

## Solid waste disposal and management in dentistry

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### Abstract

Waste disposal is an important, yet relatively neglected issue in Public Health. Waste management is crucial for proper growth, development and health of citizens. Proper waste disposal is one of the major responsibilities of the community as a whole. Historically, waste disposal has been a global problem. It has even resulted in the rise and fall of an American President. In France, excess waste accumulation resulted in difficulty in defense. Various diseases including cholera, typhoid fever, Bubonic Plague have affected Europe as a result of improper waste management.

On an average, man generates about 500 grams solid waste anywhere between 100 – 150 liters of sewage each day and about 1.3 billion tons of municipal waste is generated annually globally. In urban India, about 55 million tons of solid and 38 billion liters of sewage are generated and are expected to grow at a rate of 1-1.33% annually. India also produces nearly 960 million tons of solid waste as by – products of industry, mining municipal, agricultural and other procedures.

The importance of waste disposal is of concern for health workers/ managers as waste can be hazardous to health, both at its point of generation and when not disposed and managed within safety regulations framework. Epidemics, toxicity in the environment, disability, and injuries are a few to state which have been caused by mismanagement of the biomedical and other wastes. Boom in health industry including the oral care industry has brought to light that apart from the regular bio-wastes, dental wastes like mercury, amalgam disposal need to be paid serious attention.

This paper explores the methods of disposal for solid waste and bio – medical/dental waste and describes methods of its disposal along with the challenges faced by communities for waste disposal. The roles of authorities and regulatory boards and public health researchers in evolving newer initiative too have been discussed.

**Keywords:** waste disposal, public health, dentistry

### Introduction

The Basel Convention has defined wastes as materials that are not prime products for which the initial user has no further use in terms of his/her own purposes of production, transformation or consumption, and of which he/she wants to dispose <sup>[1]</sup>.

Waste has been classified into different categories as nonhazardous and hazardous: Potentially toxic waste and potentially infectious waste <sup>[2]</sup>. Improper waste management generates over 22,000 tons of toxic pollutants including particulate matter, carbon monoxide, nitrous and sulfur oxides along with nearly 10,000 grams of carcinogenic dioxins and furans each year <sup>[3, 4]</sup>.

### Disposal of Biomedical Waste

In the 'Waste Management Policy' of the Community Health Oxford shire (CHO) adopted on 17th November, 2010, need of a comprehensive Waste Management Policy in order to adhere to the requirements of the Health and Safety at Work Act 1974 was emphasized <sup>[13]</sup>.

The National Environmental Engineering Research Institute (NEERI) in 1997 estimated the amount of the different wastes produced in hospitals across India and concluded that general waste including garbage, paper, etc. was the maximum and the sharp metal waste was the minimum waste produced <sup>[3]</sup>.

The Bio – Medical Waste (Management and Handling) Rules, 1998 have specified the segregation of the waste in color coded bags <sup>[11]</sup>.

The different methods and management strategies applied should be effective and adhere to regulations laid down by the government. There are the 'best management practices' which are the best options available according to the technology of the day and are beyond the basic regulations of the government. The 'good management practices', though not as efficient as the 'best management practices', are in concurrence with the government regulations <sup>[13]</sup>.

The most important step for the waste management is proper sorting of the bio medical/dental waste. Recycling too, is a key factor in reduction of waste generated, this lowers incidence of health and environmental hazards. In India, biomedical waste is disposed in superficial burial or non-engineered landfills within hospital premises. The associated health problems are not difficult to imagine <sup>[14]</sup>.

Hospitals: Madras Medical Mission, Chennai, Sundaram Medical Foundation, Sri Ramchandra Medical College and Hospital, Chennai, Holy Family Hospital, New Delhi, Ortho Nova Medical Center, New Delhi have successfully attempted different models for the proper management of biomedical wastes, crucial to prevent the occurrence of health and

environmental hazards. Some of these practices include:

- Segregation of waste at source or at point of generation
- Sharp management
- Training the staff
- Dedicated waste autoclave and shredder for plastics and syringes
- Information distribution system and ensuring smooth functioning of the system and good monitoring of the system as a whole <sup>[11]</sup>.

### Methods of Solid Waste Disposal

Though, waste is of varied nature, here the focus is only on these two broad categories; solid and bio – medical/dental waste as they are of direct concern for the public health care takers.

### Classification of Waste

Waste is broadly classified as hazardous and non – hazardous. While nearly 85% waste generated non – hazardous, if the hazardous waste is not appropriately segregated and is mixed with the non – hazardous waste, the entire waste is considered to be hazardous <sup>[2]</sup>. Waste is collected as refuse from various sources for e.g. *Street waste* includes leaves, straw, paper, animal droppings and litter, *Market waste* contains large amount of putrid vegetables and animal matter *Industrial and health care refuse* consists highly inert materials toxic and explosive compounds, anatomical and non-anatomical wastes (injection, sharp etc.) *Domestic refuse* consists ash residue after cooking, rubbish including paper, clothing, wood, metal, glass, dust and dirt, garbage; waste food, vegetable peelings and other organic matter. Garbage needs to be treated urgently as it ferments quickly on storage <sup>[3]</sup>.

