



Medical Waste Generation during COVID-19 (SARS-CoV-2) Pandemic and Its Management: An Indian Perspective

Manju Rawat Ranjan^{1*}, Ashutosh Tripathi¹ and Ganga Sharma²

¹Amity Institute of Environmental Sciences (AIES), Amity University, Noida, UP, India.

²Deen Dyal Upadhyay Zonal Hospital, Shimla, Himachal Pradesh, India.

Authors' contributions

This work was carried out in collaboration among all authors. Author MRR designed the study, did the literature review, its analysis, wrote the first draft and finalized the manuscript. Authors AT and GS managed the analyses of the study. Author GS guided the concepts. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJEE/2020/v13i130171

Editor(s):

(1) Daniele De Wrachien, State University of Milan, Italy.

Reviewers:

(1) P. S. Harikumar, Centre for Water Resources Development and Management, India.

(2) Ally Nkwabi, Wildlife Research Institute (TAWIRI), Tanzania.

(3) Maxime Pichon, University of Poitiers, France.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/57090>

Short Research Article

Received 28 April 2020

Accepted 03 June 2020

Published 13 June 2020

ABSTRACT

The generation of biomedical waste has increased many times after the SARS Cov2 commencement. The biomedical waste generated from COVID-19 Patients is very infectious and contaminated. Thus, it is a big challenge with all stakeholders to avoid spreading of COVID-19 through it. This requires monitoring the complete cycle to the grave to be monitored from the cradle, if the spreading needs to be controlled. The COVID-19 waste generation, collection, storage, transportation and disposal is a big challenge with all stakeholders including isolation wards, quarantine centres, sample collection centres, laboratories, urban local bodies, and the Common Bio-medical Waste Treatment Facility (CBWTF) respectively. As its a novel virus and WHO has instructed that proper guidelines need to be followed with regards to COVID-19 biomedical waste generation and its safe disposal. The Government of India has separately developed the Guidelines for the handling of COVID-19 biomedical waste, which needs to be followed besides Biomedical Rules, 2016 so that Corona spread through this can be controlled. Owing to its novel origin and least information about its behaviour, thus it is extremely important to take all precautions possible till we get some medical treatment.

*Corresponding author: E-mail: mrranjan@amity.edu;

Keywords: SARS-CoV-2; COVID-19; biomedical waste; treatment; disposal.

1. INTRODUCTION

A novel human coronavirus that is now named as Severe Acute Respiratory Syndrome Coronavirus- 2 (SARS-CoV-2) emerged in Wuhan, China, in late 2019 as the name COVID-19 derived and is now a cause of Pandemic and a great concern to mankind. The SARS-CoV-2 is a positive-sense single-stranded RNA virus (Fig. 1). Each SARS-CoV-2 virion is approximately 50–200 nanometres in diameter [1]. Like other coronaviruses, SARS-CoV-2 has four structural proteins, known as the S (spike), E (envelope), M (membrane), and N (nucleocapsid) proteins; the N protein holds the RNA genome, and the S, E, and M proteins together create the viral envelope. The spike protein, which has been imaged at the atomic level using cryogenic electron microscopy, is the protein responsible for allowing the virus to attach to and fuse with the membrane of a host cell.

(b). Illustration of a SARS-CoV-2 virion(c). Structure of a SARS-CoV-2 virion. (Source 1) It has been reported that the viral RNA is also found in stool samples from an infected individual and also in sewage sludge of infected area [2]. There is some evidence of human-to-animal transmission of SARS-CoV-2. The research indicates that the virus is inactivated by soap, which destabilizes its lipid bilayer. As at present Coronavirus cases spread to almost over 340 countries in the World and infected almost 24,37,500 people and casualties is app. 1,97,500 as on 25 April 2020. As per the WHO, the COVID-19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes. These droplets then land on objects and surfaces around the person, thus other people catch it when they touch their eyes, nose or mouth after touching these contaminated surfaces. Due to this WHO recommended regular washing of hand with soap or sanitizer with above 70% alcohol beside that its important to stay more than one metre (three feet) away from a person who is sick or maintain physical/social distancing [3].

