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Reducing Dental Mercury Discharge in Missoula, Montana: Collaborative Opportunities

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REDUCING DENTAL MERCURY DISCHARGE IN MISSOULA, MONTANA: COLLABORATIVE OPPORTUNITIES

By

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EXECUTIVE SUMMARY

The purpose of this paper is to provide assistance in developing a program to control the release of dental mercury amalgam in Missoula, Montana. To do this, three research components were carried out. The first consisted of a survey to determine whether Missoula dentists are following the American Dental Association's (ADA) recommended Best Management Practices (BMPs) for mercury amalgam waste. The second component involved interviewing local dentists in an effort to include their voice in the process, as well as to determine what may motivate them to comply with a dental mercury control program. The final component of research involved developing and analyzing three case studies of municipalities that have designed and implemented a successful BMP program that can be used to help guide the development of a program in Missoula.

The research presented in this paper led to the recommendation of using a collaborative approach to control dental mercury. Based on this recommendation, in April 2007 a multi-stakeholder committee was formed to design and implement an educational outreach program in Missoula, Montana in an effort to control the release of dental mercury.

In the last ten years dental mercury discharge from amalgam fillings has proven to be an important and often unregulated source of mercury entering Publicly Owned Treatment Works (POTWs). It is estimated that dental practices contribute almost half of a POTWs mercury load (Drummond et al., 2002). Dental mercury discharged to a POTW may end up in surface waters, applied to land, or released to the air through the incineration of biosolid wastes. In addition to the potential problem of mercury amalgam discharge to the waste water stream, amalgam waste can also enter the environment through improper disposal in trash and biohazard waste containers. As a result, mercury amalgam waste is dumped in landfills or, in the case of biohazard waste, incinerated.

Many dental practices install chair side traps, vacuum filters and, to a lesser extent, amalgam separators, as a means to capture mercury amalgam particles. However, it is vital that practices recycle the mercury amalgam contents from these traps and filters to ensure they do not end up in the waste stream. In spite of precautionary measures such as chair side traps and vacuum filters, a certain amount of mercury release to the POTW is inevitable to mercury amalgam placement and removal. The only way to prevent this release is to eliminate or significantly reduce mercury use in dental preparations and/or install an amalgam separator.

Compliance with Best Management Practices (BMP), or guidelines for the disposal of amalgam waste, helps to reduce the amount of mercury released. The installation of an amalgam separator, a device that separates mercury particles from the waste stream, is an example of a BMP, although the American Dental Association (ADA) does not recommend separators despite the fact that they are 95-99% effective in removing amalgam from the waste water stream. The ADA does recommend a series of BMPs that advocates recycling all amalgam waste.

In the summer and fall of 2006, the author conducted a Mercury Amalgam Disposal Survey for the Missoula Wastewater Treatment Plant to determine how dental practices are disposing of their mercury amalgam. The survey found that 55% of the 29 respondents do not follow the ADA's recommendation of recycling mercury amalgam caught in chair side traps and 56% of respondents do not recycle the contents trapped in vacuum or other secondary filters as the ADA recommends. Additionally, 92% of respondents are not recycling extracted teeth with mercury amalgam fillings and 90% are not recycling empty amalgam capsules as the ADA recommends.

Interviews were conducted with Missoula dental practices in order to determine what may motivate dentists to comply with a BMP program. The objectives of the interview included:

- determining whether dentists will feel compelled to participate in a BMP program because they believe controlling dental mercury is important;
- determining whether dentists will feel compelled to participate in a BMP program if it were important to their peers and patients;
- determining whether the cost of complying would inhibit practices from participating in a mandatory program;
- measuring the level of awareness of the ADA's BMPs;
- gathering recommendations on ways to increase participation in a BMP program.

Although all of the respondents do not believe dental mercury discharge is something that needs to be regulated, there was consensus about the need for more educational outreach about BMPs. However, if it could be proved that dental mercury discharge was indeed causing permit violations at the POTW and/or if the BMP program was mandatory, the respondents would feel obligated to comply. Peer pressure was also seen as crucial to increasing compliance with a voluntary or mandatory BMP program. It was also stressed that the formulation of BMPs and/or educational outreach materials would be more palatable to the dental community if they were developed in collaboration with dentists.

The latter finding was supported by the case studies presented of successful BMP programs that have been implemented in other parts of the country. The success of BMPs in Wichita, (Kansas), Boise, (Idaho), and Western Lake Superior, (Minnesota) can be attributed to the inclusion of the dental community in all facets of program development and the amount of funding and resources committed. In all of the case studies, the issue was framed as the dental community working with the respective city to *help* reduce mercury pollution rather than resorting to finger pointing. In two of the case studies, the installation of amalgam separators cut the local POTWs mercury load in half.

Including the dental community in program formulation is critical to the success of any BMP program, especially if the information comes from within. The formation of the multi-stakeholder committee, which includes dentists, City personnel from the Missoula County Health Department and POTW, and a local non-profit (Women's Voices for the Earth), is the first step to achieving success. The committee's tasks include designing a voluntary BMP program and educational outreach materials that could potentially be

replicated throughout the state. The following recommendations are steps the committee can take in order to design a successful BMP program. These recommendations include:

- agree on a suite of Best Management Practices. Ideally, any BMP program should strongly recommend the installation of an amalgam separator;
- create a resource list of recyclers and the types of mercury amalgam waste each collects. The list should also include prices and contact information;
- create a brochure or hand out about the environmental and health concerns regarding mercury amalgam waste. The brochure should also provide a list of Best Management Practices;
- designate dentists to present BMP information and local dental society meetings;
- research sources of funding that may support biannual workshops for dental office staff about BMPs;
- work with local media to acknowledge the efforts dentists are making to reduce mercury pollution.

Missoula is in a great position to create a community-specific approach to controlling dental mercury involving local non-profits, city government, local businesses and the dental community. Dental mercury discharge is a potential environmental problem that can be mitigated through collaborative efforts in an attempt to bypass regulatory action. The success of such a program hinges on the commitment each of the above named groups makes to create a successful dental mercury control program and the participation of the larger dental community.

INTRODUCTION

In the last ten years dental mercury discharge from amalgam fillings has proven to be an important and often unregulated source of mercury entering a Publicly Owned Treatment Works (POTWs). It is estimated that dental practices contribute almost half of a POTWs mercury load (Drummond et al., 2002). Dental mercury discharged to a POTW may end up in surface waters, applied to land, or the air through the incineration of biosolids. In addition to the potential problem of mercury amalgam discharge to the waste water stream, amalgam waste can also enter the environment when disposed in trash and biohazard waste containers. As a result, mercury amalgam waste is dumped in landfills or, in the case of biohazard waste, often incinerated.

The Missoula Wastewater Treatment Division, or POTW, is in the process of reevaluating its numerical limit for mercury (i.e. how much allowable mercury can enter the POTW) and is interested in ways to reduce its total mercury load. Controlling dental mercury discharge is one way to reduce mercury released into the POTW, as well as the larger environment. There are three components to this paper that consist of original research that will assist in the development of a successful dental mercury control program in Missoula.

Previously, the Missoula POTW and other interested stakeholders had little information about local mercury amalgam disposal methods. In conjunction with the pretreatment coordinator at the POTW, I developed a Dental Amalgam Disposal Survey that was administered to local dentists in the summer and fall of 2006. The purpose of the survey was to gather quantitative data on whether or not Missoula dentists are following the American Dental Association's guidelines for Best Management Practices for

amalgam waste. The information gathered will help the Missoula POTW determine the extent to which mercury amalgam may be entering the waste stream, and whether control measures need to be established to reduce the release of mercury amalgam. The survey also provides baseline data that, after a mercury control program is put in place, can be used to measure the success the program.

Several approaches may be used to control dental mercury discharge. For example, regulating dental mercury through the development of a mandatory Best Management Practices (BMP) program is one option. A mandatory BMP program may, or may not, include the requirement to install an amalgam separator, a device used in dental practices that removes mercury from the waste water stream. Another option is to increase educational outreach about the BMPs the American Dental Association endorses, and/or create a voluntary program that emphasizes educational outreach.

Implementing any of these options requires the support and participation of the dental community. Thus, another component of my research included interviewing Missoula dentists in order to identify whether or not motivation exists within the dental community to comply with a mandatory BMP program. The interviews also sought to gauge the level of interest, support and concern for following a Best Management Program, and to gather input on whether or not they feel there is a present need to require the installation of amalgam separators, or whether or not they would install one voluntarily. Another objective of the interviews was to ascertain the level of awareness of the American Dental Association's BMPs. The underlying goal of the interviews was to give the dental community an opportunity to participate in the discussion, and to provide some "inside" insights on measures that could be taken to raise awareness about BMPs.

The final component of my research involved developing and analyzing three case studies of municipalities that have designed and implemented a successful BMP program that can be used to help guide the development of a program in Missoula. Development of the case studies involved speaking with key city personnel, analysis of documentation about the BMP program, and a review of the respective POTW's web materials about the program. In particular, factors that fostered success are highlighted, as well as aspects of the program that proved to be barriers to implementation. This information will help Missoula avoid similar obstacles and create a program that incorporates some of the successful aspects of the three presented case studies.

These three research components led to the recommendation and initiation of a dental mercury control program in Missoula in the spring of 2007 that uses a collaborative approach to control dental mercury discharge.

Paper Organization

The first two sections of this professional paper provide a brief background on mercury, mercury pollution, and mercury amalgam waste. Also provided is an overview of the health impacts of methylmercury, BMPs and the Missoula POTW. The third section provides results, analysis and discussion of the Missoula Amalgam Disposal survey. The fourth section discusses the motivating factors that may influence dental practices participation in a program to control mercury waste. The determination of what may motivate dentists to comply with a BMP program is based on interviews with local dentists. Also discussed in the fourth section is the level of concern and awareness present in the Missoula dental community about dental mercury discharge. Section five provides an analysis and discussion on three successful programs to control dental mercury in Idaho, Minnesota and Kansas. The concluding section offers

recommendations for designing a successful dental mercury control program in Missoula, Montana. Recommendations are largely based on the findings discussed in Section four and five.

BACKGROUND

Mercury (Hg), a heavy metal naturally found in the physical environment, is a highly toxic element that has increased in prevalence due to anthropogenic contributions from industrial combustion, mining and manufacturing. Human's use of mercury dates back centuries. The Romans and Greeks used mercury in ointments and cosmetics, and some ancient civilizations thought mercury had healing and life-prolonging properties. However, reverence for the element began to erode when it was realized that although mercury had a myriad number of utilitarian values, it was highly toxic, even lethal if not carefully handled. The incident where the term "mad hatter" was borne is perhaps the most well-known event highlighting the danger inherent to mercury use. During the 18th and into the 19th century hatters treated animals skins with a solution of mercury nitrate that proved to be very effective in separating the fur from the pelt. Unfortunately for the hatters, the vapors resulting from the process were highly toxic and caused an assortment of symptoms ranging from relatively benign tremors to the more insidious symptoms of dementia and hallucinations.

More recently, humans have been reminded of mercury's lethality with the widespread poisoning in Iraq in the early 1970s from contaminated grain. Nearly 500 people were killed, over 6,000 hospitalized and an estimated 50,000 exposed. In the 1950s and 1960s it was discovered that widespread poisoning had occurred in Minamata, Japan when a chemical manufacturing plant released massive amounts of the toxin into the Minamata Bay. Over 3,000 people developed symptoms as a result of their exposure through the consumption of seafood (Saito, 2004).

Although humans have wised-up to the precariousness of mercury use and our knowledge and understanding of exposure paths has advanced exponentially, mercury use in products, pesticides, batteries, pigments, dental preparations, vaccinations, and even cosmetics still abound. As a result, mercury releases from these uses as well as from the burning of fossil fuels, mining and other industrial users, pose a threat to consumers on all levels of the food chain, especially humans.

Mercury is found in several different forms: elemental, inorganic mercury and organic mercury. Human are exposed to the most potent form of mercury, methylmercury, through the ingestion of fish. Methylmercury is formed when inorganic mercury undergoes a chemical process whereby organisms convert inorganic mercury into organic mercury or methylmercury.[1] Methylmercury has the ability to biomagnify across the trophic levels. In aquatic environments, mercury bioaccumulates in fish tissue. That is, they biologically uptake the toxin faster than they can eliminate it. Therefore, the larger the fish the more likely it will have higher mercury levels. While elemental mercury is also toxic to humans when ingested or inhaled, methylmercury poses the largest threat because it is the most potent and common form of mercury humans are exposed to (EPA, 2006).

[1] Very few studies have been done on the bioavailability of elemental mercury used in dental amalgam (e.g., see McGroddy & Chapman, 1997). However, some studies suggest that mercury amalgam released in water is biologically available and is accumulated in fish. One such study found that mercury concentrations in the tissue of fish exposed to mercury amalgam were up to 200 times greater than mercury in unexposed fish (Kennedy, 2003). Although the bioavailability of dental mercury amalgam has yet to be definitively established, given the existing evidence and the amount of mercury discharged by dental offices each day the precautionary approach should be applied and measures should be taken to reduce dental mercury discharge.

Health Impacts of Methylmercury

The ingestion of methylmercury, a bioaccumulative neurotoxin, through the consumption of fish can have deleterious effects on human health and is of special concern to women because the toxin is transmitted from mother to child through the placenta or through breast feeding. According to the Center for Disease Control, 10% of women of childbearing age have detectable levels of mercury in their bodies (McDowell et al., 2004). Neurological damage and developmental delays may occur in children who are exposed to mercury *in utero* (Gilbert et al., 1995). In adults, exposure to methlymercury may result in impairments in motor function, speech and vision (Gilbert et al., 1995).

Specifically, studies have indicated *in utero* exposure to mercury through the consumption of fish can lead to neurobehavioral deficits in the domains of language, attention, memory, visuospatial and motor function (Debes, 2006; Grandjean, 1997; Jedrychowski, 2006). Based on a 2004 National Health and Nutrition Examination Survey, the authors estimate that over 300,000 newborns in the United States are exposed to mercury *in utero* and thus have an increased risk of neurobehavioral deficits (Mahaffey, 2004).

Mercury Pollution

Coal-combustion and mining are the largest source of air and land releases, respectively, of mercury in the United States (Leopold, 2002) and pose the greatest threat to water quality. Air emissions of mercury from coal-fired power plants are deposited in water bodies or on land (land deposited mercury may runoff to water bodies) (EPA, 2000). Air emissions (mainly from coal-combustion) of mercury into the atmosphere have global impacts due to the ability of atmospheric mercury to be transported over

great distances. Mercury in the atmosphere returns to the earth's surface in rainwater and snow. According to the U.S. EPA, eighty-three percent of mercury deposited in the United States is from international sources and only 17% of mercury deposition is the result of activities in the U.S. and Canada (EPA, 2006). When deposited in water bodies, air emissions of mercury can undergo methylation and subsequently biomagnifies and in the food chain.

Mercury from urban runoff and mining also account for a significant amount of mercury in ground and surface waters (EPA, 2000). Mercury is also released directly into water bodies from point sources like POTWs and industrial facilities (EPA, 2006). The EPA estimates that dental offices are the largest contributor of water releases of mercury in the United States. Dental preparations account for 37% (7.4 tons) of the 20 tons of water releases of mercury each year (coal combustion (35%), sewage treatment (28%), and chlor-alkali manufacturing (1%), comprise the remaining 63%) (Leopold, 2002). As a result, there has been an increasing amount of attention paid to dental mercury amalgam waste.

Mercury has come under increased scrutiny over the last decade as it has become evident that the pervasiveness of the toxin is cause for concern. Over 45 states have issued at least one fish consumption advisory for a particular body of water, and 19 states have issued statewide advisories because of high levels of mercury (EPA, 2003). Fish consumption advisories alert the public that mercury has been found in fish at levels unsafe for human consumption (EPA, 2003). Because of the risk to humans, the EPA has listed mercury as a priority pollutant and, pursuant to Section 304(a) of the Clean Water

Act, sets water quality criteria for states to use when developing their own water quality standards.

In Montana, a federal test showed that all of the fish caught in a total of eight lakes tested positive for mercury contamination (MDPH, 2005) and fifty-four percent of the caught fish exceeded the EPA limit for safety (0.3 mg methylmercury/kg) (MDPH, 2005). Additionally, the Montana, Fish, Wildlife and Parks sampled over 30 lakes and streams in Montana for mercury. Nearly every water body sampled contained a species of fish where an advisory had to be issued recommending vulnerable populations avoid the consumption of that particular species (MFW&P, 2004).

Dental Mercury Amalgam

Elemental mercury in dental preparations such as amalgam fillings has been used for over 200 years. The term dental mercury amalgam refers to dental fillings or "silver fillings." Despite the popular generalization of dental amalgam fillings as silver fillings, only 25% of a "silver" filling is actually silver, while nearly half (40-50%) is elemental mercury. Copper, zinc and tin comprise the remaining percentage. There has been a slight shift away from the use of dental amalgam use in the United States; however, Americans have an estimated 1,200 tons of dental amalgam embedded in their teeth (Leopold, 2002).

Mercury from dental amalgam fillings can enter the environment during placement or removal when materials are washed down the drain in dental practices, disposed of in the garbage, or in biohazard containers. Many dental practices install chair side traps, vacuum filters, or to a lesser extent, amalgam separators, to trap mercury particles and help reduce the release of mercury into the environment. However, dental practices may not recycle mercury amalgam collected in chair side traps, vacuum filters and even amalgam separators. Even with the use of chair side traps and vacuum filters,

some mercury enters the waste water during the placement and removal of mercury amalgam fillings.

Publicly Owned Treatment Works lack the ability to separate mercury particles from the influent or sludge. As a result, mercury waste from dental practices either ends up in the receiving water (i.e. a river) or a POTW's sludge or biosolids. Most POTWs either land apply or incinerate their biosolids. Biosolids laced with mercury that are land applied (e.g. often as compost) may cause ground contamination. The incineration of biosolids contributes to atmospheric releases of mercury. If mercury is disposed of in biohazard containers or the trash it may be incinerated or dumped in a landfill where, if it corrodes, can leach into the groundwater.

