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Case study of Covid-19 waste management in Indian Context.

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Abstract: *The recent covid-19 pandemic due to the outbreak of coronavirus raised the demand for personal protective equipment and medical services, which leads to an increase in covid 19 waste rapidly. Designing systematic and reliable policies in this circumstance may aid in the control of the spread of coronavirus. The objectives of this study were: (i) To evaluate the waste management and treatment system of covid-19 related waste and its mandatory compliance with rules of WHO and the Indian government, and (ii) To estimate the amount of covid waste generated in the country along with few numbers of covid waste generation in major states. During this study, it was observed that: (i) the doctors and other staff members are taught to take appropriate precautions when dealing with these covid waste materials, (ii) the process of collection, segregation, transport, storage, and final disposal of such waste is done in compliance with the guidelines of AIIMS, and (iii) the final disposal is done by the process of incineration. The government has also given instructions to set up temporary incineration plants if the amount of waste exceeds the capacity of CBWTF incinerators. This paper discusses the different covid-19 waste management strategies practiced in India. It even discusses issues encountered throughout this management, as well as potential solutions for overcoming these obstacles. It issues encountered throughout COVID-19 waste management, as well as potential solutions for overcoming these obstacles.*

Keywords*: Waste Management, Bio-medical, Covid-19*

I. Introduction

Management of waste has always been a major challenge in this 21st century. Mankind is continuously trying to find more environmentally friendly ways to dispose of this waste. But still, no process is 100% environment-friendly. The Biomedical Wastes (Management & Handling) regulations initiated in India in 1998. [1] In addition to this, Pandemic of Covid-19 has posed a new question of increase in the covid related waste, that needs to be addressed simultaneously, otherwise, it can become a huge problem in future.

In the initial stages of the covid pandemic, a lot of waste was generated around the disposal area. The main reason is less awareness about how to dispose of this waste (PPE kits, mask, face shield), and the waste was not managed well, due to which the municipal dustbins overflowed.

The current rapid spread of COVID waste as a result of the COVID-19 pandemic is increasing the situation, and there is an immediate risk that the consequences of improper trash disposal may result in a catastrophe of pollution and health-related issues The improper disposal of COVID-19 waste not only pollutes the environment, but also contributes to the spread of infectious diseases, which are primarily produced by reusing or collecting medical waste. The particle might also land on surfaces where the virus could survive, making the immediate environment of an infected person a source of transmission. So, it is a must that COVID-19 waste to be separated from other medical waste.

However, no single report exists that details all of the COVID waste disposal measures used by different countries during the COVID-19 outbreak. As a result, this analysis examines India's covid waste plans and procedures, as well as WHO guidelines. The review also attempts to investigate the difficulties in disposing of COVID-19 trash. In the fast-moving context of the COVID-19 pandemic, the document discusses alternative ways for coping with this waste.

II. Challenges

Both humans and the ecosystem are harmed by covid-19 waste. Doctors and nurses are more susceptible to infection. Near landfills, water becomes contaminated due to COVID-19 waste. The COVID-19 outbreak has put enormous strain on waste management systems already in place. During this time the amount of COVID-19 waste has gradually increased. [5] Countries around globally, there are similar issues in dealing with massive amounts of waste. Our country has faced many challenges during this pandemic such as:

1. Identifying workers involved in the waste collection and disposal sector as key workers and providing them and their families, financial security, health cover, and insurance.
2. Safe disposal of covid waste to avoid further spread of the virus.
3. Making sure that the safety of workers (both formal and informal) is insured. This includes making sure additional health and safety procedure is followed.
4. Ensuring the continuation of waste collection and recycling and making necessary readjustment.
5. Integration of waste pickers and making sure they are well equipped and are not exposed to the virus-laden waste.
6. Awareness and clear communication stressing the need for reduction in waste and source segregation.
7. Need to understand the waste generation dynamic in the wake of the global pandemic and proactively adjusting to meet the current need.
8. Development of adequate disposal facilities.

III. Guidelines

A COVID-19 waste management guideline refers to a scheme for disposing of generated waste. [4] It usually refers to:

1. Reopening of the closed waste management service.
2. Emergency treatment options need to be insured along with adequate disposal facilities.
3. Incorporation of reusable PPEs in response to the immense PPE usage.
4. Emergency waste management response plan need to be professed in accordance with the public safety guidelines.
5. Immediate policy actions need to be ensured identifying the health and financial condition of waste worker.
6. Proper communication through the social media apps or advertisements for the safe household waste management before collection and disposal.

