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Dental Office Waste – Public Health and Ecological Risk

Belma Muhamedagic, Lejla Muhamedagic, Izet Masic
Faculty of Medicine, University of Sarajevo, B&H

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SUMMARY

Waste management is one of the key ecological challenges of the modern world. As dental practitioners, we must recognize that some of the materials and procedures we use to provide dental health services may present challenges to the environment. Realizing this, we can begin to take measures to minimize the production of these wastes and their potential environmental effects. Dental office waste typically cause toxic chemicals to enter our streams, sewers, and landfills. This paper identifies some common wastes produced by dental offices (dental amalgam, silver, lead, biomedical and general office waste) and provides practical suggestions for reducing the impact of our profession on the environment. To dispose of dental wastes, if recycling is not an option, proper disposal as hazardous waste is necessary. But, problem is that dental waste is in most cases dumped at uncontrolled disposal sites, and that is public health and ecological risk.

KEY WORDS: dental office waste, dental amalgam, silver, lead, biomedical waste, general office waste, medical waste disposal, public health and ecological risk

1. INTRODUCTION

Waste management is one of the key ecological challenges of the modern world. Waste is a direct consequence of human activity and the quantity of generated waste is often an indicator of the economic strength and development of a community (1).

Dentistry is a proffession dedicated to promoting and enhancing oral health and well-being. To accomplish these goals, dentists use a variety of materials and equipment. Unfortunately, some of the materials that are currently in use–including heavy metals and biomedical waste–present potential challenges to the environment (2). Dental practices generate large amounts of waste cotton, plastic, latex, glass and other materials much of which may be contaminated with body fluids (3). Most dentists have sharps, lancets, needles, and syringes generated from normal treatment of patients. Improper handling and disposal can lead to needle sticks or spread of disease not only for those using health care products, but for anyone finding them including children, janitorial staff, and garbage collectors. Needle sticks can result in diseases such as HIV, Hepatitis. To keep sharps and other potentially infectious waste out of the trash, and therefore prevent the spread of disease, proper disposal is needed.

2. MERCURY

Dental Amalgam

- Mercury (Hg) as amalgam has been used as a dental filling material for more than 150 years (4). Mercury is a toxic and bioaccumulative metal. Mercury commonly occurs in nature as sulfides and in a number of minerals. Globally, between 20.000–30.000 tons of mercury are discharged into the environment each year as a result of human activities (5). It exists in elemental, inorganic and organic forms. The use of mercury by the dental profession represents approximately 6 percent of the total annual domestic consumption and is estimated to contribute significantly to the discharge of mercury (14 percent in one study) to waste-water streams (6).

Although individual dentists generate only small amounts of environmentally unfriendly wastes, the accumulated waste produced by the profession may have a signifcant environmental impact (7-9). Of much concern in recent years has been the impact of heavy metal contamination of water systems by dentists, particularly through the production of dental amalgam waste. Although dental amalgam is a durable, cost-efective and long-lasting restorative material (10,11), it contains mercury, silver and other metals that can enter the environment (11-14). Mercury is the heavy metal of primary concern, making up to 50% by weight of dental amalgam (9,15,16). Mercury is bioaccumulating and is

Figure 1. Dental amalgam

known to have toxic efects in plants, animals and humans (2,8,11,17-19).

Dental Amalgam Waste Products

During the placement and removal of dental amalgam restorations, a variety of waste products is generated:

- elemental mercury vapour–released from dental amalgam alloy,
- dental amalgam scrap–the amalgam particles that have not come into contact with the patient,
- amalgam waste–the particles that have come into contact with patient secretions,
- amalgam sludge–the fine particles present in dental office wastewater, commonly trapped in chair-side traps and vacuum filters (2,16).

Best Management Practices

Dental amalgam contains both mercury and silver and therefore must be properly handled. It cannot be mixed with biomedical waste because if incinerated, mercury is released into the air. The waste must never be put in the regular trash.

Major amalgam particles from trituration surplus of those produced during the carving and burnishing of new amalgam restorations are generally collected in coarse filters and sold for refinement. Minor amalgam particles released by production of new fillings or by removal of old restorations partly sediment in tubes and drains. The remaining particles are carried with the waste water stream to the local purifying plant (20).

