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## Abstract

Biomedical waste management has been in focus in India recently, particularly with the notification of biomedical waste (management and handling) rules, 1998 which was brought out by Union Ministry of Environment and Forests under the provision of Environment (protection) act, 1986. Common producers of biomedical waste include health clinics, hospitals, nursing homes, medical research laboratories, office of dentists and veterinarians, home health care, and funeral homes. The common sources of major hazardous waste at dental clinics includes X-ray film and fixers, chemical disinfectants, sharps, dental amalgam and blood-soaked dressings, silver, lead, various solvent and other chemicals. It must be properly managed to protect the general public, specifically healthcare and sanitation workers who are regularly exposed to biomedical waste as an occupational hazard.

**Keywords** Biomedical Waste, Dental Waste, Hospital Waste

## Introduction

Hospital is a place of almighty, a place to serve the Patient. On one hand hospitals cure patients and on the other hand they emerged as a source of several other diseases.<sup>1</sup> Hospital waste is often described as residual matter, either solid or liquid which is generated in the process of diagnosis, treatment or immunization of animals or human beings. Dental waste is considered as hospital waste; are dental materials that have been used and are no longer wanted for use and are therefore should be disposed in an appropriate way.<sup>2</sup>

Scientifically, BMW is defined as “any solid, fluid or liquid waste, including its container and any intermediate product, which is generated during its diagnosis, treatment or immunisation of human beings or animals, in research pertaining thereto, or in the production or testing of biological and the animal wastes from slaughter houses or any other like establishments”.<sup>3</sup> So, Biomedical waste management means the disposal of waste produced by hospitals using such techniques that will help to check the spread of disease through it.<sup>1</sup> Within waste management (WM), the health care waste management is a process that helps to ensure proper hospital hygiene and safety of health care workers and Communities.

## Classifications

Several classifications of health care waste have been described in literature.

One of them divides hospital waste into hazardous and non hazardous.

WHO classification of health care waste

- Infectious waste; Waste suspected to contain pathogens; e.g., laboratory cultures, tissues, swabs, excreta, materials or equipment that have been in contact with infected patients etc.
- Pathological waste; Human tissues or fluids; e.g., body parts, blood and rest body fluids, fetuses, etc.
- Sharps; Sharp waste e.g., needles, scalpels, blades, infusion sets, knives, broken glass.
- Pharmaceutical waste; Waste containing pharmaceuticals; e.g. expired pharmaceuticals or no longer needed, items containing pharmaceuticals (bottles or boxes etc).

- Genotoxic waste; Waste containing substances with genotoxic properties; e.g., cytotoxic drugs (cancer drugs), genotoxic chemicals.
- Chemical waste; Waste containing chemical substances; e.g. laboratory reagents, X-ray film developer and fixer, disinfectants that are expired, solvents.
- Wastes carrying high content of heavy metals; Batteries, broken thermometers, blood pressure gauges, etc.
- Pressurized containers like Gas cylinders, gas cartridges, aerosol cans.
- Radioactive waste; Waste containing radioactive substances; e.g. unused liquids from laboratory research or radiotherapy, radioactively contaminated glassware, packages or absorbent paper, urine and excreta from patients, sealed sources.<sup>5</sup>

## Steps In Waste Management

For waste management to be effective, the waste is to be managed at every single step, i.e. from acquisition to disposal. The following are the steps for a comprehensive waste management system: waste survey, segregation, storage and accumulation, transportation, treatment, disposal and also waste minimization.<sup>6</sup>