It is estimated that a single dental practice discharges anywhere between 0.035-0.3 grams of mercury per day to the sewer system (Johnson, 1999). Over the last ten years POTWs have paid an increasing amount of attention to dental amalgam waste. This is due in part to the promulgation of a federal regulation (40 CFR Part 136) approving the use of testing Method 1631, which is able to detect mercury levels at parts per trillion in water samples. The advent of Method 1631 has lowered the detection limit for mercury and as a result, some POTWs have had to lower their numerical limits for the heavy metal. In order to meet lowered numerical limits, POTWs around the nation are performing a more comprehensive assessment of mercury users, such as dental offices, who fall outside the purview of regulation.

Although dental mercury has proven to contribute almost half the mercury load to some POTWs, it does not officially fall under the purview of the Clean Water Act even though mercury is technically considered a priority pollutant. Also, despite being the

third largest user of mercury in the United States, dental practices are not considered an industrial user and therefore are not required to meet a numerical limit for how much mercury they are allowed to discharge.

However, due to the recent promulgation of a rule streamlining pretreatment regulations, if BMPs were incorporated into the Missoula Municipal Code they would become enforceable under the CWA (Federal Register, 2005). In order to do this, the pretreatment coordinator would have to write a section in the Municipal Code outlining the BMPs. The section would then go to the plant Superintendent, the Public Works Director and the EPA Region 8 for approval. After receiving approval, the City Council would review the section (after it had been submitted by the Public Works Committee) and give final approval.

The Missoula POTW

Lower numerical limits are determined, in part, on the body of water the POTW is discharging to. For example, local limits designate how much mercury a POTW is able to receive in their influent (what's coming into the plant) without risking violation of the limit listed in their permit. This is otherwise known as Maximum Allowable Headworks Loading (MAHL). In Missoula, the MAHL for mercury is 0.171 lbs per day for an overall concentration of 0.038 mg/L (38 ug/l). The numerical limit of 0.038 mg/L is the amount of mercury the Missoula plant can discharge in the effluent (what's being released into the Clark Fork River) without risking exceeding the acute toxicity standard of 1.7 ug/l listed in their Montana Pollution Discharge Elimination System (MPDES) permit (See Table 1 for EPA and Montana numeric standards for mercury). The numerical limit of 0.038 mg/L is based on the amount of flow or volume of the receiving water. In the past, the Missoula POTW was granted 100% of the flow (approximately 360

million gallons per day) but under their new MPDES permit that percentage was reduced to 25% (or 90 million gallons).

Table 1 – State of Montana and EPA Numeric Standards for Mercury (ug/L)

Numeric Standards for:	Acute Aquatic Life Standards	Chronic Aquatic Life Standards	Human Health Standards-Surface Water	Human Health Standards-Ground Water
EPA	1.4	0.77	0.05	0.051
Montana	1.7*	0.77	0.05	2 (MCL)**

*The Missoula POTW is required to meet the Acute Aquatic Life Standards of 1.7 ug/L for mercury. Mercury in the effluent must not exceed the 1.7 ug/L standard. The 1.7 ug/L standard is for total recoverable, while the EPA numeric standard is for total dissolved.

**Maximum Contaminate Level

As a result, the Missoula POTW has to reevaluate and possibly lower their local limits for heavy metals such as mercury in order to continue to ensure compliance with the 1.7 ug/l acute toxicity standard. In the past, the Missoula POTW used method 245.1, a method the EPA considers not sensitive enough "to allow the POTW to make a determination as to whether there is a mercury problem" (EPA, 2005). Past sampling using Method 245.1 did not register mercury levels exceeding the human health standard for mercury (0.05 ug/l), and with exception of one or two isolated samples, the plant's effluent has always been in compliance with the acute toxicity standard. Also, the POTW has always been in compliance with their permitted levels for mercury in biosolids. In Missoula, biosolids are either land applied or sold to EcoCompost, who in turn sells it to clients for garden application, or other compost use.

The Missoula POTW has begun using Method 1631 which is able to detect mercury at parts per trillion.[2] These requirements, in part, have led administrators at the POTW to seek ways to potentially reduce the plant's mercury load in anticipation of a lowered numerical limit. Such actions require the scrutiny of major local users of mercury, such as dentists.

In anticipation that local limits for mercury may be lowered, the Missoula POTW decided to do a review of mercury in the wastewater. As part of the review, in the summer of 2006 the author conducted a Mercury Amalgam Disposal Survey on behalf of the Missoula POTW to determine how dental practices are disposing of their amalgam waste. Determining whether mercury amalgam is being disposed of in accordance with the American Dental Association's recommended Best Management Practices will give the treatment plant an indication of whether or not mercury is being released into the POTW and help to define the scope of the problem.

Best Management Practices

Best Management Practices are a set of guidelines dental practices can follow for the proper management of mercury waste. BMPs can be mandatory or voluntary. For example, many states have passed legislation requiring dental practices to install an amalgam separator, one type of BMP. On a smaller scale, municipalities can pass an ordinance incorporating BMPs into the municipal code. Voluntary BMPs do not require regulatory action and are complied with out of a sense of obligation rather than mandate.

In 2003 the American Dental Association approved a set of BMPs that the Association recommends practices follow for the proper handling and disposal of

[2] Recent testing using Method 1631found 438 ng/L in the influent and 2.07 ng/L in the effluent. Both are very low levels of mercury.

amalgam waste. The BMPs the ADA endorse include recycling all amalgam waste, not disposing of amalgam waste in biohazard/infectious waste containers, not rinsing chair-side traps or vacuum filters over drains or sinks, and not disposing of extracted teeth in biohazard or infectious waste containers. For a complete list see Appendix A. The Montana Dental Association has adopted the ADA's BMPs and encourages their constituents to follow them (McCue, 2007).

A 2001 study estimated 90% of mercury from an amalgam filling placement is still present at the time of removal (Baron, 2001). According to the study, if BMPs are not followed, 90% of the removed mercury is released into the wastewater stream. Notably, the ADA does not recommend the use of amalgam separators, a device that separates amalgam from the wastewater. In a study prepared for the ADA, it was found that if BMPs are followed correctly for trapped waste, chair side traps and vacuum filters capture 77.8% of amalgam waste (Vandeven & McGinnis, 2002). However, another study found the capture rate to be much lower with chair side traps and vacuum filters capturing only 42% of mercury amalgam (Adegbembo et al., 2002). In a study published in the Journal of the American Dental Association, amalgam separators were found to remove 96-99% of amalgam waste (Fan et al., 2002).

Despite the ADA's recommendations for BMPs, dental mercury discharge has proved to be a nationwide problem that requires analysis on the local level. One way to define the scope of mercury discharge is to perform a survey of dental practices to elicit information on how dental offices are disposing of mercury amalgam waste, and whether the methods used are endorsed by the American Dental Association. This is especially vital considering Missoula County currently does not regulate dental mercury discharge

and the rates of dental offices following a Best Management Program were not, until recently, known in Missoula.

MISSOULA MERCURY AMALGAM DISPOSAL SURVEY

Overview

In August and September of 2006 the author, on behalf of the Missoula Wastewater Treatment Division, conducted a survey of Missoula dental practices to determine what disposal methods are being used for amalgam waste. The purpose of the survey was to gather quantitative data on whether or not Missoula dentists are following the ADA's guidelines for BMPs for amalgam waste. The information was gathered to help the pretreatment office at the Missoula POTW determine whether extra measures need to be taken (in addition to the ADA's efforts) to educate dental practices about proper disposal methods and the extent to which mercury amalgam is entering the waste stream. The survey also establishes baseline data that can be used to compare improvement in disposal methods after a mercury control program is established.

The survey was developed in close coordination with Sherri Kenyon, pretreatment coordinator at the POTW. The survey consisted of 15 closed-end questions (Appendix B). The pretreatment coordinator provided a list of 50 dental practices compiled from a Yellow Pages search. The list provides an approximate estimation of the number of dental practices in Missoula and should not be taken as comprehensive. The 50 dental offices on the list were contacted to participate in the survey, though nine of these were excluded because they do not use mercury in their practice. Of the remaining 41 dental offices, 29 (71%) participated.

Survey Development and Administration

All of the questions used in the Missoula Dental Mercury Amalgam Disposal Survey were taken from a survey the Colorado Department of Public Health administered to dental practices in Pueblo, Colorado, as part of their statewide mercury pollution and

prevention project. After I modified some of the questions, the Missoula pretreatment coordinator reviewed the survey and made some minor changes before giving her approval to begin the survey (Appendix B).

The survey questions were designed to solicit information about how dental offices in Missoula manage amalgam waste, including waste from chair side traps, vacuum filters and/or other secondary filters. Respondents were asked to identify disposal practices from a list provided. Dental practices were asked how they dispose of amalgam waste from chair side traps, vacuum filters and amalgam separators, and were asked to select from the following choices: recycle, wash down the sink, trash, biohazard waste, hazardous waste, or don't know.

The survey also included questions asking how many mercury amalgam placements and removals dental practices perform each month. The responses (0-5, 6-10, 11-15, >15 or other) were used to calculate the estimated average number of replacements and removals of mercury amalgam fillings performed each month. This estimate was then used to estimate the amount of mercury likely being released into the waste stream from improper disposal methods.

The survey was administered via phone and fax. The author called dental practices and identified myself as conducting the survey on behalf of the Missoula Wastewater Treatment Plant and explained that the survey was part of a review of mercury in the wastewater stream. I asked to speak to the person in charge of managing amalgam waste in the office. I spoke with office managers, dentists and dental hygienists. After the respondent agreed to participate in the survey I proceeded to orally administer the questions. The survey took approximately 10 minutes to complete. Respondents were

willing, for the most part, to participate, although at times it seemed they were unsure if they were giving the correct answer. For example, some respondents said they recycled their amalgam waste but they had no idea who picked up the waste.

Out of the 41 eligible dental practices, 23 participated in the phone survey. The survey was faxed to the 12 dental practices who did not participate in the phone survey. Sherri Kenyon wrote a cover letter that asked dentists to complete the brief survey as part of the POTW's review of mercury in the wastewater. The survey and cover letter were faxed to the 12 dentists and 6 faxed responses back. Thus, a total of 29 practices participated in the survey.

There were some shortfalls to my survey. In retrospect I would have liked to have included questions to gauge the level of awareness of the ADA's BMPs and the support for a BMP program that requires the installation of an amalgam separator. I should have also included a question asking whether or not the respondent felt the ADA should do more to educate dental practices about BMPs. The interviews I conducted with local dentists were designed to fill that gap. Also, a more accurate estimate of improperly disposed of mercury could have been made if there was a choice beyond >15 for the number of mercury amalgam removals and replacements. For example, many practices selected this option and it's very likely these practice may have removed/placed 25, 30 or even 40 mercury amalgam fillings each month. Thus, an option should have been included for the ranges of 15-20, 20- 30, 31-40 and >50.

Data Analysis

The survey responses were analyzed using Microsoft Excel to produce descriptive statistics. I used charts and graphs to help with data analysis and interpretation. The number of amalgam-containing tooth extractions was tabulated and the average and total

number of extractions was estimated based on the number of responses for each grouping. This same method was used to calculate the number of mercury amalgam fillings removed per month, the number of amalgam replacements performed each month, and the number of pre-mixed mercury amalgam capsules used each month. The calculated averages for these categories was then used to estimate the aggregate amount of mercury being released into the environment for the dental practices that are not properly disposing of mercury amalgam captured in chair side and vacuum filters. Also, estimates of the average number of placements and removals aided in calculating how much mercury is discharged during these processes. Refer to Appendix C for a complete explanation of calculations.

Disposal methods for empty amalgam capsules, non-contact mixing scrap, and mercury amalgam captured in chair side traps and vacuum filters were charted and analyzed by category (recycle, wash down the sink, trash, biohazard waste, hazardous waste) to determine the number of practices (as well as the percentage) using each disposal method.

Survey Results

Number of Amalgam-Containing Tooth Extractions per Month Figure 1 shows that 21 of the 29 respondents perform between 0 and 5 mercury-amalgam-containing tooth extractions per month. Five practices extract 6-10 mercury-amalgam containing teeth per month; 2 practices reported 11-15 per month; and 1 practice did not know how many mercury containing tooth extractions they performed each month. Respondents extracted an average of 4 mercury amalgam containing teeth per month for an average of 48 extractions per year. In total, respondents remove approximately 1392 extracted teeth with mercury amalgam fillings per year.

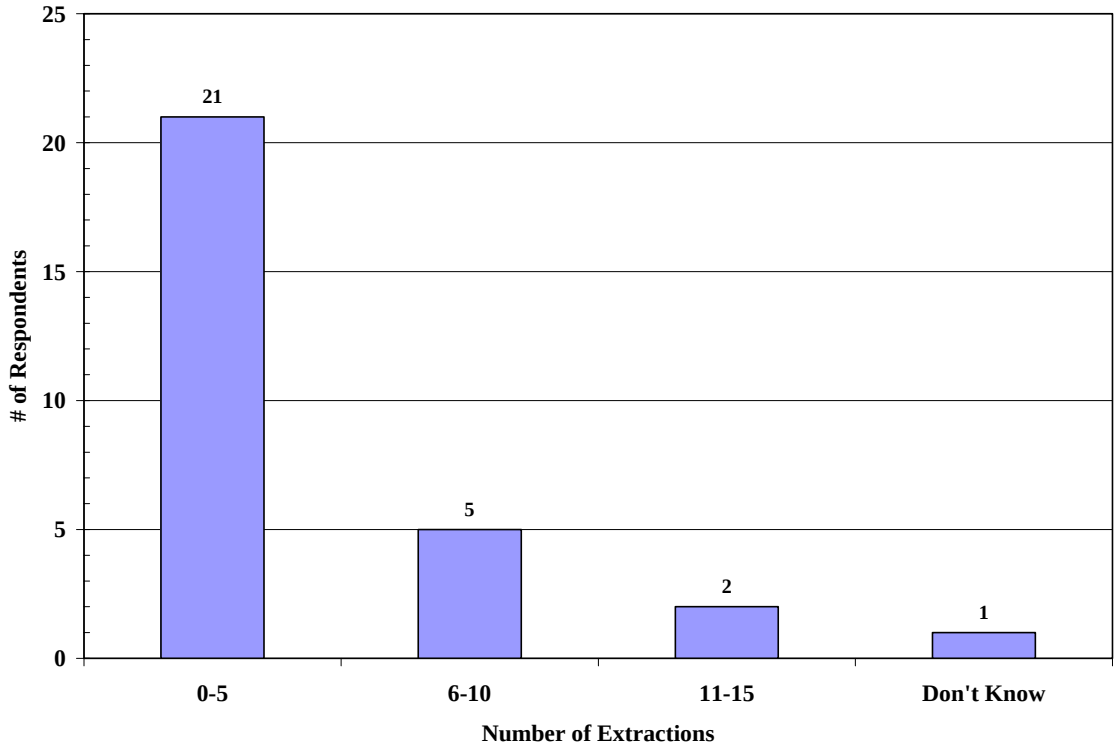

Figure 1 - Number of Amalgam Containing Tooth Extraction per Month

Disposal Methods for Extracted Amalgam-Containing Teeth As shown in Figure 2, 18 of 23, or 79% percent of practices dispose of mercury-containing extracted teeth in

biohazard containers. Extracted teeth thrown in biohazard containers are often incinerated along with other biomedical waste. Thirteen percent of the 23 respondents (3 dental practices) throw extracted amalgam containing teeth in the trash. The American Dental Association's Best Management Practices state that mercury content of extracted teeth should be recycled and not disposed of in biohazard, sharps or infectious waste containers, or in the garbage.

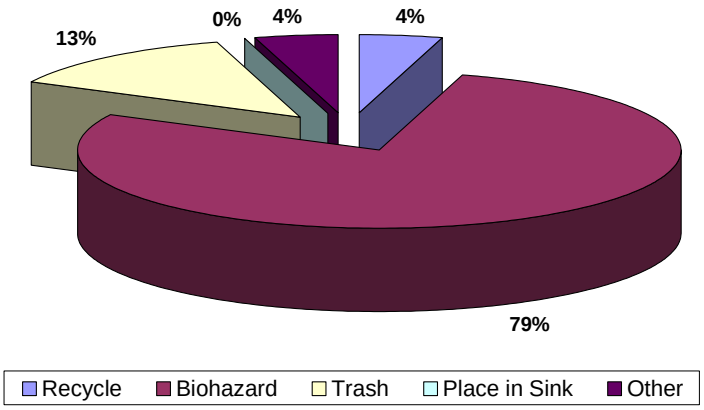

Figure 2 - Disposal Method for Extracted Teeth with Mercury Amalgam Fillings (n=23)

Number of Mercury Amalgam Fillings Removed per Month The number of mercury amalgam fillings removed per month, shown in Figure 3, can be used to estimate the amount of mercury being released in the waste stream, as discussed in the "Estimated Mercury Releases" section. Forty-one percent (12 practices) of practices remove over 15 amalgam fillings per month, 21 % (6 practices) remove between 11 and 15, and 17% (5 practices) of practices reported removing between 6 and 10 fillings per month. According to the responses, on average, they remove 11 amalgam fillings per month for an average

of 132 removals per year. In total, respondents annually remove approximately 2490 mercury amalgam fillings.