### Nature of Solid waste <sup>[3]</sup>

#### Garbage

On an average, about 0.25 – 2.5kg is the per capita waste production in different countries. (Ideally, the solid waste does not include night soil, though this norm is frequently flouted) <sup>[3]</sup>.

Inadequately treated, solid waste accumulation may become potent breeding ground for flies, Rodents vermin, pathogens, and water and soil pollution. Heaps of refuse present an unsightly appearance and emit bad odors. An association has been observed between the improper waste disposal and occurrence of vector – borne diseases. To avoid these eventualities, periodic adequate disposal of waste is essential <sup>[3]</sup>.

### Storage: For Fitting Waste Disposal

The waste generated should be properly stored prior to collection. A galvanized steel dustbin with a close fitted cover is ideal for the storage of the refuse.

Sacks are used to store domestic, market health care refuse which are collected by cleansing Municipal servers. Public bins in India are generally without cover. These are kept on a concrete raised platform to a height of 2 – 3 inches above the ground level. This is done to prevent the flood water from entering the bins. In large municipalities, the bins are handled and emptied mechanically by the Lories fitted with cranes.

### Collection: For Appropriate Waste Disposal

The best method of waste collection is house – to – house

collection. Generally, in India, people are expected to dump the refuse in the public bins. This however is rarely practices and the waste is usually scattered on the streets and some is thrown in front of the house. Manpower is required for collecting this dispersed waste and the waste dumped in public bins. The refuse is then transported in refuse collection vehicles to the place where it is to be properly disposed. Dead animals are directly transported to the place of disposal <sup>[3]</sup>.

### Treatment Methods of Waste Disposal

Waste treatment techniques are directed to transform the waste to a manageable form by reducing its volume and toxicity for easy disposal. The different methods of solid waste disposal include:

- i) Dumping
- ii) Controlled tipping
- iii) Incineration
- iv) Manure pits
- v) Composting
- vi) Burial <sup>[3]</sup>.

#### i) Dumping

The refuse is dumped in low lying areas and used to reclaim land by disposing dry waste. The volume of waste is reduced by bacterial action and converts into humus. In Kolkata, this method is used to reclaim land which is leased for cultivation <sup>[3]</sup>.

Drawbacks: Refuse is exposed to flies and rodents, it's a source of nuisance from smell and unsightly appearance, the loose waste is dispersed by the wind. Ground and surface water gets polluted <sup>[3]</sup>.

#### ii) Controlled Tipping (Sanitary Landfills)

Controlled tipping is the best method for the disposal of waste in areas where land is available. It emits least toxic gases, annihilates pathogens, improves soil quality, and possible to isolate leachate. Controlled tipping should be executed by skilled and technical hands. In this method, the waste is collected and placed in a trench, compacted and covered with earth each day. In case the process is performed at the end of a week, the process is called *modified sanitary landfill* <sup>[15]</sup>.

#### Methods of controlled tipping <sup>[3]</sup>

1. Trench method: The method is used in areas where level land is available. A trench is dug depending on the local condition. The waste is compacted and covered with the excavated earth.
2. Ramp method: This method is employed when the land has a moderate slope. Excavation is done to secure the covering method.
3. Area method: This method is used for filling the land with depressions, disused quarries and clay pits.

As a result of the chemical, bacteriological and physical changes in the buried refuse, the temperature exceeds 60o C within 7 days, killing the pathogens. There is increased decomposition process. The temperature cools within 2 to 3 weeks and almost 4 to 6 months for the complete decomposition process and formation of humus. The waste should not contain water as it creates a nuisance of the foul odors given off by the decomposition of organic matter.

**iii) Incineration**

Incineration is the process of burning or combusting the waste. This is the preferred method when land availability is limited. Hospital waste which is dangerous is best treated by incineration. Incineration kills the pathogens and destroys the materials which harbor pathogens. It is not a cost effective method for smaller quantities of solid waste. The burning of plastics in unregistered incinerators can be extremely hazardous as it creates a new set of chemical toxins which are extremely harmful, even in trace quantities. Some of these chemical toxins include gases like sulfur gases, hydrogen chloride and nitrogenous emitted from incinerating heavy metals, present in plastics. Release of dioxins and furans from incineration of plastics have major ill effects on the health of humans and may lead to neurologic problems. They may become part of fly ash which is extremely toxic and needs to be disposed off carefully<sup>[11, 12]</sup>.

