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Biomedical Waste and Its Disposal Management in India during COVID-19



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Biomedical waste poses various health and environmental hazards, thus its handling and disposal should be done with the utmost care and safely. Several hurdles exist while handling and the management of biomedical waste in India, and the pandemic posed by the coronavirus has made it even more challenging. The sudden outbreak in second waves of the virus led to an exponential rise in the quantity of biomedical waste. Furthermore, the poor infrastructure and lack of human resources have aggravated this situation. To address such serious situation in a timely manner, the government has formulated various standard operating procedures (SOPs) and has amended the existing rules and guidelines.

What is the issue?



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Biomedical waste (BMW) differs from general municipal waste as it poses various health hazards. Biomedical waste management rules 2016 and the amendment rules 2018 are the latest guidelines from the ministry of environment, forest & climate change to regulate the handling of biomedical waste activities in the country. India is the second-most populous country after China and the second worst-hit nation by the coronavirus disease 2019 (COVID-19) after the United States of America (As of November 9, 2020). Due to the flawed biomedical waste management system and lack of resources, India faces severe consequences during the COVID-19. Untreated and improperly managed biomedical waste is a potential source of infection. The diligent handling and management of biomedical waste can prevent the occurrence of hospital-acquired infection and lower the rates

of disease transmission. In addition, the untreated or the rudimentary handling of biomedical waste creates a nuisance and decreases patient satisfaction. According to the data published by the central pollution control board (CPCB) in the year 2018,

the total amount of biomedical waste generated in India is 517 tonnes/day in the year 2016 and around 501 tonnes/day in the year 2015, out of which around 4–5% remains untreated. The annual report 2018/2019 released by central pollution control board showed the generation of 557 tonnes/day biomedical wastes in 2017, out of which 517/day was treated. The country has a total of 238,170 healthcare facilities, out of which 87,267 are bedded while the remaining 151,208 are non-bedded healthcare facilities (HCFs) generating biomedical waste. There are 198 approved common biomedical waste disposal facilities (CBMWFs) in the country and 28 are under construction.

Challenges for Handling and Managing in the India



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Biomedical waste is not handled like a municipal waste. The central pollution control board is the apex body to monitor the country's biomedical waste management activities under the ministry of environment, forest, and climate change. There are separate state pollution control boards in each state to monitor and regulate the biomedical waste activities within the state and report the findings to the central pollution control board. The country has a stringent policy of onsite segregation of the generated biomedical waste and storing, transporting, and disposing of them in adherence to the biomedical waste rules framed by the ministry under the Government of India. It is mandatory for all the small clinics, diagnostics, laboratories, nursing houses, hospitals and other healthcare institutions to comply with these guidelines. Previously,

the country had ten different categories of waste for segregation. Later, it was amended into four classes for easy segregation. Infected or potentially infected waste is labeled as yellow, apparently non-infected and recyclable fall in the red category, sharps and small metallic items comes under the white category while waste consisting of glass is segregated into the blue category. Segregated waste is stored in a well-ventilated area and the stored waste is carried to the disposal facility (commonly known as common biomedical waste disposal facilities) for further treatment and disposal. The treatment of solid waste at the site of generation or storage is prohibited according to the updated guidelines. The waste should be transported in a designated closed vehicle that is equipped with the global positioning system tracker. The biomedical waste in the CBMWFs is then treated, sterilized, and sent for recycling, incineration, or landfilling based on the waste category. The qualitative process and quantitative data on the generated and disposed off biomedical waste should be accurately documented and reported to the state pollution control board.

Violating these guidelines by healthcare facilities and disposal facilities will subject them to penalties. Despite stringent rules and liability, the country reports a high degree of nonadherence to these guidelines. According to the annual report, 2018/19 published by the CPCB, 23,942 HCFs violated the biomedical waste rules 2016, and 18,210 HCFs were issued a warning for their violation. The report shows the massive amount of biomedical waste generation per day and around 13% of HCFs have violated biomedical waste rules, which show the poor biomedical handling and management in India.