IV. Process

1) **Identification**: Gloves, PPEs, Face Shields, Face masks, shoe covers, etc. is the waste generated particularly due to Covid-19. These are supposed to be addressed separately from other medical waste. [3]

2) **Collection**: For Hospital, all the waste is collected in the doffing area. There are no specific people assigned to do this. Doctors including all other helpers are given guidelines to collect all such waste only in this area. [3] For home quarantine waste, it is collected by CBWTF workers and respective municipal workers. These workers also collect the waste from temporary isolation wards in the area.

3) **Segregation**: Inefficient health-care waste management is exacerbated by segregation. It entails sorting various forms of waste based on their identification at the point of origin. As a result, if segregation is done correctly, waste will be greatly reduced. For simple identification and segregation of covid-19 waste, the hospital used color-coded, high-density polyethylene bags. [3]

Red bins and bags are assigned for waste generated by hospitals and yellow bags for home quarantine, isolation wards.
Red Bin-01: It is meant for Goggles and Face shields.
Red Bin-02: It includes N-95 masks and coveralls.

Red Bin-03: Disposable PPEs are segregated in this bin. All the above waste should be kept in double bags to ensure its durability and prevent leakage.

4) **Disinfection**: It is the most important step in this covid situation to prevent the infection from spreading through waste.

Waste of Red Bin-01 is immersed in 0.5% sodium hypochlorite solution (freshly prepared) for 10 minutes and then wiped with 70% alcohol swab.

Red Bin-02 waste is stored in bags and handed over twice daily to the sanitation and housekeeping services.

Red Bin-03 waste is handed over to authorized waste-collecting staff like CBWTF.

Furthermore, after each cycle of COVID waste collection, the trucks must be disinfected by spraying a 1 % sodium hypochlorite solution on them. Workers should avoid contacting their faces, noses, mouths, and eyes immediately after removing their PPE and facemasks, and only after using a 70% alcohol sanitizer. It is recommended that such trash be handled carefully because it can be highly infectious for up to 7 days. As a result, the discarded masks must be folded in paper for at least 72 hours.

5) **Storage**: All this disinfected waste is packed in bags and stored in a particular allocated area. It is compulsory to label all the bags with respective item waste and the "COVID-19" label. Because of its hazardous characteristics, however, medical waste assigned to temporary storage should be kept in locations that are selected based on a series of criteria. The location should have the following features: not be subject to flooding, distant from staff activities, have different wastes separated, be some distance from traffic, be secured from the climate, have good ventilation, and come up with a drainage system and absorbent material for spills. Moreover, liquid wastes and solid wastes should be stored in tanks, and bunkers, silos, and skips, respectively.

6) **Transportation**: All the waste is transported to either municipal corporation or treatment plants. Temporary COVID-19 treatment of waste centres and temporary transportation facilities can aid in waste management and transmission prevention during the COVID-19 pandemic. Waste collected from hospitals and other healthcare facilities can be transported directly or through temporary transit centres to temporary or existing treatment facilities. The processed trash can then be transported to waste disposal facilities.

7) **Treatment and Disposal**: To increase the awareness among the people about ensuring the safe handling of COVID-waste, the government, local governments, and waste treatment facilities must lead an awareness campaign that uses a variety of media outlets to reach out to the general public. Covid waste from isolation wards and home quarantine is collected and delivered to the Common Bio-Medical

Waste Treatment Facility (CBWTF) in double-layered yellow bags. The waste generated at hospitals is disposed of by different methods like incineration, microwave, pyrolysis, etc.

Fig.1 Flowchart showing process for waste management

Process	Biomedical Waste (BMW)	Covid-19 Waste
Identification	Human anatomical waste like body parts, organs and tissues. Biotechnology and Microbiology waste, Incineration ash and other chemical wastes, as well as liquid waste from any of the afflicted locations.	Along with the biomedical waste for COVID patients, gloves, PPEs, Face Shields, Face masks, shoe covers, etc. is the waste generated particularly due to Covid-19. These are supposed to be addressed separately from other medical waste.
Collection	Different types of containers from a variety of biomedical waste sources, such as operation theatres, wards, laboratory, etc are used to the collection of biomedical waste. To achieve 100% collection of waste containers/bins are kept.	All the waste is collected in doffing area. There are no specific people assigned to do this. Doctors including all other helpers are given guidelines to collect all such waste only in this area.
Segregation	Segregation helps to reduce waste, which requires specific handling and treatment. After proper and complete cleaning, certain components of medical waste, such as plastics, can be recycled.	Inefficient health-care waste management is exacerbated by segregation. It entails sorting various forms of waste based on their identification at the point of origin. As a result, if segregation is done correctly, waste will be greatly reduced. For simple identification and segregation of covid-19 waste, the hospital used color-coded, high-density polyethylene bags
Disinfection	Ethyl alcohol or isopropyl alcohol (60%–90%, v/v) commonly used t… stoppers of multi… thermometers) as… on occasion (stetl…	Waste of Red Bin-01 is immersed in 0.5% sodium …freshly prepared) for 10 minutes …% alcohol swab. …ored in bags and handed over twice …nd housekeeping services. …nded over to authorized waste …WTF.
Storage	If waste becomes… such period, then… to guarantee that… human health or… lined with chlorin… labelled accordin…	…cked in bags and stored in a …a. It is compulsory to label all the …em waste and "COVID-19" label. …us characteristics, however, …l to temporary storage should be …re selected based on a series of
Transportation	Trolleys or cover… convey the waste… manual loading should be avoided. Before transferring the BMW bag, it should be accompanied by a signed	…rted to either municipal corporation …Waste collected from hospitals and other healthcare facilities can be transported directly or through temporary transit centres to temporary or existing