The incinerator is the machine which uses oil or electricity to power itself. The waste material is fed into the incinerator and is burnt in it. Normally incinerators are operated at temperature ranging from 300 – 1100 deg. C based on the volume of waste, the type of incinerator. In India, usually a single or a double chamber incinerator is used. 11

In hospitals, incineration could be successful if handled by the trained staff. Prior to incineration, sorting of waste is an essential process, the incinerator too should be operated at the desired temperatures for the complete destruction of the waste. If not used effectively, incineration may be an extremely high risk method of disposal of waste, particularly medical waste<sup>[11]</sup>.

**iv) Composting**

In composting the refuse, night soil or sludge are treated together. The organic matter breaks down by the action of bacteria and eventually leads to humus – like material formation, called compost which has a high manurial value for the soil. The main by – product are carbon dioxide, water and heat. The temperature rises to over 60 deg. C over a period of several days and results in the destruction of eggs, and larvae of flies, weed seeds and pathogenic agents. The compost thus produced contains minimal disease producing organisms and is a good soil builder with small amount of plant nutrients including nitrates and phosphates. 3

The final quantity of the compost obtained is nearly half the amount of material used. This is because of the change in the water content during the process and also due to the rejection of non – decomposable substances. Thus, prior to composting, segregation and sorting of waste is imperative. In developed countries, if the waste has more of glass and metals, then ballistic containers are used to remove these contents. This is not a common practice in India as metal and glass content in the waste is not large<sup>[8]</sup>.

**Methods of composting:**

1. Bangalore Method (Anaerobic Method): The Bangalore method was developed by the Indian Council of Agricultural Research at the Indian Institute of Science, Bangalore<sup>[3]</sup>.  
Depth of trench: 3 ft. The depth should not exceed 3 ft. Breadth: 5 – 8 ft. length: 15 – 30 ft. The pits should be located 800 meters off the city limits.

Process of composting:<sup>[3]</sup>

A layer of refuse 25 cm thick is spread at the bottom of the trench. A 5 cm layer of night soil is spread over this. Alternate layers of refuse and night-soil of 25 cm and 5 cm thickness respectively are placed till the heap rises to 1 foot above the ground level. The top layer of refuse should be 25 cm thick. The heap is then covered with the excavated earth. If laid properly, man's leg will not sink when walking over the compost mass.

Due to the bacterial action, considerable heat is generated in the compost mass and the intense heat persists for 2 to 3 weeks. This aids to decompose and destroys the pathogenic and the parasitic organisms. The decomposition process completes within 4 to 6 weeks.

2. Mechanical Composting (Aerobic Method): In this process, the compost is generated on a large scale by the raw materials and turning out a finished product. The refuse is cleared of salvageable items like rags, bones, metal, and glass and is then pulverized in pulverizing equipment in order to reduce the size of the particles to less than 2 inches. This refuse is mixed with sewage, sludge or night soil in a rotating machine and is incubated. The carbon – nitrogen ratio, temperature, pH and aeration are controlled. The composting process is completed within 4 to 6 months<sup>[3]</sup>.

This method is employed in developed countries including Holland, Germany and Israel. In India, the Government is considering setting up plants in Delhi, Nagpur, Mumbai, Chennai, Pune, Allahabad, Hyderabad, Lucknow and Kanpur<sup>[3]</sup>.

**v) Manure Pits**

The use of manure pits goes a long way in solving the problem of refuse disposal in rural set – ups. (Agrarian communities) In rural India, though the volume of refuse is not huge, but is scattered, leading to unhygienic environment. In rural India, the refuse is thrown around the houses resulting in gross soil pollution. The garbage, cattle dung, straw and leaves are dumped in the manure pits and covered with soil at the end of the day. Ideally two pits are prepared as one is closed, the other is utilized. The decomposition process occurs in 4 to 6 months and the manure thus formed is returned to the fields improving the soil value<sup>[3]</sup>.

**vi) Burial<sup>[3]</sup>**

This method is preferred in small camps. A trench is dug at the end of the day in which the refuse is dumped.

Dimensions: Width: 1.5 meters, Depth: 2 meters. A trench 1 meter long can be used by about 200 people for a week.

The refuse is covered with 20 to 30 cm of earth. When the level of the trench is 40 cm away from the ground, the trench is filed with the earth and compacted and a new trench is dug. The contents are removed after 4 to 6 months and are used as plant growers in the field.

**Public Education**

In order to obtain efficient disposal of the refuse, public education is vital. For this purpose, newspapers, pamphlets, broadcastings, films are used as a media to educate the masses of the importance of effective waste disposal and its association with health and environment<sup>[3]</sup>.