Crisis during COVID-19 Pandemic



The most populous cities like Delhi, Mumbai, Bangalore, Chennai, Hyderabad, etc. are the most affected cities by COVID-19. According to data published by NDTV on September 18, 2020, the country is generating a considerable amount (Above 100 tonnes/day) of COVID-19 related biomedical waste in the country. Maharashtra contributes for approximately 17% of total COVID-19 related biomedical waste. Now the national daily waste generation is reaching around 850 tonnes/day. The details on the monthly generation of COVID-19 related biomedical waste across several state of India (From June 2020–December 2020) is referenced in Table 1. The country does not have sufficient infrastructure and human resources to handle this huge amount of biomedical waste. The presence of 198 CBMWFs and 225 captive incinerators was insufficient to dispose off 700 tonnes of waste generated in a day. This additional biomedical waste stirred up havoc in the disposal of biomedical waste. The workers involved in biomedical waste management are pitching in extra hours to cater to this need. **According to the Supreme Court report, there is an increment in the quantity of biomedical waste ranging from 25 to 349tonnes/day during the month of May–July and it is expected to have doubled during the months of August–October.**

Presently, there is a poor practice of segregation at the site of generation due to the exponential rise in the generation, thus elevating the risk to the environment. Additionally, inadequate safety measures for the biomedical waste workers continue to remain another major challenge in the Indian context. At present, around five million sanitation workers are performing their duty and cleaning the country and these laborers (Safai karamchari) are simultaneously handling the biomedical

waste as well. Sadly, they are not provided with the necessary personal protective equipment. These workers are at high risk and subsequently pose a threat to the residing community. According to the evidence from scientific literature, the virus may stay for more than 24-hours within the cardboard, boxes, other rigid substances and around 72-hours on the surfaces of metals and sharps, which is a significant threat for the workers collecting the waste for their daily survival. There is an estimated two to four million ragpickers or korales in India. However, they do not have sufficient information and adequate awareness about the necessary precautions to be taken. Consequently, the pandemic has recorded that more than thousands of waste workers have contracted the virus and hundreds of them have lost their lives.

S. No.	States/UTs	Generated BMW (In tons)							Total Number
		June 2020	July 2020	August 2020	September 2020	October 2020	November 2020	December 2020	
1	Andaman & Nicobar ^a	0.42	INP	INP	0.42	0.434	0.42	0.43	0 ^a
2	Andhra Pradesh ^a	165.48	182.81	118.82	112.35	116.095	317.91	328.51	11
3	Arunachal Pradesh ^a	3.36	3.36	3.80	3.36	3.472	3.36	3.47	0
4	Assam	28.38	20.68	12.57	62.61	51.739	50.07	23.41	1
5	Bihar	6.84	20.76	41.54	45.36	44.64	28.08	23.31	4
6	Chandigarh ^a	29.85	5.65	55.34	43.02	73.191	70.83	73.19	1
7	Chhattisgarh ^a	11.19	INP	13.39	9.3	9.61	9.3	9.61	4
8	Daman & Diu	0	INP	0.00	0.48	2.387	1.08	1.15	1 ^b
9	Delhi	333.42	389.58	296.14	382.5	365.893	385.47	321.32	2
10	Goa ^a	0.81	0.81	INP	15	7.75	5.43	5.39	0 ^a
11	Gujarat	350.79	306.14	360.04	622.89	545.879	423.51	479.57	20
12	Haryana	75.33	184.18	210.69	278.31	238.452	239.4	209.93	11
13	Himachal Pradesh	3.81	12.50	4.94	25.2	28.117	30.03	48.24	2
14	Jammu & Kashmir	10.71	9.77	51.77	57.39	59.303	44.82	35.12	2
15	Jharkhand ^a	INP	INP	2.59	4.8	4.96	4.8	11.63	4
16	Karnataka ^a	84	540.28	588.03	168	218.023	210.99	218.02	26
17	Kerala	141.3	293.32	588.05	494.1	641.979	600.39	542.47	1
18	Lakshadweep ^a	0.3	INP	INP	0.3	0.31	0.3	0.31	0 ^a
19	Madhya Pradesh	224.58	56.40	106.59	339	308.419	208.65	249.49	13
20	Maharashtra	524.82	1180	1359	524.82	542.314	609	629.30	29
21	Manipur	5.13	0.20	2.09	5.13	5.301	5.13	9.27	1
22	Meghalaya	5.1	1.74	6.34	9.9	12.028	7.65	8.56	2
23	Mizoram ^a	4.2	INP	INP	4.2	3.224	3012	3.22	0 ^a
24	Nagaland ^a	3.6	3.4	3.10	2.85	3.317	1.86	2.29	0
25	Odisha	31.86	106.63	109.19	134.01	183.458	222.66	125.58	5
26	Puducherry	18.63	35.82	41.54	63	58.652	28.74	17.11	1
27	Punjab	48	35.59	21.19	234.42	149.606	96.51	86.99	5
28	Rajasthan	177	7.15	50.43	145.08	171.554	141.93	105.93	8
29	Sikkim	6	0.20	0.30	6	4.216	3.69	2.45	0
30	Tamil Nadu	312.3	401.29	481.10	543.78	524.179	300.75	251.22	8
31	Telangana	12.3	10.50	24.04	188.82	144.801	103.89	68.82	11
32	Tripura ^a	0.45	INP	INP	0.45	0.465	0.45	0.47	0 ^a
33	Uttarakhand	0.45	0.82	41.45	21.72	108.996	56.76	76.26	2
34	Uttar Pradesh	210	307.54	408.86	507.15	478.082	316.71	276.46	18
35	West Bengal	195	136.37	235.12	434.76	486.793	330.84	279.06	6
Total		3025.41	4253.46	5238.45	5490	5597	4864.53	4527.55	198