The biomedical waste (BMW) generation from COVID-19 patients is increasing in India day by day. India is producing an app. 2,00,000 tonnes

of biomedical waste (BMW) per annum are treated by only 198 Common Bio-Medical Waste Treatment Facilities (CBMWTFs) and 225 captive incinerators, thus the daily generation of BMW is app. 550 tonnes. This has been reported that during the present epidemic in Wuhan, China, the city was producing 240 tonnes of additional medical waste per day. It has been estimated that hospitals are generated six times more of medical waste at the peak of the outbreak of COVID-19. The Asian Development Bank reports that in Manila 280 tonnes/day, Jakarta 212 tonnes/day, Bangkok 210 tonnes/day is the additional biomedical waste generation in this Pandemic [4]. The government had to deploy mobile treatment facilities to manage it and had to follow the proper waste disposal technique. The hospital waste can be managed by forcing regulations but there is more to worry the disease is spread out beyond hospitals. Some people who have minor symptoms are recovering at home and others who are asymptomatic, who might not know that the trash they are throwing out could be contaminated. That means people may be generating plenty of virus-laden trash and that will contaminate the sanitation workers, as the virus is reported to persist for days on cardboard, metal and plastic.

This has been noted that People handling health care waste, in particular, should wear appropriate gear, including boots, aprons, long-sleeved gowns, thick gloves, masks, and goggles or face shields, according to recommendations from the World Health Organization (WHO). According to WHO report, there is no evidence that direct, unprotected human contact during the handling of health care waste has resulted in the transmission of the COVID-19 virus [3]. The CEO of the Solid Waste Association of North America reported that practising social distancing while on the job, including maintaining appropriate distances from people, may help to reduce sanitation workers risks, a similar view has been given by the firm Alston & Bird that indicates that the COVID-19 waste should be properly bagged instead of kept loose and workers are wearing personal protective equipment, especially gloves, then there will be no risk of catching the virus [5].