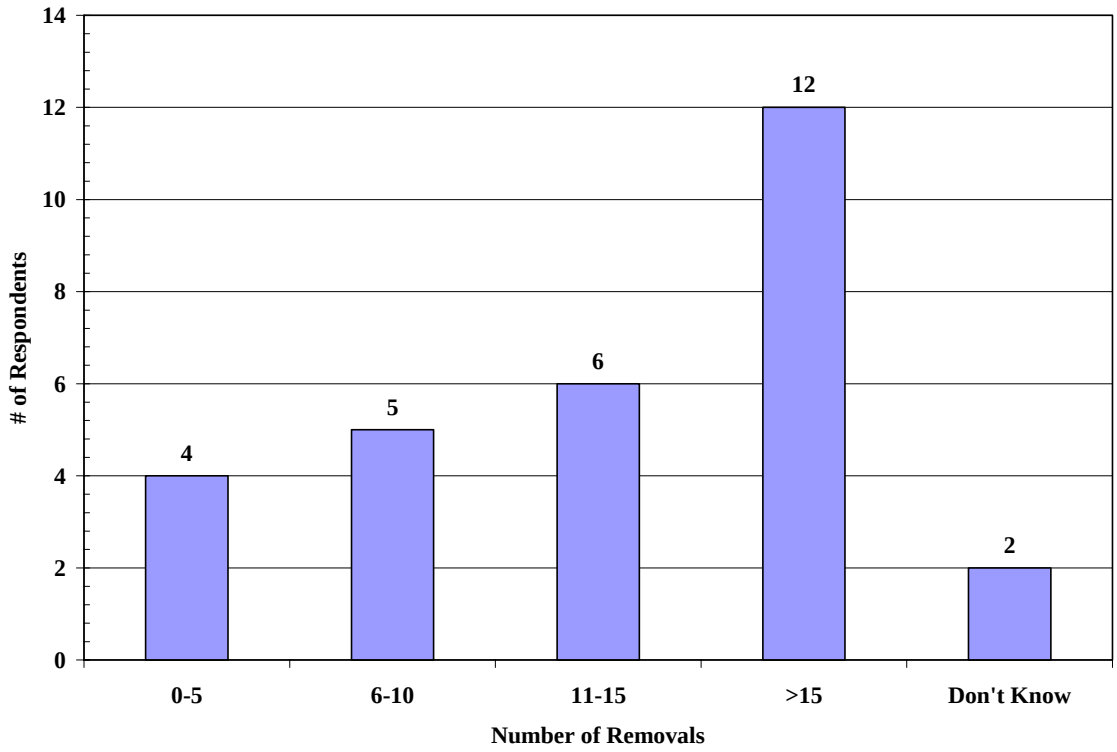

Figure 3 - Number of Mercury Amalgam Fillings Removed per Month

Amalgam Placements per Month It is estimated that 30 mg of mercury is discharged to the POTW during the placement of a mercury filling (Vandeven and McGinnis, 2005). The number of mercury amalgam replacements (essentially placements and replacements are one in the same-- a mercury amalgam filling is being placed) performed in Missoula can be used to provide an estimate of the approximate amount of mercury being released from placements in Missoula using the 30 mg estimate. Mercury discharged during placement has the potential to enter a receiving water body and/or filter out into the biosolids.

Figure 4 shows that the largest number of respondents (9 of 29 or 31%) replaced between 0 and 5 fillings with mercury amalgam per month and 28% of practices (8 of 29) performed between 11 and 15 replacements. Seventeen percent of practices (5 of 29) used mercury amalgam to replace more than 15 fillings per month and an equal percentage performed between 6-10 replacements. Seven percent (2 of 29)were unsure of how many replacements they performed each month.

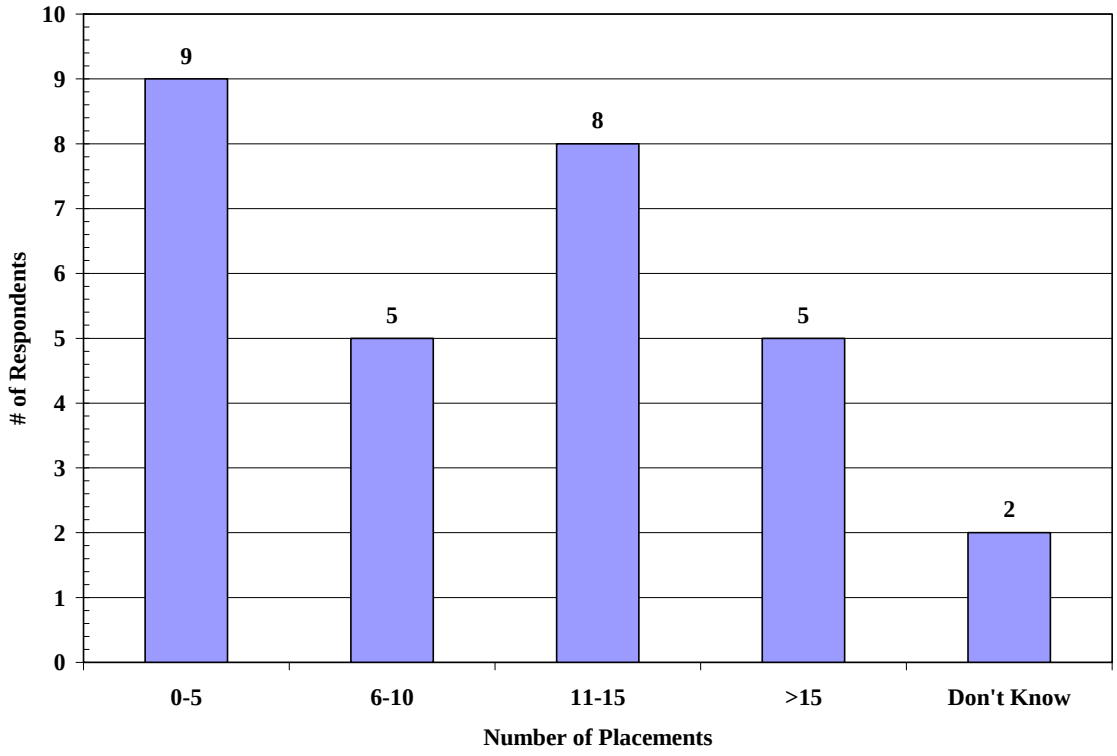

Figure 4 - Number of Amalgam Placements per Month

An estimated total of 242 replacements are performed by the respondents per month, or an average of 8 placements per dental practice/month. Per year, respondents average about 100 mercury amalgam replacements for a combined total of 2898 replacements per year.

Method of Disposal for Empty Amalgam Capsules Only 5% of the 20 respondents who answered the question recycle empty amalgam capsules. As shown in Figure 5, 70% (14 practices) throw empty capsules in the garbage and 20% put empty capsules in biohazard containers. The remaining 5% (1 of 20) of respondents selected "other" methods of disposal.

Because empty amalgam capsules have come into contact with mercury, the American Dental Association's Best Management Practices state empty amalgam capsules should be recycled and not placed in biohazard or infectious waste containers, or in the garbage.

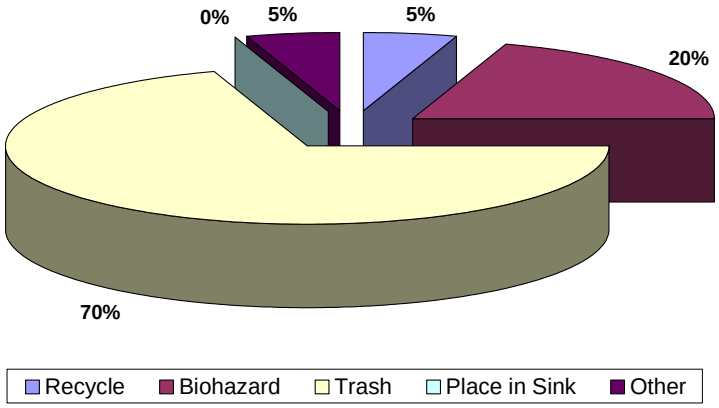

Figure 5 - Method of Disposal of Empty Amalgam Capsules (n=20)

Disposal Methods for Non-Contact Mixing Scrap Only six responses were gathered for this question. Non-contact mixing scrap is the extra amalgam mercury mix remaining after a dental procedure that has not come into contact with a patient. In Figure 6, 50%, or 3 respondents, dispose of non-contact mixing scrap in the trash. Thirty-three percent (2 practices) dispose of it in a biohazard container and one practice (17 %) reported

recycling non-contact mixing scrap. The American Dental Association's BMPs recommend recycling all non-contact amalgam scrap.

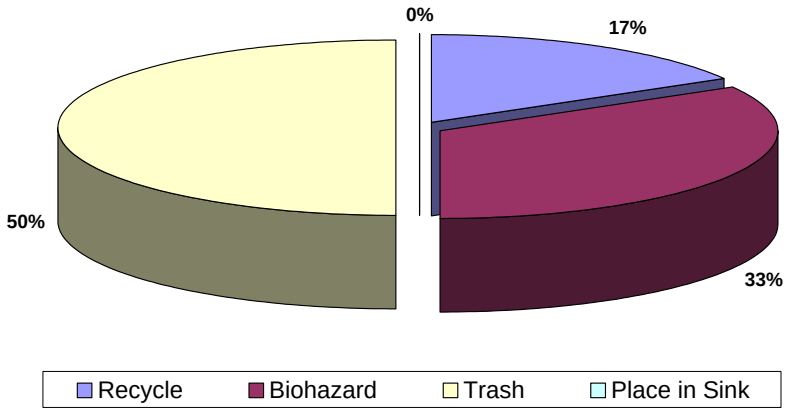

Figure 6 - Disposal Methods for Non-Contact Mixing Scrap (n=6)

Findings In total, respondents placed more mercury fillings per year (2898) than they remove per year (2490).

It is estimated that 288 mg of mercury are discharged into a dental facilities wastewater stream as a result of removal (Barron, 2001) and 30 mg are discharged during placement (Vandeven & McGinnis, 2005). It is also estimated that extracted teeth contain approximately 320 mg of mercury (Watson, et al., 2002). As discussed in the "Estimated Mercury Releases" section, the number of mercury amalgam tooth extractions, fillings removed and placed by Missoula dentists each month, can be used to calculate the amount of mercury released to wastewater and to the general waste stream each year.

In addition, these findings highlight that 92% of respondents are improperly disposing of extracted teeth with mercury amalgam fillings in either biohazard containers or in the trash. The American Dental Association recommends recycling extracted teeth

that contain mercury. An equally large percentage (90%) of respondents are disposing of empty amalgam capsules in the garbage, rather than recycling the capsules as the ADA recommends. The disposal methods used by over 90% of the respondents may result in air emissions of mercury if the biohazard waste is incinerated or the mercury waste may end up in a landfill where it has the potential to leach into ground and surface waters.

The following section looks at disposal methods for amalgam waste captured in chair side traps and vacuum filters and will help to further define the scope of improper disposal methods.

Management of Amalgam Capture Methods

Chair Side Traps Every respondent reported using chair side traps to collect amalgam and other forms of dental waste. The vast majority of practices (25 or 86%) use disposable traps; only four practices use reusable chair side traps. Seventy-six percent (22) of practices clean the traps weekly; the remaining practices clean the traps on a daily (10%) or monthly basis (14%).

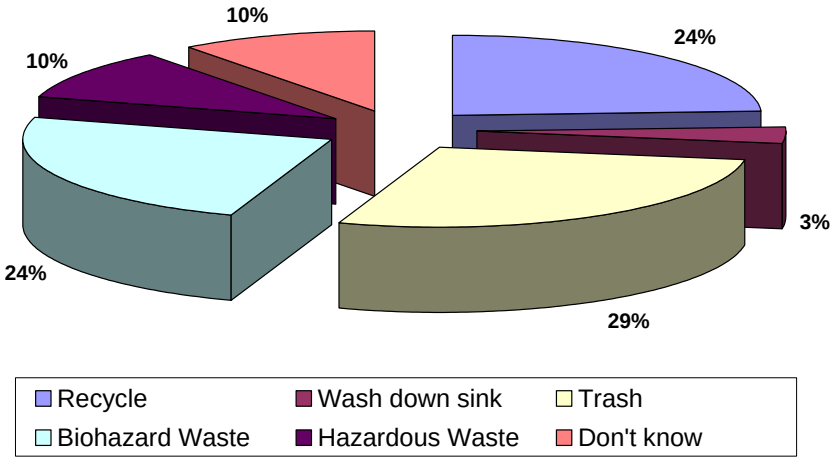

Figure 7 - Disposal Method for Waste from Chair Side Traps (n=29)

The American Dental Association's Best Management Practices note that chair side traps should not be rinsed over drains or sinks and the captured waste should be recycled. The ADA also recommends that amalgam pieces from teeth extractions and/or filling removals should be recycled and not disposed of in biohazard containers or in the garbage.

As shown in Figure 7, the largest percentage (29% or 8 or 29) of respondents dispose of waste from chair side traps in the trash. Also, contrary to the ADA's BMPs 24% (7 of 29) percent use biohazard containers as a receptacle for waste and 24% (7 of 29) recycle trapped waste. To a lesser extent, waste from chair side traps was washed down the sink (3% or 1 of 29) or put in hazardous waste containers (10% or 3 of 29). Ten percent (3 of 29) of respondents did not know how they disposed of waste caught in chair side traps.

Vacuum Filters Out of 29 respondents, 21 use vacuum filters or another form of secondary filters. Five practices reported not using any form of secondary filters and 2 practices did not know if they used a secondary filter system.

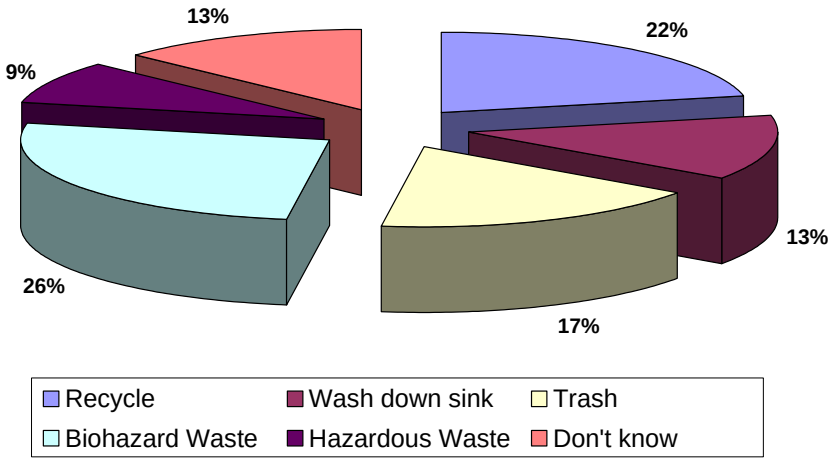

Figure 8 - Management Practices for Waste from Vacuum Filters

As shown in Figure 8, out of the practices that use vacuum filters or some form of secondary filters, only 22% (5 practices) followed the American Dental Association's Best Management Recommendations and recycle amalgam waste trapped in filters. Contrary to the ADA's recommendations, 26% (6 practices) disposed of waste caught in filters in biohazard containers, 17% (4 practices) put trapped waste in the garbage and 13% (3 practices) washed the waste down the sink. Nine percent (2 practices) placed the waste in a hazardous waste container. Thirteen percent (3 practices) of respondents did not know how they disposed of waste caught in vacuum filters or secondary traps.

Amalgam Separators Out of 29 participating practices, only 17% reported using an amalgam separator. Four of these practices recycle the waste and one reported disposing of the trapped waste in the trash. The purpose of amalgam separators is to provide an extra layer of protection for removing mercury from the wastewater stream. However, the contents collected in the trap must be recycled, as the ADA recommends, in order to achieve this benefit.

Findings Over half of the dental practices surveyed are not following the American Dental Association's recommended Best Management Practices for amalgam waste for chair side traps and vacuum filters. Fifty-five percent of respondents are not recycling waste captured in chair side traps. Assuming that the 10% of respondents who "do not know" how waste from chair side traps is managed are not following the ADA's BMPs, the percentage increases to 65%.

In addition, 56% of respondents are not recycling waste caught in vacuum filters. The percentage increases to 69% if one adds the 13% of respondents who were unaware of how their office disposed of the waste. Disposal of empty amalgam capsules had the highest rate of non-compliance--90% of respondents do not recycle empty amalgam capsules as the ADA suggests.

Estimated Mercury Releases

Data collected from the survey was used to calculate the estimated amount of mercury releases resulting from mercury amalgam removals, mercury replacements and improper disposal of amalgam waste from chair side traps and vacuum filters. Refer to Appendix C for a comprehensive explanation of calculations discussed below.

Fifty-two percent of dental practices surveyed dispose of trapped waste from *both* vacuum filters and/or secondary filters *and* from chair side traps in a manner other than what the ADA recommends. The 15 dental practices who do not follow the ADA's BMPs in both of these categories were grouped together in order to estimate how much mercury may be entering the waste stream. It can be assumed that 52% of the 12 dental practices that did not participate in the survey also do not follow the ADA's BMPs and so an additional 6 practices were included in the following calculations.

Based on the average monthly amount of mercury amalgam removals performed by non-complying dental practices each month, it is estimated that the combined release of mercury into the environment from Missoula practices is approximately 2.11 lbs per year. However, this can be considered a conservative estimate because amalgam removals beyond the rate of 15 per month were not taken into account. For example, survey respondents who indicated they remove more than 15 mercury amalgam fillings per month were not given the option of whether they removed 20, 30 or 40 a month, so it's likely that the number is much higher, especially considering 41% remove more than >15 mercury amalgam fillings per month.

Ninety-two percent of the 21 practices who responded to the survey question regarding disposal methods for extracted teeth with mercury amalgam fillings are not following the ADA's recommendation to recycle extracted teeth containing mercury. As a result, an estimated total of 445 grams of mercury, or almost a pound, may be released into the waste stream each year from these practices (Watson et al., 2002).