Total waste generated from June–December 2020 = 28,747.91tonnes

Table 1: Details on the generation of COVID-19 related biomedical waste in Indian States/UTs from June 2020 to December 2020.

INP: Information Not Provided.

As per earlier information provided by States/UTs.

Using CBWTF, Surat, and Gujarat for disposal of biomedical waste.

(Source: Sharad Chand, Updates on biomedical waste management during COVID-19: The Indian scenario Clinical Epidemiology and Global Health 11 (2021) 100715)

Measures to follow in quarantine centers

YELLOW	FIRE/SOILED		IF IN DOUBT <ul style="list-style-type: none"> ■ IS IT AN INFECTIOUS SOILED WASTE THAT CAN BE INCINERATED? ■ IS IT A DISPOSABLE RECYCLABLE PLASTIC? ■ IS IT A REUSABLE GLASSWARE? ■ IS IT A METALLIC SHARE THAT CAN CAUSE INJURY?
RED	DANGEROUS/ PLASTICS		
BLUE	REUSED/GLASS		
WHITE	CEMENT ENCAPSULATION/ SHARPS		

The waste generated within the quarantine centers should be considered as general waste, but the waste generated from the suspected and confirmed cases within the quarantine centers should be treated as BMW. The waste generated in the quarantine centers should be segregated at the site of generation and kept in the designated bags/bins/ boxes like the handling of BMW in healthcare facilities (Fig. 1).

Figure 1: Right Colour Code for Segregating BMW

The pandemic led to the generation of an unexpectedly high amount of BMW as various new materials were introduced in the market for prevention, screening, diagnosing and treating the patients. Some of the additional items generating the BMW in quarantine and isolation centers are divided into various color codes, as shown in Table 2. All the quarantine centers should be adequately supplied with yellow and red bags, blue cardboard and white punctureproof containers for onsite segregation and waste collection. The collected waste should be kept in the designated storage area. The biomedical waste generated in the quarantine centers should not be stored for more than 24 h after generation. The guideline recommends the use of PPE by all the persons handling the BMW in quarantine centers. The state pollution control board should continuously monitor the BMW handling and management procedures in the quarantine centers and ensure compliance with the standard guidelines. The guidelines also recommend the use of color-coded bins for onsite segregation and the usage of double-layered bags in the COVID-19 isolation areas. There should be additional and temporary bins for disposable PPEs, gloves and masks and separate containers for reusable materials (e.g., N95 mask for cleaning and sterilization).