### Bio-medical/dental Waste Disposal

According to the 1998 Bio – Medical Wastes (Management and Handling) Rules of India, waste which is generated during the diagnosis, treatment and immunization of human beings or animals, or in research activities pertaining thereto or in the production and testing of biological products.<sup>3</sup>

The healthcare waste includes all the wastes generated by healthcare establishments, Hospitals, Dental clinics, Diagnostic centers, Laboratories Blood banks, Nursing homes, Clinical research facilities and laboratories. It also includes the wastes originating from minor or scattered sources such as those produced in the course of health care undertaken in the home<sup>[3]</sup>.

### Classification/Categories of Bio – Medical/ Dental Waste<sup>11</sup>

To state a few, Bio – Medical/dental waste includes: Human anatomic waste, Microbiology, biotechnology waste, Sharp waste, Discarded medicines, chemical, radioactive, waste, wastes such as incineration ash, etc.

### Hazards of Health – Care Waste<sup>[3]</sup>

Exposure to hazardous health – care wastes can lead to disease of injury because of:

- i) **Infectious agents and sharps:** The pathogens in the infectious wastes may enter the human body through puncture, abrasion or cut in skin through the mucus membrane by inhalation or ingestion, which may cause HIV or hepatitis B and C.
- ii) **Toxic or hazardous chemicals or pharmaceuticals:** Chemicals used in health – care establishments may be toxic, genotoxic, corrosive, flammable, reactive, explosive or shock – sensitive. Though present in small quantities, they may cause intoxication and injuries.
- iii) **Genotoxic wastes:** The severity of the hazards for the health – care worker responsible for handling or the disposal of the genotoxic waste depends on the combination of the toxicity of the substance and the extent and duration of exposure. Exposure may occur during the preparation or treatment with a drug or a chemical. Inhalation of drug or aerosols, absorption through the skin, ingestion of food contaminated with the cytotoxic drugs, chemicals or wastes are potent ways of exposure
- iv) **Radioactive wastes:** The type of disease as a result of radioactive waste exposure depends on the type and the extent of exposure. The health care personnel may suffer from dizziness, vomiting, headache or more serious health problems. The genetic make – up of the individual too may be affected.
- v) **Public sensitivity:** The general public reacts strongly to the visual impact of health – care waste

The persons at risk of exposure include: Medical doctors, Dentists, nurses, health – care auxiliaries and hospital maintenance personnel Patients in health – care establishments Visitors to the health – care establishment Workers in support service allied to health – care establishment like laundries, waste handling and transportation Workers in waste disposal facilities like landfills or incinerators.

### Regulatory Requirements for Hazardous Waste Disposal<sup>17</sup>

The Government of India has introduced various laws over the years with an attempt to control pollution due to air, water,

environment, hazardous waste and biomedical waste. Some of the important regulations introduced include:

- Water (Prevention and Control of Pollution) Act, 1974
- Air (Prevention and Control of Pollution) Act, 1981
- The Environment (Protection) Act, 1986
- The Hazardous Waste (Management and Handling) Rules, 1989
- The Biomedical Waste (Management and Handling) Rules, 1998

Hospitals as pointed earlier have adopted models for bio-medical waste management to prevent unfavorable health and environment hazards.

The Biomedical Waste (Management and Handling) Rules introduced by the *Ministry of Environment and Forests, Government of India on 20th July 1998* is applicable to individuals who generate, collect, receive, store, transport, treat, dispose and handle the bio-medical/dental waste.

The bio – medical/dental waste is segregated into containers and bags where the waste is generated. The bags used for the collection of wastes are properly coded with different color so as to enable proper segregation and management. In case the bags are not color coded, they should be adequately labeled to avoid improper segregation, which may cause health and environmental hazards.

### Disposal Options of Bio – medical (Dental) Waste

Here, a special focus is sighted on the bio – medical waste generated and managed in the dental settings.

### Bio-medical Waste Generated in Dental Settings

There are numerous wastes generated in the dental settings like extracted teeth, amalgam fillings, teeth with fillings, blood soaked cotton, floss, contaminated water, dentures, undeveloped or expired X-Ray films, sharps needles, used burs, wires, masks etc. A lot of the waste generated in hazardous and if not treated effectively can cause harm to health and environment. The disposal of the dental wastes requires the effective management to minimize the potential impact on the environment and also reap the economic benefits of waste avoidance. The disposal of the hazardous dental wastes must follow the law of the land. The regulation requires each waste generator to be aware of how the waste is handled.

### Disposal Options of bio – medical (dental) waste<sup>18</sup>

There are statutory disposal options for oral health centers which should be stringently followed by dental professionals to avoid unforeseeable health hazard.

### Disposal of Wastes contaminated with Mercury Elementary Mercury Waste Management Options

Source of elementary mercury as waste in dental settings is fillings, extracted restored teeth, mercury spills.

### Solid Wastes

#### Nonhazardous Wastes

#### Waste Management Protocol for a Dental Clinic<sup>17</sup>

##### Step 1: Carry out a Waste Audit

One week audit is performed to understand the current disposal practices and items which are not disposed in the correct manner.

