

A Study On Biomedical Solid Waste Management In Delhi With Emphasis On Corona Waste From Hospitals

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Abstract

The quantity of waste generation and its quality along with treatment mechanisms has become a matter of concern. Bio-medical waste management is an essential constituent of future sustainability. In view of the current situation of worldwide spread of COVID -19, there is a need to create a scientific scheme for the processing, treatment and disposal of the bio-medical waste. Basic theory for sustainably managing biomedical Healthcare waste (BMW) is driven by the determination of the quantity and frequency of bio- medical waste production, its classification, categorization and handling of the respective waste categories.

Present scenario of effluent treatment and waste management demands triangulation methods namely waste reduction, prevention of hazardous impact and economically viable pollution control technologies. The best management practices and appropriate technologies is an important tool for proper biomedical waste management. The composition, generation pattern and quantity of the medical waste is important to further decide on the apt treatment of the clinical waste and medical waste generation: The per capita biomedical waste generation varies from country to country on the basis of facilities available in the hospital, number of beds, average occupancy and footfall, number of employees etc. The per capita bio-medical waste generation is higher in developed countries. According to the annual report of DPCC, 2017, there were 5,394 healthcare facilities in Delhi, which generated 24,667.05 kilogram of waste per day.

Keywords: Biomedical Waste; COVID-19; healthcare; sterile wave; coronavirus

1 Introduction:

Biomedical Waste refers to the waste generated during healthcare procedures that are directly, indirectly or potentially adulterated by infectious materials

. These are the different terms that can be used in the place of biomedical waste and all have the same meanings.

- **Medical Waste**
- **Clinical Waste Bio-hazardous Waste**
- **Regulated Medical Waste (RMW)**
- **Infectious Medical Waste**
- **Healthcare waste**

These words can be used in each other's place but there is a difference between normal medical waste and clinical waste that is hazardous in nature

. According to WHO sharps, human skin, oils, and infected materials are categorized as "bio- hazardous" and "normal medical waste" equipment and animal skin.

In reality, office paper, sweeping waste, and kitchen waste from health care facilities are also called as medical waste legally but in practice it is not controlled as it is non-toxic in nature.

Hospital waste consists of a variety of dangerous items made from hypodermic needles, scalpels, scissors, medical cottons, helmets, bandages, clothing, expired drugs and body fluids, human tissues and organs, poisons, etc. Other waste produced in the health care sector includes nuclear waste, mercury-containing equipment, PVC plastics etc. According to WHO 85% of hospital wastes aren't hazardous in nature, whereas 10% are infectious and 5% are non-infectious, but they are also treated as hazardous wastes. Infectious waste includes all those medical wastes, which have the potential to spread viral (such as the present coronavirus), bacterial or parasitic diseases. Approximately 15% to 35% of Hospital waste is treated along waste that is hazardous in nature .

All of the biomedical waste at the hospital is currently being dumped with municipal solid waste only. Health institutions let the untreated liquid waste into drainage. The waste commonly is collected without disinfection in open containers. The items that are used to absorb body fluids like bandages, cotton, and other such items are collected in plastic or other containers that are not specified. Waste processing is performed in a mixed manner. The color coding system in hospitals is normally common throughout a country but some hospitals have their own system. Waste sharps are disposed of without being disinfected and mutilated, which can potentially cause infection in the future. The hospital's waste collection and transportation workers segregate the recyclable materials from non-recyclable ones. Similarly, the waste pickers separate all disposable plastic items from where the waste can be dumped in the healthcare facility premises or outside the community dustbin so that it can be transported and disposed of along with municipal solid waste. Since the infectious waste is sent along with municipal waste, in adverse environmental conditions it has the potential to make the whole lot infectious.