Duties of the Authorities and People Involved in the Biomedical Waste Handling during the COVID 19

The duties of the persons and authorities involved in biomedical waste's handling and management are clearly described in biomedical waste rules 2016 and amendment rule 2018. All the healthcare facilities should strictly comply with the roles designated by the CPCB. The authorities should give the utmost priority to the management of biomedical waste to prevent virus transmission. The current setup

might lack the information and resources for the safe handling of biomedical waste, similar to quarantine centers. Therefore, an excellent team who are trained, prepared and informed on the updated guidelines should be in charge of the handling and processing of biomedical waste in these centers.

BMW Waste Category	Types of box/bags	Types of waste	Treatment and disposal
Yellow	Non-chlorinated plastic bag (Autoclavable)	<ul style="list-style-type: none"> Personal protective equipment (PPE) with spill Donned of PPE Disposable linen gowns Non-plastic and semi-plastic materials Soiled Gloves Headcovers Disposable bed sheets Thermal scanners Soiled masks Disposable mask Tissues and toiletries Swab contaminated with blood and other body fluids 	<ul style="list-style-type: none"> Plasma pyrolysis or Incineration or Deep burial
Red	Non-chlorinated plastic bag (Autoclavable)	<ul style="list-style-type: none"> Goggles (eye protection) Reusable bed sheets Nitrile gloves Hazmet suite Plastic water bottles used in quarantine or isolation area Other recyclable materials like pens Plastic coveralls Face shields Splash-proof aprons Empty sanitizer bottles 	<ul style="list-style-type: none"> Sterilizing the waste by autoclaving, hydroplaning or radiation-based Treated/Sterilized waste should be sent for the recycling This waste should not be incinerated or buried.
White	Leak and puncture-proof containers	<ul style="list-style-type: none"> All the sharps generated in quarantine, isolation or screening areas Sharp metallic waste 	<ul style="list-style-type: none"> Wet or dry heat sterilization Sterilized waste is shredded/ mutilated/ encapsulated and sent for landfill
Blue	Cardboard boxes	<ul style="list-style-type: none"> All the glassware's Tube lights and bulbs CFL and LEDs All the glass bottle Metallic waste (recyclable size) 	<ul style="list-style-type: none"> Disinfection or sterilization Sent for the recycling

Table 2: Segregation of biomedical waste generated in he hospital and temporary BMW generating centers during COVID-19

(Source: Sharad Chand, Updates on biomedical waste management during COVID-19: The Indian scenario Clinical Epidemiology and Global Health 11 (2021) 100715)

Duties of Quarantine Facilities Authority

Providing all the legal authority for the establishment and allocation of resources for of the biomedical waste storage area are given as under:

- Arranging authorized vehicles for the transportation of biomedical waste to the hospital or disposal facilities.
- Conducting induction, orientation programs and training the personnel involved in the handling and management of biomedical waste.
- Monitoring the processes and ensuring its compliance with SOPs that have been laid down.

- Issuing the authorized identity card to the person entering the quarantine facilities.
- Handing over the generated biomedical waste to the authorized collectors.
- Maintaining accurate documentation and reporting the same to the higher authorities.

Duties of Biomedical Waste Management Company, Hospital or CBMWFs

- Timely collection of biomedical waste from the quarantine centers (at least twice a day).
- Providing all the personal protective equipment to the persons involved in the transportation and disposal of biomedical waste.
- Regular sanitization of the biomedical waste workers.

- Encouraging the strict adherence to the guidelines during the transportation and bisposal of waste.
- Providing the information regarding the reception of biomedical waste to the generating facilities.
- Handing over the disinfected or sterile waste to the respective agency for recycling.
- Providing updated information to the biomedical waste handlers.
- Assist healthcare facilities and quarantine centers during the training.
- Maintaining proper records and documents for at least five years.
- Auditing the records with the generating facilities.
- Any injury or accident case should be reported to the quarantine facility in charge or the sanctioned authority.
- Continuous education, training, monitoring and supervision of biomedical waste handling processes (daily basis).



