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Greening Healthcare Effective and Sustainable Management of Biomedical Waste

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A B S T R A C T

The United Nations Sustainable Development Summit in January 2015 marked the adoption of 17 Sustainable Development Goals by member states of the UN. These goals must be achieved by 2030 to promote a peaceful and pollution-free world. One of the critical goals among these 17 SDGs is "Good Health and Well Being," which aims to provide high-quality healthcare services to everyone.However, the management of biomedical waste has become a significant obstacle to achieving this goal. The proper disposal of biomedical waste is vital to prevent the spread of infections and diseases, reduce environmental pollution, and protect public health. The management of biomedical waste has become even more critical in the current pandemic situation across the globe.The sustainable management of biomedical waste is essential to ensure the safety of healthcare workers, patients, and the general public. Effective waste management includes the proper segregation, collection, transportation, and disposal of biomedical waste. Sustainable practices such as waste minimization, reuse, and recycling can also reduce the environmental impact of biomedical waste.Several challenges must be overcome to achieve sustainable biomedical waste management. These challenges include insufficient resources, lack of awareness and training, inadequate infrastructure, and ineffective regulations. Therefore, it is crucial to implement effective policies, regulations, and guidelines to promote sustainable biomedical waste management.To achieve sustainable biomedical waste management, healthcare facilities must prioritize waste management as an integral part of their healthcare services. They must develop a waste management plan that outlines the appropriate procedures and protocols for the segregation, collection, transportation, and disposal of biomedical waste. Additionally, healthcare workers must be trained on proper waste management practices, including the use of personal protective equipment (PPE) and waste segregation.In conclusion, the sustainable management of biomedical waste is critical to achieving the SDG of "Good Health and Well Being." It is essential to promote awareness, provide training, and implement effective policies and guidelines to ensure the proper management of biomedical waste. Healthcare facilities must prioritize waste management as an integral part of their healthcare services to protect public health and reduce environmental pollution..

Keywords: Sustainable Management, Biomedical Waste

1. Introduction

The recent outbreak of COVID-19 has brought attention to the management of biomedical waste, as the improper disposal of medical equipment, such as masks and personal protective equipment (PPE) used for COVID-19 diagnosis and treatment, can potentially spread the virus. In India, it is estimated that approximately 2 kg of biomedical waste is generated per bed per day, which includes anatomical waste, cytotoxic waste, sharps, and other types of medical waste. If this waste is not managed efficiently, it can cause the outbreak of deadly infectious diseases. This is particularly concerning for the health workers who are at the forefront of treating patients and are most vulnerable to such infections.

Biomedical waste refers to any solid and liquid waste, along with its containers and intermediate products, that are generated during the diagnosis, treatment, and immunization of human beings and animals. Such waste is usually generated in hospitals, nursing homes, health centers, health clinics, pathological laboratories, offices of physicians, dentists, veterinarians, as well as in households and funeral homes.

Effective management of biomedical waste involves several steps, beginning from the initial stage of waste generation to the final stage of disinfection. The intermediate steps include categorization, segregation, storage, accumulation, and transportation of waste. Categorization involves classifying waste based on its characteristics, such as its potential to cause infections or harm to the environment. Segregation involves separating different types of waste into separate containers based on their characteristics. Storage involves storing waste in secure containers until it is ready for transport. Accumulation involves collecting waste from different sources and consolidating it for transport. Finally, transportation involves moving waste from the site of generation to the treatment and disposal facilities[1][2][3][4][5][6][7].

Proper management of biomedical waste is essential to protect the environment and public health. It is crucial to adopt sustainable practices, such as waste minimization, reuse, and recycling, to reduce the volume of waste generated. Additionally, healthcare workers must be trained on proper waste management practices, including the use of PPE and waste segregation. There is a need to implement effective policies, regulations, and guidelines to promote sustainable biomedical waste management.

In conclusion, the management of biomedical waste is crucial in preventing the spread of infectious diseases, particularly in the current pandemic situation. Effective management involves several steps, including categorization, segregation, storage, accumulation, and transportation of waste. Sustainable practices must be adopted to minimize the volume of waste generated, and healthcare workers must be trained on proper waste management practices. There is a need for effective policies, regulations, and guidelines to promote sustainable biomedical waste management and protect public health..

2. Litrature Review

The effective management of biomedical waste involves several crucial steps, with treatment being the most significant one. Biomedical waste can be treated using a variety of methods, including incineration, chemical disinfection, microwave irradiation, wet and dry thermal treatment, land disposal, and inertization[8][9][10][11][12][13].

Incineration is a commonly used approach for treating hazardous healthcare waste. The process involves high-temperature combustion, which reduces organic and combustible waste to incombustible waste and results in a significant reduction in waste volume and mass. Incineration is usually used for wastes that cannot be recycled, reused, or disposed of in a landfill site. The wastes that are best suited for incineration are human and animal anatomical wastes and biological wastes from laboratories with combustible matter above 60%, moisture content below 30%, non-combustible solid below 5%, and non-combustible fine particles below 20%. There are different types of incineration technologies, including single-chamber furnaces with static gates, double-chamber pyrolytic incinerators, and rotary kilns operating at high temperature.