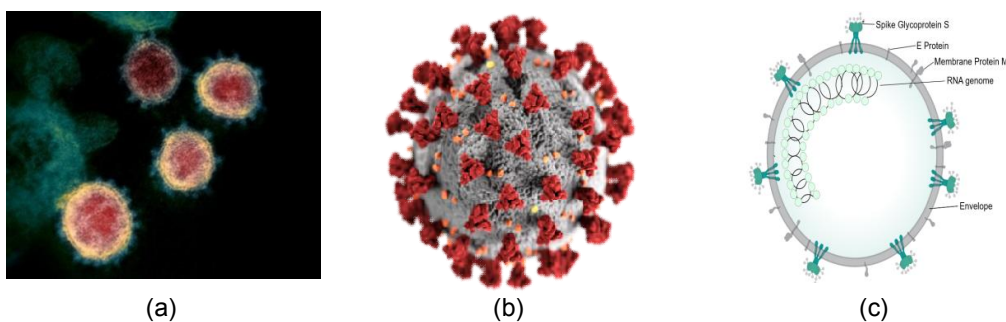


Fig. 1(a). Electron micrograph of SARS-CoV-2 virions with visible coronae

2. CHARACTERISTICS OF BIO-MEDICAL WASTE GENERATION DURING COVID-19 PATIENTS AND IN HOSPITALS

Health care workers like Doctors, Nurses and staff are quickly going through medical supplies and disposable of personal protective (PP) equipment like masks, gloves, gown/overall, shoes, caps, goggles, eyeshield etc. The other COVID-19 biomedical waste generated from the patient wards are as human tissues, body fluids, dressings, cotton swabs, beddings contaminated with blood or body fluid, blood bags, needles, syringes, and other contaminated sharp object etc is becoming a bigger concern for hospitals as waste is increasing with the increase in the number of patients. Eventually, this highly infectious medical waste needs to be discarded with great care. According to medical waste management company Stericycle, US, there is already increase of garbage from personal protective equipment and the waste food, now need to be handled more carefully after coming in contact with a COVID-19 patient, as they are usually not considered as medical waste. Thus, to make sure contaminated trash from health care facilities doesn't pose any harm to the public before going to a landfill, it should be properly burned, sterilized with steam, or chemically disinfected. As reported by Los Angeles times, red bags of medical waste laden with the coronavirus have been flowing from Southern California hospitals and are tossed into an autoclave and scorched with pressurized steam. Steam autoclave is used to treat California's medical debris. It kills all the bugs in the garbage and then could be sent to the landfill [6].

3. SURFACE STABILITY OF SARS-COV 2/COVID-19

The study done by scientists indicates that SARS-CoV-2 on Aerosol and Surface stability

indicates that SARS-CoV 2 was more stable on plastic and stainless steel than on copper and cardboard, and the viable virus was detected up to 72 hours after application to these surfaces, on copper, no viable SARS-CoV-2 was measured after 4 hours and on cardboard, no viable SARS-CoV-2 was measured after 24 hours [7]. Similar finding by Chin et al, 2020 [8].

Table 1. Surface Stability of SARS-CoV 2/ COVID-19

Surface	In hours
Plastics	72
Stainless Steel	72
Copper	4
Cardboard	24
Printing and Tissue Paper	3
Wood and Cloth	48
Glass and Banknote	96

[Sources: 7 and 8]

Guidelines for Handling, Treatment and disposal of waste generated during treatment/ diagnosis/quarantine of COVID-19 Patients.

The Central Pollution Control Board (CPCB), has released guidelines for handling, treatment and safe disposal of biomedical waste generated during treatment, diagnosis and quarantine of patients confirmed or suspected to have the novel coronavirus disease (COVID-19) in March 2020 [9]. These guidelines are a part of a provision in Bio-Medical Waste Management Rules, 2016, though India already has biomedical rules but to ensure that the waste generated specifically during testing of people and treatment of COVID-19 patients is disposed of scientifically. The CPCB clarified that these guidelines need to be followed by all stakeholders including Isolation wards, Quarantine centres, Sample collection centres, Laboratories, Urban local bodies (ULBs), STP/ETPs and the Common Bio-medical Waste

Treatment Facility (CBWTFs), in addition to the existing biomedical waste management rules.

The Guidelines related to COVID-19 BWM was notified in March 2020 and after the second revision of 19 April 2020, they have prescribed seven major guidelines for all stakeholders, Healthcare facilities (HCFs), Quarantine camps/homes/Homecare, Sample collection centres, laboratories, SPCBs/PCC, ULBs and CBWTFs for proper collection, treatment and disposal of biomedical waste related to COVID-19infected patients.

(i) **COVID-19 Isolation wards:** Waste should be collected in separate colours bins/bags/containers. It should be double-layered bags (two bags), should be used for the collection of waste to ensure adequate strength and no-leaks. Collect and store COVID-19, biomedical waste separately before handing over the same to Common Bio-medical Waste Treatment Facility (CBWTF). Use a dedicated collection bin labelled as COVID-19to store this waste. This will help CBWTF to identify waste easily before treatment and its disposal and maintain a separate register for the same. Separate trolley for COVID-19 waste transportation. Wash Bags with 1% Sodium hypochlorite solution. Need to reportCOVID-19 waste generation to SPCB and CBWTFs. There should be a dedicated sanitary worker for COVID-19 waste.

