

Recasting Biomedical Waste Management Strategies during COVID-19 Pandemic in Dental Practice

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Abstract

A rise in the COVID-19 pandemic has led to increase in biomedical waste (BMW) all over the globe that leads to the perilous situation. Hence, this review has made an attempt to gather all the guidelines for appropriate BMW management in dental practice during COVID-19 pandemic. The keywords such as Biomedical waste management guidelines, COVID-19, dental waste management, and India were used in the literature search engines such as PubMed, Scopus, Web of Science, and Google Scholar along with the various guidelines provided by international, national agencies and verified government websites with a focus on the BMW management in dentistry during COVID-19. The result enumerated that Biomedical Waste Management Rules, 2016, categorizes the bio-medical waste generated from the health-care facility into four categories based on the segregation pathway and color code. These guidelines were reshaped in 2018, 2019, and in 2020 for COVID-19 pandemic. Collection and segregation of biomedical waste separately before handling it to the Common Bio-medical Waste Treatment and Disposal Facility was highly recommended that should be labeled with “COVID-19” both in medical and dental waste management guidelines. This review revealed that BMW management guidelines should be followed by all the health-care fraternities including oral health professionals as they are at a heightened risk of COVID-19, it is vital that they are informed of the most up-to-date protocols for BMW disposal in this pandemic.

Keywords: COVID-19, dental practice, disposal, guidelines

INTRODUCTION

The outbreak of COVID-19 pandemic can create another hazardous condition if proper measures are not taken such as biomedical waste (BMW) management during COVID-19. All wastes generated during diagnosis, treatment, or vaccination of people need to be disposed of properly.^[1] According to the World Health Organization (WHO) out of the total amount of waste generated by health-care activities, about 85% is a general and nonhazardous waste. The remaining 15% is considered hazardous material that may be infectious, poisonous, or radioactive, hence it is of substantial cause for concern.^[2] On an average, high-income countries produce 0.5 kg of hazardous waste per hospital bed every day, while low-income countries produce 0.2 kg. However, in low-income nations, health-care waste is sometimes not divided into hazardous and nonhazardous wastes, resulting in a substantially higher real quantity of hazardous waste.^[3]

Although, municipal incinerators and installations manage hazardous waste disposal or recovery but they inevitably

generate and release toxic emissions and effluents, such as dioxins, carcinogens recognized by the International Agency for Research on Cancer (1997) – into the environment. Such BMW treatments are also known to release carcinogens, such as dioxins, arsenic, benzene, cadmium, and chromium that can cause detrimental reproductive, respiratory outcomes, and cancer.^[4]

SARS-CoV-2, a pathogenic human coronavirus, produced disease COVID-19 in December 2019, resulting in significant illness and multiple deaths. Because the situation is fast developing, the eventual magnitude and impact of this outbreak

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are still unknown.^[5] During pandemics, not only the amount of BMW rise in hospitals, but the collection at home also escalates due to the isolated people and infectious trash from residential settings.^[6] In India as per the information submitted by the Central Pollution Control Board (CPCB)/Pollution Control Committee as well as daily data received from COVID19BWM tracking app, the updated average quantity of COVID-19-related BMW generation during December 2021 was about 23.02 Tonnes per day.^[7]

Dental practice generates a huge amount of waste, including plastics, latex, cotton, glass, and other materials, the majority of which are contaminated with infectious bodily fluids. Other types of trash produced by dental practices include silver amalgam, mercury, and other chemical solvents, all of which must be properly addressed.^[8,9] A decreased volume of BMW equals less work for waste disposal personnel, a more efficient waste disposal system, and cost savings.^[10] In the current COVID-19 pandemic, dentists, auxiliaries as well as patients undergoing dental procedures are at high risk of cross-infection. Most of the dental procedures require close contact with the patient's oral cavity, saliva, blood, and respiratory tract secretions. It is a known fact that saliva is rich in COVID-19 viral load and many patients even asymptomatic may be carriers for the disease. Due to such hazardous condition, it is vital to follow all precautions in dental clinical practice.^[11] Many developing countries either do not have appropriate regulations, or do not enforce them. Lack of awareness about the health hazards related to health-care waste, inadequate training in proper waste management, absence of waste management and disposal systems, emission of toxic effluents and carcinogenic gases due to BMW treatment, insufficient financial and human resources, and the low priority given to the topic are the most common problems connected with poor management of the health-care waste.^[2]

Furthermore, since its inception until COVID-19 pandemic, the recommendations for BMW management have evolved. It is critical that the medical fraternity along with oral health professionals and those who handle BMW should adhere to the most recent BMW management rules and guidelines. As a result, this review evaluation emphasizes and discusses the BMW management strategies in dental practice during COVID-19 pandemic in India.

