

A Study on Bio-Medical Waste Segregation and Disposal

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ABSTRACT

This paper mainly focuses on the study of diverse biomedical wastes that are generated on a daily basis in various medical and healthcare establishments. It delves into the techniques, methodologies, equipment, and machinery employed to segregate and dispose of these wastes, ensuring the safety of workers and preventing the further spread of any disease caused by contaminated wastes. In the large scale medical facilities various kind of modern disposal facilities such as incineration chamber, autoclaving etc. are available, but in case of small scale medical facilities due to lack of infrastructure, lack of funds and various other reasons such as being located in remote areas they are not accessible to these facilities. This paper mainly focuses on the study of segregation and disposal techniques utilized by these small scale medical facilities in Assam, various issues and difficulties encountered and possible solution of these issues.

Biomedical wastes are considerably more hazardous than any other form of wastes due to the potential contamination with deadly viruses and bacteria. As such, direct disposal or recycling is not feasible. In case of biomedical wastes proper treatment and decontamination is necessary prior to disposal or recycling. These wastes pose a threat not only to human health, but also to the environment, as the accumulation of medical waste can lead to environment pollution (water and soil pollution to be more specific). Thus even case of small scale medical establishments which are lacking proper infrastructure and facilities the appropriate treatment and disposal of these biomedical wastes is utmost necessary with the maximum utilization and advancements of the limited funds and ammonites available to them.

Keyword:- Incineration, Biomedical, Assam, Deep Burial, Decontamination, Segregation, Arduino

1. INTRODUCTION

Wastes can be defined as substances which are no more intended to be used. Wastes can be of different forms such as solid waste, liquid waste, various types of exhaust gases etc. Based on origin and use wastes can again be of different types such as industrial waste, biomedical waste, household waste etc. Among all these different types of wastes one of the most hazardous for of waste is biomedical waste. Biomedical waste can lead to the outbreak of different diseases if they aren't properly treated and disposed.

Biomedical waste may be defined as any kind of wastes that are been generated during the diagnosis, treatment of patients and testing of biological products [1] etc. All the wastes that are been generated in the medical establishments, healthcare facilities and during treatment a diagnosis can be classified as biomedical wastes.

Due to potential contamination with deadly viruses, the biomedical wastes pose severe threat to the life of the individuals handling these wastes, thus proper treatment of these waste is necessary. The improper treatment of biological waste can pose major risks to human health and the environment. If not managed and disposed of appropriately, biomedical waste can contain potentially infectious agents like bacteria, viruses, and other microbes that can cause disease. If biomedical waste is not adequately managed, it may also contain radioactive elements and dangerous compounds that pose health hazards. The primary producers of biomedical waste are healthcare facilities such hospitals, clinics, nursing homes, and laboratories. The rules and recommendations for the proper handling of biomedical waste must be adhered to by these facilities[5].

For the safe management and disposal of biological waste, it is equally crucial that healthcare professionals receive the appropriate training. Employing a variety of methods, such as burning, autoclaving, microwaving, and chemical disinfection, biomedical waste can be treated and disposed of. The type of trash and the laws controlling its disposal affect the technological choice. But however in small scale medical establishments these facilities are not available because of lack of infrastructure,

funds and inaccessibility of the region. Thus it is preferred to have a less costly, less complicated and preferably portable set-up to facilitate on-site treatment of these biomedical wastes, which will enable the small scale medical establishments and healthcare facilities located at the remote areas to onsite segregation, treatment and disposal of biomedical wastes.

The daily production of biomedical waste is increasing as healthcare facilities expand. Several issues can be avoided if biomedical waste management is done properly. As part of health care waste management, it is normal practice to separate, store, process, transport, and dispose of biological waste. Organisational, planning, administrative, financial, engineering, legal, and human resource production all entail multidisciplinary interactions. Medical professionals at all levels must be committed to medical waste management [3].

