Issues Impacting Dental Hospital Waste

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Quick Response Code

doi: .....

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Article Info:
Received: April 11, 2012;
Review Completed: May, 9, 2012;
Accepted: June 9, 2012
Published Online: August, 2012 (www. nacd. in)

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ABSTRACT:

Hospital waste management has been brought into focus in India recently, particularly with the notification of the biomedical waste management and handling rules. The ministry of environment and forests, government of India notified the bio-medical waste (management and handling) rules on 27 th July 1998. Improper management of biomedical waste emanating from the healthcare establishments have given rise to many environmental and health problems. Although awareness in this issue has considerably increased over the last few years, sensitivity to this problem has been limited and also the awareness regarding biomedical waste handling and disposal is abysmally low and scientific literature search show significant gap in the knowledge and practice among the dentist about hospital waste management.

Key words: Hospital waste management, biomedical waste, dental hospital waste, health care waste. Best management practices.

INTRODUCTION

Dentists and their support staff use generate certain substances that may be or are regulated under federal, state or local environmental regulations. Examples include chemical solutions, lead foil film backing, mercury, scrap dental amalgam, fluorescent tubes and batteries. If liquid hazardous wastes are discharged into a sewer system, they potentially impact the wastewater treatment plant, and/or pass through the treatment plant into the bay, ocean, river, or other receiving waters. Alternatively, if materials are disposed of in the trash, they may eventually contaminate the soil, ground water, or create a public health problem. Most chemical waste streams generated in the dental office can be managed as non-hazardous waste, if proper disposal guidelines are followed. For example, glutaraldehyde waste can be neutralized; amalgam and lead waste can be recycled, as can silver-containing waste; and liquid developer that is slightly basic can be disposed down the drain if local pH limits are not exceeded. To ensure compliance with the law, of these materials must be properly handled, recycled, treated and/or disposed. Recycling these materials minimizes potential impacts on the environment and liability for the dental practice. Therefore, recycling should be the option selected whenever possible.

INDIAN JOURNAL OF DENTAL ADVANCEMENTS
Journal homepage: www. nacd. in

Pollution Prevention Strategies

With respect to pollution prevention in the dental office, control strategies must be implemented to reduce the generation of waste and minimize the potentially detrimental effect on employee safety and the environment. Such practices include product substitution where appropriate, safe work practices, employee training, and recycling.

Product Substitution

Product substitution practices include using alternative products with less or non-hazardous components or using technologies that generate less toxic or less volume of waste. For example, consider alternatives such as:

- precapsulated amalgam instead of bulk mercury;
- digital radiography;
- steam sterilization instead of chemical sterilization;
- non-hazardous biodegradable detergents for clean-up;
- Non-chromium containing x-ray system cleaners.

However, when making any changes, carefully evaluate the new product, material or technology for its effectiveness, durability, ease of use, and potential to contain other toxic or hazardous chemicals.

Safe Work Practices

Safe work practices should be incorporated into office policy and procedure documents. Some examples of such practices include good housekeeping procedures, routine equipment maintenance, proper storage and labeling, and effective recordkeeping.

Good Housekeeping

- Containers should be inspected of potentially hazardous materials and wastes regularly to spot damaged or leaking containers. Repackage or place damaged containers in secondary containment immediately.
- Hazardous, universal, recyclable and non-hazardous wastes is stored in separate and appropriate containers. Place liquid waste containers in secondary containers that can hold 110% of the waste volume.
- Protect containers from damage by storing in a protected area.

Equipment Maintenance

All dental equipment - dental units, waterlines, vacuum systems, x-ray equipment, sterilizers, etc., should be inspected and maintained regularly.

Labeling

Waste streams that are designated for recycling/ reclamation and meet specific requirements can be labeled as recyclable materials, e.g., “Scrap metal - to be recycled.” Containers that store hazardous waste must be labeled with the words “Hazardous Waste” and words that identify the contents. The label must also have the following information:

1. Accumulation start date;
2. Name and address of office generating the waste;
3. An indication of the type of hazard, i.e., flammable, corrosive, reactive or toxic.