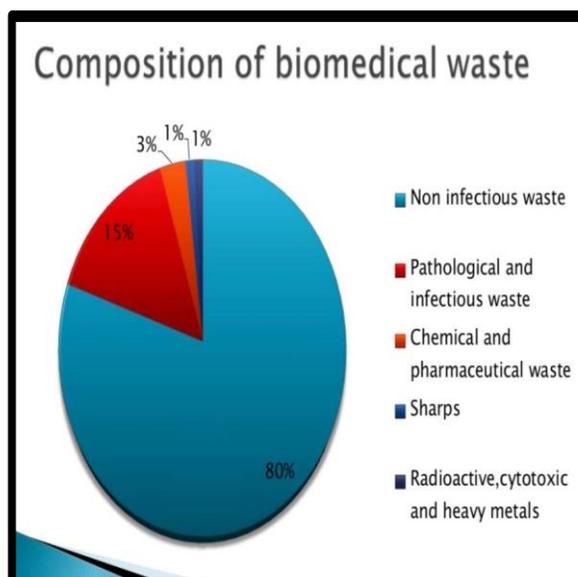


Fig. 1.1 Composition of Biomedical Waste

1.2 GENERATION PATTERN

BMW per bed per day rose from 306 grams in 2001 to 432 grams in 2011 and 520 grams in 2017. Delhi's annual solid biomedical waste production is about 9200 tons. In Delhi, waste generation ranges from just 110 grams to 2783 grams on a bed/day . The variation in range is attributable to factors such as HCF type,

occupancy, and number of beds, category of hospitals such as government or private and segregation efficacy. For example, the quantity of biomedical waste generated by bed strength is as follows:

- The bio-medical waste generation in hospitals having bed strength 50-99 is 5.3 TPD.
- The bio-medical waste generation in hospitals having bed strength 100 and above is 18 TPD.
- The biomedical waste generation in 100 bed hospital and above in capital is ranging from

0.028 to 1.669 kg/bed/day with an average of

0.486 kg/bed/day.

1.3 TREATMENT PATTERN:

For the treatment of biomedical waste in Delhi, the Bio-medical waste management regulations, 2016 are implemented. Two famous bio-medical waste treatment plants, namely SMS Water Grace BMW Pvt, handle the Bio-medical waste from Delhi hospitals. Ltd. which supplies sections of Delhi and Biotic Waste Solutions Pvt to the West, South West, Middle, East, Shahdara and Northeast. Ltd. which is supplying Delhi's North, North West, New Delhi, South and South East areas. Displayed figures show that two Bio-Medical Waste Plants are handling about 25 metric tons of Bio-Medical Waste per day.

On analysis of total quantum of bio-medical waste treated by both the operators of CBWTFs in Delhi, it was found that on an average, 59% component of total BMW is incinerable, 30% is autoclavable, 8.0% is glass and 3% are sharps.

2 Biomedical Solid Waste Management

Biomedical Waste (Management and Handling) Rules, 1998 of India say that “ Waste which is produced during the diagnostic processes , treatment or immunization of humans or animals or in research activities pertaining thereto or in the production or testing of biologicals. The quantity of waste generation and its quality along with treatment mechanisms has become a matter of concern. Management of biomedical waste is a fundamental constituent of future sustainability

Need for health-care waste management Management of medical waste was introduced to protect local communities from infection and it has since become a global problem. Waste separation in the hospital has an impact on infection control, safety of patients , occupational safety (health of hospital staff) and general health and climate in the city. It also helps reduce greenhouse gas emissions, persistent organic pollutants (POPs), mercury and other dangerous residues (HWs). Biomedical waste management affects many of the major environmental issues in our ecosystem, including the POPs released during incineration of healthcare waste . The health sector is very instrumental in addressing health and environmental issues.

Management of healthcare waste affects many important issues that are matter of global concern and prominence. Secretariats (under WHO) on injection safety and patient safety are collaborating along with different nations . These two shed much light on the properly managing healthcare waste . On the environment area , healthcare waste management is associated with the proper implementation of treaties Such as the POPs Convention of Stockholm, the Basel Convention on Transboundary Movements and Disposal of Hazardous Wastes and the Minamata Treaty on Mercury.