2. SURVEY AND DATA COLLECTION METHODOLOGY

Mainly two methodologies of data collection and survey are employed while preparing the paper, those are as follows

Primary Data collection: The primary data collection mainly includes the visit to various small and large scale medical facilities in our locality. Prior to conducting the survey, official authorization was obtained from the relevant hospital authorities. Throughout the course of the study, we were accompanied by the appropriate personnel and granted permission to observe and analyze their biomedical waste segregation and disposal procedures from a secure distance, with the intention of ensuring our safety. The medical facilities that were visited for survey purpose are as follows:

1. Jorhat Medical College and Hospital, Jorhat
2. Mahatma Gandhi Hospital Chabua (Model Hospital) , Chabua
3. Barbaruah P.H.C, Dibrugarh



Secondary Data Collection: As a source of secondary data collection we have mainly referred to various journals and research papers published on biomedical waste management, segregation and their disposal. We studied various regulatory norms and laws that have been issued by the Indian and state government regarding the segregation and disposal of these biomedical wastes

3. SURVEY DATA AND FINDINGS

Biomedical wastes cannot be directly segregated, disposed, recycled or transported from the medical facilities; there are certain norms and laws that are to be followed. The Biomedical Waste Management norms 2016, which specify the norms and regulations for the collection, segregation, transportation, and disposal of biomedical waste, are in place in Assam[2]. All healthcare facilities, including hospitals, clinics, nursing homes, and laboratories, are subject to the regulations.

The state's regulatory body in charge of carrying out the biomedical waste management regulations is the Assam Pollution Control Board (APCB)[2]. The APCB grants permission to healthcare establishments for the appropriate biomedical waste disposal and carries out routine inspections to verify compliance with the regulations.

For the treatment and disposal of biomedical waste produced by healthcare facilities, the APCB has also created common biomedical waste treatment facilities (CBWTFs) throughout the state. These facilities process the garbage with environmentally friendly technologies.

In small scale medical facilities modern equipments such as incineration chamber, autoclaving facilities are not available. In most of the medical facilities especially in small scale establishments biomedical wastes are manually segregated and are stored in different coloured bags, and different categories of medical wastes are stored in different colour coded bags (Blue Bin, Red bin etc). In those small scale facilities these wastes are later collected by the respective municipality board or other concerned authorities, or some portion of the highly contaminated wastes are directly sent for deep burial as per norms.



Fig-1: Deep Burial facility in Model Hospital Chabua



Fig 2: Disposal Facility in Model Facility Hospital, Chabua



Fig-3: Biomedical waste Storage Section, Tengakhar P.H.C

3.1. Challenges encountered in the management of biomedical waste

When it comes to biomedical waste segregation, treatment and disposal the small scale medical establishments encounter various issues such as

- Due to lack of infrastructure the onsite treatment of biomedical wastes is not possible in most of the small scale medical facilities
- Lesser funds are allotted to small scale medical facilities due to which they are not able to have costly machineries for decontamination, disposal and transportation of medical wastes.
- In Assam a huge number of small scale medical establishments are located in remote areas due to which transportation of biomedical waste becomes very troublesome.

3.2. Categories of biomedical waste and disposal

Depending on where it comes from and what it is, biomedical waste can be divided into a number of categories. These categories include radioactive waste, chemical waste, pathological waste, sharps waste, and infectious waste. Trash containing pathogens or potentially hazardous substances is referred to as infectious trash. Needles, scalpels, and shattered glass are just a few examples of the objects that fall under the category of sharps waste. Human or animal tissues, organs, and body parts are considered to be pathological waste. Any garbage that contains dangerous chemicals, such as disinfectants and solvents, is referred to as chemical waste. Last but not least, waste containing radioactive materials is referred to as radioactive waste.

Biomedical waste can be classified into several categories, each with its unique characteristics and handling requirements.