Practitioners are encouraged to follow „best management practices" in the handling and disposal of dental amalgam to limit its potential environmental effects. Best management practices apply to a variety of hazardous wastes and depend on the type of waste in question. They are designed to provide guidelines to practitioners to limit the occupational and environmental hazards of a particular substance. For mercury, best management practices are designed to address the various forms that are used and generated in the dental office. Practitioners are advised to use precapsulated dental amalgam to reduce the risk of liquid mercury spill or clinic–environmental contamination. Alternative restorative materials (i.e., composite resin, ceramic or other metal alloys) can be used, when indicated. Limiting the amount of dental amalgam triturated for a procedure also reduces the amount of waste generated (2,16).

Many dental offices have chair-side filtration devices, as well as secondary filters to protect vacuum pumps. These devices trap larger particles of dental amalgam (7,10,13,21-23). Chair-side traps have been found to be approximately 68% efective in their removal of amalgam particles from dental wastewater, while the average vacuum filter is approximately 40% effective (9).

These devices separate the fine particles (generated during restoration fnishing, polishing and removal procedures) from wastewater, thereby limiting the amount sent to wastewater management facilities or the environment.

Once collected, mercury and dental amalgam waste should be handled in the same manner as all hazardous waste; staff members should be properly trained and should use gloves, masks, gowns and protective eyewear when disposing of amalgam waste. Contact and noncontact amalgam waste should be stored in separate containers, as reclamation of the components can be complicated by the need to decontaminate contact waste (2,16).

Waste storage containers should be collected for reclamation by a registered agency. Ideally, these wastes should be recycled, but not all hazardous waste collection agencies are qualifed or able to perform this service (2,8,12,13,16,21,24,25).

Regardless of the means of disposal of dental amalgam, practitioners should not flush contaminated wastewater down sinks, rinse chair-side traps or vacuum filters in sinks, nor place material containing dental amalgam in general garbage or waste to be incinerated. These practices release mercury into the environment and negate the profession's efforts to reduce environmental mercury contamination (2,12,13,21,24,25).

Amalgam Separators

If practitioners who routinely place and remove amalgam restorations were to install amalgam separators, the amount of waste released into the environment would be dramatically reduced (19,26).

Due to the toxic properties of mercury and bioaccumulation in biota of mercury emitted via dental clinic waste water, amalgam separators were introduced in Sweden in the 1980s. Although these amalgam separators in the certification process are required to remove at least 95% of incoming mercury in a standardized laboratory test, their efficiency in practical use has not been properly investigated (4).

An amalgam separator is designed to remove waste amalgam from the rinse water in the vacuum line before discharge to sewer. These separator systems are used to capture scrap amalgam which is too fine to be removed by a trap or a screen. There are a number of separator manufacturers that offer a variety of models. Which separator to use depends on the amount of water discharged or the number of dental chairs operated at the dentist's office. These systems are usually installed by the suppliers and maintenance agreements are common. Amalgam separators can remove up to 99 % of the mercury from the wastewater before it is discharged from the dental office. Many of the available separators have been subjected to rigorous testing and have met ISO 11143 standards. Separation technology is based on sedimentation, filtration or centrifugation of the dental amalgam particles from wastewater. Some devices use a combination of these methods, in addition to ion exchange (2, 9,13,16,25,27).

3. SILVER

Silver is another heavy metal that can enter our water system via improper disposal of dental office waste. Used radiographic fixer (a solution normally used in the processing of dental radiographs) contains silver. Dental offices generate a very small amount of silver waste relative to other photographic processing facilities. According to one source, a batch-replenished processing of 450 size 2 dental films and eight 35-millimeter film strips, each 250 mm long, yields 830 milliliters of used fixer solution with a silver concentration of 10.90 grams per liter. Silver concentrations in used fixer solutions generally range from 8 to 12 g/L (28).

Silver in used fixer solutions is in the form of silver thiosulphate complexes, which are extremely stable and have very low dissociation constants. There is virtually no free silver ion (Ag+) in used fixer solutions. Waste-water treatment processes convert the silver thiosulphate into mostly silver sulfide, which settles in the sludge. The effect of silver on aquatic life depends on the form of silver. In one aquatic life toxicity study using fathead minnows, silver thiosulphate was more than 17,500 times less toxic and silver sulfide was more than 15,000 times less toxic than free silver ion (Ag+) (28). Because of these high silver levels, it's illegal to put used fixer down the drain, into a septic system or into the garbage. The best way to manage silver waste is through recovery and recycling. Dentists can install in-house silver recovery units to salvage the silver themselves, allowing for some monetary return on the equipment investment when the silver is later sold.