Containers that store Universal Wastes such as fluorescent lamps and batteries need to be labeled as follows””Universal Waste-Batteries”, “Universal Waste-Lamps”, or “Waste Dental Amalgam”

Appropriate labels are usually available from licensed hazardous waste recycler or hauler.

Storage

All hazardous waste should be stored in containers that can be tightly closed and the container should be compatible with the nature of the waste which is stored. Containers should be kept secondarily contained and protected from damage in a secure area. This area must be away from the public and must be inspected once a week for leakage or deterioration

Recordkeeping

Records of the hazardous waste must be kept whether it is recycled or disposed offsite.

Employee Training

- Training of all employees regarding the importance of pollution prevention on the job.
- Training of all employees on proper hazardous material and waste handling, including proper utilization of personal protective equipment, storage, and disposal in accordance with federal and state regulations. Provision of retraining when there is a change in procedures or process.
- Develop and keep current a spill response plan. Make the plan available to employees at all times.

Recycling

Mercury, zinc, and silver from amalgam, silver from used x-ray fixer, and lead from film backings can be recycled and/or reclaimed. In addition to the environmental benefits, reclaiming these resources can also reduce the regulatory requirements, liability, and costs associated with management and disposal. If dentists send dental amalgam or lead foils for recycling, they are considered to be scrap metal, not hazardous waste. If these wastes are not recycled/reclaimed, they must be managed and disposed as hazardous wastes.

MANAGEMENT OF HAZARDOUS WASTE STREAMS

The following discusses the proper management of materials commonly used in dental offices which are potentially hazardous or otherwise regulated materials. These materials include mercury and dental amalgam (elemental mercury, amalgam capsules, scrap amalgam, contact amalgam) x-ray processing wastes, lead foils or other heavy metals, disinfectants and medical waste.

Mercury & the Environment

Elemental mercury does occur naturally in the environment; however, there are also other forms of mercury that are a concern to the environment. The type and location of the mercury can make a difference in the potential toxicity of the deposits. The four forms of mercury are as follows:

1. Elemental Mercury; (Liquid/Gas) Hg0 absorbed if touched or inhaled.
2. Amalgam (Silver/Mercury/others); compounded mercury & end ash; very stable but it can corrode with time. Incineration is a risk since it becomes a gas.
3. Inorganic Mercury; (Hg+2) or (Hg+1). Between 5 to 15% of this mercury will be absorbed if ingested.
4. Organic Mercury; linked to the carbon molecule; very toxic; if it is ingested, then up to100% will be absorbed.

Dental Amalgam Wastes

Amalgam

Dental Amalgam particles are a source of mercury, which is known to be neurotoxic and nephrotoxic. Fetuses and newborn babies are more sensitive to mercury than adults and there seems to be a great difference in sensitivity among individuals.

Dental amalgam is nearly 50% mercury, a metal that is classified as either a hazardous or universal waste when discarded, and also contains other heavy metals such as silver, zinc, copper and tin.

To minimize the amount of mercury vapour emitted from waste amalgam, ADA recommends that it be stored under a small amount of photographic fixer in a closed container. It should be labeled as 'scrap amalgam'. If scrap dental amalgam is collected and sent away for recycling, then it is considered universal waste, as long as certain best management practices are followed. If dental amalgam waste is discarded, then it must be removed offsite as hazardous waste.

Best Management Practices (BMPs)

- Do not rinse amalgam-containing traps, filters, or containers in the sink.
- Do not place amalgam, elemental mercury, and broken or unusable amalgam capsules, extracted teeth with amalgam, or amalgam-containing traps and filters with medical "red-bag" waste or regular solid waste.
- Recycle, or manage as hazardous waste, amalgam, elemental mercury, broken or unusable amalgam capsules, extracted teeth with amalgam, amalgam-containing waste from traps and filters. Empty dental amalgam capsules containing no visible materials may be disposed of as a non-hazardous waste, except as required by local regulations.
- Collect and store **dry** dental amalgam waste in a designated, airtight container. Amalgam which is designated for recycling should be labeled "Scrap Dental Amalgam" with the name, address and phone number of office and the date on which it was first started to collect material in the container.
- Keep a log of generation and disposal of scrap amalgam. A generation and disposal log is a record of what is placed in the amalgam container, when it was placed in the container, and when the container was picked up by or sent to a recycler or hazardous waste hauler.
- Check with amalgam recycler for any additional requirements. Some recyclers do not accept contact amalgam (amalgam that has been in the patient's mouth); others may require disinfecting the amalgam waste. All recyclers have very specific packaging requirements.