In the last ten years placements or replacements of mercury-containing fillings has been steadily declining (Vandeven et al., 2005). Based on the survey responses, Missoula dental practices perform, on average, 100 placements per year/per dentist. According to a study performed in 2001, during the placement process, approximately 9% of mercury, or 30 mg, is discharged into the influent (even with the use of chair side traps and vacuum filters) (Barron, 2001). If an average of 30 milligrams of mercury is discharged during each placement, a total of 123 grams of mercury is released into the wastewater stream each year from Missoula dentists. This figure can be considered conservative because there is not a definitive number of amalgam placements for dentists

that placed more than 15 amalgam fillings per month. So, it is conceivable some dentists are placing 20, 30 even 40 mercury amalgam fillings each month which would considerably raise the estimated 123 grams of mercury released.

Conclusion

As a result of not following the American Dental Association's Best Management Practices, an estimated total of almost 2.11 lbs of mercury is released into the environment each year from Missoula dental practices. When mercury is disposed of in biohazard containers the waste is incinerated or landfilled. Mercury amalgam particles disposed in the trash also end up in landfills.

Mercury in chair side traps and vacuum filters is released to the POTW when traps and filters are rinsed over the sink. Even with the use of chair side traps and vacuum filters a small amount of mercury discharge to the POTW is inevitable during the placement and removal of mercury fillings. Although the amount of mercury discharged to a POTW may not undergo methylation, and therefore would not be bioavailable for the uptake in fish tissue, the prudent approach would be to work with Missoula dentists to control mercury discharge from being released in the waste water and, more generally, the waste stream. Following a Best Management Program and recycling all amalgam waste is an effective way to control dental mercury discharge. Additionally, installing an amalgam separator will remove over 95% of mercury amalgam from the waste water stream.

INTERVIEWS WITH MISSOULA DENTISTS

In *Motivation for Compliance with Environmental Regulations*, Soren Winter and Peter May (2001) discuss three conceptual frameworks that influence compliance: normative motivation, social motivation and calculated motivation. One-on-one interviews were conducted with Missoula dentists in order to identify the type of motivation that would be most influential in achieving compliance with a mandatory Best Management Program.

Normative motivations are driven by a sense of moral obligation and a belief in the importance of the regulation. When individuals are driven by normative values they comply with regulations because they feel a civic duty to obey laws (Winter & May, 2001). Normative motivations may also stem from the perceived need or value of the regulation. The value or necessity of the regulations may be shaped by the extent to which other regulates/peers comply with regulation or the perceived fairness or reasonableness of the rule (Winter & May, 2001).

Social motivation differs from normative motivation in that compliance of BMPs results not from an inherent belief in the value of the policy but rather to earn the respect of, for example, other dentists, patients and/or other relevant individuals dentists may hold in high esteem (Winter & May, 2001). Compliance with a regulation is therefore the result of social pressure by regulates, advocacy groups, trade associations (like the Montana Dental Association) the media and friends and family (Winter & May, 2001). Social motivation may also be spurred by group leaders and other role models.

Calculated motivations, on the other hand, are influenced by the risk of detection and fines and also by the cost of compliance (Winter & May, 2001). For example, individuals may be more likely to comply if they know the risk of detection is high or if

they are likely to get fined for the violation. Or, individuals may not comply if the costs are deemed significant.

According to Winter and May (2001), the definitions of normative, social and calculated motivations may overlap and thus an individual's motivation for compliance is not always mutually exclusive and may involve more than one motivating factor.

Winters and May (2001) also point out that "awareness of rules is critical to enhancing compliance." Considering this, other interview objectives include measuring the level of awareness the dentist has of the ADA's BMPs, especially in light of the survey results which indicate that over half of dental practices surveyed in Missoula are not following the ADA's Best Management Practices.

Another important impetus for the interviews rests in the author's belief in the importance of participatory decision-making. Giving the dental community the opportunity to participate in the discussion is critical to designing a successful mandatory or voluntary best management program. Thus the interview questions were designed to gauge the level of interest, support and concern for adopting a mandatory BMP program that includes the installation of amalgam separators, and to gather suggestions on how to increase compliance with, at the very least, the ADA's voluntary BMPs.

Method

On January 25, 2006, forty-one dentists were mailed a letter of inquiry (Appendix D) outlining the intent of the interview and why it was important for dentists to participate. It was noted in the letter that their responses would be confidential but had the potential to inform possible policy decisions. Dentists were selected from the same list used for the survey, which was supplied by the Missoula Wastewater Treatment Plant and was comprised of a Yellow Pages search of local dental offices.

Two weeks after the letter of inquiry was mailed, a follow-up call was made to each of the 41 practices. Out of the 41 dental practices contacted by phone, two agreed to participate in the interviews. One dentist contacted the author and agreed to the interview before the follow-up calls were made. In total, three dental practices participated in the interviews.

Each of the three interviews took place at the participating dental practice's office. An interview protocol was followed during the interviews (Appendix E). Approval from the University of Montana Institutional Review Board (IRB) was sought and obtained on January 7, 2007 with no suggested changes. Before the questions were administered, the participants were informed that their responses would be used for a professional paper on controlling dental mercury discharge in Missoula and asked if their responses could be recorded using a tape recorder. The respondents were told that although their responses may be used in the paper, their identities would be kept confidential. All of the participants declined to have their responses tape recorded, but did allow notes to be taken during the interview by the author.

Because a strong representative sample was not achieved, it is impossible to draw reliable inferences about all of the dental practices in Missoula. However, the following findings and recommendations are helpful when considering a mandatory or voluntary program in Missoula.

Explanation for the Low Response Rate

There are a number of reasons that can be inferred about the low response: 1) dentists feel this issue is not important enough to address; 2) dentists did not trust the author's intentions; and/or 3) time constraints.

After interviewing a dental office manager and the Executive Director of the Montana Dental Association (MDA), it seems the dental community misconstrued the author's intentions. During an interview with an office manager, the author was informed that she was "hated" by the dental community and that they were up in arms about the letter. A discussion with the Executive Director (ED) of the MDA lent some further perspective on why the letter caused such a stir. The ED forcefully informed the author that her involvement with Women's Voices for the Earth (WVE), a local non-profit working on dental amalgam discharge, should have been included in the recruitment letter.[3]

It seems dentists may not have participated because they felt the author was "hiding" her relationship with WVE. Also, the ED and the dental community were confused about why the interviews were being carried out and for whom, despite it being clearly explained in the letter that the research was being conducted as part of an academic professional paper on dental mercury discharge and that it was not in any way associated with the Missoula POTW but that anonymous responses may be shared with the division in order to help inform policy decisions (See Appendix D). Obviously dental practices took the letter somewhat seriously (the recruitment letter was faxed to the ED by several dentists) probably because of the mention of "mandatory BMPs." In retrospect, especially after considering the uproar the letter caused, it would have been prudent to include the author's relationship with WVE.

After a lengthy and initially contentious phone conversation with the Executive Director of the MDA, she finally came to the understanding that the interviews were

[3] The author has been an intern at Women's Voices for the Earth (WVE) for approximately 9 months, however WVE had absolutely no involvement in the interviews.

meant to give dentists the opportunity to express their views about a mandatory Best Management Program and any suggestions they may have for improving compliance with the ADA's BMPs. After a level of understanding was reached, the ED offered to contact the district BMP trainer for Missoula to encourage her to motivate other dental practices to participate. However, the conversation did not result in any additional interviews.

Findings

When referencing responses, the participants for each of the dental practices will be referred to as dental practice #1, dental practice #2, and dental practice #3 in order to protect the identities of the participants. Dental practices #1 and #2 had been in practice for more than 20 years and dental practice #3 has been practice for over 15 years. Two of the participants are dentists and one is an office manager.

Normative Motivations All of the participants do not believe dental mercury discharge is a problem in Missoula because elevated levels of mercury have not been found at the POTW, the use of bulk elemental mercury is virtually non-existent and the use of elemental mercury in general is on the decline. When asked the question of whether dental mercury discharge is a problem in Missoula, all the respondents said that to their knowledge it was not a problem. After the initial response to the question the author would inform the respondent that the POTW has not registered levels of mercury above what is listed in the permit which led all the respondents to deem that dental mercury discharge is not an environmental problem in Missoula. Dental practice #1 also said mercury in the amalgam form is not bioavailable and believed that the wastewater treatment plant is able to separate mercury from the effluent.

All the participants believe mandatory BMPs are not necessary unless the Missoula POTW can "scientifically" prove that high levels of mercury are coming from dental offices. All of the practices agreed that if the plant was in violation of permitted levels for mercury, and it could be traced to dental offices, then mandatory action requiring the installation of an amalgam separator is necessary. When it was mentioned that over half of surveyed dental practices are not following the ADA's BMPs, all of the respondents said instead of mandatory action more needs to be done to educate the Missoula dental community about the importance of following the ADA's BMPs. Mandatory regulation, then, was deemed unnecessary at this point but that if the need for such a regulation can be proven they would support it. This attitude is illustrative of a normative motivation. That is, respondents would comply with regulation if provided with sound justification for why it is important.

Two of the respondents had installed amalgam separators voluntarily. When asked why their practice had installed an amalgam separator, dental practice #3 said it was because they felt it was the "right thing to do." The respondent was a fly fisherman and cared about water quality issues. Dental practice #1 also had installed a separator and had done so because they felt obligated to "minimize imprint on the environment as much as possible," and therefore is "overly cautious" when it comes to amalgam disposal. These statements demonstrate a normative motivation based on an internalized value (Winters & May, 2001). In other words, the respondents value the environment and thus take measures to protect by installing an amalgam separator. Dental practice #2, who does not have an amalgam separator but considers himself to be environmentally aware has not installed a separator because dental mercury discharge is not a "proven" pollution

problem in Missoula. Dental practice #2 said he would install an amalgam separator as part of a BMP program if a regulatory authority required it. All of the dental practices agree amalgam separators are an effective means of removing mercury amalgam from the waste stream.

Calculated Motivations Practice #2 does not believe cost is a barrier to installing a separator except for practices that are just getting started. Dental office #1 believed one of the reasons practices do not install separators is due to the expense of purchasing and associated maintenance costs of a separator. When asked if the cost of an amalgam separator may be a barrier to installation dental practice #3, replied "look, dentists make a lot of money—cost is not an issue." The perception that the cost of installing an amalgam separator would not inhibit a practice from complying with a regulation is a form of calculated motivation. For the respondents, all of whom have established practices, cost is not a barrier to installing an amalgam separator, although it may be a barrier to installation for other practices—especially new practices. Calculated motivations may be more relevant to practices that cannot afford to install an amalgam separator. The discussion of fines or penalties, and whether or not they would be a barrier to compliance was not discussed in the interviews.

Social Motivation The respondents were also asked whether they would be more inclined to install an amalgam separator if the names of dental practices who voluntarily did so were published in the *Missoulian.* Practice #2 feels this tactic is "tacky and ridiculous" and "unfair peer pressure," because recognizing dentists who install separators versus those who don't is not reflective of the conscientious nature of many of

the dental practices in Missoula. The respondent explained many dental practices perform a great deal of pro bono work and are doing "good things in the community." Dental practice #1 was somewhat ambivalent about publicly acknowledging practices that installed separators, but thought that it may work if it was done in a way that "did not make it seem like they were better than anyone else."

Dental practice #2 said they would consider installing an amalgam separator if it was important to their patients. However, since the current "scientific data" does not prove dental offices are significant mercury polluters the practice would try to "educate their patients" about why separators are not necessary. This same respondent said that if dental offices in Missoula came to a consensus and agreed to voluntarily install separators, the practice would be on board.

Dental practice #1 believes that peer pressure from other dentists is the least intimidating type of pressure and the best way to ignite change within the profession. According to practice #1, the most effective way to promote the use of amalgam separators is if it comes from the inside and a dialogue is created on an "equal level." Therefore, based on these three interviews, social motivation from the media is not as effective as peer pressure or the use of role models or leaders in the dental community.

Existing Compliance with the ADA's Best Management Practices

One of the questions asked whether or not they are aware of the ADA's BMPs and if they followed them. All three of the respondents responded that they are aware of the ADA's recommendations and did follow them. However, as shown in Table 2, after reviewing their responses from the Missoula Mercury Amalgam Disposal Survey dental practice #2 and #3 did not follow the ADA's BMPs for disposal of amalgam waste from

chair side traps and vacuum filters and all three do not dispose of empty amalgam capsules in accordance with the ADA's recommendations.

Table 2 – Awareness and Compliance with the ADA's BMPs

Dental Office	Aware of and follow ADA's BMPs	Comply with BMPs for chair side traps and vacuum filters*	Comply with ADA's BMP for empty amalgam capsules*	Comply with BMPs for extracted teeth with Hg amalgam fillings*
#1	Yes	No	No	N/A
#2	Yes	Yes	No	N/A
#3	Yes	No	No	No

* Based on Mercury Amalgam Disposal Survey

Dental practice #3 follows the ADA's BMPs "wherever" possible, but said it was difficult to find recyclers for contact amalgam and empty amalgam capsules. Dental practice #2 also said it can be difficult to find recyclers in Montana.

Respondents' Recommendations

Although all of the dental practices interviewed do not support a mandatory Best Management Program, there is consensus that steps need to be taken to encourage proper amalgam disposal. Dental practice #2 recommends more educational outreach needs to be done in the form of increased training sessions with dental offices and more frequent trainings are important because of staff changes.[4] Dental office #1 also believes more educational outreach would be helpful and recommends the MDA conduct periodic half day trainings for staff covering BMPs and the different types of chair side traps and vacuum systems available. One practice suggested yearly audits of each dental practice to review whether or not BMPs are being carried out in the correct way and/or a quarterly or yearly reporting of where amalgam waste is sent. It was emphasized that it would be

[4] Dental hygienists are usually the staff member in charge of amalgam disposal.

helpful if dental practices did not have to seek out information on where to recycle amalgam waste, but rather if the information was provided to practices or if the POTW took care of all the logistics.

One practice pointed to several incentives that can be employed to encourage the use of amalgam separators. Besides peer pressure, which was mentioned previously, the practice felt that if amalgam separators were subsidized dental practices may be more willing to install one. However, the practice pointed out that amalgam separators should not be held out as the panacea for all the problems. In other words, amalgams separators are not a substitution for other forms of BMPs. This is an important point to note considering the amount of mercury that is captured in chair side traps and vacuum filters, which is often a dental practice's first line of defense. Mercury captured in these traps should be disposed of properly even with the installation of an amalgam separator.

Discussion

The respondents clearly do not think dental mercury discharge is something that needs to be regulated based on the fact that elevated levels of mercury have not been found in the influent and because the use of mercury in dental procedures is on the decline. It was also expressed that the POTW captures mercury particles and that dental mercury amalgam is not bioavailable. Both of these assumptions have some merit. Although the scientific data is limited on the ability of dental amalgam to undergo methylation, some studies do suggest dental mercury can become bioavailable. It is correct that some mercury particles, if large enough, are separated out from the effluent. However, the particles end up in biosolids, which are then land applied or used for compost; POTWs do not have the capability to filter out mercury particles from solid waste for proper disposal.

It is likely the respondent believes mercury is separated from the effluent because of information disseminated by the Montana Dental Association. In literature obtained from the Montana Dental Association, it was noted that:

> POTWS capture 95% of waste amalgam that does enter their system (and, therefore, most of the amalgam waste that would be collected by amalgam separators), use of separators results in virtually no noticeable additional reduction in the amount of mercury discharged from the POTW in its effluent. The amount of mercury in the POTW effluent is what contributes to the release of mercury in the environment (McCue, 2007).

Also, the MDA has adopted the ADA's stance on amalgam separators. That is, they do not recommend the "universal" installation of separators because the "presence of mercury varies from locality and from state to state" (McCue, 2007). The MDA also maintains that the amount of mercury in waters, fish tissue and sludge is, in fact, much lower than "previous estimates" and was based on the amount discharged to a POTW and "not the mercury that reaches the environment" (McCue, 2007).

The Montana Dental Association evidently has taken the position that dental mercury amalgam is not a source of environmental concern, and dental practices need not go to any extra lengths to prevent the release of dental mercury besides voluntarily following the ADA's BMPs. The information the MDA presents is somewhat misleading considering the number of POTWs that have violated their permitted levels for mercury because of mercury discharged from dental practices. The MDA's position could prove to be a barrier when attempting to educate Missoula dental practices about the need to control dental mercury discharge.

As noted in several of the interviews, the level of outreach conducted by the MDA should also be increased. Currently, there is one qualified member of the dental that has undergone a training process and is qualified to teach other dental practices about

BMPs (M.McCue, personal communication, Feb 7, 2007). The BMP trainer gives presentations about BMPs at local dental society meetings. Additionally, the MDA does educational outreach by posting their BMPs on their website, in the MDA's newsletters and occasional mailings about BMPs that include information on recyclers in Montana. The Executive Director of the MDA concedes that educational outreach needs to be done more regularly and that it should come from not only the MDA, but also the Missoula POTW (M.McCue, personal communication, Feb 7, 2007).

Conclusions

Due to the small sample size it is impossible to extrapolate the findings to the dental community as a whole or reliably infer what factors motivate dental practices in general to comply with BMPs, especially a BMP program requiring the installation of amalgam separators. However, tenable conclusions can be made based on the interviews as to what *may* motivate dental practices. All of the practices interviewed said they would comply with any BMP program if it were mandatory and would feel obligated to support such a program if it were proven that dental practices were a significant contributor of mercury to the POTW. Therefore, normative motivation appeared to be an important and effective motivating factor for following any type of BMP program.

Two of the dental practices had installed amalgam separators based on the normative motivation that it was the right thing to do in order to protect the environment. However, the fact that dental practice #1 and #3 had already installed amalgam separators, and therefore any mandatory regulation requiring the use of separators would be moot, may be an indication that the respondents participated because *despite* having an amalgam separator to help reduce mercury discharge, they feel very strongly about *not* being regulated.