Chemical disinfection is another method of treating biomedical waste. It involves adding chemicals to the waste to kill or inactivate the pathogens present in the waste. This process is typically carried out on hospital premises, and the wastes that are treated using chemical disinfection include used sharp needles, scalpels, syringes, glass, blades, PPE kits, catheters, etc. Before disinfection, the waste is pulverized to increase the contact between waste and disinfectant, eliminate any enclosed space, and render any body parts unrecognizable to avoid any adverse visual impact on disposal. Water is usually added during shredding to prevent excessive warming and facilitate subsequent contact with the disinfectant. The presence of an excessive proportion of sharps in waste may cause deterioration of the shredder. Dismantling of waste before disinfection and compacting thereafter can reduce the original volume of waste by 60-70%. Some commonly used disinfectants include formaldehyde, ethylene oxide or oxirane, glutaraldehyde, and sodium hypochlorite. Several self-contained waste treatment systems based on chemical disinfection are commercially available[14][15][16][17][18].

Wet thermal treatment involves exposing the shredded infectious wastes to high temperature and high-pressure steam. This method is effective in inactivating most types of microorganisms, including bacterial spores, if the temperature and contact time are sufficient. A minimum temperature of 121°C is required for inactivating approximately 99.9% of microorganisms and bacterial spores. Chemical disinfection-treated biomedical waste can also be treated thermally for further disinfection. The process requires the wastes to be shredded before treatment for sharps, and milling or crushing is recommended to increase disinfection efficiency.

Dry thermal treatment is another type of thermal treatment in which the wastes are heated at 1100°C-1400°C by oil circulation for 20 minutes after shredding it to particles about 25 mm in diameter.

Land disposal involves the disposal of waste in specially designed and controlled landfills. This method is suitable for non-hazardous biomedical waste, such as solid waste, non-hazardous chemicals, and non-infectious waste. Inertization involves the mixing of waste with cement and other materials to stabilize it and reduce its hazardousness. This method is suitable for hazardous biomedical waste, including chemicals and toxic substances that cannot be treated using other methods[19][20][21][22][23][24].

In conclusion, the treatment of biomedical waste is a critical aspect of waste management. Several methods are available for treating biomedical waste, and the choice of method depends on the type of waste being treated. It is essential to ensure that the treatment method used is effective in eliminating the pathogens present in the waste and that the.

3. Research Methodology

Choosing the Right Treatment System for Biomedical Wastes:

Selecting the appropriate treatment system for biomedical wastes is a critical decision that must be made with caution, considering various factors that are dependent on local conditions. Some of the key factors that must be taken into account are.

Negative Effects of Improper Biomedical Waste Management:

Improper management of biomedical waste can lead to a variety of harmful effects. Biomedical waste can be sourced from two main categories:

A. Major sources: Hospitals, laboratories, research centers, autopsy centers, mortuaries, and blood banks.
B. Minor sources: Funeral services, cosmetic and dental clinics, and home care facilities.

Some of the negative effects of improper biomedical waste management include:

Spreading of vulnerable diseases.
Pregnant women and newborn babies are at risk due to radioactive hazards.
Solid medical waste, such as cotton, can create health hazards for both humans and animals.

4. Conclusion

It is evident that the management of biomedical waste is crucial in ensuring the delivery of quality healthcare services. Biomedical waste can pose significant challenges to the provision of effective and safe healthcare, making it essential to take proactive measures towards its sustainable management. This can be achieved through a collaborative effort among the health departments of different states and other stakeholders in the healthcare industry.

By working together, healthcare stakeholders can implement effective strategies for managing biomedical waste. Such strategies should be sustainable and address various factors, including disinfection efficiency, health and environmental considerations, volume and mass reduction, occupational health and safety, and the types of waste for treatment and disposal. Other important factors to consider include infrastructure requirements, the availability of treatment options and technologies, options for final disposal, training requirements for personnel, operation and maintenance considerations, available space, and the location and surrounding of the treatment site and disposal facility. It is also essential to consider investment and operating costs, public acceptability, and regulatory requirements.

Failure to manage biomedical waste effectively can have severe negative impacts on public health and the environment. Biomedical waste can spread dangerous and infectious diseases, posing a risk to pregnant women and newborn babies. Solid medical waste such as cotton can create health hazards for both humans and animals, while chemical healthcare wastes can degrade the environment. Outdated or discarded medicines and cytotoxic drugs can cause serious health issues and accelerate the spread of contaminating diseases. Additionally, human anatomical waste can create significant social issues.

Given the detrimental effects of biomedical waste, it is imperative to take necessary steps towards its sustainable management. Collaborative efforts among healthcare stakeholders can help to identify and implement effective strategies for managing biomedical waste. This will not only enhance the quality of healthcare services but also promote public health and environmental safety.

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