Duties of State Pollution Control Board

- They should ensure the compliance of healthcare facilities and other biomedical waste generating centers to the biomedical waste rules 2016.
 - They can allow the CBMWF for additional hours of work, but it should be monitored and recorded accurately.
 - They should make sure that the minimum documentation for the authorization of quarantine centers is received and maintained.
 - They shall monitor and supervise the biomedical waste handling activity of all the facilities regularly and document the same.
- Remote quarantine centers beyond the reach of CBMWFs should be permitted for the deep burial of biomedical waste.
 - The state control board should assist CBMWFs with any required resource collection and disposal during the pandemic.
 - In case the amount of biomedical waste exceeds the capacity of CBMWFs, the hospital or healthcare setting can be permitted for incineration within the health care setting
 - State pollution control should download and use the COVID19 biomedical waste app and stay updated with the uploaded data regularly.

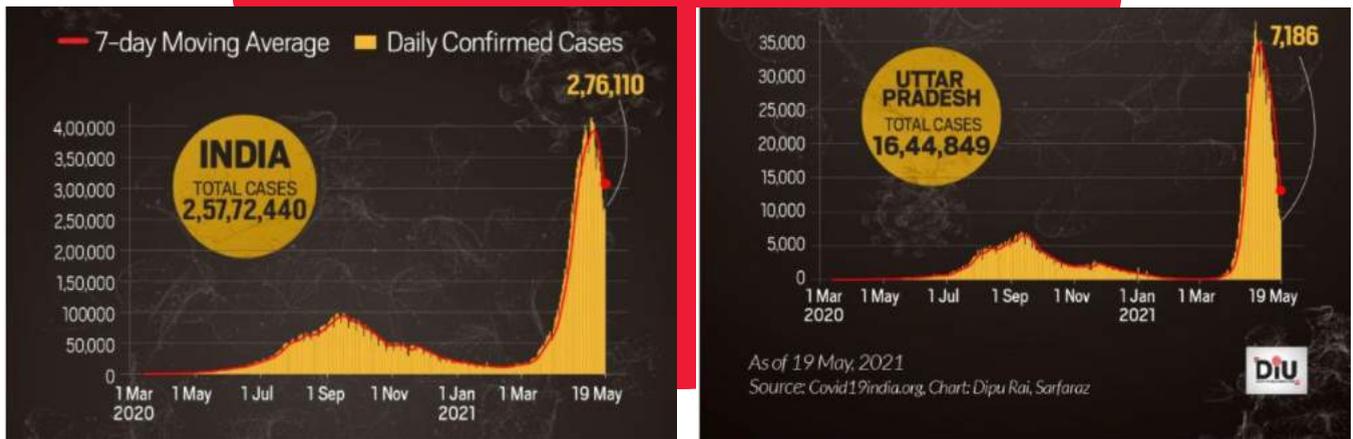


Figure 2(a) & (b): Status of Covid 19 in India vs Uttar-Pradesh from 1 Mar 2020 to 19 May 2021

From the above study, we can say that biomedical waste is a serious health concern. Untreated biomedical waste serves as a potential source of pathogens. It has been reported that more than 40 species of harmful micro-organism to possess the potential to transmit and cause human illness. The etiological agent of the pandemic is highly contagious and rapidly transfers from one person to another via various routes. It was found more disastrous during second wave started from end week of March 2021 and given spike of 4,00,000 than it was 1,00,000 in Oct 2020 totaling 2,57,72,440 and in Uttar-Pradesh, it has very steep spike 5,000 in end of Sep 2020 to 35,000 on 19 May 2021 and death toll 2,76,000 in India (Fig. 2a, 2b). This has threatened Govt. to create infrastructure like Oxygen Cylinders and Ventilators in each Health Centre.



Due to its high transmission rate, the risk of getting infected is persistently high. Realizing the threat of disease, state and central pollution control boards in association with AIIMS New Delhi have framed various guidelines. These guidelines are focused on the prevention of healthcare personals and workers involved in its handling and management. This update has enabled the preparation of policies for the temporary centers and has emphasized the roles and responsibilities of the concerned persons and authorities. Thus the strict compliance with these re-framed guidelines will definitely make the management of the exponential increase in biomedical waste easier and safer for the environment and community.

CORONAVIRUS TIPS!

Symptoms



Fever



Cough



Shortness
of Breath

If you feel sick



Stay at home



Call doctor



Avoid contacts with
other people

Prevention



Wear a mask



Don't touch face



Wash your hands