

Biomedical Waste Management during COVID-19 Pandemic: A Medical Institute Perspective

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ABSTRACT

Background: The existing considerable lack of awareness about general waste management in low-income countries like India imposes a significant challenge during the COVID-19 pandemic when due to outbreak of novel coronavirus, burden on health agencies has significantly increased.

Objectives: In present review article, we aim to highlight the medical institute's perspective towards the management of biomedical waste in COVID-19 pandemics. We also aim to analyze the challenges faced during the management of biomedical waste and mentioned the novel strategies which could be applied at the ground level to cope with the challenge of biomedical waste management.

Methods: Data was gathered from government repositories and by interviewing the biomedical waste management staff in our hospital.

Results: Apart from the regular biomedical waste, now the hospitals are generating huge COVID-19 waste in the form of used personal protective equipment, disposable gloves and face masks. The patient overload has also increase in the hospitals, leading to the generation of biomedical waste of used syringes and other disposables like cotton, tissue and blood samples.

Conclusion: The present article will help the health agencies to analyze the critical factors involved in biomedical waste management in a medical institute and help in devising new strategies to approach the problem of biomedical waste management during pandemics.

Keywords: Pandemic, Coronavirus, Biomedical waste, PPE Kits, Face mask

INTRODUCTION

The biomedical waste (BMW) is the waste generated during diagnosis, treatment, immunization, or research activities of humans and animals or in the production or testing of biological products. One of the neglected dimensions of the health care system of low-income countries is the proper management of biomedical waste in compliance with the stipulated legislation. The waste generated by hospital especially in COVID times poses a threat not only to patients and HCWs but also to public in general and environment. Biomedical waste

is the product of rehearsals of therapeutic services and research centers (1). The biomedical waste may include sharps objects (needles or scissors), biological waste (tissues or blood etc.) and the disposable gloves, cotton gauges and similar infectious waste. Toxic waste generated from biomedical waste may include the expired medicines, toxic chemicals, disinfectants, and radioactive waste (2, 3). The WHO reports that 85% of waste generated from hospital is not hazardous, while 10% waste is infectious and 5% waste is hazardous waste that is non-infectious. In

India, between 15% and 35% of hospital waste is targeted as infectious waste. India generates approximately 2 kg/bed/day, which includes waste such as anatomical waste, cytotoxic waste, sharp items (1).

The Government of India (GOI) introduced the biomedical waste management rules in 2016 and several amendments have been made to that by the Ministry of Environment, Forest, and Climate Change. The ministry now recommends BMW to be segregated in standardized color-coded containers. According to a recent amendment that came into force in 2018, the rule to strengthen compliance with predefined guidelines were introduced (4). It is estimated worldwide that around 5.2 million individuals, including 4 million infants, die every year because of unmanaged medical waste-related diseases (5). Before the onset of COVID19 pandemic, the total amount of BMW generated in India in the year 2015, 2016 and 2017 was 501, 517 and 559 tons per day. The annual report issued by CPCB showed the generation of 614 tones/day and 619 tones/day in 2018 and 2019. However, with onset of COVID 19 pandemic, the BMW generation showed a peak from June 2020 onwards and reaching up to 966 tones/day in 2021 and 775.5 tones/day in 2022. The report from Central Pollution Control Board (CPCB) states that India had generated 2044.8 tons of Covid 19 Bio-medical waste between June 2020 and December 2021 (Figure 1) (6).