Social motivation, in the form of peer pressure or role models, also appeared to be an effective motivating factor for following any type of BMP program. Respondents noted that if the pressure to install amalgam separators came from within the dental community it would be much more palatable. In other words, involvement of dental representatives in BMP formulation is seen as crucial to achieving maximum results, even if it were just increased compliance with the ADA's Best Management Practices. However, feelings were mixed when discussing using another form of social motivation, such as the media. One respondent felt this would be an unfair tactic and another responded that using the media as an incentive to get other dentists to install an amalgam separator may work if it was done in a sensitive way.

Calculated motivation was not as obvious, in part because the majority of questions dealt with deciphering normative and social motivation; although if the mandatory BMP program included the installation of an amalgam separator, the cost of installing an amalgam separator was not viewed as a barrier to compliance.

Again, the motivating factors expressed in the interviews should not be taken as representative of the Missoula dental community as a whole. However, the social and normative factors did have the strongest showing and should be considered when designing a BMP program and conducting educational outreach. These considerations may be especially helpful if the program is voluntary, as calculated motivations do not play a strong role unless the regulation is mandatory.

THREE CASE STUDIES FOR DESIGNING A SUCCESFUL BEST MANAGEMENT PROGRAM

Best management programs have been implemented throughout the country as a means to control the release of dental mercury to the waste stream. Publicly Owned Treatment Works in Boise, (Idaho), Wichita, (Kansas), and Western Lake Superior, (Minnesota), have pinpointed dental practices as a significant source of mercury and have designed and implemented BMP programs to control dental mercury discharge. These three BMP programs are presented here as case studies that can be used to help design a successful BMP program in Missoula. Factors that proved to be a barrier to BMP implementation and aspects of the program that fostered success are highlighted. Having this knowledge upfront may help to avert similar obstacles when a BMP program is implemented in Missoula.

The three municipalities presented were selected for review based on their membership in the National Association of Clean Water Agencies (NACWA) and have been recognized by the agency for their involvement in a mercury control program.

The NACWA was initially established in 1970 to advocate for increased funding for POTWs and to formulate policy prescriptions to improve water quality nationwide. Since then, NACWA has proven to be a powerhouse in building collaborative relationships with the EPA, Congress and presidential administrations to design scientifically-based, technologically-sound and cost-effective programs to improve all facets of water quality (NACWA, 2007). Members of NACWA, such as the three municipalities mentioned previously, are central to carrying-out the goals of the NACWA and thus an appropriate choice for case study selection.

The goal of the analysis is to provide an inclusive understanding of the impetus, design and implementation of the respective POTW's Best Management Practices program. Three approaches were used to accomplish this goal: review of the POTW's website for any pertinent information/documentation about the dental mercury BMP program 2) informal interviews with key city personnel involved with managing the BMP program 3) analysis of additional documentation about the BMP program not available on the municipality's website.

The informal interviews were conversational in nature and covered common themes. Questions were site-specific and designed to address any knowledge gaps left unfulfilled by the review of the POTWs website. However, there was uniformity with questions regarding basic thematic concerns such as what worked well with the program and factors that influenced success, what problems were encountered, and how those problems were addressed. In all the interviews, additional documents were requested and received to bolster the analysis. The documents contained details of the programs, quantitative data on mercury levels before and after a BMP program was implemented, and data on the compliance rate. The documents also included information about specifics of the program.

City of Wichita, Kansas

In the spring of 2000, the City of Wichita, in conjunction with the Kansas K-State Pollution and Prevention Program (K-State P2), developed a voluntary program to reduce the amount of mercury and silver entering the Wichita Publicly Owned Treatment Works. According to Rebecca Gagnon, Wichita's Pretreatment Administrator, the POTW's effluent levels were over the Maximum Allowable Headworks Loading (MAHL) for mercury and provided the impetus for the program (R.Gagnon, personal communication,

Feb 15, 2007). MAHL is the maximum amount of a pollutant allowed to enter a POTW. Levels exceeding the MAHL indicate the plant may be at risk for an effluent or biosolids violation.

The elevated levels of mercury initially caused the POTW to institute a BMP program with hospitals to encourage, for example, the proper disposal of mercury thermometers and other mercury-containing medical devices. However, the program did not result in significantly lower MAHL levels. As a result, the City began to scrutinize other users of mercury, such as dentists. The City began testing strategic manholes near dental practices and based on the testing, determined dental practices were discharging between 50-70% of the mercury entering the POTW.

In 2000, the City and K-State P2 developed a voluntary program aimed at reducing mercury and silver levels from small businesses, namely the approximately 200 dental practices in Wichita. The program was designed to be initiated in two phases. Phase I one consisted of strictly following the American Dental Association's BMPs, including the requirement of installing chair side traps and vacuum filters. Phase II would be implemented if Phase I did not prove to significantly reduce mercury levels. Phase II required the installation of International Organization for Standardization (ISO) certified amalgam separators or the issuance of a permit to discharge mercury. The program was funded using the permit fees of significant users (R.Gagnon, personal communication, Feb 15, 2007).

In an attempt to develop relationships with the dental community, as well as educate them about the program, the City and K-State P2 held several workshops at the dental association's annual meeting. In addition to the workshops, a presentation was also

given at the general meeting where it was explained the plant was exceeding its MAHL for mercury and that if measures were not taken to reduce mercury from source contributors the plant would "get in trouble with the EPA" (R.Gagnon, personal communication, Feb 15, 2007). The workshops provided more details about the voluntary program and outlined the steps dentists needed to take to reduce dental mercury discharge. Also, the workshops gave dentists the opportunity to give feedback about the program. In the workshops dentists voiced skepticism about the need for such a program. Mainly, they considered themselves to be minor contributors and viewed even the voluntary program as onerous.

In order to assuage the dental community's doubts about the program the City and K-State P2 organized a conference that described the mercury portion of the program and also allotted a portion of the program for feedback. In addition, the City did poster and oral presentations at the local dental society meetings (held every two months). They also convened a task force that included City staff, K-State P2 staff and local dental society officers. The multi-stakeholder task force was formed to help design effective tenets of a BMP program that would be considered "fair" by the dental community. (Gagnon, 2007). See Appendix F for the Wichita's compliance plan.

After approximately four years of the voluntary program, mercury levels had still not significantly decreased to a suitable level. As a result, the City and K-State P2 decided to go ahead with Phase II in 2004. Although strong relationships had been developed with dental community, there was opposition to Phase II because of the regulatory bent. As mentioned previously, Phase II would either require dental practices to install amalgam separators, or apply for a discharge permit that enforced strict mercury

limits. The greatest opposition came from the local Air Force base that felt dental mercury amalgam discharge was not a problem. However, a sampling of the base's effluent showed significant levels of mercury and the City permitted the base as a significant industrial user. Despite the opposition and because the City had the support of the task force (which included key members of the dental community), and because the City had no choice but to enforce stricter measures in order to reduce mercury, they decided to forge ahead with Phase II.

Dentists who did not use mercury amalgam in their practice were exempt from Phase II. The majority of dentists who were required to comply with Phase II chose the option of installing an ISO certified amalgam separator rather than apply for a discharge permit. The latter option was much more onerous for the dental practices because it would require them to not only meet a stringent limit for mercury, but would also result in increased monitoring costs, permit fees and enforcement actions if the limit was not met (R.Gagnon, personal communication, Mar 7, 2007).

Initially, 60% of the dental practices complied with Phase II by installing an amalgam separator (Gagnon, 2007). The City continued to hold workshops at the annual dental society meetings in order to achieve optimal compliance rates. The City performed on-site inspections to verify amalgam separators have been installed. In addition, a recycling log is required in order to track recycling history. See Appendix G for an example of the recycling log. To date, a 98% compliance rate has been achieved (Gagnon, 2007). The City is still in the process of inspecting and/or permitting the remaining 2% of dental practices. In the years following Phase II implementation the POTW's MAHL has been reduced by more than half. The pretreatment administrator

attributes this success to the installation of amalgam separators. She also pointed out that immediately following Phase II there was a spike in mercury levels because the installation of amalgam separators had the effect of releasing the mercury that built up in the pipes.

According to the pretreatment administrator the key factor that made the program successful rested on the relationships that were built with the dental community and the involvement of key leaders within the dental community. As a result, the dental community was able to give input every step of the way and thus had ownership of the program. Also, dentists involved in the program recognized that significant levels of mercury could pose a human health risk and that it was an environmental problem (R.Gagnon, personal communication, Feb 15, 2007). The outreach conducted also helped to raise awareness about why it was environmental problem and what steps need to be taken to reduce mercury discharge.

There were difficulties with implementing the program, particularly in regards to Phase II. The pretreatment administrator conceded that resources were a big issue and that it would have been helpful to have an additional paid staff member to carry out the inspections and permitting processes. Also, initially she found the dental community to be the hardest commercial group to work with because 1) many did not see the need for regulation and 2) they were opposed to regulation in general. Although the pretreatment administrator maintains that strict adherence to the ADA's BMPs are a great first step to reducing dental amalgam discharge, she feels amalgam separators are the only way to significantly reduce this source of mercury.

Boise, Idaho

In 2002 the City of Boise, Idaho began to take measures to control mercury in the wastewater by developing a BMP program to promote the proper disposal of mercury amalgam waste from dental practices. The City's Pollution Prevention Strategy designated mercury as a priority because a local limits assessment showed mercury was above the designated MAHL, and therefore a local limit for mercury was needed. Mercury also came under increased scrutiny because of the large number of water bodies in the region that have a public health advisory listing for the consumption of fish, and because the state follows the EPA's recommended methylmercury criterion U.S. EPA, 2006).

Robbin Finch, Water Quality manager for the Boise Department of Public Works, acknowledges that the Boise POTW is a minor contributor of mercury and believes the total load of dental mercury is a very small portion (R Finch, personal communication, Feb 21, 2007). Although the Boise POTW did have elevated levels of mercury, Finch believes the mercury data that indicated mercury exceeded the MAHL was not entirely accurate at the time because the testing method used was highly variable and unreliable. Testing using Method 1631 has proved to be much more reliable, and subsequent testing at the plant has shown levels below the MAHL. Finch believes the earlier data was not an accurate representation of mercury loadings due to the analytical method used.

Before the more advanced method was available, a BMP program was instituted. However, even in light of the new data, Finch says they would have still initiated the creation of a BMP program because mercury is a high profile pollutant, and BMPs are an inexpensive way to net good reductions with no controls (Finch, personal communication, Feb 21, 2007). To initiate the program, administrators at the POTW

approached the Idaho Dental Association (ISDA) to develop BMPs for mercury amalgam as well as other waste generated by dental practices such as x-ray fixer and developer, and florescent bulbs. POTW administrators met with the board members of the ISDA and member dentists to craft a suite of BMPs, and to discuss ideas and options for implementing a Best Management Practices program. After a finalized set of BMPs were agreed upon, they were sent to the ADA for review and approval, and set a 2-3 year date for implementation. The suite of BMPs was mailed by the ISDA on their letter head to every dental practice in the state. The BMPs also were printed in the ISDA's newsletter and presentations were made at the annual ISDA meeting prior to the effective date.

The BMPs designed by the ISDA are more comprehensive than the ADA's and recommend practices install an amalgam separator and even suggest recycling mercury products such as thermostats and florescent bulbs. For a complete copy of the ISDA's BMPs see Appendix H. The Executive Director of the ISDA was opposed to making the installation of amalgam separators central to any BMP program, and as a result, amalgam separators are listed under "additional recommended BMPs." The Executive Director believed amalgam separators would be a cost constraint to newly established dental practices. Amalgam separators are also not listed as a recommendation on the BMP handout available on the Boise Public Work's website (Appendix I).

Although the BMPs are marketed as voluntary, the Boise Public Works Department conducts inspections of the City's 135 dental practices to ensure compliance. The inspection checks that mercury amalgam waste is being recycled and collects information about how mercury amalgam waste is handled from chair side traps and vacuum filters. See Appendix J for inspection sheet. To fund the program, the department

included dental practices as a new class of inspections and designated them as a priority. The inclusion did not require the hiring of additional staff. Since 2002 the Public Works Department has inspected approximately 20% of dental practices per year. After the initial inspections are completed, inspections will be completed once every five years. For practices that are not in compliance, for example if a practice is not recycling or storing its mercury amalgam waste properly, a compliance order is issued. If necessary, a follow-up inspection is done on a two, three or five year schedule.

The Water Quality manager stated the program has thus far proved to be successful-- 101 of the approximately 135 dental practices that have been inspected are complying with the program. There are some areas that could use improvement-- mainly in the area of cleaning or replacing contaminated sink traps and sumps (only 22 or 22% followed this BMP). Some practices have taken additional steps to remove mercury from the waste stream: 35 (35%) have voluntarily installed and properly maintained an amalgam separator, and 58 (58%) practices recycle mercury-containing thermostats, switches and fluorescent light bulbs. The success of the program can be attributed to working closely with the Idaho Dental Association to develop a suite of BMPs, the fact that the BMPs came from the ISDA and the level of follow-up in the form of inspections.

Western Lake Superior, Minnesota

In 1989 high levels of mercury in fish in the St. Louis River in Minnesota prompted the Western Lake Superior Sanitary District (WLSSD) to review mercury sources. The WLSSD sampled several dental clinics and determined that each dentist discharges approximately 0.3 grams of mercury each day. Additional wastewater monitoring determined that the 53 dental practices in the Western Lake Superior District were contributing a total of 9.53 grams of mercury per day to the total mercury load

(WLSSD, 2002). Based on this and other sampling completed, the WLSSD estimated that hospitals, dentists and universities account for 44% of the mercury sources to WLSSD's wastewater.

WLSSD staff presented the local dental society with the data and suggested creating a partnership to educate dental practices about dental amalgam waste. According to Tim Tuominen, Pollution Prevention Chemist at the WLSSD, the Dental Society initially was opposed to any type of regulation of mercury amalgam (Tuominen, personal communication, Feb 2, 2007). However, they became more receptive when the WLSSD framed it as dentists helping the treatment plant to reduce mercury. This approach differed greatly from the "finger pointing" that characterized the first attempts at collaboration (Tuominen, personal communication, Feb 2, 2007).

The partnership between the dental society and the WLSSD resulted in the creation of a Best Management Practices manual that included information on how to dispose of mercury and other dental office waste. The manual was given to all dental practices in the Western Lake Superior District. The WLSSD also hired two dental assistants to train dental practices about BMPs with on-site visits. The Minnesota Dental Association (MDA) made a BMP video that was distributed to dental practices. In 1993, when the WLSSD completed wastewater monitoring, they found a concentration of 0.3 grams in the wastewater discharge from a building that housed several dental practices. In 1995, two years after the program had been initiated, monitoring of the same building found the mercury concentration reduced to 0.086 grams of mercury per dentist per day (WLSSD, 2002).

In 1995 the WLSSD completed on-site audits of waste disposal practices for individual dental practices. The audits revealed dental practices were improperly disposing of waste captured in chair-side traps and vacuum pump traps in biomedical waste and solid waste containers. While the waste was not being discharged to the sewer line, it still posed an environmental threat because of the potential of leaching once landfilled or the release of air emissions of mercury from the incineration of biomedical waste. In response, the WLSSD established a pilot program in 1996 with regional medical waste contractors and recyclers to collect captured mercury amalgam waste. The dental society also mailed an insert to the BMP manual about the program and information on recyclers. For two years running starting in 1999, a survey was completed with local dental practices to determine where practices were recycling amalgam waste and how much mercury waste was being recycled each year. Nearly every practice surveyed responded that they were recycling their waste as well as the tracking the amount of waste being recycled (Tuominen, personal communication, Feb 2, 2006). The WLSSD also started a "Clean Shop" hazardous waste program that, for a small fee, picks up waste such as dental amalgam, from local businesses for safe disposal.

The efforts of the WLSSD to reduce dental mercury amalgam discharge were well-funded by state, local and EPA grants. The grants enabled the WLSSD to devote the necessary resources to ensure the program was success. The grants also allowed the WLSSD to purchase amalgam separators for all 53 dental practices. Initially, the installation of amalgam separators was not a component of the Best Management Program because of the burden of cost it would place on practices. However, the Pollution Prevention Chemist was given a few different models of separators to test and

felt widespread installation of the separators would reduce mercury discharge even more. Although the up-front costs of amalgam separators were covered, it took several years for all the dental practices to install one. The few dentists that were reluctant to install a separator were contacted by a peer and encouraged to participate. This approach was successful; currently all 53 practices in the district have installed an amalgam separator.

As a result of the WLSSD mercury reduction program, which included outreach with a comprehensive list of mercury users, the mercury levels in the biosolids and the effluent are lower than pre-program amounts. The WLSSD developed a "Blueprint for Mercury Elimination: Mercury Reduction Project for Wastewater Treatment Plants," to help other wastewater treatment plants throughout the country reduce mercury pollution (WLSDD, 2002). For a successful mercury reduction program, the publication recommends developing a plan for 5 points of mercury use and disposal: elemental or bulk mercury, unused amalgam, amalgam caught in chair- side traps, amalgam sludge in vacuum pumps and wastewater discharged from the pumps.

Analysis

The success of the Wichita, (Kansas), Boise, (Idaho), and Western Lake Superior Best Management Programs is the result of adequate funding and the inclusion of the dental community in program development. Including the dental community early on was central to the makings of a successful BMP—a fact that was reiterated in all of the city personnel interviews and highlighted in supporting documentation. Also, framing the issue as the dental community *helping* to reduce mercury loadings rather than pinpointing them as perpetrators of mercury pollution was essential for fostering positive relationships.

The approaches to inclusion varied little. In all three case studies, the regulator approached the local dental society and state dental associations. In Wichita, Kansas, leaders in the dental community were asked to join a taskforce dedicated to dental mercury amalgam reduction. What resulted is a partnership that led to the development of educational materials that the dental community could feel a sense of ownership over. Dentists were much less reluctant to participate in a BMP program if they felt the pressure coming from within the dental community, rather than having the finger pointed at them by outside regulators. This point illustrates the importance of using social motivation as a means to induce action. In the Boise and Minnesota case studies, the State's dental association and dental society, respectively, were responsible for contacting the dental practices about the new BMPs. In Wichita, the City performed most of the outreach, presenting BMP materials at dental society meetings and at conferences. That the materials were presented by an outside agency may explain why voluntary compliance to the BMPs in Kansas was largely unsuccessful—the information was coming from an outside source.