- Separate excess contact dental amalgam from gauze that is retrieved during placement and place in an appropriate container.
- Use chair side traps to capture dental amalgam.
- Change, or clean, chair side traps frequently. Flush the vacuum system before changing the chair side trap.
- Change vacuum pump filters and screens at least monthly or as directed by the manufacturer.
- Eliminate all use of bulk elemental mercury and use only precapsulated dental amalgam for amalgam restorations.
- Limit the amount of amalgam triturated to the closest amount necessary for the restoration, i.e. don't mix two spills when one spill would suffice. Keep a variety of amalgam capsule sizes on hand to ensure almost all triturated amalgam is used.
- Train staff that handle or may handle mercury-containing material in its proper use and disposal.
- Consider the use of amalgam removal technologies, such as sedimentation systems or amalgam separator.
- Do not use bleach to clean discharge systems as this may mobilize legacy mercury and amalgam in the system.

Amalgam Separators

- Use of amalgam separators in the dental office can reduce the amount of hazardous waste material leaving through suction lines by 95%.
- The traps that most offices are using today do not adequately remove the sludge that is entering the sewer system. Amalgam separators work in conjunction with the amalgam traps to reduce the amount of mercury leaving office.

ISO STANDARDS

Currently there is an ISO (International Standards Organization) Standard 11143 for amalgam separators. The ISO standard states that 95% of all amalgam must be captured passing through the dental unit. Most separators are attached to the dental suction line before it enters the sewer. They use a combination of filtration and sedimentation to remove the unwanted mercury from the waste material passing through the suction lines. If this mercury sludge gets past the dental suction units, then it can enter into the food chain. By using an ISO approved amalgam separator, the waste management of mercury can be dramatically improved.

When elemental mercury or amalgam particles are discharged into a sewer or septic system, bacteria can convert the mercury into methylmercury, an organic compound that is readily absorbed by most organisms and produces significant toxic effects. This material will also bioaccumulate (i.e. build up in the body) and can biomagnify (i.e. concentrations dramatically increase as we move up the food chain). Elemental (i.e. liquid) mercury can vaporize at room temperature or when incinerated with municipal waste but will recondense on dust or moisture in the atmosphere and return to earth where it can enter the food chain.

Amalgam Traps

- Disposable amalgam traps are *preferable* to reusable traps because of the difficulty in effectively removing amalgam particles from the trap without discharging them to the sewer or garbage. Disposable traps should be changed weekly or more frequently if needed, or as recommended by the manufacturer of equipment.
- Only traps on chairs used for amalgam placement or removal need special handling. Traps from chairs not used for amalgam procedures may be placed in the regular solid waste.
- The use of reusable chair-side amalgam traps is not recommended. However, if reusable amalgam traps are used, please follow the following steps:
  a. Disinfect the traps in a minimum amount of disinfectant;
  b. Remove visible scrap amalgam from the reusable amalgam trap and store in an airtight container per licensed recycler or waste hauler directions;

Bulk Mercury

- To control or eliminate bulk mercury in office:
  a. Use precapsulated dental amalgam;
  b. Use the proper work area designed to provide secondary containment and follow a written mercury spill clean-up procedure;
  c. Maintain a mercury clean-up kit in your office to manage accidental spills, which may occur regardless of the delivery form of the mercury;

d. React small amounts of unused elemental mercury with silver alloy to form scrap amalgam for recycling;

e. Elemental mercury from spills and absorbent from the clean up of mercury spills are accepted by some mercury recyclers.

f. Maintain a mercury clean-up kit in office to manage accidental spills, which may occur regardless of the delivery form of the mercury

Contact Amalgam (e.g., Extracted Teeth Containing Amalgam)

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. Many scrap amalgam recyclers accept teeth with amalgam as long as the sender certifies that they are not infectious wastes. Extracted teeth without attached tissue are considered non-medical wastes, unless the extracted teeth are deemed as biohazardous by the attending surgeon or dentist. However, *extracted teeth with amalgam* should be managed as hazardous waste or recycled.