METHODS

The data for this review were compiled from relevant articles focusing on BMW management during COVID-19 in dentistry using MeSH and free text terms such as BMW management guidelines, COVID-19, Dental waste management, and India in the comprehensive search on reputable citation databases such as PubMed, Scopus, Web of Science, and Google Scholar, online news articles, and various guidelines provided by international, national agencies and verified government websites. Recent updated information and data were extracted from government websites such as the Ministry of Health

and Family Welfare, CPCB, Welfare CPCB Ministry of Environment, Forest and Climate Change, WHO, Indian Dental Association (IDA), Dental Council of India (DCI), Centers for Disease Control and Prevention, and the Indian Council of Medical Research.

RESULTS

Biomedical waste management in dentistry

As dental health professionals are in close contact with saliva, blood, and the oral cavity, they are at a higher risk of contracting viral and bacterial infections and even transmitting them through occupational exposures which is raised during COVID-19.^[12] Improper segregation, disposal and mixing of BMW with municipal waste can result in the possible exposure of the health care workers, waste handlers, waste pickers, and also the general public to deadly infections, such as acquired immunodeficiency syndrome, hepatitis B and recently huge amount of COVID 19 waste generated by dental clinics make it crucial for dentists to have adequate knowledge and training on BMW management.^[2]

Classification and management of biomedical waste in dentistry

Dental amalgam wastes (amalgam Traps, bulk mercury, and contact amalgam)

Dry dental amalgam waste should be collected and preserved in airtight containers, according to IDA recommendations.^[8,9,13] The container should be labeled "scrap dental amalgam" and included your office/name, clinic's address, and phone number, as well as the date the material was originally gathered in the container. Disposable amalgam traps are preferable and should be changed weekly, or more frequently if necessary, or as directed by the equipment's manufacturer.^[13]

An amalgam that has been in contact with the patient is known as contact amalgam

Examples are extracted teeth with amalgam restorations, carving scrap collected at chairside, and amalgam captured by chairside 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 nonmedical wastes, unless the extracted teeth are deemed as biohazards by the attending surgeon or dentist. Extracted teeth with amalgam should be managed as hazardous waste or recycled. However, the usage of amalgam has been reduced recently and shifted to other nonhazardous restorative materials, and this practice should be encouraged to minimize BMW hazard.^[8,13]

Other scrap heavy metals such as lead foils

Lead from lead foil of X-ray film and lead shields is the most common source of regulated heavy metals in dental settings and should not be placed in regular solid waste containers or drained.^[13-15] It must be managed as recyclable metal or hazardous waste. It is recommended that the lead should be disposed of by licensed recyclers and agencies.^[14]

Other metal sources include nickel and chromium from stainless steel orthodontic wires and crowns, and beryllium and nickel from crowns should not be discharged into the sanitary sewer system. X-ray photochemical containing heavy metals, 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. Impression materials containing zinc oxide could be considered hazardous waste.^[15]

X-ray processing wastes

Processing waste includes silver-containing wastes (X-ray photographic fixer), X-ray photographic developer, X-ray system cleaners containing chromium, and many other chemicals. Fixer containing the silver can be recycled. Untreated fixer should not be discharged into the sewer.^[13,14]

Onsite treatment and disposal for fixer management

Silver recovery units are available to remove the silver from the fixer. When using a silver recovery unit, leaks, spills, and overflows should be checked on a regular basis. Typically, a lower flow rate and a longer retention time will maximize the silver recovery of the solution. In 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, that can be performed with an analytical test kit or a lab analysis done by agencies.

Not treated onsite silver-rich photo processing waste waters or hauled offsite for silver recovery are subjected to full regulation as hazardous wastes.

Used X-ray fixer solutions can be hauled offsite for treatment and recycling to an environmental protection agency licensed recycling facility. For offsite recycling, the generator should be collected and stored 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.

Developer and fixer solutions should not be mixed. 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. Caustic solutions (developer) with a pH greater than the local pH limit should not be discharged down the sanitary sewer. Nonchromium-containing cleaners which can be discharged into the sanitary sewer are advised to clean X-ray developing systems. Otherwise, the waste must be handled as hazardous waste, requiring proper collection, labeling, and disposal.