The guidelines also sought that bags/containers used for collecting biomedical waste from COVID-19 wards should be labelled as COVID-

19 waste to enable CBWTFs to identify the waste easily for priority treatment and immediate disposal after getting it. Besides, the guidelines sent to all states, direct use of dedicated trolleys and collection bins in COVID-19 isolation wards and recommended that the surface of containers, bins, trolleys used for storage of COVID-19are disinfected regularly. The faeces and bedpan urine from COVID-19 patients should be carefully disposed of. PPE to be collected and disposed of in Red (goggles, face shield, splash-proof apron, plastic coverall, Hazemet suit. Nitrile gloves) and Yellow colour bags (triple layer masked, N95 marks, head cover/cap, shoe-cover, gown, non-plastic and semi-plastic coverall) respectively.

(ii) **The sample collection centres and laboratories for COVID-19 suspected patients:** The CPCB suggested similar steps for the sample collection centres and laboratories for COVID-19 suspected patients. The pollution watchdog said opening or operation of COVID-19 ward, sample collection centres and laboratories should also be intimated to the State Pollution Control Boards (SPCBs). Pre-treat viral transport media, plastic vials, vacutainers, Eppendorf tubes, plastic cryovials, pipette tips as per BMW Rules, 2016 and to be collected in red bags (Fig. 2).

(iii) **The quarantine facilities:** The quarantine facilities and during home care for suspected COVID-19 patients, the guidelines noted that even though a low quantity of biomedical waste is expected to be generated, they still need to follow strict steps to ensure safe handling and



Fig. 2. Red and yellow bins in hospitals for COVID-19 biomedical waste

disposal of waste. The general waste with no contamination to be disposed of according to SWM Rules, 2016 and the contaminated or infectious waste to be given to CBWTFs in yellow bags for treatment and proper disposal. They can report ULBs in case any difficulty in disposing of waste.

(iv) **Duties of CBWTF:** Needs to report on receiving of COVID-19 waste to SPCB/PCC from all stakeholders. Use dedicated vehicles for COVID-19 waste and it should be sanitised properly. The COVID-19 waste should be disposed of immediately after receiving, in case extra hours required for the disposal. This Sanitization and proper PPE for Sanitary workers, if they have any symptom for COVID, may provide paid leave to them. There is a need to maintain separate records for this waste.

(v) **8 Duties of SPCBs/PCC:** They shall maintain separate records of COVID-19 treatment wards, quarantine centres, quarantined homes in respective states. Ensure proper collection and disposal from all stakeholders. At remote areas, the deep burial of such waste in yellow bags could be permitted. The hazardous waste incinerators should be allowed to be used by CBWTFs for COVID-19 waste. Allow extra hours to CBWTFs COVID-19 waste disposal.

(vi) **Duties of Urban Local Bodies (ULBs):** They are responsible for safe collection and disposal of biomedical waste generated from all stakeholders. Designated sanitary staff for collection of COVID-19 waste from all generation points, training of staff, proper PPE and sanitization for them is mandatory to ensure by ULBs. They are responsible for providing yellow colour bags to the person responsible for operating quarantine camps or home care and also facilitate the smooth operation of CBWTFs.

(vii) **Management of Wastewater from HCFs/Isolation wards:** As per recent reports and centre for Disease Control and Prevention (CDC) information the sewerage discharge from COVID-19 patients might have a low risk of transmission thus, the STP/ETPs should take care of PPE for its worker and proper disinfection of treated wastewater. Also, the utilization of treated wastewater should not be utilized by the HCFs for the period of COVID-19.

The Guidelines for COVID-19 Biomedical Waste is being updated with WHO and other advisories norms. This will help to take all precautions to

reduce the spread of contaminants from this waste.