- Infectious waste, for instance, is a type of waste that contains pathogens or potentially infectious agents. It is generated from patients with communicable diseases, such as tuberculosis, HIV, and hepatitis B and C. Examples of infectious waste include used dressings, swabs, and laboratory cultures.
- Sharps waste, on the other hand, refers to any item that can puncture or cut, such as needles, scalpels, and broken glass. This type of waste requires special handling and disposal due to its potential to cause injury and infection.
- Pathological waste, meanwhile, pertains to human or animal tissues, organs, and body parts. This includes tissues removed during surgery, biopsy specimens, and animal carcasses.
- Chemical waste, as the name suggests, includes any waste that contains hazardous chemicals, such as solvents and disinfectants. This type of waste requires special handling and disposal to prevent environmental pollution and human exposure to hazardous chemicals.
- Radioactive waste is another type of biomedical waste that contains radioactive materials. It is generated from medical procedures, such as nuclear medicine and radiation therapy.
- Lastly, pharmaceutical waste includes expired or unused drugs and other medications. This type of waste requires special handling and disposal to prevent environmental pollution and the potential for drug diversion and abuse.

It is crucial to properly segregate and handle each type of biomedical waste to prevent environmental pollution, the spread of infection, and other health hazards. National and international guidelines and regulations govern the proper disposal of biomedical waste to ensure the safety of healthcare workers, patients, and the general public.

The pollution control board of Assam has categorized biomedical wastes and has recommended respective disposal procedures for their disposal [2]

Category 1: Human anatomic wastes (tissues, blood, organs)

Category 2 : Animal wastes

Category 3 : Microbiology and biotechnology waste

Category 4 : Waste sharps (needles , syringe etc)

Category 5 : Discharged medicines and drugs

Category 6 : Solid wastes contaminated with blood etc.

Category 7 : Solid Wastes generated from disposable items

Category 8 : Liquid wastes

Category 9 : Incineration ash

Category 10 : Chemical Waste

COLOUR CODING	TYPE OF CONTAINER	WASTE CATEGORY	TREATMENT OPTIONS
Yellow	Plastic bag	Cat. 1, Cat. 2, Cat. 3, & Cat. 6	Incineration / deep burial
Red	Disinfected container / plastic bag	Cat. 3, Cat. 6, Cat. 7.	Autoclaving / Microwaving / chemical Treatment.
Blue / white translucent	Plastic bag / puncture proof container	Cat. 4, Cat. 7	Autoclaving / Microwaving / chemical Treatment and destruction / shredding
Black	Plastic bag	Cat. 5 and Cat. 9 and Cat. 10(solid)	Disposal in secured landfill.

Fig-4 : Colour coding and respective waste categories

Without an effective infrastructure for transporting generated waste, waste management practises cannot be implemented. The crucial link between garbage collection and disposal is transportation. Waste is collected using a variety of vehicles from homes, markets, hotels, business spaces, parks, and gardens and delivered to facilities for processing or disposal. The cost of waste transportation accounts for about 30 to 45 percent of the total SWM budget, making it a capital-intensive operation[4]. Waste has been transported through uncovered small trucks and tractors-trailers provided by the Municipal Board in the research region. It has been noted that waste is transported once day from a certain location to the landfills. By JCB, garbage is loaded and unloaded automatically or by hand [4].

4. FUTURE SCOPE

Biomedical waste management is a very important issue that needs to be addressed properly. Segregation of biomedical waste is another issue that one encounters, as unlike the other forms of wastes biomedical waste cannot be segregated easily, the various metal sheets and needles, scalpels are a part of medical wastes are non-ferrous, thus segregation using magnet is not feasible. Also different graded of plastics, PPEs and masks etc are also included in biomedical wastes which can't be easily segregated.

In our project research and design we have been trying to segregate the biomedical wastes with the help of various sensor outputs, we are trying to use **PNP-NO**, and **NPN-NO** metal and proximity sensors and taking their outputs signal into arduino in order to control servo motors and perform the segregation to the best of our ability. Also for on-site treatment of the biomedical wastes we are using chemical sanitizers and UV-C tubes that are known for its germicidal qualities.

5. CONCLUSION

The management of biomedical waste is of paramount importance in guaranteeing the safety of society and mitigating environmental pollution. It is imperative that appropriate measures be taken to enhance the overall biomedical waste management system. The establishment of facilities such as on-site waste treatment, segregation facilities, and secure modes of transportation for biomedical waste is necessary to ensure preparedness in the event of another pandemic akin to COVID-19.

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016