## Dental Waste

The amount of waste generated in dental offices and clinics is considerably less than that coming from other types of health care facilities.<sup>7</sup> Improper disposal of dental waste can cause harm to the dentist, the people in the immediate vicinity of the dentist who handle the materials, waste handlers or the general public at large through production of toxins from materials or as by products of destruction of these wastes e.g. through incineration.<sup>8</sup> Careless and indiscriminate disposal of this waste can contribute to the spread of serious diseases such as hepatitis and human immunodeficiency virus (HIV) among people who handle waste and also among the general public.<sup>9</sup> Important types of waste generated in dental clinics and dentists offices include large amounts of cotton, plastic, latex, glass, extracted teeth and other materials, which is contaminated with body fluids, sharps, infectious waste, and waste with high heavy-

metal contents.<sup>6,10</sup>

## Dental Amalgam

Dental amalgam is one of the oldest filling materials used in dentistry and mercury (Hg) as component of amalgam has been used for more than 15 decades. By definition amalgam is a special type of alloy of two or more metals having mercury as an essential component which may be exposed either through incinerators or Hg in waste water from the different sources which could be either from households or dental clinics. These releases make the environment polluted through direct wastewater, land-filling, incineration and sewage sludge incineration.<sup>11</sup>

There are four possible harmful effects of dental amalgam – toxicity, oral galvanism, allergy and ecological grievances. The possible toxic effects of mercury are strongly dependent on its chemical form. In dentistry, only the metallic form is used. The metallic form is mainly absorbed in the human body through skin, while mercury vapour absorption is through the lungs. The absorbed mercury passes into the circulation and is disseminated throughout the body.<sup>12</sup>

## Dental Amalgam Waste Products

During the placement and removal of dental amalgam restorations, waste products is generated in various forms :

- Elemental mercury vapour — released from dental amalgam alloy
- Dental amalgam scrap — the amalgam particles that have not come into contact with the patient (i.e., particles remaining in the dappen dish following restoration placement)
- Amalgam waste — the particles that have come into contact with patient secretions (e.g., particles generated during carving and restoration removal procedures)
- Amalgam sludge — the fine particles present in dental office waste water, commonly trapped in chair-side traps and vacuum filters.<sup>13</sup>

## Elemental Mercury Waste Management

It can be done by Storing unused elemental mercury in a tightly sealed container, By contact a certified waste carrier for recycling or disposal, By using a “mercury spill kit” if you have a spill of elemental mercury, By reacting unused elemental mercury with silver alloy to form scrap amalgam, By not placing elemental mercury in

the garbage and also by not washing elemental mercury down the drain.

#### Scrap Amalgam Waste Management

It is performed by using a Sponge type Mercontainer TM to store the scrap amalgam, empty amalgam capsules are non-hazardous and can be disposed in the garbage, use an amalgam separator on the suction lines to remove over 95% of the contact amalgam prior to entering the sewer system, use disposable suction traps on your dental units and change them weekly, use gloves, mask, and glasses when cleaning the suction traps, mix only as much amalgam as is immediately required using premeasured amalgam capsules, manually remove large pieces of amalgam produced when removing old fillings and place them in a contact amalgam container, Do not dispose scrap amalgam in the garbage, Do not wash scrap amalgam down the drain, Do not rinse the traps and filters in the sink as amalgam particles will discharge into the sewer, Do not throw disposable traps that contain amalgam particles into the garbage, Do not place extracted teeth with amalgam fillings in the regular garbage (It should be disposed of in the "Scrap Amalgam" container to avoid incineration), Do not suction up unused particles of amalgam, instead place them in a mercury vapor suppressant container.<sup>14</sup>

#### Solid Waste

During combustion of amalgam-contaminated solid waste, such as extracted teeth with amalgam fillings, trituration capsules, and cotton rolls, mercury will be released as bio-available mercury vapor. Trituration capsules and extracted teeth with amalgam fillings should therefore be collected for delivery to authorized handling facilities, similar to the procedure adopted for the handling of mercury-containing batteries.

#### Amalgam Separators

Several amalgam separating devices are commercially available now. Two main principles for separation are:

Sedimentation, where sedimentation of amalgam particles is facilitated by filters, slats, or granular material: and

Centrifugation, where the water stream passes a rotating unit before outlet.<sup>15</sup>

#### Silver

Silver is another heavy metal that can enter our water system via improper disposal of dental waste. Although dental amalgam has one of its components i.e. silver, the silver thio sulfate in radio-graphic fixer presents a greater environmental concern.<sup>14</sup>

#### Dental Radiographic Waste

The discovery of x-rays has revolutionized the field of medicine and in turn, dentistry. These radiographs have become a third eye to the dentist. These radiographic procedures generate certain waste substances that present a potential challenge to the environment. Examples of such waste materials include used x-ray processing solutions, processor system cleaners, lead foil, used/unused dental films. In addition to the waste generated by the conventional processing, lead aprons, lead shields and non-functioning x-ray units are also considered waste when they reach

their end life.