### **Step 2: Develop a Waste Management Plan**

The purchasing, work and recycling practices are reviewed to reduce the amount of waste generated. The review is best done with the team involving the entire staff.

### **Step 3: Train Staff**

Each staff member is involved in the process of proper waste management. Each staff member is entrusted with specific responsibilities and the staff is kept informed regarding the progress, achievements, and shortcomings of the process of waste management being practiced.

### **Step 4: Monitor Procedures and Review the Plan**

A random check may be carried out wherein the dustbins are checked to ensure that the proper waste disposal and segregation methods are being practiced. The audit is repeated and waste management plan is reviewed at end of a year.

### **Step 5: Amend the plan as required**

Once the plan has been implemented, flaws may be detected during the review of the plan and is altered as per the needs and requirements.

### **Discussion**

Proper waste management is the need of the hour to minimize adverse health burden on the society. The determining factors or proper waste disposal depends on the type and the quantity of waste produced. A few issues related to ineffective waste management in India are: the inadequate infrastructure and finances for waste management, insufficient training of different stake holders in management of wastes and above all inadequate planning with respect to waste management. (This is probably true for most developing countries)

### **Dumping**

Despite the WHO strong advocacy for banning of the dumping method of waste disposal, it still stays to be one of the most popular waste management methods practiced in India as it is cost effective and the reclaimed land can be used for the cultivation of green-belt areas and construction.

In the earlier days, the waste generated primarily composed of biodegradable material and hence open dumping did not produce much of a problem. Off late, however, the nature of the waste produced has changed drastically and the content of the non – biodegradable material including plastics, metal and synthetic material is on the rise. Thus alternate methods need to be looked into in order to minimize the health and environmental hazards produced as a result of the improper waste disposal practices. In line of this argument, Nair 1993 suggests treatment of leachate at sites (which pollutes both surface and ground water) and use of natural and synthetic liners to isolate it.<sup>5</sup>

Perhaps the most important single factor in improving the efficiency of public cleansing services is to introduce a primary storage and collection system as pointed in Chandigarh Case Study. Present collection systems often involve double handling or, when non-tipping trucks, trailers or trolleys are in use, even treble handling of all wastes. Use of simple indigenous equipment such as hand or pedal driven carts working in conjunction with tractors, trailers or container handling equipment can improve collection of wastes where the lanes are narrow and have dense population.<sup>6</sup>

Initiatives have been tried in different cities of India to segregate the waste at the source of generation. In some cities, separate bags are provided for the appropriate disposal of waste and for recycling. As a result, many of the things are returned to the society. For example, the use of plastic waste in pavement modification, recycling of cans, papers, bottles, etc. <sup>[14]</sup>.

### **Landfill**

Landfill is the most practical and ecologically sustainable method of waste management. The drawback of the landfill method is that the decomposition of the organic waste results in the release of leachate, a fluid harmful to the ecosystem. This problem can be addressed by the use of sanitary – landfills. In the sanitary landfills, the waste disposal is carried out to protect against ground and surface water pollution, air fugitive dust, litter, foul smell, fire hazards, bird menace, pests or rodents, methane emissions, soil erosion. The gas generated in the landfills can be used as a source for fossil fuel. The major drawback is that the sanitary landfills are not cost effective. Often, as a result of improper segregation, hospital, industrial and domestic wastes are deposited at the same place and may lead to environmental and health hazards. Hence, segregation at the source is imperative for effective sanitary landfills. Given the merits of burial method of waste disposal, it could be an alternative choice, especially for managing the waste of smaller communities.

### **Composting**

Composting is a microbial based aerobic/anaerobic process and is an effective environmental friendly method to produce organic fertilizer. Composting is suited for a country like India wherein most of the waste generated is biodegradable. Composting method is of particular importance where there is low water content; the soil is erodible, sandy; as it helps to improve the quality of the soil and plants and provides valuable plant grower medium. Composting is carried out by either the Bangalore or the Indore method. While the Bangalore method is an anaerobic method of composting, the Indore method is an aerobic method. The final quantity of the compost obtained is nearly half the amount of material used for the composting. This is because of the change in the water content during the process of composting and also due to the rejection of non – decomposable substances <sup>[8]</sup>.

### **Incineration**

Incineration is the method of thermal treatment process. There is combustion of waste in the presence of oxygen. After incineration, the waste is converted into carbon dioxide, water vapor and ash. There is a problem of proper disposal of the ash produced. The method is advantageous as the energy produced may be used for the generation of electricity and heating. The volume of waste generated is reduced in volume, renders it harmless and minimizes the transportation costs. (Solid waste management) <sup>[19]</sup>. The release of the greenhouse gas methane too is minimized. This method is useful in limited land availability and large population. The problem of incineration is the emission of toxic gases during the burning process, particularly in cases where open burning is practiced. Using an incinerator for incineration may not always be the best option for waste management as there may be production of micro – pollutants. Dioxins are extremely harmful pollutants which

may be produced during the process of incineration in an incinerator<sup>[11]</sup>.