Because of the current outbreaks of infections in health in some countries, like Ebola and MERS-COV disease outbreaks , the requirement of solid disease prevention and control (IPC) gauges in has come to light. Management of biomedical waste along with proper sanitary practices and cleanliness are

important steps for preventing and controlling infections in hospitals . The United Nations (UN) human rights master observed that clinical waste is turning into a major problem . According to Article 6 of the International Covenant on Civil and Political Rights, the special reporter's focused on the need for more measures so that people could enjoy the right to natural life within the context of managing and disposing healthcare waste .

World Health Organisation has developed a numerous policies and instruments(of managing and advocating) to help reduce the danger to health workers, patients, waste operators, the larger and the society, by properly managing health care waste. It has also contributed to the establishment and ongoing management of an effective scenario of clinical waste management. It had the Policy Paper on Safe Waste Management in Healthcare (2004) and the key principles for achieving safe and sustainable waste management in Healthcare (2007). Since then, the World Health Organisation has drawn up a handbook on responsible management of health care waste, a policy document promoting the adoption of the National Action Plan on Biomedical Waste Management, and specializing in the effective management of various types of waste such as solid clinical waste and waste that contains mercury (WHO, 2005). The WHO has already given consumption thresholds for dioxin and furan but not for pollution. The emissions should be decided domestically.

Scenario Of Delhi

India now has world's 9th worst COVID-19 case count as number of those infected in the country rose to 1,65,799. According to the Healthcare Ministry , the number of deaths from coronavirus in our country stands at 4,706. Out of the total cases, 89987 are active, while 71,106 people have been cured, discharged or migrated.

There are only 1,185 empty beds in all quarantine centers in Delhi. The Southwest Delhi was one of the first districts to prepare a quarantine framework .Sub-divisional magistrates of the district traveled to hotels such as Taj Vivanta and ITC Welcome in Dwarka to set up a detention facility . In the South District, officials have sent a proposal to the Health Department to have three hotels ready. Currently, they live in about 150 of our quarantine centers. In Shadara district, the space was not empty till Monday. The quarantine center at the Delhi Police Residential complex has a capacity of 450 people.

Currently, the largest blockade facility in Delhi is located in Narela in the Norther Previously, the largest isolation facility in the country was a paid center at Aero City near Indira Gandhi International (IGI) airportn District, where the Delhi Delhi Development Authority flats are used.

The quarantine facility has a dedicated team of doctors and health workers, with center-level dedicated sanitation workers. Such a facility is different from the COVID Care Center (CCC) for people who show symptoms and test positive for the virus.

In the quarantine facility, most asymptomatic people or others who are in contact with the COVID-19 positive person are kept for 14 days. Upon exiting the center, he will be allowed to leave the facility only after having twice tested negative for COVID-19, after which he will be required to undergo house arrest for 14 days.

2.2 SUITABLE MANAGEMENT PRACTICES AND TREATMENT TECHNOLOGIES:

The spirit of the law demands three things, firstly all infected waste has to be disinfected. Secondly all items that can be reused, have to be disfigured/mutilated /destroyed and lastly and most important is prevention and control of harmful impacts on environment. For achieving these, the adoption of the most

appropriate waste management practices and technologies is crucial. For treating and managing solid biomedical wastes, the following treatment technologies should be used:

Autoclave is the wet steam sterilization process in which waste is subjected to temperatures around 160°C and pressure up to 6 bars for 45 minutes. The process of autoclaving has a very high pathogen and virus killing rate, however the fibre-like substances which are generated during autoclaving are receptive to bacteria and fungus as they have high amount of starch, cellulose and amino acids.

Dry Heat Sterilization (Destroying or eliminating all microorganisms, including bacterial spores) is a procedure that takes with more time (about 1.5 to 3 hours) and higher temperatures than the technique of wet heat sterilization; Dry heat operates by oxidizing molecules before the essential sections of the cell are killed and the organism is murdered. The temperature is held for almost an hour to kill the most persistent immune spores.

3 Guidelines For Waste Management

For covid 19 isolation wards

1. Under the guidelines given by the Central Pollution Control Board (CPCB), when diagnosing and treating suspected and certified COVID-19 patients, the use of two layered bags, compulsory labeling and color-coded dustbins for the management of healthcare wastes.