	document from a nurse or doctor stating the day, shift, quantity, and destination.	treatment facilities. The processed trash can then be transported to waste disposal facilities.
Treatment and Disposal	Bio-medical waste must be managed and disposed of in compliance with the law. Every occupant should set up the necessary bio-medical waste treatment facilities, such as an incinerator, autoclave, and microwave system, ahead of time.	Covid waste from isolation wards and home quarantine is collected and delivered to the Common Bio-Medical Waste Treatment Facility (CBWTF) in double-layered yellow bags. The waste generated at hospitals is disposed of by different methods like incineration, microwave, pyrolysis, etc.

Table.1 Comparison of waste management (Biomedical waste Vs Covid-19 waste) [1]

V. Smart Garbage Decomposition Machine

This machine was invented as an alternative way for the disposal of general waste. Due to the tremendous increase in COVID-19 waste this machine can be a boon in the present time. This can help in decentralising the waste management system. A completely new perspective towards waste destruction that does not require any fuel, electricity, and furnace for destruction, no high-temperature boilers for burning. The Smart Garbage Decomposition Machine technology is very different from the existing technologies in India in terms of how it works. This technique was developed after considering the practical issues that predecessors in this sector had to deal with.

The ash generated can be used in ceramic, as it has got ceramic properties, and does not contain any hazardous substances, hence it can be safely landfilled. The town can save enough money in the first year to cover the cost of the machine because it won't have to deploy a significant number of expensive transportation facilities. [6]

In all of these ways, Smart Garbage Decomposition Machine technology contributes to the generation of benefits and employment for a huge portion of the population.

Salient Features of Smart Garbage Decomposition Machine

1. Closed chamber Destruction/ Decomposition with plasma and ionization techniques.

2. Concentrated Magnetic Action Technology

3. No segregation is required. All kind of mixed waste can be directly fed into the system including COVID-19 Waste as well Municipal Solid Waste

4. No residue except ceramic ash is generated which is non-toxic and neutral.

5.The life of the plant is a minimum of 20 years.

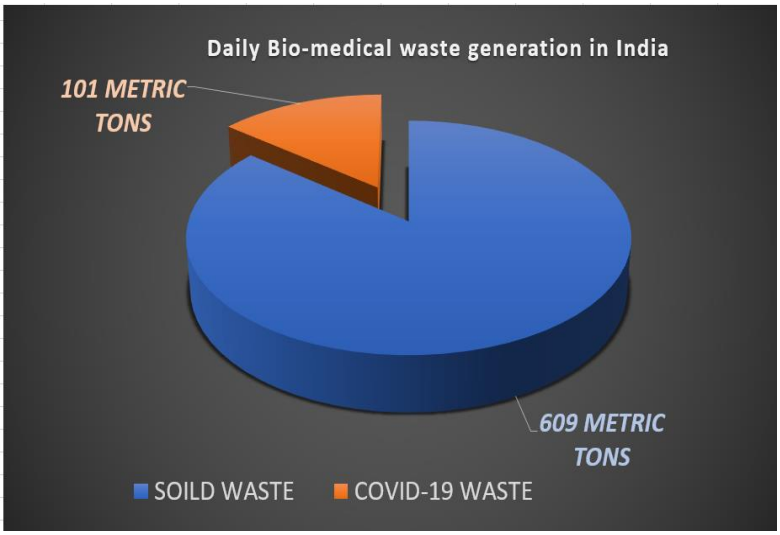

Fig .2 The treatment and disposal of biomedical waste in metric tons per day

Fig.3 daily bio medical waste generation statistics in India. A total of 710 MT of bio medical waste was generated.

