sealed bag made specifically for dental amalgam. Remove these encapsulates the trash, releasing mercury vapor into the office.

Mercury in the “Toxic” exposure to the office.

Dentists throw out amalgam, used amalgam capsule and almost the encapsulates, which can release mercury vapor from the tooth, where they release mercury vapor back into the patient office.

Dental amalgam filings are removed and replaced every day by dentists, for reasons not related to health concerns. The vast majority of dentists are presently unaware of the serious human health effects and contaminated particulate matter produced in this process.

ADA recommends training all personnel involved in the handling of mercury and dental amalgam to understand the hazards of mercury vapor.

ADA recommends removing professional ppe while the workplace.

ADA recommends continually checking the dental operatory atmosphere for mercury vapor.

In addition to discontinuing the use of amalgam fillings as a restorative media, the International Academy of Oral Medicine and Toxicology has developed a set of guidelines to protect both the oral health professionals and patients from the harmful effects of mercury.
IQAir DentalPro and DentalPro Flex-Vac
Mercury Air Cleaner

| Received | 5.5.03 |
| Scientific Review | 4.3.06 |
| IAOMT Board Review | 3.15.07 |
| Re evaluation | |
| Environmental | Approval | 3.15.07 |
| Provisional Approval | No Opinion | No Approval |

**Explanation of IAOMT position:** This type of equipment is an important adjunct for those professionals concerned with optimal protection for the patient, Dr. and staff while removing mercury amalgam fillings.

**Name of SR:** IQAir DentalPro and DentalPro Flex-Vac Mercury Air Cleaner

**This SOC/SR is related to:** Medicine & Dentistry

**This SR is:** Equipment

**Do you have a vested financial interest in any part of this SR?** yes

**Purpose of the SR:** A portable air cleaner to remove, among others, mercury vapor, odors (VOC’s), formaldehydes, latex and perfume from office air and reduce particulate matter in the air over 99%.

**SR History:** IQAir have been making medical quality air cleaners, the HealthPro Plus units and highly efficient commercial and industrial Gas and Odor removal units for many years. In 2002 the DentalPro and Dental HgFlexVac were introduced.

**Briefly describe the SR:** Both types of units are of modular design and remove mercury vapor and particulates from air with HEPA-type filters and Gas Phase Filter Cartridges via a high-performance centrifugal fan. The FlexVac hose can be positioned at the patient’s mouth while the amalgam mercury filling is removed. Mercury vapor readings indicate almost no mercury vapor (0.0 mmg/cubic cm) over one foot from operative site while unit was operating and filling was removed. Total particulate matter over 0.3 microns is reduced over 99%.

**Specifically, by outline if appropriate, describe the SR:**

**BOTH UNITS:** Dental Pro & Dental Hg Flexvac

A. Centrifugal fan w/capacity of 700 cuft/min, with actual point-of-use air delivery of 235 cfm at speed 6.
B. Air intake from bottom enters High-Efficiency HEPA-type pre-filter (holds back 90% of particulates <0.3 microns)
C. Air forced through four cartridges and out through post-filter sleeves (electrostatically charged removes 99% <0.3 microns)
D. Closed system, i.e. no air can get around filters/cartridges once brought in through bottom of unit (no leakage)
E. Removes microbiologicals as fine aerosols and gaseous vapor in dental office, e.g. blood, saliva, filling particles and bacteria/viruses within particles.
F. Digital Control Panel allows setting unit to alert user when each of the three filters reach saturation based upon fan speeds and user setting of particle, dust and gas sizes to be filtered.
G. A remote control is supplied.
DENTAL PRO
A. Cartridges contain three pollutant specific gas phase media: sulfur-impregnated activated charcoal, plain activated charcoal and potassium permanganate
B. Mercury is removed by two of the four canisters at each pass (near 50% reduction of mercury vapor each pass)

DENTAL Hg FLEXVAC
A. Cartridges all contain sulfur-impregnated activated charcoal for close to 100% mercury removal at each pass.
B. FlexVac hose at mouth area captures vapor at the source of drilling/aerosol at chairside.

Manufacturer: IQAir, Santa Fe Springs, CA at www.IQAir.com

Scientific Literature:
A. Several US and European Patent for fan and housing design
B. Research Report Institute of Hygiene, Univ of Heidelberg, Germany “Indoor Air 99” Presented at the 8th Int’l Conference on Indoor Air Quality and Climate, Edinburgh, Scotland, Aug 1999

Legal Aspects of this SOC/SR: N/A

| Applicant Name: Donald Robbins, DMD, MIAOMT (SMARTAir Solutions) | Office Phone: 610-363-1980 |
| Mailing Address: 340 North Route 100 | Office FAX: 610-363-7798 |
| City: Exton | Home Phone: 610-363-2654 |
| State of Province: PA | Home FAX: 610-363-2654 |
| Zip code: 19341-0449 | e-mail: SmartAir@dentallearningresource.com |
| Country: USA | IAOMT Member #: 828 |
| IAOMT Chapter: North American |

The IAOMT and Mankind Thanks You!
Operatory Elimination of Mercury Vapor and Other Airborne Contaminates

Explanation of IAOMT position: Minimizing mercury vapor and other airborne contaminants in the dental operatory is necessary to safeguard the health of the patient, doctor and staff.