To dispose of contact amalgam, dentists can choose to either collect or store it as hazardous waste or collect and store as recyclable waste, if the metal recycler accepts contact amalgam. Consult with amalgam waste recyclers about any special requirements to follow prior to disposal.

Silver and the Environment

Silver, in the form of silverthiosulfate, is found in high concentrations in fixer solutions and rinses from x-ray film. Light-sensitive silver-halide crystals present on the x-ray film are released as silverthiosulfate during the fixing process. Used x-ray fixer is regulated as a hazardous waste because of the high silver content. In the environment, free-ionic silver acts as an enzyme inhibitor by interfering with the metabolic processes of organisms.

X-ray wastes

1. X-ray fixer solution: It is considered a hazardous waste because of its high silver content. In the environment, free ionic silver acts as an enzyme inhibitor by interfering with the metabolic processes of organisms. These have to be disposed off as a hazardous waste or sent to a silver recovery system.
2. X-ray developer solution: Developer solution can typically go into the wastewater drain. Developer and fixer solutions should not be mixed with fixer solutions. If mixed, they should be separated and treated independently as required.
3. X-ray cleaner solution: Many cleaners for X-ray developer system contain chromium. If the cleaner solution used contains chromium, it should be disposed as a hazardous waste or switch to a non-chrome cleaner.

X-ray lead foil/lead shields

The lead foils and lead shields contain pure lead. Lead is a heavy metal that affects neurological development and functions and can potentially leach from landfills into the environment. These are hazardous waste unless they are recycled for their scrap metal content or disposed off as hazardous waste. Lead cannot be placed in the regular solid waste containers nor can it be disposed of down the drain; it must be managed as either recyclable metal or hazardous waste.

Lead scrap can be either recycled or disposed as hazardous waste.

Elemental nickel, chromium in stainless steel (does not include x-ray cleaning solutions), and other heavy metals should be recycled as scrap metal. As long as it is not fine powder, elemental metals other than lead or mercury can be disposed of as solid waste.

X-ray Processing Wastes

Dental offices that house and operate standard radiography equipment must process the x-ray films using photochemicals - fixer, developer, and equipment cleaner. Each of these chemical solutions is unique and requires special handling and disposal procedures.

Silver-Containing Wastes (X-ray Photographic Fixer)

Silver from used fixer is a valuable resource that should be recycled. There are two basic management options for fixer: (1) onsite treatment and disposal; or (2) offsite treatment and disposal. Whether treated onsite or offsite, fixer is easily and economically recyclable and recycling is the preferred method of management. **Untreated fixer can not be discharged to the sewer.**

Silver-rich photo processing wastewaters that are not treated onsite or hauled offsite for silver-recovery are subject to full regulation as hazardous wastes.

Onsite Treatment and Disposal

Silver recovery units are commercially available to remove the silver from the fixer. Prior to sewer discharge, treated solutions must meet the sanitation agency's pollutant discharge limits (i.e. most sanitation agencies have a 5 ppm or mg/l discharge limit for silver).

When using a silver recovery unit, remember to:

- Check the unit daily for leaks, spills, and overflows;
- Periodically check the flow rate of solution to the recovery system. Typically a lower flow rate and a longer retention time will maximize silver recovery;
- If using an electrolytic unit, check the appearance of the silver plate. The plate should be tan to brown and grainy. If it is black, mushy and smells like sulfur, the amperage may be too high. If the silver plate is hard and white, the amperage is probably too low.
- Test the silver concentration of the treated fixer monthly. The test can be performed with an analytical test kit or a lab analysis. Periodic testing will tell how effective unit is at capturing silver and will alert to recovery unit problems;
- Record test results in a silver recovery log.

