

Effect of improper Biomedical waste management on Environment and its consequence

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Abstract:

Biomedical waste management is getting greater importance after pandemic covid-19. Health care sector has generated tons of biomedical waste during covid-19. Improper management of biomedical waste can pose problems on healthcare workers, patients, communities and their environment. Biomedical waste is very different from other waste management so it thrown a biggest challenge during covid period, because it may have direct consequences on human health and significant impact on environment .since it is hazardous, requires safe handling and appropriate treatment. The Ministry of Environment and Forests had framed and implementing the Bio Medical waste management rules 2016 for proper handling and disposal of biomedical waste .The present survey was conducted in various Primary health care centres of villages and small towns to assess the disposal methods, handling and their treatment. After survey it was found that there is inappropriate treatment of biomedical waste in addition it is mixing with normal garbage generated in houses. To overcome shortcomings in the above, improvement of waste management policies, plans and regulations are recommended mean while awareness programmes are need to be conducted.

Key Words: Biomedical waste, covid-19, Hazardous, Incineration, Waste management, Autoclave

Introduction:

Most of the waste is being generated regularly by human activities. This waste may be hazardous or non-hazardous. The waste generated may be solid waste and fluid waste. Depending on the source of generation solid waste can be classified into house hold waste, Industrial waste and biomedical waste. Biomedical waste is any waste containing biological and chemical materials so it is able in spreading the various types of diseases which can spoil public health and environment. This waste is generated during the diagnosis, treatment; clinical tests, and research activities, immunization of human beings and animals .Biomedical waste (BMW) is generated in hospitals, research institutions, health care teaching institutes, clinics, laboratories, blood banks, animal houses and veterinary institutes. The waste generated during process of health care comprising of surgical cottons, gloves, bandages, clothes, discarded medicine hypodermic needles, scalpels, and body fluids, human tissues and organs. In addition to this other waste is also generated which include heavy metals, radioactive wastes, mercury containing equipment, various plastics ,hazardous chemicals and e-waste. All these are extremely environmentally sensitive and hence requires safer disposal.

Pandemic covid -19 in India has generated huge amounts of waste in health care sector. This covid related waste was generated not just at health care settings but also at homes. Only 20% of infected people had gone to hospitals and mild infected people have got the treatment at their homes. So during covid biomedical waste generated in large amount in rural areas and small towns where no facilities were provided for managing this waste and treated like general garbage at homes. Because BMW management facilities are developed only in major towns and cities.

Mismanagement of biomedical waste generated at health care settings causes a direct effect on health of community, the health care workers and on the environment. The waste produced mainly consists of solid and liquids which may be harmful, infectious and non-infectious.

According to WHO, approximately 85% of health care waste generated is general waste which is non-hazardous and only 10% is hazardous and infectious and remaining 5% is other wastes such as chemical and radioactive which are highly hazardous. This survey aims at providing awareness on life cycle biomedical waste management and how to minimize their effect on environment and minimization methods

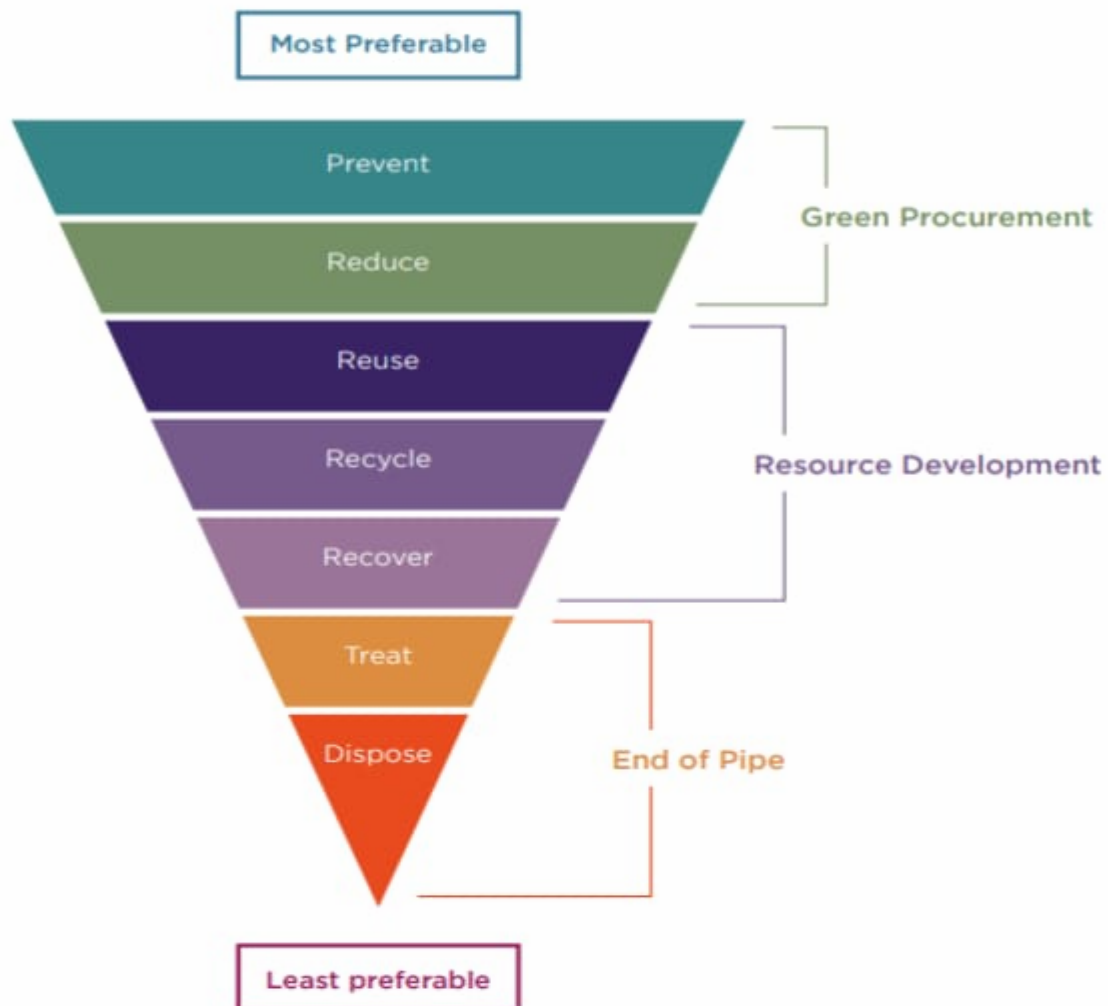
Bio-Medical waste management must be approached in a life cycle manner. The management of waste starts from waste minimization, segregation at source till its final treatment and disposal options. The important aspect that should be kept in mind throughout the lifecycle is that of workers safety, patient safety and environmental safety.