Out of which 101 MT of waste covid related bio medical waste. [4]

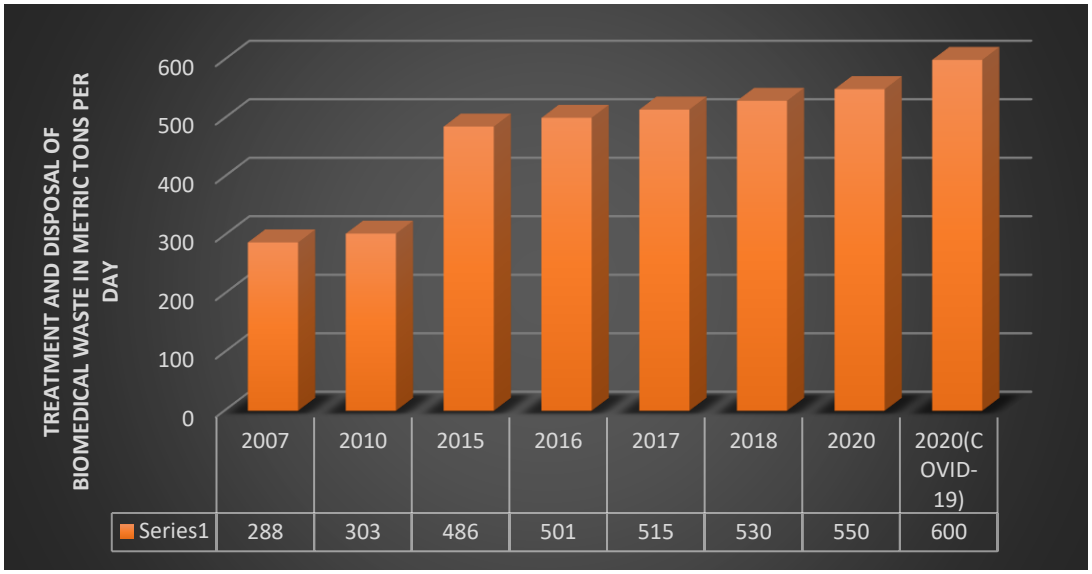

Table no 2 Implications and impacts of measures taken about Covid-19 waste [7]

Taken measures	Implications	Impacts
Safety	Workers should wear PPE and use hand sanitizer	Stops infected workers from spreading the disease.
Disinfection	Prior to sorting, waste must be disinfected.	Prevents workers from being infected and spreading the infection to others.
Storage	9 days of temporary storage	Aids in the disposal of excess waste and the prevention of the virus's spread, which can last up to 9 days.
Treating location	Treatment on-site	Suitable for increased waste management
Treating technique	Sterilwave (a transportable treatment device that is ultra-compact), autoclave, burn incinerator, SF-CO2 sterilisation, microwave or radio-wave treatment	It eliminates the virus.
Handling	Sorting waste and placing it in different bags according to the type of waste.	It's less difficult to manage and dispose of.
Advertisement of guidelines	Social media and workplace display	People will become more conscious of health-related issues.

VI. Discussion

As the covid-19 pandemic spread has a greater impact on economic growth and health outcomes, there is a pressing need for waste to be regarded as a critical public service. The volume of covid-19 waste is increasing extremely because of the novel COVID-19 virus's high infection rate. Waste contaminated during these pandemic situations may infect workers in the waste management sector as a result of their direct contact with garbage. Due to this The World Health Organization (WHO) has issued clear management guidelines for COVID-19 waste during this pandemic. Different countries have tried a number of techniques to appropriately dispose of COVID-19 waste. Many effective safety precautions and working tactics may make it possible to properly manage COVID-19 waste without spreading the virus to others.
Due to COVID-19, the world has been exposed to a number of environmental concerns to COVID-19 waste causing plastic pollution which aspects to the unsustainable use of single used plastic. By looking forward to the global adaption of PPE, future research should focus on developing biodegradable and eco-friendly protective gears to achieve sustainable development. Excess COVID-19 trash can be handled with mobile treatment and temporary storage options, allowing for long-term management of COVID-19 waste without further spreading the virus. Understanding the necessity and adhering to all rules will aid in the prevention of the COVID-19 virus's spread as well as proper and efficient waste disposal. All stakeholders should work together to tackle the emergency conditions caused by COVID-19 infection and infected wastes based on several factors such as sustainability, transparency, and safety.

VII. Conclusion

COVID-19 waste has serious health concern hence it needs exceptional treatment at every stage of waste management.

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