Depending on the nature of biomedical waste generated needs to be disposed off as the Ministry of Environment and Forest, Government of India Guidelines. The most important factor to minimize menace due to pathogens, injuries by sharps, chemicals is to reduce the waste generated and systematic segregation at the source. For example, soiled towels, masks, cups should be disposed in a regular general waste and PVC should not be mixed with sharp or infectious wastes.<sup>18</sup>

Incineration are most effective for biomedical waste and is best for cities where there conglomeration of hospital, nursing homes, dental settings, where the biomedical waste, collected from these centers could be disposed safely. This would probably address the concern stated in *State of Environment Report 2003* study which states that in most Indian cities biomedical waste is unscientifically disposed in a slapdash fashion<sup>[14]</sup>.

**Conclusion**

The proper management of waste is extremely important for sustained growth and development of civilizations. It is well documented and debated that there cannot be one unique method for waste disposal. The nature of waste, source of its generation the quantity of waste, size and lifestyle of community where waste is generated the geographical and climatic conditions where it is generated, the available infrastructure, the affluence and development of the region disposal would be deciding factors for the choice of waste management method: dumping, burial, composting incineration and many more. In addition the disposal technique would be weighed for its eco-friendly and cost-effective merits.

The solid waste management would have different consideration as compared to biomedical/dental waste.

However a few actions are imperative for any category of waste

- Segregation of waste at the source.
- Reduce the size of waste
- Use ecofriendly techniques for waste management
- Adequate planning before deciding for waste disposal method
- The health care personnel need to practice waste management at the basic levels and initiate methods to ensure adequate waste disposal.
- The citizens groups need to be more proactive and ensure that the government enacts laws for waste management and disposal and also ensure their implementation.
- The government needs to be alert to the need of the hour and enact or modify the existing laws and also ensure their effective implementation through policing and reinforcement initiatives.

**Suggestions for Actions against Improper Waste Disposal in Medical and Dental Setups**

- Advocacy for commitment towards appropriate bio/dental waste disposal among health practitioners.
- Formation of dental and medical professional committees as watchdog for bio medical/dental waste disposal
- Promoting newer initiatives and methods which are ecofriendly and safe in disposing off the bio-medical/dental waste
- Both medical and dental public health professional should take stronger initiative to develop educative material (keeping in focus the region and waste disparities) for awareness of proper waste disposal in health care setups.
- With collaborative effort of media and public health activist, incidents related to improper waste management should be publicized.

**Table 1:** Category, Treatment and disposal of different category of wastes

Option	Category	Treatment and Disposal
1	Human & animal waste: Human tissues, organs, body parts	Incineration Deep burial
2	Animal waste: Animal tissues, organs, body parts, carcasses, bleeding parts, fluids, blood and experimental animals in research, wastes generated in veterinary hospitals, colleges, discharge from hospitals, and animal houses	Incineration Deep burial
3	Microbiology & biotechnology wastes: Wastes from laboratory cultures, stocks, specimen of microorganisms, human & animal cultures, wastes from biological, toxins, dishes and devices in transfer of culture	Incineration Autoclaving Microwaving
4	Waste sharps: Needles, syringes, scalpels, blades, glass which may cause puncture and cuts – used and unused	Disinfection Autoclaving Microwaving Mutilation Shredding
5	Discarded medicines and cytotoxic drug: Outdated, contaminated and discarded medicines	Incineration Destruction and drug disposal in landfills
6	Solid waste: Items contaminated with blood and body fluids including cotton, dressings, soiled plaster casts	Incineration Autoclaving Microwaving
7	Solid wastes: items generated from disposable items apart from sharps like tubing, catheters, intravenous sets, syringes, injections.	Chemical treatment Autoclaving Microwaving Mutilation Shredding
8	Liquid wastes: Wastes generated from laboratory and washing, cleaning, housekeeping and disinfecting activities	Chemical treatment Discharge in drain

9	Incineration ash: Ash from the incineration of any bio–medical waste	Disposal in municipal landfills
10	Chemical wastes: Chemicals used in the production of biological, chemicals used in disinfection	Chemical treatment Discharge in drains (Liquids) Landfills (Solids)

**Table 2:** Average Composition of Hospital Waste in India (National Environmental Engineering Research Institute, 1997) <sup>[3]</sup>

Material	Percentage
General waste (food waste, sweepings from hospital premises)	53.5
Paper	15
Rags	15
Plastics	10
Glass	4.0
Infectious wastes	1.5
Metals (Sharps)	1