These units generally recover silver ions from the waste solution through displacement of iron ions or through a closed-loop electrolytic system that recovers not only silver for reuse, but also the radiographic fixer. Alternatively, the waste can be collected by a registered agency certified to carry and manage the waste (2,13,29).

Another common waste product in the dental office, unused film should also not be placed in the general waste. Unused films contain unreacted silver that can be toxic in the environment. Safe disposal can generally be accomplished by simply contacting the supplier of the product and returning the waste for recycling. Alternatively, a certified waste carrier can be contacted to dispose of the waste, ideally by recycling.

With recent advances in radiographic technology, digital imaging is becoming a popular means of obtaining dental radiographs. Among its advantages are reduced radiation exposure and the absence of chemical image processing. Incorporation of digital imaging within the dental office can greatly reduce the amount of silver waste generated (2,13).

4. LEAD

An additional byproduct of traditional radiography is the lead shields contained in each film packet. Although the lead shields themselves are relatively small, the cumulative waste produced can be considerable. An added benefit of digital radiography is the reduction in lead waste production. Lead, like mercury and silver, is toxic and persists in the environment. Reducing environmental lead contamination by dental practitioners is an inexpensive and easy task. The lead shields from film packets merely have to be collected and returned periodically to the manufacturer for recycling (2,13,30).

Lead is a hazardous metal that can contaminate soil and groundwater, if placed in regular garbage, and sent to a landfill. Lead waste is generated at dental offices in foil from intraoral film packets, and discarded lead aprons and collars. Lead foils and aprons/shields can be collected, and dropped off at a local recycler for free, or picked up by your recycling service. Lead aprons can be used for several years with good management.

Biomedical waste

Figure 2. Lead shield

Biomedical waste encompasses materials capable of causing disease or suspected of harbouring pathogenic organisms; it includes blood-soaked gauze, tissues and syringes, although not extracted teeth. Non-sharp biomedical waste products should be stored in a yellow bag that is properly labelled with a biohazard symbol. Sharps (i.e., syringes, suture needles) should not be included in the bagged general or biomedical waste, but should be stored in a puncture-resistant, leak-proof, properly labelled container until collection and incineration (2,31).

General office waste

Dental staff can also implement a variety of other practices to make the dental office more environmentally friendly. Purchase of products with minimal packaging and use of reusable plastic containers (e.g., for cleaning and disinfecting solutions) can reduce general waste production. Products made from recycled or partly recycled materials can also be used (e.g., cotton or wool rolls, paper towels). Energy-efficient lighting and temperature regulation can limit office energy use (2,13).

5. CONCLUSIONS

Dental waste from dental clinics and dental offices has become an imperative environmental and public safety problem. Dental waste has become one of the most urgent environmental problems. As producers of hazardous waste, dentists have a responsibility and a duty of care for the correct management of waste within their practice. Dental practitioners are becoming increasingly concerned about the potential impact of dentistry on the environment and often take voluntary measures to reduce the production and release of environmentally unfriendly wastes from their practices. As health practitioners, we should be concerned with promoting not only human health and well-being but also that of the environment. A proactive approach will allow our profession to succeed in an era of increased public environmental concern and environmentally protective legislation. It is not only our legal obligation to provide dental services that benefit the public at minimal expense to the environment, but also our moral and ethical obligation. (2,10,13,14)

Dentists need education regarding health care waste disposal methods to improve their knowledge. A large pro-

portion of the dentists are not practising proper methods of health care waste disposal. Dental waste is in most cases dumped at uncontrolled disposal sites, and that is public health and ecological risk.

Dental wastes are regulated under medical waste control regulations in most countries. Even though the quantity of hazardous wastes in dental solid wastes is a small proportion, there is still cross infection risk and potential danger for environment associated with mismanaged wastes. For this reason, knowledge of waste composition and development of proper management alternatives are necessary (32).

Current waste management is characterised by the lack of accurate information about the quantity of waste produced, who produces what type of waste in what quantities, how it is further treated and disposed; then by inadequate treatment of waste, by the lack of adequate facilities within waste management system (treatment, disposal); by difficulties in finding appropriate location for disposal sites (difficulties in obtaining approvals by local communities and permits by relevant authorities) (1).

It is very important to establish a medical and dental waste management system that would implement the existing legislation in all waste management cycles from waste production to treatment and final disposal (33).

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Corresponding author: Belma Muhaedagic, Faculty of Medicine, Sarajevo University, Cekalusa 90. Tel.: 00 387 33 663 742.