Chemicals, disinfectants, and sterilizing agents^[16,17]

The use of sterilizing agents is increased due to pandemic. Moreover, chemicals used in dentistry may negatively impact the environment and human health. Using less harmful alternatives, cleaning methods and/or surface barriers can reduce the impact on the environment and the need for special handling of waste

in the dental practice. Used cleaning or disinfectant solutions should be stored in labeled, sealed, and leak-proof containers in a secure location that prevents their accidental falling and drain into any sanitary sewer, septic system, or storm drain. As per the guidelines for chemical waste management, if any chemical has a pH ≤ 6.0 or ≥ 10.5 , municipality should be contacted for disposal guidance. Similarly, for formaldehyde and/or formalin, glutaraldehyde, ammonia, or phenols containing solutions and detergent containing nonylphenol ethoxylates, municipality should be contacted for disposal guidance. Pharmaceutical wastes such as unused drugs and narcotics should be discarded through an approved waste carrier.^[16,17]

Medical waste

Sharps (hypodermic needles, blades, and syringes) and biohazardous wastes make up-regulated medical waste (e.g. laboratory wastes, solid wastes covered with blood, or other potentially infectious materials and pharmaceuticals). Sharps should be stored in a puncture-resistant, leak-proof container designed exclusively for sharps disposal. A sharps container should be located in each operatory and the sterilization lab (provided by BMW disposal vendors) and should be labeled as “biohazard waste sharps.” These are permanently sealed in the container (when full) and picked up by a BMW disposal vendor for proper disposal.

Other types of BMW including soiled rubber gloves, used swabs, and other blood or body fluid-saturated items should be separated from waste sharps, placed in a red bag that is labeled as “biohazard,” and should be stored in a rigid leak-proof container.^[13]

Anatomical wastes (human tissue)

Separated human tissue from sharps and blood-soaked materials should be collected in red liners that are marked with the universal biohazard symbol. It should be stored at a temperature at or below four degrees. The storage area must be marked as a BMW Storage Area with universal biohazard symbol. For portable dental equipment and mobile dental units, transport human waste tissue should be transported in an appropriately labeled and sealed red liner to a dental practice for disposal through an approved waste carrier.^[13,18]

Pharmaceutical waste

Expired or excess pharmaceuticals and laboratory/surgical wastes must be collected and transferred by a registered hauler to a licensed incinerator.^[1,13]

Nonhazardous office waste

This should be recycled whenever possible to improve their overall environmental performance of dental offices. A simplified biomedical segregation scheme^[17,19] for dental clinic is shown in Table 1.

Guidelines for handling, treatment, and disposal of waste generated during treatment/diagnosis/quarantine during COVID-19

The outbreak of COVID-19 has given a rise to global health crisis along with diverse impacts on economy, society, and

Table 1: Proposed biomedical waste segregation scheme for dental settings

Category	Type of waste	Type of bag or container to be used
Yellow	a. Human anatomical waste Human tissues, organs, body parts. Anything contaminated by blood or body fluids Body parts	Yellow-colored nonchlorinated plastic bags
	b. Animal anatomical waste Experimental animal carcasses, body parts, organs, tissues, including the waste generated from animals used in experiments or testing in laboratory or colleges. Unwanted laboratory specimens	
	c. Soiled waste 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, aprons, masks, drapes, contaminated wipes, throat packs. Discarded crowns, bridges and cast partial dentures Waxes, gutta-percha 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 unwanted laboratory specimens plastic X-ray pouches (outer covering) suture materials without needle	
	d. Expired or discarded medicines Pharmaceutical waste like antibiotics, cytotoxic drugs including all items contaminated with cytotoxic drugs along with glass or plastic ampoules, vials etc.	Yellow-colored nonchlorinated plastic bags or containers
	e. Chemical waste Chemicals used in production of biological and used or discarded disinfectants	Yellow-colored containers or nonchlorinated plastic bags
	f. Chemical liquid waste Liquid waste generated due to use of chemicals in production of biological and used or discarded disinfectants, Silver X-ray film developing liquid, discarded Formalin, infected secretions, aspirated body fluids, liquid from laboratories and floor washings, cleaning, house-keeping and disinfecting activities etc.	Separate collection system leading to effluent treatment system
	g. Discarded linen, mattresses, beddings contaminated with blood or body fluid	Nonchlorinated yellow plastic bags or suitable packing material
	h. Microbiology, biotechnology and other clinical laboratory waste Blood bags, laboratory cultures, stocks or specimens of microorganisms, live, human and animal cell cultures used in research, industrial laboratories, production of biological, residual toxins, dishes and devices used for cultures COVID-19: Used masks, head cover/cap, shoe cover, disposable linen gown, nonplastic/semi-plastic coverall anatomical waste, discarded medicine	Autoclave safe plastic bags or containers Yellow container/bin/trolley The inner and outer surface of containers/bins/trolley used for storage of COVID-19 waste should be disinfected with 1% sodium hypochlorite solution
Red	Gloves, disposable injection 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 COVID-19: PPEs such as goggles, face shield, Splash proof apron, hazmat suit, nitrile gloves, used syringes, IV sets, etc.	Red-colored nonchlorinated plastic bags or containers Red container/bin/trolley The inner and outer surface of containers/bins/trolley used for storage of COVID-19 waste should be disinfected with 1% sodium hypochlorite solution
		Cardboard boxes with blue-colored marking
Blue	a. Glassware Broken or discarded and contaminated glass including medicine vials and ampoules except those contaminated with cytotoxic wastes. Discarded medicines antiseptics, disinfectants (not contaminated by body fluids)	Cardboard boxes with blue-colored marking
	b. Metallic body implants	Cardboard boxes with blue-colored marking
White (translucent)	Waste sharps including metals Needles, syringes with fixed needles, needles from needle tip cutter or burner, scalpels, blades, or any other contaminated sharp object that may cause puncture and cuts. This includes both used, discarded, and contaminated metal sharps. Metal matrix bands. Broken metal instrument tip 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 implant-related materials	Puncture-proof, leak-proof, tamper-proof containers