**Table 3:** Color Coding and Types of Containers for Disposal of Bio – Medical Waste<sup>11</sup>

Color Coding	Type of Container	Waste Category	Treatment Options
Yellow	Plastic bag	Categories 1, 2, 3, 6	Incineration Deep burial
Red	Disinfected container Plastic bag	Categories 3, 6, 7	Autoclaving Microwaving Chemical treatment
Blue/White/Translucent	Plastic bag Puncture proof container	Categories 4, 7	Autoclaving Microwaving Chemical treatment Destruction Shredding
Black	Plastic bag	Categories 5, 9, 10 (solid)	Landfills

Category 8 and 10 (liquids) do not require containers or bags

Category 3 if disinfected locally need not be put in the containers or bags

**Table 4:** Best Management Practices

<p><b>Best Management Options</b></p> <ul style="list-style-type: none"> <li>▪ Store unused elemental elementary mercury in air – tight, sealed, break – resistant container</li> <li>▪ The container should be properly labeled as ‘Hazardous Waste: Elementary Mercury’</li> <li>▪ For the disposal or recycling, a certified waste carrier should be contacted</li> <li>▪ ‘Mercury spill kits’ are used in case of spill of the elementary mercury</li> </ul>
<p><b>Good Management Practices</b></p> <ul style="list-style-type: none"> <li>▪ React the unused elementary mercury with the silver alloy and form scrap amalgam</li> </ul>
<p><b>Don’ts</b></p> <ul style="list-style-type: none"> <li>▪ The person should not transport the elementary mercury personally</li> <li>▪ The elementary mercury should not be disposed in the garbage</li> <li>▪ To elementary mercury should not be washed down the drain</li> </ul>

**Table 5:** Best Management Practice of Amalgam Scrap.

<p><b>Best Management Practice</b></p> <ul style="list-style-type: none"> <li>▪ The scrap amalgam is stored in Mercontainer</li> <li>▪ The empty amalgam capsules can be disposed in the garbage</li> <li>▪ The amalgam separator should be certified</li> <li>▪ The amalgam carrier should be certified and should be called regularly to dispose the waste generated</li> <li>▪ Disposable suction traps are preferred and should be changed weekly</li> <li>▪ Gloves, masks and glasses should be worn while cleaning the suction traps</li> <li>▪ The used suction traps need to be put in properly labeled containers</li> <li>▪ A certified waste carrier needs to be contacted for the appropriate disposal and recycling</li> </ul>
<p><b>Good Management Practices</b></p> <ul style="list-style-type: none"> <li>▪ The containers should be properly labeled and should have mercury suppressant</li> <li>▪ Label the container ‘Hazardous Waste: Scrap Amalgam’</li> <li>▪ Remove the large pieces of amalgam manually and place them in a contact amalgam container</li> <li>▪ Do not mix amalgam in excess quantities</li> <li>▪ As far as possible, replace amalgam with proper substitutes</li> <li>▪ Wear gloves, mask and glasses when removing the non – disposable traps from the suction lines.</li> </ul>
<p><b>Don’ts</b></p> <ul style="list-style-type: none"> <li>▪ The scrap amalgam should not be disposed in garbage</li> <li>▪ The scrap amalgam should not be washed down the drain</li> </ul>

- The scrap amalgam should not be given to non – certified dealers for disposal and recycling
- The traps and filters should not be rinsed in the sink
- Extracted teeth with amalgam restoration should not be disposed with the regular garbage
- The unused particles of amalgam should not be suctioned