**Name of Scientific Review:** Operatory Elimination of Mercury Vapor and Other Airborne Contaminates

**What is this Scientific Review related to?** Dentistry

**Is this Scientific Review a ...?** Equipment

**Purpose of the Scientific Review:** Mercury vapor in the operatory environment: evacuation of mercury vapor and other airborne contaminants at chairside with the use of an outside vented vacuum system, centrally installed high flow evacuation system. This will also reduce besides mercury vapor, other toxic fumes and particles (e.i. acrylic temporaries) in the immediate clinical area.

**Do you have a vested financial interest in any part of this Scientific Review?** no

**Scientific Review History:** There are few excellent high volume self contained evacuation systems on the market (e.i. Dent-Air-Vac) that filter air and return it to the operatory. This is a less expensive alternative for use in situations where installation is possible and multiple sites need to be protected.

**Briefly describe the Scientific Review:** Using a high powered central vacuum unit, vented to the outside, with outlets in each operatory and laboratory work station. Depending on the length of hose required, a regular central –vac hose should be coupled to a larger diameter flexible scoop such a s the one supplied by Dent-Air-Vac Co. The larger hose diameter slows down the velocity and collects the air over a larger area promoting a more laminar flow around the patient’s head.

**Specifically, by outline if appropriate, describe the Scientific Review:**

1. After the patient is seated, comfortable and is ready to start the amalgam removal or other procedure, the large diameter suction hose is rested beside the patient and adjusted to be just far enough from the mouth to be out of the way.
2. The hose is inserted into the wall socket and a relay turns on the unit.
3. This is to be left on during all of the drilling and bonding procedures or while nitrous oxide is in use.
4. When finished the hose is unplugged from the wall, the motor shuts itself off, and the hose is rested on a hook taking up little or no floor space.

**Advantages:**
- Takes up little or no floor space in crowded operatories
- The hose is easily transferred from room to room
- Inexpensive to have a unit available in each room
- No dependence to have filters to remove contaminants (many units do not contain mercury or chemical filters. No units filter out nitrous oxide gas)
- No expensive filters to periodically replace
- Quieter than at an equal volume of airflow than room units. Motor is in a remote location reducing noise and EMFS compared to operatory-based units
- Greater volume of air flow is possible if needed Much less expensive for multiple operatory installation
- Central vacuum systems are readily available and competitively priced
- No additional intimidating machines sitting in operatories
- May also help with nitrous oxide leakage if used
Disadvantages:

- Requires professional installation
- Commercial use may reduce some warranties
- Entry level system around $600.00-$1,000.00 for multi operatory system
- Vents mercury and other contaminants into the environment. This is considered much less of a threat than having the contaminants in the operatory. An auxiliary filter capable of trapping mercury vapor could be used if desired.

Manufacturer(s), distributor, or publisher: Central vacuum systems are available from many manufacturers. Definitely get competitive bids and compare products, warranties and installation. Crews are trained and can easily install a system in a day, just the way and where you want.

- Must be vented outside
- Should be muffled and sound insulated. This makes a big difference in sound
- The larger capacity motors run on 220 volts which is probably available in the equipment area. Twin 120 V motors also work well, (e.i. NuTone). Fit the size to your office.
- Place a unit in your lab where acrylics are mixed and grinding takes place to control contaminants
- A shop vac dry suction pump may also be used. However this type of suction installation may require more of your time and be just as costly in the end and less convenient.

Hose Connectors:

- Large scoop, large diameter semi-flexible hose source: Dent-Air Vac
- Flexible central vac hose and wall coupling from installer
- Coupling between hoses from installer or Dent-Air Vac (send a sample of hose and they can fit it to theirs)
- Plastic barrier over large hose from Dent-Air Vac
- White barrier over intake scoop. Check out sales in local stores on white knee stockings. These make better barriers than those sold from dental suppliers. Purchase the stockings with the closed toe which is useful should something be inadvertently be sucked into the hose. If something is trapped, it can easily be retrieved.

Scientific Literature: Common sense of getting the contaminant away from you.

Legal Aspects of this Scientific Review: Collecting and venting mercury and other toxic substances may constitute some environmental challenges. Unfortunately this is the method already being used with all central wet-vac systems. Even with mercury particulate scavengers, the vapor is vented outside.

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<th>Office Phone: Retired</th>
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