Double layer bags (using 2 containers) should be used as a measure to collect waste from the Covid-19 Isolation Wards to make it leak-proof.

Separately store the healthcare waste until the Popular Biomedical Waste Treatment and Disposal Facility (CBWTF) is available. Using a separate dustbin called 'Covid-19' to hold Covid-19 waste and position it in a specific interim storing room before turning it over to the CBWTF's approved staff. Healthcare waste generated in these isolation areas may also be pumped from the CBWTF recycling truck directly from the hospital.

2. Along with compulsory marking, bags / containers used to collect healthcare waste from Covid-19 wards should be printed as 'Covid-19 waste', also stating that non-contaminated common waste can be used as solid waste according to 2016 Solid Waste Management Regulations.

3. Maintenance of special data of waste generated from Isolation Ward Covid-19. Using dedicated trolleys and recycling containers in Covid-19 isolation units. The 'Covid-19 Waste' label should also be put on the articles. The inside as well as outside surface of the containers / dustbins / trolleys used to keep the Covid-19 waste must be sterilized with solution of 1 percent sodium hypochlorite everyday.

4. The SPCBs and CBWTF should be reported after the commencement or operation of a new COVID-19. Hire a dedicated sanitation worker dedicated to hazardous waste and common solid waste so that it is collected and sent to a disposing area in good time.

5. Covid-19 is collected from a certified patient in a toilet, disposable toilet, and stool diapers, which are treated as health care waste and must be put in a yellow bag / container.

6. Rinse the waste in the bathroom with bedpan, rinse with neutral detergent and water, sterilize with a solution of 0.5 percent chloride and rinse with clean water. Use PPE such as eye gear, shield for face, splash-resistant apron, plastic covers, hazmat suits, nitrile red bag gloves. In yellow containers (three-layered facemasks, N95 masks, etc.), head cover / cap, shoe cover, removable linen bag, not plastic or

half-plastic cover-all masks that are discarded.

I. QUARANTINE CAMPS, QUARANTINE HOME, AND HOMECARE FACILITIES

1. The people given charge of maintaining the Covid-19 persons detention camp / centre / home care must follow the steps for safe operation and disposal of the garbage. Normal solidwaste (domestic waste) produced in quarantine centers or camps shall be given to workers collecting waste by the municipalities assigned to them or by the current local method of disposal of common solid waste.

2. People who run quarantine camps / centers must call the CBWTF staff to take out healthcare waste . Local bodies have the details to contact the concerned CBWTF .

3. Clinical waste produced from quarantine facilities is referred to as 'household hazardous waste' as given in the Solid Waste Management Rules, 2016 and dumped according to the rules of Biomedical Waste Management Rules, 2016 and the guidelines.

4. Healthcare waste collecting area must be frequently sterilized with a prepared 1% hypochlorite solution. The administration and all other hospital staff, including medical, paramedical, nursing officers, other paramedical staff, and other health care workers, including sanitation department staff, attendants and hygiene attendants, should be very effective in managing of common as well as healthcare waste. The stages of healthcare waste management are production, accumulation, handling, storage, treatment, transportation and disposal as outlined in the Standard Operating Procedure and it must be followed properly .Staff is trained ; supervised and monitored everyday to evaluate implementation to manage compliance problems. All waste produced from the quarantine centres is considered isolation waste and its sterilization and treatment is properly checked by healthcare institutions.

II. DUTIES OF SPCB AND PCCS

1. Will keep proper data and records of Shall covid19 treatment ward or quarantine centers or quarantine homes in all the states .

2. to make sure that the healthcare waste is properly collected and dumped according with the Biomedical Waste Management rules ,2016 and Standard Operating Procedure given in guides .

3.Sufficient number of PPEs should be provided to the staff of CBWTFs (like three layered masks, splash proof gowns, nitrile gloves, gum boots and protective eye gear) by the healthcare departments of various states .