**Table 6:** Disposal of Waste Containing Lead

<b>Disposal of Wastes with Silver Contents</b>
<b>a) Spent X – ray fixer</b>
<p><b>Best Management Practices</b></p> <ul style="list-style-type: none"> <li>▪ Silver recovery units are used to recapture the silver from the fixer and should be collected in containers as per the specifications of the manufacturer</li> <li>▪ Label the silver container properly</li> <li>▪ For the disposal and recycling, a certified waste carrier needs to be contacted</li> <li>▪ Once the silver is removed, the fixer solution can be mixed with the developer solution and water and disposed down the drain</li> <li>▪ The used developer may be discharged into the sewer after diluting with water</li> <li>▪ The use of digital X – Ray units minimizes the need of the fixer solution</li> </ul>
<p><b>Good Management Practices</b></p> <ul style="list-style-type: none"> <li>▪ The developer and fixer is collected in a container provided by the disposal company</li> <li>▪ Label the container properly and use a certified waste carrier for the disposal and recycling</li> <li>▪ Avoid developer cleaners containing chromium</li> <li>▪ Enquire regarding the return of the unused developer</li> </ul>
<p><b>Don'ts</b></p> <ul style="list-style-type: none"> <li>▪ The silver recovery unit cartridge should not be mixed with garbage</li> <li>▪ The fixer should not be poured down the drain</li> <li>▪ The chromium – containing cleaners should not be discharged into the sewer system</li> </ul>
<b>b) Undeveloped X-ray Film</b>
<p><b>Best Management Practices</b></p> <ul style="list-style-type: none"> <li>▪ The unused films meant for disposal should be collected in a container specified by the disposal company</li> <li>▪ The supplier is to be contacted for the take back program</li> <li>▪ The certified waste carrier is contacted to dispose and recycle the waste collected</li> <li>▪ Digital X – ray units minimize the purchase of new x – ray films</li> <li>▪ Developed X – ray films can be placed in the regular solid waste disposal stream</li> </ul>
<p><b>Don'ts</b></p> <p>The undeveloped film should not be thrown in the regular garbage</p>
<b>c) Lead Foil Packets/ Lead aprons</b>
<p><b>Best Management Practices</b></p> <p>Inquire about the lead recycling program</p> <p>Contact the certified waste carrier for the recycling or the disposal of the unwanted lead aprons</p>
<p><b>Good Management Practices</b></p> <p>The lead foils are collected in a marked container</p> <p>The certified waste carrier is contacted for the disposal and recycling</p>
<p><b>Don'ts</b></p> <p>Do not throw the lead foil packets in the regular garbage</p>

**Table 7:** Disposal management of Chemicals, Disinfectants and Sterilizing Agents

<b>Disposal of Biomedical Wastes at Dental settings</b>
<b>a) Non – Anatomical Wastes (Blood soaked materials, extracted teeth)</b>
<p><b>Best Management Practice</b></p> <ul style="list-style-type: none"> <li>▪ Use a yellow biomedical waste bag for the collection of the non – anatomic wastes</li> <li>▪ The bag should be properly labeled with the biohazard symbol</li> <li>▪ In case the waste is to be kept for more than 4 days, it should be refrigerated</li> <li>▪ The certified biomedical waste carrier should be informed for the disposal and recycling</li> <li>▪ <i>Extracted teeth should be cleaned disinfected and put separately in labeled bags</i></li> </ul>
<p><b>Don'ts</b></p> <ul style="list-style-type: none"> <li>▪ Do not throw the blood soaked materials into the regular garbage</li> <li>▪ Do not throw the blood soaked materials in the compost waste</li> <li>▪ Do not place the blood soaked materials in the sharps container</li> </ul>
<p><b>b) Non – Anatomic Wastes</b></p> <p>It includes sharp, syringes, chemicals, used broken burs, dentures, etc.</p>

<p><b>Best Management Practice</b></p> <ul style="list-style-type: none"> <li>▪ Collect the sharps in red or yellow puncture resistant container with a lid which cannot be removed</li> <li>▪ The sharps container should be labeled with the biohazard symbol</li> <li>▪ For disposal, a certified waste carrier should be contacted</li> <li>▪ <i>Dentures and other such material should be segregated for appropriate disposal / recycling process</i></li> </ul>
<p><b>Don'ts</b></p> <ul style="list-style-type: none"> <li>▪ Do not mix the sharps with the regular garbage</li> <li>▪ Do not place other biohazard waste materials in this container</li> <li>▪ Avoid over – fill to prevent injury</li> </ul>
<p><b>Best Management Practices</b></p> <ul style="list-style-type: none"> <li>▪ The practitioner should be aware of the Material Safety Sheets for chemicals, disinfectants and sterilizing agents</li> <li>▪ The staff which handles the materials ought to be trained in the Workplace Hazardous Information System</li> <li>▪ As far as possible, the chemical sterilants should not be used</li> <li>▪ Steam or dry heat method of sterilization is preferred</li> <li>▪ In case disposable plastics are used, non – chlorinated plastics are preferred to minimize the environmental impact</li> <li>▪ For appropriate disposal, the manufacturer's recommendations are to be exercised.</li> <li>▪ Rinse the empty sterilant containers with the water and place the empty containers in solid waste stream.</li> <li>▪ Halogenated products are avoided as these may have adverse effects on the environment</li> </ul>
<p><b>Good Management Practice</b></p> <ul style="list-style-type: none"> <li>▪ Minimize the use of the disinfectants whenever possible by the disinfecting only when required.</li> </ul>
<p><b>Don'ts</b></p> <ul style="list-style-type: none"> <li>▪ The ignitable substances should not be poured down the drain</li> <li>▪ Do not pour the X – ray cleansing solutions containing chromium in the drain</li> <li>▪ Used or unused chemicals should not be poured down the drain</li> <li>▪ Do not pour sterilant solutions into the septic system.</li> <li>▪ The concentrated or date expired sterilant solution into the municipal sewer system</li> <li>▪ The concentrated alcohol, ether or peroxides should not be poured down the drain</li> </ul>

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