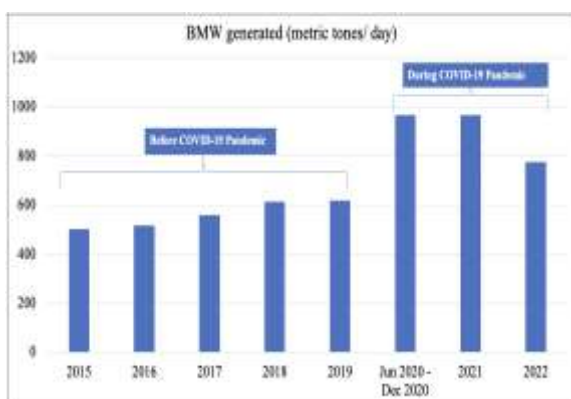


Figure 1: Bio medical waste generation in India before and during COVID 19 pandemic

In India, the annual growth rate of biomedical waste was reported to 7 percent with an approximate projection of 965.5 tones/day in the year 2021 (6). Proper segregation, storage and disposal of the biomedical waste remained a serious concern for public health across various medical institutions in India. Despite the enforcement of the rules on biomedical waste management, no secure mechanism for the management of health care waste produced every day in hospitals, clinics and households has yet been created. Waste produced within health centers is often gathered by untrained, unprotected, and unaware workers without any separation, and disposed of in prohibited locations without any segregation or proper care. This poorly handled waste presents a significant threat to the environment and may create a sustained and unnecessary threat to public health and be a likely source of re-emerging infection (7).

Before the COVID-19 pandemic, India has already dealt with inadequate medical waste management is now facing the instant raise in the amount of biomedical waste at the time of the pandemic. Biomedical waste from health centers, quarantine facilities, and quarantine homes is of considerable concern to the officials handling COVID-19 waste management. If this waste is combined with general waste and treated without additional precautionary steps, the contaminated waste will spread the virus in the environment and will cause significant harm to humans. Several studies on the spread of infection due to waste have been done and it has been seen that the virus will sustain for a certain duration on the surfaces of the material. It is, therefore, necessary to take into account the effective and efficient storing, transportation, processing and disposal of biomedical waste (2).

Since the beginning of the COVID 19 pandemic, the production of waste is often higher and complex steps are needed to cope with the increased biomedical waste. The treatment of the produced waste often demands careful attention, since it can also

be infectious and risky to monitor the spread of this COVID-19 pandemic. In view of the present situation of the pandemic (COVID-19) in India, we assess the important aspect of biomedical waste management in medical institutions. The health centers have a high burden of COVID 19 related waste which needs to be handled in a proper manner to break the spread of infection. The aim of the present review article is to represent the medical institute's perspective towards the management of BMW during COVID-19 pandemics. We have the challenges faced by medical institutions during the management of biomedical waste and mentioned the novel strategies which could be applied at the ground level to cope with the challenge of BMW management during a pandemic.

Surge in the Biomedical Waste due to COVID-19 Pandemic

With the COVID-19 pandemic, the production of BMW has escalated due to the accumulation of personal protective equipments (PPEs) in hospitals. Despite the recommendations of WHO Indian Health Ministry on the rational use of PPEs for COVID-19, medical institutes are facing extraordinary demand for PPE from all sections of health care workers due to the fear of spread of virus. The anxiety also promotes the misuse of PPE on several occasions which results in large amounts of biomedical waste that are strenuous to store and transport at the time of crisis with minimal capital and workforce available. Apart from health workers, single-use disposable surgical masks (sometimes N95 masks) by the patients visiting the hospitals has also led increased burden of biomedical waste in hospitals. Due to lack of awareness, the patients tend to dispose of the face masks along with the non-infectious general waste which imposes the additional challenge of waste segregation. The indiscriminate dumping of biomedical waste in the general garbage imposes a high risk to the waste management stakeholders. Moreover, since the fomite-borne

transmission is yet to be identified for the new strains of the coronavirus, it imposes a significant threat to the local community (8).

There are several methods for handling and disposing of the different forms of biomedical waste which includes the controlled combustion (incineration), dry and wet heat based method of sterilization, irradiation by UV radiation. Other supplement disposal methods are not widely accessible in low- income and middle-income countries. (2) Because of this COVID-19 pandemic scenario, India recently generates about 600 metric tonnes of biomedical waste daily, which is around 10 percent more waste compared with previous records. It is assessed that, overall, 2 tonnes of COVID waste are produced from disease analysis, isolation, and treatment in each state. The nation has 200 biomedical waste treatment centers and these centers are now operating at a 60% limit, which is a 15% bounce since last year, according to CPCB information. A health center that will usually generate 500 g of biomedical waste per bed per day before the COVID-19 pandemic is now has increased to 4 kg per bed per day (1).