#### Lead Waste

The lead-containing products used in dentistry are lead foils, shields and aprons. The lead content of this foil is 69% to 85%. Most of the dentists prefer to discard the lead foil in the common garbage. Lead poisoning in adults can affect the peripheral and central nervous systems, the kidneys, blood pressure and reproductive systems. Children are more sensitive to lead than adults as the exposure is increased by their hand-to-mouth activity with their gut absorbing lead more readily than an adult. The developing CNS is more vulnerable to toxicants than the mature CNS. Additionally, some of the dentists or the supporting staff does not wash their hands or change their gloves after processing intraoral films. Lead oxide might adhere to the gloves or hands and can be introduced onto instruments and dental paraphernalia used in the mouths of patients. The lead foil from film packets has to be collected and returned back to the manufacturer for recycling. Even the lead aprons and lead shields should not be thrown into the regular garbage and they should be returned to the manufacturer.<sup>16</sup>

#### Undeveloped Film Management

Undeveloped film contains a high level of silver and must be treated as a hazardous waste. Silver can contaminate the soil and groundwater if it is sent to a landfill. Unused film should be recycled rather than being placed into the waste.<sup>14</sup>

#### X-ray Film Processing Waste

Dental hospitals that operate conventional imaging use chemicals like fixer, developer, and equipment cleaner. Used developer is not typically a hazardous waste because of its low silver content (usually below the regulatory level of 5 mg/l silver) and lack of other constituents or characteristics that would make it hazardous waste.<sup>16</sup>

The fixer that Dental offices use to develop x-rays is a hazardous material that should not be simply rinsed down the drain. Spent fixer solution carries about 4000 mg of silver per litre. Use a Silver recovery unit to recapture the silver from the fixer and once the container is full, send to a Certified Waste Carrier for recycling or disposal. Utilize a digital X-ray unit to minimize the need for fixer solutions. Many cleaners for x-ray developer systems contain chromium, a toxic substance so ask the supplier for a cleaner that doesn't use chromium, Do not pour fixer down the drain, Do not place silver recovery unit cartridge in the garbage, Don't discharge chromium-containing cleaners into a sewer or septic system<sup>14</sup>

#### X-Ray System Cleaners

Many cleaners used for automatic processors contain chromium, which is hazardous waste when discarded. As an alternative, it is easier and cheaper to use a system cleaner that does not contain chromium.<sup>16</sup>

#### Blood Soaked Materials

Biomedical waste encompasses materials capable of causing disease or suspected of harbouring pathogenic organisms; it includes blood-soaked gauze, human tissues and syringes, but not extracted teeth. Non-sharp waste products should be stored in a yellow bag that is

properly labelled with a biohazard symbol.<sup>13</sup> Once accumulated, contact a certified biomedical waste carrier for disposal and do not throw blood soaked materials into the regular garbage.<sup>14</sup>

**Sharps** (i.e., syringes, suture needles) should not be included in the bagged general or biomedical waste, but should be stored in a leak-proof, puncture-resistant, properly labelled container until collection and incineration.<sup>13</sup>

#### General Office Waste

Although this article attempts to address some of the larger issues relating to the environmental impact of dentistry, dentists can also implement a variety of other practices for a Smore environmental friendly dental office. Purchase of products with minimal packaging and use of reusable plastic containers (e.g., for cleaning and disinfecting solutions) can reduce general waste production.<sup>30</sup> Products made from recycled or partly recycled materials can also be used (e.g., cotton or wool rolls, paper towels). Lighting which is Energy-efficient and temperature regulation can limit office energy use. Use of both sides of pages and Single-spaced printing can decrease the amount of paper used in the dental office.<sup>13</sup>

#### Demands on collection, storage and transportation of healthcare waste

Audits of healthcare waste management and storage areas have shown different problems and demands have been concluded from them:

- Collection and transportation of waste has to attend to safety provisions for workers. Contamination of hospital environment has to be prevented.
- Appropriate protective clothing, at least solid puncture-proof gloves have to be provided to employees who are charged with the collection and transport of waste.
- Non hazardous waste produced during care or treatment of patients has to be collected in tear proof bags or barrels.
- To avoid contamination of the outer surface of bag or container during collection, pedal bin containers or foot controlled folding mechanisms to fix bags should be used.
- Waste should not be transferred or re-sorted. Segregation of waste at the point of production.
- Waste bags should not be thrown or dragged across the floor for transport. Carts for transporting waste can be used. They should have no sharp edges or corners that could lead to a rupture of waste bags. They should provide protection against leakage of fluids. They should be cleaned and disinfected regularly.
- If in-house storage is necessary, the room should be ventilated and surfaces should be disinfected regularly. Waste should be picked up at least once daily.
- If waste bags or containers are stored outdoor, they have to be protected from weather and animals.
- Unauthorized access to collecting space has to be prevented.<sup>17</sup>

#### Switch to Eco-friendly dentistry

1. Switch to re-usable cloth infection control and sterilization products.
2. Choose eco-friendly disinfectant to protect

our waterways.

3. Reusable towels to reduce waste. Stop disposables and start reusables.
4. Paperless records to reduce paper consumption and waste.
5. Using digital imaging (not traditional X-rays) which means 75 to 90% less radiation exposure to patient and reduction in use of X-ray development chemicals.
6. Incorporating aromatherapy: The patients who are sensitive to chemicals can easily avoid "chemical dental smell".
7. Using Biodegradable sterilization solutions, used to clean the chairs after patient examination.
8. Avoid VOC (volatile organic compounds) paints in the clinic.
9. Installing only energy efficient lights in the clinic and making sure electronic equipment is turned off every night.<sup>19</sup>

**Biomedical waste segregation for dental clinics**

Red bag	Yellow bag	Blue bag	Black cartony
Disposable syringes IV set without needle Saline bottles Plastic suction tips Toothbrushes, denture brushes Disposable plastic/fiber instruments Plastic/rubber tubes Rubber lids of any vial Used plastic drapes	Things contaminated by blood or body fluids Body parts Any item which have been in contact with the patient Bandages, cotton Teeth (with/without fillings but without amalgam fillings) Dressings and swabs Disposables such as throat packs, gloves, aprons, masks, drapes, contaminated wipes Discarded crowns, bridges and cast partial dentures Waxes, gutta purcha points, absorbent points Disposable impression trays with impression material Acrylic partial dentures, complete dentures, denture teeth Plaster/stone casts Cheek retractors, tongue depressors wedges Rubber dam material Plastic X-ray pouches (outer covering) Catheters (after draining) Unwanted laboratory specimens Suture materials without needle	Glass bottles Broken glass Discarded medicines Antiseptics, disinfectants (not contaminated by body fluids) Used or unused drug vials Cartridges and ampoules	Used or unused sharps Needles without syringes Scalpel blades Metal objects Metal matrix bands Broken metal instrument tips Burs Endodontic files, broaches, reamers, spreaders, silver points Orthodontic metal brackets, wires, bands Suture needles Broken/discarded ultrasonic tips Metallic bars, clasps from partial dentures Metal lids of vials All metallic dental implants related material X-ray <sup>7</sup>

**Conclusion**

Bio-Medical Waste management programme cannot successfully be implemented without the devotion, willingness, self-motivation,

Monika, et al.: Waste Management & Dental Office cooperation and participation of all sections of employees of any health care establishment. The most imperative component of the waste management plans is to develop a system and culture through education, training and persistent motivation of the health care staff. Clearly the dental contribution to environ-mental pollution is very small and getting smaller. But , if we prevent even a small amount of inorganic mercury entering the environment where it can combine to form organic mercury and end up in your next can of a fish, we should certainly try to do it. Separators in dental practices and the incorporation of a company to effectively recycle collected waste amalgam, may help control the discharge of amalgam into the wastewater stream.

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