Offsite Reclamation/Recycling

Used x-ray fixer solutions can be hauled offsite for treatment and recycling at licensed recycling facility. If the silver is reclaimed, the waste stream may qualify for exemption or reduction in generator and hauling requirements. For offsite recycling, the generator should collect and store the used fixer solution in a labeled closed plastic container. The label affixed to the container should indicate the contents - "Silver-containing Used Fixer - To Be Recycled" and include the accumulation start date.

X-ray Photographic Developer

Do not mix used developer and fixer solutions.

Waste developer may be flushed down the drain, as long as the pH of the solution does not exceed the pH standard of the local sanitation agency. Most developer solutions are slightly caustic in nature, i.e., they have a high pH. Caustic solutions with a pH greater than the local pH limit may not be discharged down the sanitary sewer.

Lead Foil Packets

The lead foil inside each x ray packet is a leachable toxin and can contaminate the soil and groundwater in landfill sites. Lead foil packets should never be thrown in the regular garbage.

This material must be either recycled or treated as a hazardous waste

Lead Aprons

Lead aprons should not be thrown into the regular garbage since the lead can contaminate soil and groundwater via the landfill

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 is needed: this will eliminate the need to dispose of the excess material.. The local wastewater agencies would like to avoid a large "slug" of formaldehyde at any one time.

Waste Formalin

Formalin is commonly used as a tissue preservative. Formalin is a generic mixture containing formaldehyde; it may also contain methanol and other chemicals.

Waste formalin **cannot be discharged** to the sewer unless the following requirements are met:

1. Solution must be non-hazardous (i.e. must pass the state's aquatic bioassay test for toxicity);
2. Solution must have flash point no less than 140° F;
3. Solution must have pH that is within the local sewer sanitation limits.

Generators of waste formalin should check with their suppliers or treatment vendors if they have data to support determinations that the above requirements are met. If the information is not available, generators will have to produce their own supporting data through laboratory analyses or haul the solutions offsite as hazardous waste. Generators should also contact the local sanitation agency for additional guidance on formalin waste disposal.

Sharps Waste

Disposable sharps should be placed in a proper sharps container. A sharps container should be located in each operatory and the sterilization lab OSHA requirements. Full sharps containers should be disposed as medical waste; a registered hauler should transfer the sharps waste to a licensed treatment facility. Proper treatment by a permitted facility consists of either autoclave sterilization or incineration.

Below is a list of wastes which are included in the "universal waste" category that may be present in a dental office:

Aerosol cans – Not considered a hazardous waste when completely empty, however, non-empty containers may be a universal waste if the remaining *propellant* is ignitable, or toxic or the *product* itself is ignitable, corrosive, or toxic. An aerosol containing pesticides, for example, would be considered a universal waste.

Batteries – Included in the regulation are rechargeable, alkaline, button and small, sealed, lead-acid batteries. Batteries are a unique product comprised of heavy metals and other elements. Some of these toxic heavy metals include nickel, cadmium, mercury, nickel metal hydride and lead. It is these elements that can threaten our environment if not properly discarded. (Note: Automotive batteries are NOT universal waste. They must be managed like other hazardous wastes.)

Light tubes and lamps – Fluorescent light tubes, high intensity discharge, and sodium vapor lamps contain mercury and other hazardous elements. They become a hazardous waste when the bulb or lamp no longer functions. Businesses may accumulate fluorescent tubes and lamps for up to one year prior to disposal. These items must be recycled or they must be managed as a hazardous waste.

Mercury containing items – Mercury-containing thermometers, thermostats, blood-pressure gauges and switches are considered universal wastes. (Note: Amalgam has been regulated as a universal waste for several years and was never exempted for small businesses like the other items listed). These items must be recycled or they must be managed as hazardous waste.

Computer monitors, televisions, and other electronic devices – Many of these devices can contain lead and other toxic metals which cannot be disposed of in the regular trash. Cathode ray tubes (TV's and computer monitors) must be recycled or they must be managed as a hazardous waste.