Segregation is the primary step and heart of safe management of biomedical waste simply put across segregation means collection and separation of different types of waste right from the point of generation to final disposal. Waste which is segregated at the point of generation should continue to remain in the same category during storage transportation till final disposal. Only 10-25% of waste produced at health care centres is hazardous and requires appropriate management and remaining is general waste which follows suitable disposal management. The waste generated always contains a sizable portion of waste to recycle, which contributes in minimizing a quantum of waste.

The ministry of environment and forest has framed Biomedical waste management (Management and Handling) rules 2016 and amended in 2018 under the Environment protection act 1986 that make it mandatory to all hospitals ,clinics, nursing homes ,slaughter houses and research centres, blood banks ,medical shops, drug manufacturing units etc for ensuring environmentally sound management of waste generated by them.

For a sustainable management of biomedical waste every health care facility have to adopt the policy of **REDUCE -REUSE- RECYCLE -RECOVER** .This policy helps to minimize the waste that goes to disposal.

Health care waste Management Hierarchy:



Different Methods for Biomedical waste Treatment:

As per the BMWWM rules-2016 the following methods are suggested for proper management of biomedical waste. They are

1. Auto Clave
2. Micro wave
3. Chemical disinfection with sodium hypochlorite solution
4. Incineration

In addition to these there are some other methods also used .

Auto Clave:

An autoclave is made of metal vessel, that is designed to high pressure and temperature system of pipes and valves are used to deliver steam and create vacuum in the vessel sealed door prevents escape of steam. The basic principle of sterilization is that steam under pressure and required temperature microbicidal and sporicidal. The four parameters that are important for autoclave are stem ,pressure, temperature and time. Usually Soiled waste, left over samples in the laboratory, any waste contaminated with blood and body fluids, sharps, microbiological waste like culture media, limited amount of fluids. Autoclaving is not used for anatomical waste as complete penetration of heat is not uniform

Micro wave:

Moist heat and steam are generated by microwave energy and micro waving is essentially a steam based process. The frequency radio waves that are generated will create friction between molecules that will generate heat which helps in disinfection. Items which can be disinfected using micro waves are cultures and stocks, sharps, material contaminated with blood and body fluids isolation and lab waste excluding chemical waste and soft waste from patient care. Some Items are not allowed to microwave which are volatile organic compounds, chemotherapeutic waste, mercury and other hazardous chemical waste and radiological waste

Disinfection with sodium hypochlorite solution:

Sodium hypochlorite solution is active against most bacteria, viruses and spores ,widely used for treatment of waste water. As per the BMWM rules 2016 Sodium hypochlorite solution is the disinfectant to be used. Chemical disinfection is most suitable for treating liquid waste and blood ,urine, and hospital sewage. Solid, even highly hazardous, health -care wastes, including microbiological cultures and sharps ,may also be disinfected chemically with certain limitations. Milling of waste is usually necessary before disinfection .Disinfection of intact solid waste items by chemical disinfectants is limited to only the surface of solid waste.

Sodium hypochlorite is available as greenish –yellow solid. To prepare 10% Sodium hypochlorite solution we need to dissolve 100 gm in 1000 ml.

Incineration:

Incineration is a high temperature, dry oxidation process that minimizes organic and combustible waste to inorganic, incombustible matter and results in a significant reduction of waste volume and weight. High heat thermal process takes place at temperatures from about 200 to more than 1000. Usually the waste that can be incinerable is human and animal anatomical waste, soiled waste, discarded medicines, chemical waste but this process yields high amounts of ash which can pollute the air and water.