4. Vehicles must be disinfected with sodium hypochlorite or any other alternative chemical substance post usage everytime .

III. SJH POLICY ON BIO-MEDICAL WASTE MANAGEMENT

for BMW from patients in novel Corona Virus Ward/OPD

Different Healthcare waste types and their choices for segregating , collecting, treating, processing and disposing at Safdarjung Hospital and VMMC. Only the initial treatment and isolation shall be carried out at the hospital, and ultimate disposal shall be conducted by a specific biomedical waste treatment and disposal facility (CBMWTF). Healthcare waste tools, items produced in diagnostic procedures, treating, managing, immunization etc. from coronavirus and HCW and wards / opd patients must be treated in according to safety routine processes and regulations.

IV. YELLOW CATEGORY

(a) **Human Anatomical Waste:**

Human tissues, biopsy: Yellow colour unchlorinated plastic bags/containers .

(b) **Animal anatomical waste:** This is unapplicable to Covid-19 ward/OPD but applicable in research laboratories for COVID-19 .

(c) **Soiled Waste:** Articles adulterated with blood, body fluids like dressings, plaster casts, cotton swabs and bags carrying used or discarded blood and blood constituents are dumped in yellow containers .

(d) **Chemical Waste:** It includes chemical substances used for generation of solid disinfectants (biological or used ones) , residual chemical solid waste and chemical sludge which are dumped in plastic bags (unchlorinated) of yellow colour or containers and final disposal is done by the process of incinerating by respective CBMWTF.

(e) **Liquid waste** produced by the use of chemical substances in the manufacture of biologicals, used or discarded disinfecting agents, patient samples of infected secretions, aspirated liquid body fluids from labs, wards, operation theatres and disinfection activities should be collected in separate containers and sterilized by chemical sterilization by using 1-2% sodium hypochlorite², 4solution for a 30 min contact period. The combined discharge should comply with the discharge standards set out in Schedule III in accordance with BMWM (Principal) Regulations, 2016.

(f) **Discarded items:** Linen, Mattresses, bed sheets adulterated with blood or body fluid unchlorinated (lime/alcoholic: 5 % Lysol for 30 minutes, 5% Phenol for 30 minutes) or 1-2% sodium hypochlorite chemical disinfection succeeded by shredding and customized to fit in unchlorinated yellow bag for incinerating .

(g) **Microbiology, biotechnology waste** Microbiology, biotech waste, i.e. lab crops, stocks or samples of microorganisms, live or attenuated vaccines, human and animal cell culture used in research, residual toxin crop plates must be initially treated on site by an autoclave machine after being sent to CBMWTF in their respective color category for final disposal. The blood bags discarded must be measured, sealed, weighted and all the documents to be made and then placed in autoclave protected plastic bags or containers for autoclaving on the sites itself and then transported to respective CBMWTFs to get incinerated in a yellow bag.

V. RED CATEGORY CONTAMINATED WASTE (RECYCLABLE)

Waste manufactured from recycled products such as oxygen masks, used jars, intravenous tubing and sets (with needle cutting), catheters, urine containers, and gloves are labeled, when appropriate, and stored in red container. The destroyer needle / needle cutter is ideally used to remove the needles of the syringes. The cut / mutilated" syringe is finally dumped in red-colored plastic bags (not chlorinated ones).

VI. TRANSLUCENT (WHITE) CATEGORY WASTE

Biomedical waste types and their classification methods at Safdarjung Hospital and VMMC, recovery, diagnosis, sorting and disposal. Just pretreatment and isolation shall be carried out at the institution, and a separate biomedical waste treatment and disposal facility (CBMWTF) shall conduct final disposal. Waste tools for health care, items produced in diagnostic procedures, treating, managing, immunization etc. from coronavirus and HCW, and wards / opd patients must be treated in according to the safety routine

processes and regulations.