Guidelines to Handle Biomedical Waste during COVID-19 Pandemic

On 20th July 1998, BMW rules (Management and Handling) were framed by the Ministry of Environment and Forests (MOEF) and Government of India (GOI). Further amendments were passed in the following years: 2000, 2003 and 2011. On 28th March 2016, new BMW Rules were figured by the Ministry of Environment, Forest and Climate change under Environment (Protection) Act, 1986 (4) However, in view of pandemic situation, the CPCB had issued guidelines on 19th march 2020 for handling, treatment and disposal of waste produced during treatment/ diagnosis/ Quarantine of COVID 19 patients, specifying the duties of stakeholders to ensure proper management of COVID-19 waste (11). Later on these guidelines were

revised based on implementation aspects and ground situation of pandemic. The fourth version (17th July 2020) is the latest version of the guidelines as if now (12).

Poor management of hospital biomedical waste can exacerbate the transmission of coronavirus to medical personnel and those who handle the waste (5). Hospitals and health workers are thus particularly at the risk of COVID-19 infection (9). If used masks, gloves, and other personal protection devices are not adequately handled and disposed of, there may be a significant danger of transmitting coronavirus. In addition, domestic waste (e.g., tissues, discarded papers, left-over food etc) poses an elevated health risk to waste management staff (5). Failure to resolve the massive surge of medical waste in the aftermath of COVID-19 is likely to place medical institutions at more risk for the environment and public health (10). In order to counter

the COVID-19 pandemic, numerous initiatives have been taken by state and central governments, including the establishment of quarantine centers, isolation wards, sample collection centers and laboratories. All stakeholders along with the common BMW treatment and disposal facilities was instructed to follow strict guidelines for the waste management created during diagnostics and treatment of confirmed or suspected COVID-19 patients, in addition to current procedures under biomedical waste Management. These recommendations are based on current COVID-19 awareness and current procedures of hospital-generated infectious waste management when dealing with transmissible disease. The guidelines issued by CPCB for various sources generating Biomedical wastes (Table 1) along with the duties of concerned agency is tabulated (Table 2) (12).

Table 1: Guidelines issued by CPCB for waste management during COVID 19 pandemic (12)