Funding was also important to a successful BMP program, although not as central as working in collaboration with the local and state dental community. The Western Lake Superior Sanitary District appeared to have the most funding through state and local grants, and as a result was able to install amalgam separators in every dental practice in the district. Funding was also used to perform comprehensive mercury monitoring, which could then be used as justification for a BMP program and enabled the WLSSD to hire additional staff to perform educational outreach. The City of Boise did not solicit additional funding, but did designate dental practices for priority inspections and

performed the inspections using available resources. In Wichita, funding for the program came from significant permit users. Innovative sources for funding and resource allocation are important to carrying-out a successful program. Funding for a program can be as much as tens of thousand dollars of grants or as little as tapping into existing resources and funds. Both sides of the spectrum have proved to be successful in the presented case studies. However, the success of the program hinges on what the resource and funding base is to start off with.

The receptiveness of the dental community may be partly attributed to the scientific data the municipalities used to define the problem. Dentists are bred from a discipline rooted in empirical processes and, thus, they are much more apt to respond to and understand the importance of the scientific data presented. This type of normative motivation can be used to compel dentists to participate or comply with a Best Management Practices program.

The installation of amalgam separators also proved to be key in reducing the amount of mercury discharged to a POTW. The Wichita and Western Lake Superior, programs eventually required the installation of separators when just following the ADA's BMPs alone did not prove to be the panacea for mercury reduction. In both cases, the installation of amalgam separators led to a reduction in the plants' total mercury load.

The City of Boise took a different approach, and did not stress the importance of amalgam separators. This has to do, in part, with differing philosophies among the POTW administrators. In Boise, the administrators were skeptical of the impact amalgam separators would have in reducing dental mercury amalgam discharge. The other two

municipalities expressed a strong belief in the effectiveness of separators, mainly because the data showed a reduction in mercury levels after installation.

In the case of Wichita, Kansas, the high compliance rate was due to the regulatory action by the city requiring the installation of amalgam separators, while in Western Lake Superior peer pressure and, of course, the incentive of a free amalgam separator, led to a high compliance rate. It is likely either route would achieve high compliance rates if applied elsewhere.

It is interesting that all of the programs were billed as voluntary, but upon closer scrutiny definitely have mandatory components. For example, all of the municipalities did inspections to ensure compliance with the Best Management Program and in the case of Wichita, which evolved into a mandatory program, dental practices were required to apply for a discharge permit if they did not install an amalgam separator. In Boise, the Public Works Department issued a compliance order that resulted in subsequent inspections until compliance was achieved. The Western Lake Superior program, however, did not include inspections although a great deal of follow-up (with regards to monitoring and the survey) was completed and the installation of amalgam separators was strongly recommended.

The success of the WLSSD program, therefore, can be attributed to having a working relationship with the dental community and a large funding and resource base to work with. The success of the Boise and Wichita programs also can be attributed to the partnerships created with the dental community, but the inspections, permitting processes and compliance orders that characterized the enforcement part of the programs no doubt contributed to the high compliance rate.

RECOMMENDATIONS

The results of the Missoula Mercury Amalgam Disposal Survey clearly indicate measures need to be taken in Missoula to control the release of mercury into the environment. However, because the POTWs current data does not indicate that mercury levels exceed the Maximum Allowable Headworks Loading (MAHL), the permit levels for sludge (a monthly average of 17 mg/kg) or the acute toxicity level (1.7 ug/l), it is difficult to justify the need for a mandatory program. Instead, a voluntary approach is a good first step to increasing the rate of compliance with, at the very least, the ADAs suggested Best Management Practices.

Given the success of the partnership approach that characterized the mercury control programs in Wichita, Boise and Western Lake Superior, it is advisable to take a similar route in Missoula. In fact, the research collected for this paper informed the decision to convene a committee in Missoula to address dental mercury discharge and disposal. The purpose of the committee is to create and implement an educational outreach plan on the proper disposal of mercury amalgam waste. In addition, the committee will also likely spearhead follow-up actions such as surveys or on-site visits to measure the effectiveness of the program. Committee members include several local dentists, Sherri Kenyon, Pretreatment Coordinator at the Missoula Wastewater Treatment Plant; two representatives from the Missoula County Health Department's Water Quality Division; a staff member from Women's Voices for the Earth and myself. The creation of a multi-stakeholder committee is essential in giving the Missoula dental community a sense of ownership over the program and helps to avoid defensive reactions. Erin Thompson, Regional Campaign's Coordinator at Women's Voices for the Earth, is responsible for convening the meetings.

If the Missoula survey results are indicative of what may be occurring in the rest of the state in terms of mercury amalgam disposal, the larger goal of starting a voluntary program in Missoula should be to replicate a similar program in all major cities in Montana (Great Falls, Billings, Helena and Bozeman). Thus it would be helpful to have members from state agencies such as the DEQ on the committee.

Educational Outreach

One of the committee's tasks should include deciding whether educational outreach should focus on the ADA's suggested BMPs or if the committee should write their own set of Best Management Practices. Ideally, Best Management Practices should include the recommendation of installing amalgam separators. However, because the Montana Dental Association believes amalgam separators do not "significantly reduce the levels of mercury in fish and surface water," the inclusion of the recommendation warrant further discussion (McCue, 2007). It is important that evidence of the effectiveness of amalgam separators is closely reviewed by committee members before a decision is made.

The statewide BMPs initiated in ISDA are a great example of comprehensive BMP program that covers not only mercury amalgam waste but also X-Ray fixer and developer, lead foil and lead shields, chemiclave waste and responsible labeling of used chemical. The BMPs the ADA endorses are not as inclusive and thus it would be prudent to use the opportunity to create a more extensive outreach tool about other ways to reduce the environmental imprint of dental office waste.

Besides drafting and agreeing upon a set of BMPs, the committee should also decide the best way of conducting outreach about BMPs. It would be best if a copy of the BMPs and cover letter stating the importance of following them were sent jointly by the

POTW, Health Department and the Montana Dental Association. Also, the cover letter should include a line that if the voluntary BMPs are not followed, stricter enforcement may follow.

In addition to mailing out a copy of the committee's BMPs, a brochure should be designed that reiterates the BMPs and includes information about recycling, amalgam separators and possibly some stats on the amount of mercury dental practices release each day (for example, the statistics referred to earlier in the paper). This will highlight *why* the issue is important and frame it in terms of how the dental community can *help* to reduce mercury waste in the name of good environmental stewardship. The brochure should be sent out quarterly as a way to keep the issue alive and on the forefront of people's minds. Separately, the Missoula POTW could include a list of BMPs along with the sewer bill.

Also, the Missoula Dental Society meets every two months. The dentists who are on the committee could do a brief presentation about the Best Management Practices program at two or three of the meetings. It would also be useful to preface the presentation with results from the Missoula Mercury Amalgam Disposal Survey. The Montana Dental Association holds an annual meeting where the information could also be presented.

Depending on whether the resources are available, holding workshops about BMPs (as one Missoula dentist suggested in the interviews) for dental hygienists and dentists is another good way to get the word out about BMPs. The workshops could include a review on the proper maintenance of equipment like chair side traps and vacuum filters. The Western Lake Superior Sanitary District had the resources to hire two

dental hygienists to head the workshops. That Missoula will have the same amount of resources is doubtful, however, another option would be to have the MDA host the workshops and cover any associated costs.

In order to highlight and acknowledge the efforts Missoula dental practices are taking to reduce mercury pollution, a “green marketing” campaign could be designed. It doesn’t have to be extensive, perhaps as simple as creating a decal dental practices could stick in their window notifying patients they practice environmentally responsible dentistry. A press release about the dental community’s participation in the program would likely get published in the Missoulian although based on the responses of the Missoula dentists interviewed, it may not be wise to print individual names of participating practices. The press around Missoula dentists’ commitment to environmentally responsible dentistry will create pressure on dentists who have not jumped on board and make them feel obligated to participate.

It was ascertained in the interviews with local dentists that they may not be recycling their amalgam waste because it is too difficult to figure out the logistics about what company recycles non-contact scrap, empty amalgam capsules or contact scrap. Part of the committee’s job should include creating a resource guide to simplify the process of finding the appropriate recycler. The resource guide should include the contact information of recyclers in Montana and elsewhere, and the types of mercury amalgam waste each accepts. It would also be helpful to highlight the Missoula Health Department’s Hazardous Waste Days which allows dentists to bring in mercury waste as long as it is contained in a glass jar or other suitable container.

The committee should work with Montana mercury recyclers like Sure-Way Systems, located in Deer Lodge, to try and build on existing infrastructure and broaden the acceptable forms of mercury amalgam they accept. For example, they currently do not accept empty amalgam capsules, which should be recycled, and therefore many dentists in Missoula do not recycle the empty capsules. It would be useful to have a Sure-Way representative attend a committee meeting to help facilitate this dialogue and work collaboratively to create innovative ways to encourage mercury amalgam recycling.

Measuring Success

Without the proper funding it is unlikely the City will have the resources to inspect individual practices to determine whether or not they are following the voluntary BMPs; although the "threat" of inspections would provide incentives for dental practices to follow BMPs. In lieu of inspections, the committee could craft a survey to be administered one year after program implementation to assess the effectiveness of the program. Survey results could be measured against the baseline data provided by the Missoula Dental Mercury Amalgam Disposal Survey completed in the summer and fall of 2006. The survey questions would incorporate the questions from the first survey, and should also include questions to assess what worked and didn't work about the BMP program in Missoula. For example, did the dentists feel the educational outreach helped to increase their awareness and ability to comply with the recommended Best Management Practices? And, in the same vein, what could be done to make the program better? The number of dentists with a decal in their window could also be used to measure the success of the program. If a large amount of dental practices are still not following BMPs, regulatory action should be strongly considered.

Concluding Remarks

The vast majority of Missoula dentists surveyed are not following the American Dental Association's recommended Best Management Practices. Although mercury amalgam is a relatively stable and insoluble conglomerate, there is no guarantee that it will remain in that form after it is disposed of in a landfill or released to a POTW. Mercury in biosolids is either land applied or sold to EcoCompost, where it is then sold for use in personal gardens and for other composting needs. Also, mercury amalgam disposed of in biohazard containers are usually incinerated which results in the release of air emissions of mercury. The use of mercury in fillings results in some unavoidable discharge of mercury to a POTW when the mercury is placed or removed. Phasing out the use of mercury in fillings and/or the installation of amalgam separators would help to reduce this type of release.

Dental mercury discharge is a potential environmental problem that can be mitigated through the collaborative efforts of the multi-stakeholder Missoula Dental Mercury Committee. The research presented in this paper supports this approach. The success of the Boise, Wichita, and Western Lake Superior programs largely rested on the involvement of the dental community in virtually every step of program development. Interviews with Missoula dentists also supported the idea that a successful program depends on the involvement of the dental community. In the interviews, respondents felt dentists would be more willing to participate in a program if dental representatives were actively involved in program formulation and outreach efforts. Several dentists have joined the committee--an act that suggests that this is an issue they feel is worth addressing. Their participation will no doubt be central to the success of the committee efforts.

The prospects for implementing a successful program to control dental mercury discharge in Missoula are excellent. The establishment of the committee is a great first step. The recommendations made in the previous section will help guide the committee's development of a program to control the release of dental mercury. However, the success of the program hinges on the participation of the larger dental community. Because of their dedication, I am confident that representatives from the dental community, the Missoula POTW, Missoula County Health Department, and Women's Voices for the Earth, will create a program that will effectively appeal to Missoula dental practices.

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APPENDIX A

American Dental Association's Best Management Practices

American Dental Association
www.ada.org

BEST MANAGEMENT PRACTICES FOR AMALGAM WASTE

American Dental Association
September 2005

211 East Chicago Avenue, Chicago, Illinois 60611-2678

American Dental Association
www.ada.org

Dental Amalgam Waste

Dental amalgam waste can be recycled to help prevent the release of mercury to the environment. Following the simple suggestions outlined in this document will help protect the environment.

Concern about the effects of mercury in the environment has increased over the years. Mercury in the environment is bioaccumulative, which means that it can build up in fish and cause health problems in humans and other animals that eat fish. Many state health professionals recommend limiting fish consumption, especially for children and pregnant women.

Mercury is a naturally occurring metal; however, about half of the mercury released to the environment comes from human activity. Of that amount, 53% is emitted from combustion of fuels for energy production and 34% is from the combustion of waste.[1] Sources associated with manufacturers and consumers make up the remaining 13%, with dentistry contributing less than one percent.

Some mercury released into the air eventually collects in the waterways, where it enters the food chain. As a precautionary measure, U.S. regulators typically assume that all or most of the mercury released into the air or surface water may accumulate in fish. As of 2000, the U.S. EPA lists more than 43,971 miles (covering 3,426,244 acres) of rivers and streams in the U.S. as "impaired" because of the presence of mercury.[2]

Although mercury in the form of dental amalgam is very stable, amalgam should ***not*** be disposed of in the garbage, infectious waste "red bag," or sharps container. Amalgam also should ***not*** be rinsed down the drain. These cautions are important because some communities incinerate municipal garbage, medical waste, and sludge from wastewater treatment plants. If amalgam waste ends up in one of these incinerated waste streams, the mercury can be released to the environment due to the extremely high temperatures used in the incineration process. Increasingly, local communities are enacting restrictions on the incineration of wastes containing mercury.

The good news is that amalgam waste, kept separate from other waste, can be safely recycled. The mercury can be recovered from amalgam wastes through a distillation process and reused in new products. The ADA strongly recommends recycling as a best management practice for dental offices.

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[2] EPA. Major Pollutants Causing Impairment by State. Available at www.epa.gov/owow/tmdl/303dcaus.html. Accessed February 10, 2004.

American Dental Association
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The following information demonstrates how to manage and recycle dental amalgam waste to help protect the environment.

Types of Amalgam Wastes

- **Non-contact amalgam (scrap)** is excess mix leftover at the end of a dental procedure. Many recyclers will buy this clean scrap.
- **Contact amalgam** is amalgam that has been in contact with the patient. Examples are extracted teeth with amalgam restorations, carving scrap collected at chair side, and amalgam captured by chair side traps, filters, or screens.
- **Chair side traps** capture amalgam waste during amalgam placement or removal procedures (traps from dental units dedicated strictly to hygiene may be placed in the regular garbage).
- **Vacuum pump filters** or traps contain amalgam sludge and water. Some recyclers will accept whole filters, while others will require special handling of this material.
- **Amalgam sludge** is the mixture of liquid and solid material collected within vacuum pump filters or other amalgam capture devices.
- **Empty amalgam capsules** are the individually dosed containers left over after mixing precapsulated dental amalgam.

The ADA recommends against the use of bulk elemental mercury, also referred to as liquid or raw mercury, for use in the dental office. Since 1984, the ADA has recommended use of precapsulated amalgam alloy.

If you still have bulk elemental mercury in the office, you should recycle it. Check with a licensed recycler to determine whether they will accept bulk mercury. ***Do not*** pour bulk elemental mercury waste in the garbage, red bag or down the drain. You also should check with your state regulatory agency and municipality to find out if a bulk mercury collection program is available. Such bulk mercury collection programs provide an easy way to dispose of bulk mercury.

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Steps for Recycling Amalgam Waste

1. Stock amalgam capsules in a variety of sizes to minimize the amount of amalgam waste generated.
2. Amalgam waste may be mixed with body fluids, such as saliva, or other potentially infectious material, so use personal protective equipment such as utility gloves, masks, and protective eyewear when handling it.
3. Contact an amalgam waste recycler about any special requirements that may exist in your area for collecting, storing and transporting amalgam waste.
   If you need to find a recycler, check with your city, county or local waste authority to see whether they have an amalgam waste recycling program.
4. Store amalgam waste in a covered plastic container labeled "Amalgam for Recycling" or as directed by your recycler.
   Consider keeping different types (e.g., contact and non-contact) of amalgam wastes in separate container—talk to your recycler about any advantages in doing so.

Questions to Ask Your Amalgam Waste Recycler

Below is a list of questions you may want to ask your amalgam waste recycler. Note that not all recycling companies accept every type of amalgam waste, and the services offered by recyclers vary widely. The ADA recommends that you contact a recycler before recovering amalgam and ask about any specific handling instructions the recycler may have. Importantly**,** select a reputable company that complies with applicable federal and state law and provides adequate indemnification for its acts and omissions.

Ask Your Recycler …

- What kind of amalgam waste do you accept?
- Do your services include pick up of amalgam waste from dental offices? If not, can amalgam waste be shipped to you?
- Do you provide packaging for storage, pick up or shipping of amalgam waste?
- If packaging is not provided, how should the waste be packaged?
- What types of waste can be packaged together?
- Do you accept whole filters from the vacuum pump for recycling?
- Is disinfection required for amalgam waste?
- How much do your services cost?
- Do you pay for clean non-contact amalgam (scrap)?
- Do you accept extracted teeth with amalgam restorations?
- Does your company have an EPA or applicable state license?
- Does the company use the proper forms required by the EPA and state agencies?