VII. BLUE CATEGORY: GLASS AND METALLIC IMPLANTS

Blood testing beaker, cracked or discarded glass and dirty water such as slides etc. It must be sterilized (at least 1-2% sodium hypochlorite for 30 minutes) and then packed into puncture and leak-proof containers or blue-colored containers and eventually transported to the famous central waste disposal site at CBMWTF. Uninfected + glass, such as bottles of medication or ampoules, is not tainted and is stored in evidence of puncture and spill confirmation + boxes or packages in blue color. The metallic constituents are equally pre-treated and are to be shipped in different puncture proof and leak"evidence bins or barrels with a blue tab.

VIII. ARTICLES: BINS, BAGS, TROLLEYS

Bags: The bags required for the storage and transportating healthcare waste should comply with the Bureau of Indian Standards(BIS) . The carry bags should comply with the Plastic Waste Management Rules, 2016 till the standards are published .

BINS: An ideal number of easy to operate, standard in properties , uniformly built, properly covered, foot operated bins of different colours like yellow coloured , red coloured dustbins of proper size will be planted at required positions in the areas of healthcare facilities .

IX. DISINFECTION OF BINS

Chemical sterilization of the waste collecting dustbins using solution of hypochlorite (1-2%) should be done regularly at a washing area in the healthcare facility, everyday and atleast once every week.

X. SEGREGATION, PACKAGE AND THEN TRANSPORT AND STORAGE TO COMMON WASTE SITE

Any of the biological waste is classified as waste type, generation site, pre-transportation date from the generation site. Waste is stored at an identified safe area in the generation areas, for a temporary time after which it is sent to facility for final treating and disposing. It's the duty of the administrative, sanitary & safety workers during this period to make sure about the safety and prevention of waste pilfering and recycling. Any non-treated healthcare waste is to be stored within a 48-hour span.

Collection is done -

-Two times everyday sometimes on a regularly basis from patient's rooms OR labs

- workers that are on the duty mention the labels which are then forwarded to the collectors.

Area of patient care is given receipt of waste notebook so that the number of yellow blue, red, white/translucent bags used can be recorded and given to healthcare worker . Workers must fill the waste logbook according to coding system of color and mention the no and sizes given on the bags and the receipt must be signed for future data as well as to write the Biomedical Waste notebook everydayaccording to color.

XI. TRANSPORTATION:

Waste from the hospital is transferred from the generation site to the central waste storage site along a specified route in tightly bound containers, on dedicated, colour marked, sealed and leak-proof wheel

barrows / trolleys. The number / size of bags of all trolleys are verified by the cleanliness worker at the waste treatment premises for recording and quantification and barcoding prior to disposing it. Central site where waste is stored is cleansed everyday . At the waste storage site, chemical sterilization of trolleys using hypochlorite soln is carried out , and they are cleaned and disinfected everyday .

XII. TRANSPORTATION TO CBMWTF

The operator of CBMWTF should send the waste from the occupant 's place to any healthcare waste treatment facility off-site only by trucks or vans labeled in according to the Biomedical Waste Management Regulations, 2016.1, 2,3,4 Vehicles used for the transport of biomedical waste should be according to the conditions specified by the SPCB in along with the requirements of the Motor Vehicles Act . The CBMWTF has added globalized positioning system.

4 Conclusion

All the healthcare institutions generating Healthcare Waste should comply with segregation, color coding and other rules of Bio-medical waste (Management & Handling) rules, 1998 strictly .

One solution in this situation of global emergency due to COVID -19 which makes safe management of biomedical solid waste very critical is to use Sterile wave machines. They are widely used in China to treat the biomedical waste generated while combating coronavirus. In the Sterile wave in-situ process the waste is grounded down and heated in a container for twenty minutes at around 100 degree Celsius . After treating the waste trough the Sterile wave machine , all the treated waste can be managed as regular municipal waste without any threat and associated risks to the health of people .

Other important solutions are to provide equipment/ accessories to the workers handling waste , maintenance of waste generation records , proper treatment and disposal by healthcare facility and bringing the required technological and human resources together for effective management of biomedical solid waste. All the regulatory agencies, Healthcare institutions , Indian Medical Association & Municipal Corporations should constructively work together for proper management of Healthcare waste in cities and towns

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