4. CONCLUSION

The Major Challenges with the management of COVID-19 is its safe disposal from point of generation to treatment facilities. There is great concern on the management of COVID-19 waste, as the cases increase exponentially, the treatment centres will be overburdened by such medical waste and if precautions are not ensured could result in infections among sanitary workers. There is a big challenge of mixing of COVID-19 waste with regular medical waste and including food waste from COVID-19 wards. Regular sanitisation of workers and adequate personal protective equipment including three-layer masks, splash-proof aprons/gowns, nitrile gloves, gumboots, and safety goggles involved in handling and collection of biomedical waste should be mandatory. Dedicated vehicles must be employed to collect COVID-19 ward waste and its sanitisation. The proper monitoring is quite essential while disposing of COVID-19 waste so the workers at CBWTFs should not get infected by it. The communities in large home quarantine need to dispose of their used napkins, tissues, empty sanitiser bottles in a separate bag, to ensure the safety of municipal workers and ragpickers. There is an urgent need to monitor proper safety kits and training to municipal workers engaged in handling during the outbreak. Sewage sludge coming out from the COVID-19 patients needs to be properly disinfected. Urgent need of collected all COVID-19 waste in separate bags/bins and marked as COVID-19, if India needs to prevent the outbreak of COVID-19, its' important to take care of Biomedical waste from all HCFs so that infection spread through this could be checked.

ACKNOWLEDGEMENT

The authors are grateful to Amity University for providing congenial environment to do research work and also thankful to SERB, DST for providing a project on MSW compost. The other author is thankful to her health department, Himachal Pradesh to be given duty of Nodal officer for Biomedical Waste Management in 2019-20 and to deal with Kayakalp and SPCBs survey in Shimla Zonal hospital.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Nanshan C, Zhou M, Dong X, Qu J, Gong F, Han Y. Epidemiological and clinical characteristics of 99 cases of 2019 Novel Coronavirus Pneumonia in Wuhan, China: A descriptive study. *The Lancet*. 2020;395(10223):507-513. DOI:[https://doi.org/10.1016/S0140-6736\(20\)30211-7](https://doi.org/10.1016/S0140-6736(20)30211-7)
2. Holshue ML, De Bolt C, Lindquist S, Lofy KH, Wiesman J, Bruce H, Spitters C, Ericson K, Wilkerson S, Tural A, Diaz G, Cohn A, Fox Le A, Patel A, Gerber SI, Kim L, Tong S, Lu X, Lindstrom S, Pallansch M A, Weldon WC, Biggs HM, Uyeki TM, Satish K, Pillai SK. First case of 2019 novel coronavirus in the United States. *The New England J Med*. 2020;5;382(10):929-936. DOI: 10.1056/NEJMoa2001191
3. WHO. Water, Sanitation, Hygiene and waste management for the COVID-19 Virus. WHO and UNICEF. Interim Guidance, WHO/2019-nCoV/IPC_WASH/2020.2. 2020;1-6.
4. Asian Development Bank. Managing Infectious medical Waste during the COVID-19 Pandemic; 2020. Available:<http://www.adb.org>
5. Available:<https://www.theverge.com/2020/3/26/21194647/the-COVID-19-pandemic-is-generating-tons-of-medical-waste>
6. Available:<https://www.latimes.com/environment/story/2020-03-30/medical-waste-industry-coronavirus-contaminated-trash>
7. Doremalen NV, Bushmaker T, Morris DH, Holbrook MG, Gamble A, Williamson BN, Tamin A, Harcourt JL, Thornburg NJ, Gerber SI, Lloyd-Smith JO, Wit E de, Munster VJ. Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1, *The New England J Med*. 2020; 382:1564-1567. DOI:10.1056/NEJMc2004973
8. Chin AWH, Chu JTS, Perera MRA, Hui KPY, Yen Hui-Ling, Chan MCW, Peiris Malik, Poon LLM, Chu JTS. Stability of SARS-CoV-2 in different environmental conditions. *The Lancet Microbe*. 2020;1(1):E10. DOI:[https://doi.org/10.1016/S2666-5247\(20\)30003-3](https://doi.org/10.1016/S2666-5247(20)30003-3)
9. CPCB Guidelines. Available:<https://www.cpcb.nic.in/uploads/Projects/Bio-Medical-Waste/BMW-GUIDELINES-COVID.pdf>

© 2020 Ranjan et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:
<http://www.sdiarticle4.com/review-history/57090>