American Dental Association
www.ada.org

Best Management Practices for Amalgam Waste

DO	DON'T
Do use precapsulated alloys and stock a variety of capsule sizes	***Don't*** use bulk mercury
Do recycle used disposable amalgam capsules	***Don't*** put used disposable amalgam capsules in biohazard containers, infectious waste containers (red bags) or regular garbage
Do salvage, store and recycle non-contact amalgam (scrap amalgam)	***Don't*** put non-contact amalgam waste in biohazard containers, infectious waste containers (red bags) or regular garbage
Do salvage (contact) amalgam pieces from restorations after removal and recycle the amalgam waste	***Don't*** put contact amalgam waste in biohazard containers, infectious waste containers (red bags) or regular garbage
Do use chair-side traps to retain amalgam and recycle the content	***Don't*** rinse chair-side traps containing amalgam over drains or sinks
Do recycle contents retained by the vacuum pump filter or other amalgam collection device, if they contain amalgam	***Don't*** rinse vacuum pump filters containing amalgam or other amalgam collection devices over drains or sinks
Do recycle teeth that contain amalgam restorations. (*Note:* Ask your recycler whether or not extracted teeth with amalgam restorations require disinfection)	***Don't*** dispose of extracted teeth that contain amalgam restorations in biohazard containers, infectious waste containers (red bags), sharps containers or regular garbage
Do manage amalgam waste through recycling as much as possible	***Don't*** flush amalgam waste down the drain or toilet
Do use line cleaners that minimize dissolution of amalgam	***Don't*** use bleach or chlorine-containing cleaners to flush wastewater lines

Practical Guide to Integrating BMPs Into Your Practice

Non-contact (scrap) amalgam
• Place non-contact, scrap amalgam in wide-mouthed, airtight container that is marked "Non-contact Amalgam Waste for Recycling." • Make sure the container lid is well sealed.
Amalgam capsules
• Stock amalgam capsules in a variety of sizes. • After mixing amalgam, place the empty capsules in a wide-mouthed, airtight container that is marked "Amalgam Capsule Waste for Recycling." • Capsules that cannot be emptied should likewise be placed in a wide-mouthed, airtight container that is marked "Amalgam Capsule Waste for Recycling." • Make sure the container lid is well sealed. • When the container is full, send it to a recycler.
Disposable chair-side traps
• Open the chair-side unit to expose the trap. • Remove the trap and place it directly into a wide-mouthed, airtight container that is marked "Contact Amalgam Waste for Recycling." • Make sure the container lid is well sealed. • When the container is full, send it to a recycler. • Traps from dental units dedicated strictly to hygiene may be placed in with the regular garbage.
Reusable chair-side traps
• Open the chair-side unit to expose the trap. • Remove the trap and empty the contents into a wide-mouthed, airtight container that is marked "Contact Amalgam Waste for Recycling." • Make sure the container lid is well sealed. • When the container is full, send it to a recycler. • Replace the trap into the chair-side unit (Do ***not*** rinse the trap under running water as this could introduce dental amalgam into the waste stream.
Vacuum pump filters
• Change the filter according to the manufacturer's recommended schedule. *Note:* The following instructions assume that your recycler will accept whole filters; some recyclers require different handling of this material, so check with your recycler first. • Remove the filter. While holding the filter over a tray or other container that can catch any spills, decant as much of the liquid as possible without losing any visible amalgam. The decanted, amalgam-free liquid can be rinsed down the drain. • Put the lid on the filter and place the sealed container in the box in which it was originally shipped. When the box is full, the filters should be recycled.
Line cleaners
• Use non-bleach, non-chlorine–containing line cleaners, which will minimize amalgam dissolution, such as those listed in the ***Additional Resources*** section of this document.

Additional Resources

"Dental Mercury Hygiene Recommendations" are available through the ADA Division of Science. These recommendations were published in the *Journal of the American Dental Association* (November 2003) and also are available to ADA members online.

The following line cleaners do not contain bleach or chlorine and therefore minimize the dissolution of amalgam. This listing is provided for informational purposes only and should not be construed as an endorsement of these products by the ADA. Check with your manufacturer to determine which line cleaner would be appropriate for use with your equipment.

Biocide (Biotrol International), BirexSe (Biotrol International), DRNA Vac (Dental Recycling North American Inc.), E-Vac (L&R Manufacturing Co.), Fresh-Vac (Huntington), GC Spray-Cide (GC America Inc.), Green and Clean (Metasys), Microstat 2 (Septodont USA), Patterson Brand Concentrated Ultrasonic Cleaner/Disinfectant Solution (Patterson Dental Supply, Inc.), ProE-Vac (Cottrell Ltd.), Pure-Vac (Sultan Chemists Inc.), Sani-Treet Plus (Enzyme Industries Inc.), SRG Evacuation (Icon Labs), Stay Clean (Apollo Dental Products), Turbo-Vac (Pinnacle Products), Vacusol Ultra (Biotrol International), Cavicide (Metrex Research Corp.), Vacuum Clean (Palmero Health Care).

APPENDIX B

Missoula Amalgam Disposal Survey Questions

As part of a review of mercury in the wastewater, the Missoula Wastewater Treatment Division is conducting a survey with local dentists to determine what disposal methods dentists use for their amalgam waste. Please take a few minutes to complete the following survey. Please fax the completed survey to **406-549-4100**. Thank you-your time is greatly appreciated. If you have any questions, please call Jamie at 531-1811.

Name:
Position:

General Practice Info

Name and address:

Number of chairs/dentists in office:

AMALGAM USE:
1. Do you use elemental mercury or pre-encapsulated mercury?

2. Approximately how many amalgam-containing tooth extractions does your practice perform each month?

0-5 **6-10** **11-15** **>15** **Other_____**

3. Approximately how many mercury amalgam removals does your practice perform each month?

0-5 **6-10** **11-15** **>15** **Other_____**

4. Approximately how many mercury amalgam replacements does your practice perform each month?

0-5 **6-10** **11-15** **>15** **Other_____**

5. Approximately how many pre-mixed mercury amalgam capsules does your practice use each month?

0-5 **6-10** **11-15** **>15** **Other_____**

AMALGAM DISPOSAL

6. Do you have chair side traps? **Yes** **No**

7. What kind of chair side trap do you use?

Reusable Disposable Not Applicable

8. How often are the traps cleaned?

Daily Weekly Monthly Quarterly Yearly Never

9. How do you manage waste from chair side traps (i.e. primary filter)

Recycle Wash down the sink Trash Biohazard Waste Hazardous Waste

Don't Know

10. Do you use vacuum filters or some form of secondary filter? **Yes No**

11. How do you manage waste from vacuum or secondary filters?

Recycle Wash down the sink Trash Biohazard Waste Hazardous Waste

Don't Know

12. Do you have an amalgam separator? **Yes No**

What kind of separator?
(make, model, ISO standard?)

13. How do you manage waste from the separator?

Recycle Wash down the sink Trash Biohazard Waste Hazardous Waste

Don't Know

14. Do you use any other equipment or procedure to capture dental mercury? **Yes No**

If yes, what do you use?

15. How do you dispose of extracted teeth with mercury amalgam fillings, non-contact amalgam mixing scrap, and empty amalgam capsules?

Place in container for pick by amalgam recycler

Place in red bags for disposal as medical waste

Place in trash

Place in sink

Other

Thank you for taking the time to complete our survey.

APPENDIX C

Calculations

Calculations: Estimated Amount of Mercury Released*

Amalgam Removals

52% percent (or 15 dental practices) of dental practices surveyed are not disposing of waste from both chair side traps *and* vacuum filters in accordance with the ADA's recommended BMPs. These practices were grouped together in order to calculate the approximate amount of mercury being released into the environment each year. In addition, it was assumed that the rate of non-compliance to the ADA's BMPs would be the same for the 12 practices that did not respond to the survey so 6 practices were added to the calculations (0.55*12=6). It is estimated that an average of 320 mg of mercury is present at the time of removal (Vandeven & McGinnis, 2005). Of this 320 mg it is estimated that 90% of mercury amalgam is released into a dental facilities wastewater system (320 mg *0.90=0.288 mg) (Barron, 2001). I took the estimated minimum (180) and maximum (205) amalgam removals performed by the 15 dentists per month and multiplied each by 12 to get the minimum (2160) and maximum (2460) removals per year. The average of the minimum and maximum removals was 2310 per year (154 per dentist/per year). I multiplied 154 by the 6 non-respondents for a total of 1016 amalgam removals per year for non-respondents. The sum for these two groups (3326) was then multiplied by 0.288 mg for a total of 957.89 grams or 2.11 lbs per year.

Table 3 - Estimated Mercury Releases per Year from Amalgam Removals

Amount of amalgam released during removal	Average # of removals performed each year by the 15 practices	Average # of removals for non-respondents	Sum for respondents and non-respondents	Calculation	Estimated release of mercury per year
288 mg (0.288 grams)	2310	1016	3326	0.288 g *3326	958 grams (2.11 lbs)

Extracted Teeth

Twenty dentists disposed of extracted teeth in biohazard containers and the trash. The minimum number of total extracted teeth removed each month was 52, the maximum was 180. The average of the two was taken (116) and multiplied by 12 (116*12=1392) for a total of 1392 extracted teeth per year. There is approximately 320 mg present at the time of removal (Watson et al., 2002). To calculate the amount of mercury being released into the environment, 0.320 mg was multiplied by 1392 for a total of 445.44 grams, or almost one pound of mercury disposed of each year.

Table 4 - Estimated Mercury Releases per Year from Extracted Teeth

# of dentists disposing of extracted teeth in biohazard containers or trash	# of mercury containing teeth extracted per year	Amount of mercury in an extracted tooth	Calculation	Estimated release of mercury per year
20	1392	320 mg (0.320 grams)	0.320 g *1392	445 grams (0.98 pounds)

Amalgam Placements

It is estimated that together, the 29 participating dental practices perform 242 placements each month. The minimum number of placements is 193 and the maximum number of replacements is 290 for a minimum of 2316 each year and a maximum of 3480 replacements each year. The average of the two is 2898. This rate was assumed to be the same for the 12 dental offices that did not respond to the survey (estimated at 1200). Based on the estimate that 30 mg of mercury is released during placement 0.03 grams was multiplied by 4098 or the total of the respondents and non-respondents averages (1200+2898=4098). Based on this calculation, it is estimated that Missoula dentists discharge of 123 grams, or 0.27 lbs, per year to the wastewater stream during placement.

Table 5 - Estimated Mercury Releases per Year from Amalgam Replacements

# of dental practices	Amount of Hg released during placement	# of placements per year	# of placements for non-respondents	Sum of respondents and non-respondents	Calculation	Estimated release of mercury per year
29	30 mg (0.03 grams)	2898	1200	4098	4098*0.03 g	123 grams (0.27 lbs)

*Estimates do not include residual mercury in amalgam capsules

APPENDIX D

Letter of Inquiry

January 25, 2007

Dr.
Address
Missoula, Montana

My name is Jamie Silberberger and I'm a graduate student in environmental studies at the University of Montana. As part of my thesis on dental mercury in Missoula, I will be conducting short 20- minute interviews with local dentists about potential upcoming policy prescriptions that may affect dental practices in Missoula. You may recognize my name from the work I have been doing with the Missoula Wastewater Division. This past summer I administered a survey on behalf of the Wastewater Division to garner information about the amalgam disposal methods of Missoula dental offices.

The Missoula Wastewater Division is considering installing best management practices for dental amalgam waste. Best management practices may include: not using chlorine bleach as a line cleaner, recycling amalgam waste caught in all chair side traps and vacuum filters, recycling amalgam scrap, recycling disposal amalgam capsules and extracted teeth with mercury fillings, and installing an amalgam separator.

The interview is meant to provide you with the unique opportunity to speak freely and confidentially about your thoughts on a mandatory best management practice program. Participant's identities will be kept confidential but your responses will be shared with the Wastewater Division and have the potential to influence policy decisions. Although your responses may be shared with the Wastewater Division's pretreatment coordinator, Sheri Kenyon, I am conducting this research independent of the Wastewater Division.

If you are interested in participating in an interview please contact me by February 9th. Interviews will be scheduled for the end of February and the beginning of March. The interview will take place at the location of your choice, such as your office. Again, to accommodate your busy schedule the interview should not take more than 20-minutes unless you chose to extend it.

Thank you in advance for your interest. Your participation is greatly appreciated and will help make sure your views and opinions are considered by policy makers.

I look forward to speaking with you.

Sincerely,

Jamie Silberberger

406-531-1811

APPENDIX E

Interview Protocol

Interview Protocol

Approximately ten dentists will be interviewed. Interviews will take place at the location of the participant's choice-- more than likely at the office of the dental practitioner. The identities of participants will be kept confidential. Subject's responses will be recorded, but names will not be identified in relation to specific quotes or information obtained from the interview. Transcripts of the interview and any related notes will be kept in a locked file cabinet in a private residence. Any computer files related to the interview will be kept in a password protected file.

Interview Introduction

Thank you for meeting with me today. As I mentioned in the recruiting letter, your participation will be kept confidential but I may use your responses to my questions in my final paper. Your identity will be kept confidential and not assigned to any quotes or observations I may use in my final paper.

As I mentioned in my letter, the Missoula wastewater treatment division is considering creating mandatory best management practices as method to reduce dental mercury discharge in Missoula County. Best management practices may include: not using chlorine bleach as a line cleaner, recycling amalgam waste caught in all chair side traps and vacuum filters, recycling amalgam scrap, recycling disposal amalgam capsules and extracted teeth with mercury fillings, and installing an amalgam separator. The purpose of this interview is to find out about your interest in such a program and any concerns you might have. The interview is meant to provide you with the unique opportunity to speak freely and confidentially about your thoughts on the subject.

I will be using your responses for my professional paper. The report will be given to the Missoula pretreatment coordinator at the wastewater treatment plant. My report has the potential to influence policy decisions regarding best management practices. I encourage you to speak freely but feel free to pass on any questions you may not be comfortable answering. In my report, I will protect your confidentiality. That means that your name will not be associated the view you express.

Do you understand the purpose of this interview? Do I have your permission to conduct this interview? Do you have any questions before we get started?

1. How many years have you been in practice?

2. Are you familiar with the ADA's recommended best management practices (BMPs)? *(if no I will explain to them briefly what the BMPs entail and provide a copy of the ADA's BMPs)*

3. Does your practice follow the ADA's recommended BMPs or any other type of BMP for amalgam disposal? Could you give me an example of how your practice manages amalgam waste?

Prompt: For example, how do you manage waste from chairside traps and/or vacuum filters. Or, how do you dispose of extracted teeth with mercury fillings? (I could list a variety of examples here).

If no. Could you explain why you feel it is not necessary to follow BMPs?

4. Do you feel Missoula dentists need more information about BMPs?

Prompt: For example, do you feel the ADA or the Missoula waste water treatment division needs to do more educational outreach to dentists to increase awareness about BMPs for amalgam disposal?

5. Do you feel the disposal of dental mercury into the municipal waste water system is a problem that needs to be addressed in Missoula? *Why or why not.*

6. Does your office have an amalgam separator? *Why or why not ?*

Prompt: Would you be interested in using one?

7. Do you think amalgam separators are effective means of removing mercury from the wastestream?

8. Do you think installation of amalgam separators should be a component of any mandatory BMPs drafted by the waste water treatment division? *Why or why not?*

Prompt: What are some of the barriers you perceive to installing /using amalgam separators?

9. If amalgam separators were required as part of a mandatory BMP program, would you install one?

Prompt if asked: provide info about the costs of amalgam separators cost and annual maintenance costs

Prompt: *If you knew other dentists had been cited for non-compliance would that motivate you to comply?*

10. In other cities where dentists were required to reduce their dental amalgam wastes, dentists had to apply for a discharge permit that required them to either install an

amalgam separator or monitor and sample their office wastewater. If a similar program was adopted in Missoula, would you rather install an amalgam separator or monitor and sample your wastewater?

11. What measures can be taken to provide incentives for dentists to install amalgam separators?

> *Prompt: For example, do you think a larger fine would increase compliance? Or yearly inspections?*
>
> *Prompt: What if the City subsidized the costs of the amalgam separator?*

12. If it were important to your patients, would you install an amalgam separator even if it were not required by the municipal code?

13. If the names of dental offices who voluntarily installed an amalgam separator were published in the Missoulian, would you install one?

14) Would you <u>voluntarily</u> install an amalgam separator if you knew that in doing so you were significantly reducing mercury pollution?

15) If you knew that dentists in Missoula were contributing a significant amount of mercury pollution into the environment, would you agree that the <u>mandatory</u> installation of amalgam separators is the best way to reduce that pollution? Or, do you think the ADA's recommendations are sufficient (note-they do not require the installation of an amalgam separator?

16) If you knew other dentists were supportive of installing amalgam separators would that influence your decision to install one?

17) If you were in charge of drafting BMPs for the City of Missoula, what would they look like?

Do you have any additional comments? Thank you for participating.

APPENDIX F

Wichita, Kansas Compliance Plan

Silver & Mercury Code of Management Practice Program

Compliance Plan

Facility Name:

Location Address: _____

Mailing Address: _____
(If different from above)

City, State Zip: __

Contact Name:

Phone Number: _ ___ Fax Number: _

E-mail:

Silver Dischargers:

Implementation of the CMP will require treatment of the used fixer from photo development or x-ray diagnostic activities either on-site silver recovery or dispose of silver fixer solution off site.

I plan to manage the silver laden solution generated at my facility by doing the following.
Please indicate by checking the option below:

☐ *Maintain On-Site Silver Recovery*

Requirements:

- Conduct quarterly tests on solution entering the treatment unit (influent) and leaving the treatment unit (effluent) using silver test strips. Results are to be recorded in a log book and kept on-site.
- Maintain Operation and Maintenance records of the Treatment Unit.
- Once per year collect samples on influent and effluent of treatment unit and send to a KDHE certified laboratory for analyses. Compliance with the CMP is verified with the City by calculating the percent silver recovery amounts of the Unit.
- Once per year on January 30 following the preceding report year, a Self Monitoring Report shall be submitted to the City. The certified analyses shall be included in the report.

☐ *Off-Site Silver Laden Waste Disposal*

Requirements:

- Maintain record verifying the amount of solution that was transported off site for recovery. Must maintain manifests and hauler receipts. The generator can transport the material to the Household Hazardous Waste Site for disposal at the City operated silver recovery unit. The City will only accept the fixer for disposal purposes. The container with the material must be clearly marked: SILVER FOR RECOVERY
- Once per year on January 30 following the preceding report year, a Self-Monitoring Report (SMR) shall be submitted to the City. The SMR no-discharge statement must be signed. Analytical data ***will not*** be required.