<p>Isolation wards Keep color coded bags/box/containers with lids which are foot operated Red – used PPEs (eye protection, plastic coverall, nitrile gloves, face shield etc) Yellow – mask, head and shoe cover, non-plastic or semi-plastic coverall, diaper etc Collection of waste in double layered bags Dedicated collection bins, trolleys used for COVID-19 wastes should be labelled with “COVID 19” Separate collection and storage of Biomedical wastes before handling to common Bio-medical waste treatment and disposal facility (CBWTF) Separate records of COVID 19 wastes should be maintained Surfaces of bins/containers/trolleys should be disinfected with 1% sodium hypochlorite on daily basis Separate dedicated sanitation workers for BMW and general wastes Update details of COVID 19 wastes in CPCB mobile application (eg, COVID19BWM) Functioning of COVID 19 ward and ICU should be reported to SPCBs/PCC and concerned CBWTF General solid wastes such as: left over food, discarded papers, medicine wrappers etc should be collected separately according to SWM Rules, 2016 Proper segregate of BMW and general waste at the point of generation Designated Nodal officer will educate waste handlers about preventive measures such as: donning and doffing of PPE, social distancing, hand hygiene etc Use non-disposable items where feasible and have the hospital guidelines in place to disinfect such items</p>
<p>Laboratories and Sample collection centres Guidelines given for isolation wards are applicable for testing centers and Laboratories Functioning of COVID 19 sample collection centers and laboratories should be informed to concerned SPCB/PCC The wastes generated like plastic vials, vacutainers, eppendorf, VTM, cryovials, pipette tip etc should be collected in RED bag and pre-treated as per BMWM Rules, 2016</p>
<p>Quarantine camps/ homes/ home-care facilities General solid waste should be collected in bags, properly tied and given to waste collector assigned by Urban Local Bodies (ULBs) Maintain separate bins for general household waste and biomedical waste If any biomedical waste generated, it should be separately collected in yellow bag Biomedical wastes generated at such sites are used masks, gloves and tissues/swabs soiled with blood/ body fluids of COVID 19 positive patients Persons involved in operating quarantine camps should call the CBWTF operator for collection of bmw whenever its generated Nodal person is assigned by agency involved in operation of Quarantine camp/centre for waste management and its record maintenance Nodal person of Quarantine camp/centre should register the camp/centre on CPCBs bio-medical waste tracking App ‘COVID19BWM’ Persons taking care of Quarantine camps/centres can deposit the COVID19 biomedical waste generated in homecare by any of the following method: Hand over the yellow bag to waste collectors assigned by ULBs or deposit it at designated centre established by ULBs General waste is handed over to waste collector engaged by CBWTF operator</p>

Table 2: Duties of concern agencies in management of Bio medical waste during COVID-19 pandemic (12)
<p>Duties of CBWTF Inform to SPCBs/PCCs after receiving the COVID 19 waste from various facilities such as isolation wards Workers involved in COVID 19 waste handling should be regularly sanitized and provided with adequate PPE kit. For transportation of COVID 19 waste dedicated vehicles should be used and should be sanitized after each trip with chemical disinfectant (sodium hypochlorite). Waste should be immediately disposed of on receiving at facility. CBWTF operator must maintain record of COVID 19 waste. Workers having symptoms of COVID 19 should be avoided to work at facility. CBWTF can operate for extra hours if large amount of biomedical waste is generated. CBWTF should maintain coordination with ULBs. CBWTF operator and waste handler should register themselves on waste tracking application for entry of biomedical waste received and disposed. Waste handlers should be regularly educated about infection prevention measures.</p>
<p>Duties of SPCBs/PCCs Maintenance of COVID 19 waste generated from isolation wards/ quarantine centers of respective states. Ensure proper Biomedical waste management as per BMW Rules, 2016. In case of requirement, allow CBWTFs to work for extended hours. The remote/rural areas beyond CBWTFs reach should be allowed for deep burial of yellow category biomedical waste. Proper coordination with ULBs and CBWTFs for establishment of COVID19 waste collection and disposal centers If the amount of incinerable waste exceeds the capacity of CBWTFs, the hospitals can be allowed for incineration within health care premises. It can direct the ULBs for general solid waste collection and disposal from quarantine homes/ centers / homecare units. Every SPCB/PCC should use the COVID19BWM app and upload the data on daily basis.</p>
<p>Duties of Urban Local Bodies Ensure biomedical waste collection and disposal from Quarantine homes/camps/ home care facilities by CBWTFs on call basis. Provide updated list of Quarantine homes/camps/ home care to SPCBs/PCCs. Ensure proper separation of general waste and biomedical waste from Quarantine homes/camps/ home cares. Provide adequate support and security to CBWTF staff involved in biomedical waste collection. Provide yellow-colored bags to quarantine facilities for biomedical waste collection. Engage CBWTF operator for final disposal of BMW generated at quarantine camps/homes. For biomedical waste receiving/ collection, the common waste deposition centers should be established. ULBs should assign a Nodal Officer, responsible for waste management and record maintenance. Elementary training should be given to sanitization workers.</p>