Effect of improper biomedical waste management on Environment:

Medical waste can be infectious to both people and the environment causing high contamination and cross contamination risks. Based on the references of World Health Organization (WHO) and other guidelines medical waste must be treated near to its source of its generation. This needs responsibility from every employee working in the hospital who is involved in the segregation process. Suitable location and equipped waste disposal facilities can reduce the necessary transportation of hazardous materials. There is high risk considering the transportation of biomedical waste such as illegal or inappropriate disposal (dumping and obsolete treatment technologies) by haulage personnel and accidents. In addition, transportation of hazardous waste to the treatment centres is prohibited in some urban areas.

Exposure and emission of toxic gases during incineration:

As per the regulations all biomedical waste should be treated within 48 hours and hence every hospital and other HCFs generating bio-medical waste is required to set up proper BMW treatment facilities to ensure proper treatment of waste. Incineration is a widely used and the most popular method of disposing majority of hazardous medical waste. However open burning or burning of medical waste in incinerator emits harmful and toxic gases such as black smoke, toxic flue gas, fly ash, and odours which lead to atmospheric pollution causing respiratory and skin disease or even cancer. US Environmental agency has found that medical waste was the third main source of dioxin emission and 10% of mercury emission. Burning of medical waste such as plastic materials which are generated from polyvinyl chloride (PVC) products is the major producer of dioxin.¹

Impact of biomedical waste on water :

The improper disposal of biomedical waste may cause negative impact on the water quality as different pollutants may leach out from the waste dumping sites into the ground water. Al Raisi et al¹⁵ assessed and found that heavy metals in leachate were exceeding the drinking water standards. The concentrations of Al, V, Cr, Mn, Co, Ni, Ba, Pb, and Fe 2.050, 0.9775, 2.800, 0.503, 0.128, 0.773, 0.8575, 0.130, and 39.25 mg/L, respectively. The effect of these contaminants was considered as a surface and ground water contamination.

Impact on soil:

Improper and unscientific disposal of biomedical waste may change the quality of soil near waste dumping sites. Different pollutants may get mixed with the soil and may change the chemistry and biology of the soil ecosystem. Abidemi and Theresa¹⁶ analyzed five heavy metals (chromium, mercury, nickel, zinc, lead, and copper) for their levels in soil. The concentration of heavy metals in soil were zinc (1133 ± 897 mg/kg), nickel (26.3 ± 51.1 mg/kg), copper (110 ± 90 mg/kg), lead (137 ± 64 mg/kg), and chromium (3.63 ± 2.46 mg/kg). The level of heavy metals at different sampling site were higher than soils from background with factors of 67 (zinc), 18 (copper), and 20 (lead).

Impact on air quality:

Burning of biomedical waste may pollute the environment and will mix different pollutants to a level that may be dangerous to human health. It has been argued that greenhouse gas and particulate emissions are considered as a challenging issue from municipal solid waste dumping sites. The burning of hospital waste at these sites is a serious threat for the environment and human health. It releases harmful pollutants that cause various types of respiratory problems among the residents. Their study revealed that dust, black carbon, ammonia, sulfate, and nitrate are the major species of PM10 and PM2.5. The particulates were found to be high during the summer than the monsoon. The significant variation among the samples were observed and ranged from 211 to 900 $\mu\text{g}/\text{m}^3$, and exceeded the upper limits of 150 $\mu\text{g}/\text{m}^3$ standards prescribed by Central Pollution Control Board (CPCB). The ambient air samples were further contaminated by hazardous organic compounds like diethyl phthalate, decane, dodecane, octane, nonane, methenamine, cyclobutane, carbon disulfide, and acetone diperoxide.

Way Forward:

Judiciously Managing the Waste: The potential of biomedical waste of spreading a disease through the environment, largely by polluting water, is extremely high. The biomedical waste generated should be collected and treated properly and must not be allowed to reach the water bodies as then it will be a problem too big to handle. The biomedical waste generated should either be incinerated or gasified. Along with managing the biomedical waste generated, nature should also be taken care of. The waste must be managed so judiciously so that it does not contribute to climate change or trigger any other harm.

Role of State Agencies: The state agencies responsible for providing the data to higher authorities have to play a crucial part in ensuring that data is not missed and no wrong data is forwarded to the CPCB.

Awareness Among People: The waste segregation and management is done by the state agencies by colour coding like the red coloured container means that the biomedical waste is highly hazardous. So the people must also be aware about these color codings as they represent the hazard level of each biomedical waste. If people will have knowledge about such basic things then they will be more cautious about keeping themselves away from such hazardous waste. People must also understand that even if they are not infected, they should not put their masks and gloves in the same municipal bins that they have; waste segregation is a must. People have to follow the SOPs generated by not just the WHO but other various health agencies to control the infection.

SOPs for Waste Management at Home: The CPCB shall come out with SOPs for managing biomedical waste at home for rural as well as urban communities. While burning biomedical waste is not an option in urban areas as the pollution levels are already high, burning biomedical waste in pits can be a possible way of managing waste in the village areas.

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