Mercury Dischargers - Dental Mercury/Silver Amalgam Restorations

Implementation of the CMP will require cleaning chairside traps regularly and if still using mercury silver amalgam for restorations switching to precapsulated amalgam.

- Never rinse amalgam traps over the drain or discard as biohazards or in the garbage.
- Collect amalgam scrap in a designated airtight container. Label Container: MERCURY AMALGAM FOR RECOVERY
- Maintain log of the amount of material generated and disposed of
- Clean or Replace Central Vacuum Filters regularly

If your facility plans to utilize Separator technology, please indicate below:
This may be a requirement in the future. The City is currently evaluating the effectiveness of these units and will announce later if using separator technology will be a requirement for CMP compliance.

☐ I am currently using Separator technology

☐ I plan to implement Separator technology by __ _.
(date)

☐ Unless indicated by the City it is necessary, I am not planning to implement Separator technology.

_____
Signature date

_
Print Name

APPENDIX G

Wichita, Kansas Recycling Log

MERCURY AMALGAM COLLECTION AND RECYCLING/DISPOSAL LOG FOR

_____
(Name of Business)

_____
(Responsible Party)

_____
(Address of Business)

_____
(For Year(s))

Waste amalgam is made up of approximately 50% mercury. When any amount of mercury enters the environment through your clinic waste systems, sink drains, trash or biohazard, it bioaccumulates and is very toxic to both aquatic and human life. The best solution for this problem is prevention. If properly collected, mercury can be recycled through a number of licensed companies. Best management practices recommend that at a minimum your clinic collect the solids from the chair side traps as frequently as needed. According to some studies, this simple measure can recover about 60% of the mercury amalgam now going "down the drain". Other systems that remove up to 95% of all mercury amalgam are available from private vendors. Mercury-amalgam recovered from the vacuum pump by your maintenance service person should also be collected for recovery. *Never wash traps down the sink drains or throw amalgam in the trash or biohazard.*

When recovering mercury, label the collection container "Waste Amalgam for Recycling". Keep this record and the paperwork from the vendor related to when and where material was recycled for a minimum of three years.

At the chair side trap, what method is used for amalgam removal? (check all that apply)

☐ 1. Removal of mercury-amalgam solids from chair side traps to a sealed, labeled container every few days or as needed.

☐ 2. Solids are also periodically removed from the vacuum pump for collection.

☐ 3. Entire chair side trap is collected and sent off site for recycling.

☐ 4. Use of on-line system that is periodically serviced by a contractor

Date collected material is sent off for recycling	Quantity sent or collected by contractor	Name of facility accepting the mercury-amalgam for recycling	Comments

- Even if you use only non-mercury composite filling materials, you still need to capture the mercury amalgam that is generated when the old fillings are replaced.
- Retain this record in a permanent log book for at least three years.

Contact the Small Business Environmental Assistance Program at 800/578-8898 if you have questions.

APPENDIX H

Idaho Dental Association Best Management Practices and Cover Letter

BEST MANAGEMENT PRACTICES (BMPs)
FOR DENTAL OFFICES

For Minimization of Mercury and Imaging Discharges to the Sewerage System By Dental Care Providers

Prepared by the Idaho State Dental Association

Introduction and Regulatory Background:
The Idaho State Dental Association has prepared this guide to assist dentists on how to best manage the disposal of dental office wastes. Dental office wastes (amalgam particles, waste mercury, fixers, developers, x-ray film packets, and chemiclave chemicals) typically cause toxic chemicals (mercury, silver, lead, developer solution chemicals, and chemiclave solutions) to enter our streams, sewers, and landfills. In addition to the environmental benefits of proper waste management, through pollution prevention, dentists can also reduce the regulatory requirements associated with dental wastes by voluntarily complying as outlined.

Mercury discharges to the environment are receiving significant attention throughout the United States and in Idaho. Local city and county wastewater agencies have mechanisms to regulate dental office discharges through existing sewer use ordinances and the local pretreatment program. The ISDA Dental BMP Program has been developed to address mercury amalgam and other environmental concerns and regulatory requirements. Specifically, the ISDA has developed this program to help Idaho dentists properly manage dental wastes to ensure compliance with applicable environmental, biomedical, occupational health, and transportation regulations.

This program is a two-tiered process that relies on relatively easy-to-implement and cost-effective BMPs with additional or optional BMPs included to provide further waste management and pollution prevention options that are available.

This guide has been approved by the Idaho State Dental Association Board of Trustees.

You should share this information, or a summarized version of it, with your local wastewater treatment facilities. It is anticipated that wastewater facilities representatives may visit some dental offices within their service areas from time to time to ensure the appropriate BMPs are in place. You can assume any visit will consist of confirmation that staff are trained and are performing the minimum BMPs. The request we make of inspectors is that they make prior arrangements with the dental office before an inspection visit which will allow for minimum disturbance of office routine.

The target date recommended for Idaho dental offices to have this BMPs plan in place is October 1, 2004.

Best Management Practices
Recommended Minimum BMPs

This set of recommended minimum BMPs relies on two principal concepts:
1) Dentists using a minimum of dental waste products in order to minimize the amount of waste generated by the dental office.
2) Properly collect, store, and ship dental wastes

Minimizing the use and recycling of dental waste products is the preferred approach because this reduces the amount of, and costs associated with, dental wastes. Local and state recycling vendor information is contained in an appendix to this document to make it easy to contact recyclers that can help.

To dispose of dental wastes, if recycling is not an option, proper disposal as hazardous waste is necessary. Many local, city, and county wastewater agencies have hazardous waste collection programs designed for small generators of wastes such as dental care providers. For example, Ada County operates a conditionally-exempt small quantity generator (CESQG) program that can accept up to 200 combined pounds of scrap amalgam, x-ray fixer solution, and lead foils per month.

AMALGAM WASTES

1) Limit the amount of amalgam used to the smallest appropriate size for each restoration.

2) Eliminate all use of bulk elemental mercury (also referred to as liquid or raw mercury). Use only pre-capsulated dental amalgam. Any unused bulk elemental mercury must be recycled or hauled away as hazardous waste. It must never be poured in the regular trash, infectious waste (red bag), or down the drain. (See # 6)

3) Change or clean chair-side amalgam traps frequently. If cleaning the traps, flush the vacuum system before changing the chair-side trap. Don't rinse the amalgam traps over drains or sinks. Consider dedicating specific chairs to amalgam placement and removal to minimize the number of amalgam-containing traps that need to be managed (traps associated only with hygiene chairs can be disposed of in the regular trash).

4) Change vacuum pump filters at least once per month or as directed by the manufacturer. This action will also improve suction and extend the life of the vacuum pump.

5) All amalgam waste must be recycled or hauled away as hazardous waste:

X Non-contact amalgam (scrap);

X Contact amalgam (e.g., amalgam removed from patients and extracted teeth containing amalgam);

X Leaking or unusable amalgam capsules.

Amalgam waste must never be put in the regular trash, put in with infectious waste (red bag), or flushed down the drain. Chair-side traps or vacuum pump filters containing amalgam must never be rinsed over drains or sinks.

6) Used or empty amalgam capsules can be placed in the regular trash.

7) Store amalgam waste as directed by your recycler or hazardous waste disposal program. This typically includes being in covered, segregated, and clearly labeled airtight plastic containers. Check with your recycler for any other specific requirements such as disinfection steps or necessary dry storage.

8) Maintain a log of amalgam waste generation and recycling/disposal.
Documentation of all amalgam waste recycling and disposal must be obtained from your recycler or hazardous waste hauler, kept on file, and made available upon request.

X-RAY FIXER AND DEVELOPER

1) Properly manage X-ray fixer waste. Fixer waste is considered a hazardous waste because of its high silver content. However, fixer is easily recyclable. Recycling is the management method recommended by regulatory agencies. There are two suitable methods of managing fixer waste:

a) Keep used fixers separate from used developers.

b) You may use a silver recovery unit for you developing system; or

c) You may give, sell, or pay someone that operates a silver recovery unit to take your fixer.

If you dispose of your fixer off-site, collect and store it in a closed plastic container labeled: Hazardous Waste -- Used Fixer--Contains only fixer. Many recyclers want to be sure that the liquid does not contain developer. If it does, it could actually remove silver from the recycling equipment. The liquid that has run through a recovery unit can be disposed of down the drain.

In addition, some photo developing companies will accept x-ray fixer from dental offices. You may wish to check with those companies in your area.

2) Do not use products to solidify x-ray fixer or other dental waste. These products simply transfer the waste to a different wastestream because regular trash is taken to the landfill.

3) Do not mix X-ray developer solutions with fixer solutions. Waste developer can be washed down the drain, if it is not mixed with fixer. Flush the drain thoroughly as you discharge developer down the drain.

Some units mix the fixer and developer after they are spent. The resulting solution is hazardous and should be disposed of as hazardous waste (see amalgam waste for more information on hazardous waste disposal options). However, you may purchase an adapter kit to keep the fixer and developer separate.

LEAD FOIL AND LEAD SHIELDS

1) Recycle or dispose of lead foil that shields x-ray film or protective lead shields as hazardous waste. These materials should never be disposed of in the regular trash because they are hazardous waste, unless they are recycled for their scrap metal content. Companies which recycle amalgam or fixer may also accept lead waste. Eastman Kodak has a special mail in program for dentists to recycle lead foil. A list of metal reclaimers is given in the appendix.

2) Do not use lead foil or give lead foil to patients to melt down for fishing weights. This is not a recommended practice . Dental offices are especially encouraged not to give the lead foil to patients.

CHEMICLAVE WASTE

1) Move away from chemiclave sterilization to autoclaves. Normal use and discharge of chemiclave solutions is acceptable although discouraged. Flush following disposal with several gallons of water so that it does not sit in the sink trap or introduce a slug of material to the sewer system.

2) Use up or dispose of discarded materials properly. Dental offices should buy only the amount of chemical sterilizer that you need: this will eliminate the need to dispose of the excess material. If you switch to an autoclave and has a supply of unused formaldehyde, you should give this to a dentist who still uses a chemiclave. The local wastewater agencies would like to avoid a large "slug" of formaldehyde at any one time.

LABELING

1) Properly label the container in which you store your hazardous waste. Although you should check with your disposal company, typically these containers must be labeled with the words "hazardous waste" with a description of the waste. Example: "Hazardous Waste - - Contains only used fixer, for recycling only."

The date you start filling the container should be written on the container or on a label. Standard labels are commercially available. Make sure you keep a written record of any material you send or deliver to a recycling entity. Be sure to request a "Certificate of Recycling or Disposal." This could be simply a note on their letterhead that they received "x" gallons of fixer and that it would be processed in their silver recovery unit.

ADDITIONAL RECOMMENDED BMPs

1)_____ Use disposable amalgam traps instead of reusable traps, and have them recycled or
hauled away as hazardous waste if they contain amalgam waste.

2)_____ Clean or replace sink traps and sumps, taking care to avoid spillage of the contents
from plumbing parts. Removed sludge must be recycled or hauled away as hazardous waste.

3)_____ Use, when appropriate, based on your professional judgement, mercury-free alternatives to amalgam (e.g., gold, ceramic, porcelain, composites, polymers, glass ionomers).

4)_____ Install and properly maintain a dental amalgam separator or other technologies to
reduce amalgam discharge.

5)_____ Implement a program to have mercury-containing thermostats, switches, and

fluorescent light bulbs recycled when they are replaced. Thermostats and switches should be replaced with mercury-free alternatives.

6)_____ Describe on attached pages any additional BMPs for mercury discharge minimization that you may have identified and plan to implement

APPENDIX I

Boise, Idaho Best Management Practices

DENTAL BEST MANAGEMENT PRACTICES

HAZARDOUS WASTE DISPOSAL

DO

AMALGAM

Do use precapsulated alloys and stock a variety of capsule sizes

Do recycle used disposable amalgam capsules

Do salvage, store and recycle non-contact amalgam (scrap amalgam)

Do salvage (contact) amalgam pieces from restorations after removal and recycle the amalgam waste

Do use chair-side traps to retain amalgam and recycle the content

Do clean vacuum pump filters once a month or as directed by the manufacturer

Do recycle contents retained by the vacuum pump filter or other amalgam collection device, if they contain amalgam

Do appropriately disinfect extracted teeth that contain amalgam restorations by storing them in a container of glutaraldehyde or 10% formalin and recycle along with the chair side trap waste

Do use line cleaners that minimize dissolution of amalgam

XRAY FIXER & DEVELOPER

Do segregate and recycle spent fixer

Do put developer down the drain

Do use approved silver recovery unit

Do contract for spent fixer recycling

LEAD FOIL & SHIELDS

Do recycle lead foil or shields

LABELING/RECORDS

Do properly label and store your hazardous waste

Do maintain a log of amalgam waste generation and recycling, collect and keep receipts from your recycler

DON'T

AMALGAM

Don't use bulk mercury, **don't** ever pour it down the drain, in infectious waste containers (red bags) or regular garbage.

Don't put used disposable amalgam capsules in biohazard containers, (red bags) or regular garbage

Don't put non-contact amalgam waste in biohazard containers, infectious waste containers (red bags) or regular garbage

Don't put contact amalgam waste in biohazard containers, infectious waste containers (red bags) or regular garbage

Don't rinse chair-side traps containing amalgam over drains or sinks

Don't rinse vacuum pump filters containing amalgam or other amalgam collection devices over drains or sinks

Don't dispose of extracted teeth that contain amalgam restorations in biohazard containers, infectious waste containers (red bags) or regular garbage

Don't flush amalgam waste down the drain or toilet

Don't use bleach or chlorine containing cleaners to flush wastewater lines

XRAY FIXER & DEVELOPER

Don't mix fixer and developer

Don't pour fixer down the drain

Don't use products to solidify xray fixer

LEAD FOIL & SHIELDS

Don't give lead foil to patients for fishing weights

LABELING/RECORDS

Don't mix waste streams

Don't assume your waste is handled correctly. Ask for a Certificate of Recycling or Disposal

Public Works

If you have any questions or would like more information contact Walt Baumgartner at City of Boise Public Works (208) 384-3991 or ISDA at (208) 343-7543

ISDA
Idaho State Dental Association

APPENDIX J

Boise, Idaho Inspection Sheet

GENERAL DENTISTRY

☐ Dental BMP
☐ Pretreatment Regulations

700 E Street
BOISE ID 83712
Inspection Report Checklist

Date/Time

Notes

Phone Number 208-

Fax Number

Contacts

Contact Name	Title	Phone	Fax
	DMD	208-	
E-Mail			

MERCURY

Is Any Bulk Mercury on-site? ☐ Yes ☐ No If YES: Provide "Don'ts" List; "We'll Get Back to You

If YES: Is Bulk Mercury Currently Used? ☐ Yes ☐ No

Mercury Amalgam used in practice? ☐ Yes ☐ No

Average Number of Amalgam Fillings per Month?

Non-Contact Waste Amalgam Handling? ☐ Recycled ☐ Haz.Waste ☐ Empty Capsules to Trash

Waste Handler/Contact Info?

Contact Waste Amalgam Handling?

Chair-Side Traps? ☐ Yes ☐ No Filter Type? ☐ Disposable ☐ Non-disposable

Cleaning Frequency? Notes

Central System? ☐ Yes ☐ No Filter Type? ☐ Disposable ☐ Non-disposable

Cleaning Frequency? Notes

Waste Handler/Contact Info?

Amalgam Waste Properly Stored? ☐ Yes ☐ No

Waste Handling Records Available? ☐ Waste-Hauler Invoices ☐ Maintenance Logs

Other Maintenance? ☐ Non-chlorine/bleach containing cleaners

Comments

RADIOLOGY

If Digital Only, skip this section.

Type of x-ray equipment used? ☐ Digital Only ☐ Traditional Only ☐ Both Digital & Traditional

Fixer Disposal? ☐ Silver Recovery Equipment On-Site ☐ Spent Fixer Stored for Pick-up ☐ Fixer Solidifier products

If ON-SITE: Type of Equipment ☐ Metallic Replacemen ☐ Electrolytic ☐ Other

Frequency of Cartridge Change/System Maintenance?

Waste Handler/Contact Info?

Quantity of liquid fixer/day? Fixer separated from Developer? ☐ Yes ☐ N

Lead Foil & Lead Shields? ☐ Recycled ☐ Haz.Waste

Waste Handler/Contact Info?

STERILIZATION

If Autoclave, skip this section.

Type of sterilization equipment used? ☐ Chemiclave ☐ Autoclave

Chemicals Used? Monthly Quantity?

Chemical Storage?

LABELING

Are all waste containers properly labeled? ☐ Yes ☐ No

If NO: List:

ADDITIONAL RECOMMENDED BMPs

	Implemented?
Use disposable amalgam traps instead of reusable traps, and have them recycled or hauled away as hazardous waste if they contain amalgam waste.	☐ Yes ☐ No
Clean or replace sink traps and sumps, taking care to avoid spillage of the contents from plumbing parts. Removed sludge must be recycled or hauled away as hazardous waste.	☐ Yes ☐ No
Use, when appropriate, based on your professional judgement, mercury-free alternatives to amalgam (e.g., gold, ceramic, porcelain, composites, polymers, glass ionomers).	☐ Yes ☐ No
Install and properly maintain a dental amalgam separator or other technologies to reduce amalgam discharge.	☐ Yes ☐ No
Implement a program to have mercury-containing thermostats, switches, and fluorescent light bulbs recycled when they are replaced. Thermostats and switches should be replaced with mercury-free alternatives.	☐ Yes ☐ No
Describe on attached pages any additional BMPs for mercury discharge minimization that you may have identified and plan to implement.	☐ Yes ☐ No

Actions/Requests/Recommendations