These guidelines recommended the use of dual-layered bags (combining two bags), compulsory marking of bags and containers as "COVID-19 waste". Regular disinfection of trolleys dedicated to COVID 19 facilities with 1-2% sodium hypochlorite, separate record-keeping of waste produced from isolation wards of COVID-19 is also a recommendation to keep the infection rate low during the pandemic (7). Hospital isolation wards are recommended to hold up discrete color-coded canisters for waste isolation. A committed container with 'COVID-19' biomedical waste should be stored separately. It was also recommended that appropriate PPE, including triple-layered masks, splash-proof aprons, gloves, gumboots and protective goggles, need to be provided for those handling the COVID-19 biomedical waste (1). For management of liquid waste, the Sewage Treatment Plants (STPs) should strictly adhere to the SOPs issued by pollution control board. However, risk of transmission is low but consumption of treated waste should be avoided during COVID 19 pandemic. The healthcare

facilities/ Isolation wards/ STPs are responsible for liquid waste management (12). Although CPCB is the primary agency for making biomedical waste management recommendations in India, other government agencies also issued certain guidelines for the management of COVID-19 waste. Since the handling of COVID-19 specific biomedical waste demands separate guidelines for proper handling and disposal, certain agencies follow the recommendation issued by the CPCB while others follow the guidelines which the agencies find best suitable under pandemic conditions. This sudden shift in the category of biomedical waste leads to a significant challenge in the handling of the COVID-19 specific biomedical waste (8).

Strategies to cope up with raised Biomedical Waste during Pandemic

Biomedical waste management imposes a significant challenge in low-income countries compared to the developed nations.

The increased quantity of biomedical waste in India raises a complicated concern that needs short-term solutions that can aid in decision-making. The selection of the most appropriate method for the management of biomedical waste is a challenging task which depends on different factors, such as climate, protection, politics and economics. The availability of multiple waste management systems of varying output standards makes decision-making even more complicated. In addition, the vague, unreliable, and contradictory evidence make

the decision-making process more confusing. A reliable procedure for prioritizing the management of biological waste would be of considerable use to decision-makers. CPCB has made special guidelines for the handling of COVID-19 biomedical waste. In addition to ensuring compliance to CPCB guidelines, priority should also be given to specified biomedical waste management requirements of the medical institute. The steps involved in management of biomedical waste are given in Figure 2 (13).



Figure 2: Steps involved in management of BMW

The health agencies should consider the strategies to control spill from the biomedical waste bags or barrels. An ideal PPE should be provided to the persons who are handling the biomedical waste. Occasional testing for the coronavirus infection should be performed of the individuals who are handling the COVID-19 biomedical waste. Leading to a rise in the volume of waste, hospitals and organizations should extend their capacity to move and store biomedical wastes. In order to determine the exact quantity of 'COVID-19 waste' generated in various categories, an online electronic database could be created. A system should be there to monitor the handling and transportation

of biomedical waste which could inform the Nodal body regarding the violation of waste management rules. The health agencies should periodically educate and track the activities of all impacted biomedical waste management employees. In addition to existing facilities, temporary transfer centers and temporary treatment centers need to be built to provide adequate space for the treatment of increased biomedical waste. Infectious biomedical waste can be shipped immediately to care centers, or at least moved and amalgamated into transit centers. Concerning functional conditions, a special transportation facility must also be built. Specially designated government officials

should closely track the enforcement of the waste management guidelines.

CONCLUSION

The continuous dissemination of the COVID-19 pandemic imposes a significant impact on human health, the economy, and the global climate. The COVID-19 pandemic poses specific concerns regarding the methods of biomedical waste management from medical institutions and hospitals. Proper biomedical waste management is an essential and integral part of infection management mechanisms. There should be training programs for HCWs to empower their handling the situations better. There should be regular inspections and a checklist should be maintained. Through this article, we aim to draw the attention of the authorities for the HCWs for the rigorous execution of the specified policies with a view to improve the overall segregation and disposal of biomedical in medical institutions, which will be of immense assistance even after the pandemic.

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