Biohazardous Waste

- **Solid 'red-bag' waste** must be collected and disposed as regulated medical waste. Proper treatment by a permitted facility consists of either autoclave sterilization or incineration.
- **Pharmaceutical waste,** either expired or partially-used, must be collected and transferred by a registered hauler to a licensed incinerator.
- **Laboratory/surgical wastes** must be collected and transferred by a registered hauler to a licensed incinerator.

Nonhazardous Wastes

Paper, Cardboard, Aluminum, Plastics, etc

Best Management Practice (BMP)

Paper, cardboard, aluminum and plastic packaging should be minimized by using responsible suppliers

Office paper should have a high-recycled content

Minimize plastic waste by using refillable bottles for disinfecting or cleaning products and reusable devices for dental procedures where feasible

Avoid containers or packaging made of PVC plastic where feasible. This material is difficult to recycle and can produce acid gases if incinerated as part of your municipal waste treatment

Batteries, fuel oil, solvents, pharmaceuticals, aerosols, corrosive cleaners, paint, pesticides, gasoline can be disposed of via the household hazardous waste system

Shred confidential documents before they leave the office

GENERAL REGULATORY REQUIREMENTS

Dental offices must consider carefully what requirements apply if they generate a waste that can be regulated as hazardous waste.

Certain requirements will be waived if the waste is recycled or reclaimed. Hazardous wastes must be hauled by haulers licensed or approved by the state. Generators may "self-haul" their own waste in volumes less than 5 gallons or 50 pounds without being licensed. Facilities receiving hazardous waste, whether for recycling, treatment or disposal must be licensed by the state, or in some cases, the local agency. Dentists may also be able to take their wastes to local hazardous waste collection events for small businesses. The following requirements apply to generators of hazardous waste except for generators that generate no more

than 100 kg/month exclusively of silver-only hazardous waste. A "generator" is any person, by site, whose act or process produces hazardous waste or whose act first causes a hazardous waste to become subject to regulation.

Small Quantity Generators

Most dentists qualify as small quantity generators (SQG) of hazardous waste, which are those that generate less than 100 kg/month or 220 lbs/month. Such generators have less stringent requirements than large quantity generators.

Accumulation

- Large quantity generators, those that produce more than 1000 kilograms per month have an accumulation time limit of 90 days. This period commences on the first day of waste generation.
- Generators that produce more than 100 kilograms and less than 1000 kilograms per month have 180 days for accumulation.
- Small quantity generators which produce less than 100 kilograms per month have 180 days for removal once the 100 kilogram limit has been met. There is NO accumulation time limit for generators of not more than 100 kilograms per month that are not using the satellite accumulation area and who have not yet accumulated 100 kilograms of hazardous waste.

Managing these wastes is not complicated, but these rules should be followed:

1. Do not accumulate more than 5,000 kg of universal waste at any one time.
2. Do not accumulate for longer than one year.
3. Document the length of time you began accumulation.
4. Label or mark packages to identify the type.
5. Never try to treat or alter the wastes in a way which may alter their characteristics.

Safe and effective management of waste is not only a legal necessity but also a social responsibility. Lack of concern, motivation, awareness and cost factor are some of the problems faced in the proper hospital waste management. Proper surveys of waste management procedures are needed. Clearly there is a need for education as to the hazards associated with improper waste disposal. Lack of apathy to the concept of waste management is a major stymie to the practice of waste disposal. An effective communication strategy is imperative keeping in view the low awareness level among different category of staff in the health care establishments regarding biomedical waste management.

The most vital component of the waste management plans that have been formulated is to bring about a transformation in the mind sets and develop a system and culture through education, training and persistent motivation of the health care staff. It should involve the co-ordinated working of several departments in a health care establishment. i.e. not just the conventional hospital infection committee but myriad others such as house keeping, engineering, laundry, kitchen and security besides nursing, medical, surgical, laboratory and administrative departments. The cliché lies in segregation of the waste especially infectious waste from the non-infectious waste. At the same time, the quantity of waste generated is equally important. A lesser amount of biomedical waste means a lesser burden on waste disposal work, cost-saving and a more efficient waste disposal system. Hence, health care providers should always try to reduce the waste generation in day-to-day work in the clinic or at the hospital.

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