Source: Guidelines for Management of Healthcare Waste as per Biomedical Waste Management Rules, 2016. Directorate General of Health Services Ministry of Health and Family. Welfare Central Pollution Control Board Ministry of Environment, Forest and Climate Change and Baghele *et al.*^[19]
PPE: Personal protective equipment, IV: Intravenous

environment. Efforts to battle COVID-19 have remarkably enhanced the BMW management including existing infrastructures, capacity utilization, policy guideline, operational practices, and waste handlers aspects are indeed necessity of today. The increased demand and spike in generation of BMW is unavoidable during this pandemic. Safe handling, treatment, and disposal of waste must be prioritized for minimizing environmental harm and human hazard.^[20,21]

Separate color-coded bins/bags/containers and double-layered bags to ensure adequate strength and no leaks were assigned along with proper segregation of waste as per the BMW Management Rules 2016 as amended and CPCB guidelines for implementation of BMW Management Rules. Collection and segregation of BMW separately before handling it to the Common Bio-medical Waste Treatment and Disposal Facility is highly recommended that should be labeled with "COVID-19." Trolleys and collection bins labeled with COVID-19 should be used, whose inner and outer surfaces should be disinfected with 1% sodium hypochlorite solution.

The CPCB directed in their revised guidelines regarding disposal of masks and gloves that even if it is infected or not used, everyone must cut it and kept it in paper bags for minimum 72 h before its disposal. They also directed that discarded personal protective equipments (PPEs) from general public at commercial establishments, shopping malls, institutions, offices, etc., should be stored in a separate bin for 3 days, thereafter, disposed of as dry general solid waste after cutting/shredding. According to the Union Ministry of Health and Family Welfare, the masks used by patients/caregivers/close contacts during home care must be disinfected by ordinary bleach solution (5%) or sodium hypochlorite solution (1%) and then disposed of either by burning or deep burial.

Several guidelines have been issued earlier by DCI, IDA, and other organizations and hence there is a need to issue unified guidelines.^[22]

According to the CPCB guidelines, used PPEs such as goggles, face shield, splashproof apron, hazmat suit, and nitrile gloves must be collected in red bag, whereas used masks, head cover/cap, and disposable linen gown must be collected in yellow bag, as shown in Table 1.

Guidelines for mouth mask

Cloth mask – It should be washed properly and regularly after use in running water. Left to hang and air dry.^[6,21-23]

Surgical mask – It should be removed chin upward and should be removed from the strings. Front portion of the mask should not be touched. After taking the mask off, fold it half inward, such that droplets from mouth and nose should not be exposed. Then, fold the mask into another half, until it looks like a roll. The mask can also be wrapped with its ear loops so that it will not unravel. Then wrap the mask in a tissue paper or polythene bag or in a paper bag and immediately discard it in the yellow waste bag. Or it should be kept in paper bag for minimum 72 h

and then can be disposed as general waste. The surgical mask was preferably cut and then discarded.

If the surgical mask is dry and the layers and shape are intact, put it in a zip lock pouch with a desiccated gel. The gel absorbs moisture and keeps the mask dry. If the mask is intact and not torn, it can be reused for 3 days.^[21-23]

N95 mask – Holding the edge of the straps attached, remove the N95 mask. Do not touch the inside part of the mask. Wash hands before and after removing the mask. Place the mask in a plastic bag or zip-lock bag to avoid dispersing contaminants. It can also be stored in a breathable container such as a paper bag between uses. Keep it secure. Place the bag into a garbage can or BMW disposal unit. It should also be put into a paper bag for 72 h and then disposed of as general waste. Never put on a new mask until you have properly washed your hands.^[6]

CONCLUSION

Improper BMW management is a menace to the environment, society, and economy. The COVID-19 pandemic has already resulted in heightened BMW around the world. In such perilous circumstances, it is not only essential to follow the updated BMW management recommendations but also a responsibility of all medical professionals to avert the adverse outcome due to poor management of BMW. Dental settings differ from others as it requires close touch with patients, which escalates the risk of infection. Advanced Dental Clinical Practice generates modern BMW as well, hence oral health professionals should follow all the guidelines and take extreme care about the safe disposal of dental waste in order to prevent its hazardous effects and for their safer clinical practice.

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Conflicts of interest

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