

# Biomedical Waste Management: An Approach To Reduce Environmental Pollution

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*Abstract: Biomedical waste analyzed under many phraseologies like hospital waste, healthcare waste, medicinal waste etc., which are originated due to long or short term care of persons. Several different health care establishments are the minor and major sources of these medicinal wastes. Biomedical waste can be primarily incorporated as 1) Hazardous and 2) Non Hazardous wastes. Inappropriate management of waste generated in health care facilities leads to a direct health impact on the community, the health care workers and on the environment. Heterogeneous disposal of BMW or medicinal waste and exposure to such waste possess serious risks to environment and to human health that requires proper treatment and management prior to its final disposal. Proper handling, treatment and disposal of hospital wastes are important elements in any health care setting. The present systematic review was conducted to assess knowledge and awareness regarding BMW management among staff and students of medical institutions in India.*

*Keywords: Biomedical waste, dental waste, hospital waste, waste management, legal aspects*

## I. INTRODUCTION

'WASTE' is anything that no longer has a use or purpose and needs to be disposed of.

*"Nothing is waste until it is wasted."*

'BIO-MEDICAL WASTE' refers to those wastes which are produced during diagnosis treatment or immunization of humans or animals. Hospital wastes include a large number of objects such as syringes, discarded medicines, swabs, bandages, body fluids, human excreta, etc. This waste is highly infectious and can be a serious threat to human health if not managed in a scientific, careful and discriminate manner.

Before 1980s, bio-medical waste was not a topic of concern for anyone. But as we moved in 1980s and 1990s, concerns about exposure to Human Immunodeficiency Virus (HIV) and Hepatitis B virus (HBV) led mankind to think over this threatening issue. Now a day the Hospital waste generation and its safe management has become a serious issue because of deadly risk to the health of patients, hospital staffs, and extending beyond the boundaries of medical establishment to the general population.

It has been documented that the disease transmission from medical wastes is very little but American Dental Association (ADA) and Center for Disease Control recommended that disposal of medical wastes must be carried out in accordance with certain steps.

In India, the hospital waste management came into focus after the notifications of the BMW rules in 1998. These rules apply to all persons who generate, collect, receive, store, transport, treat, dispose or handle bio-medical waste in any form. Biomedical waste generating institutions must take all steps to ensure that such waste is handled without adverse effect to human health and environment.

## II. DISCUSSION

Biomedical waste management is mandatory so as to prevent transmission of diseases from patient to patient and among healthcare personnel as well as to prevent injury and exposure to the harmful effect of cytotoxic, plastic and chemical waste.

## A. POTENTIAL IMPLICATIONS OF BIOMEDICAL WASTE

Threats to health of healthcare workers and waste handlers

Improperly handling of contaminated sharps pose greatest infectious risk associated with bio-medical wastes. Health risks are generally due to pathogens that may spread through air during the treatment processes like compacting, grinding or shredding process. Also, Incinerators and Steam sterilizers which are used in the treatment process operate on high temperature which may cause physical as well as health hazards.

### THREATS TO THE PUBLIC

Careless disposal and improperly operated incinerators or other equipments can pose infectious risk to public also. Poor waste management can increase risk of nosocomial infections in patients. It can also lead to microbial ecology and spread of antibiotic resistance.

### OTHER HAZARDS

Many infectious diseases like cholera, rabies, tetanus, poliomyelitis, mumps, septicemia, typhoid, tuberculosis, hepatitis, HIV, etc can be transmitted by direct or indirect contact with waste such as infected clothing, body secretions. The transmission risk of HIV can occur through needles during collection of blood and other body fluids, mucosal splashes and injured skin contact with HIV infected body. During the process of autopsy the drainage of water, blood and body secretions is also risky, it's spilling out on floor can also cause infectious diseases to doctors as well as their helpers.

## B. SOURCES OF BMW

The sources of BMW can be categorized into two types:

### ✓ MAJOR SOURCES

- Hospitals
- Health Centers
- Medical colleges and Research centers
- Paramedic services

### ✓ MINOR SOURCES

- Physicians
- Dentist's clinics
- Animal houses
- Blood Donation camps
- Vaccination centers

## C. CLASSIFICATION OF HOSPITAL WASTES

The Health Department classified biomedical wastes as follows:

### a. PATHOLOGICAL WASTES

It consists of tissues, human fetuses, organs, body parts, blood and body fluids from hospitals of different specializations.

## INFECTIOUS WASTES

It includes cultures and stock from labs, wastes from autopsies and surgery, from patients undergoing haemodialysis and in isolation wards.

## SHARPS

It includes syringes, scalpels, saws, needles, broken glass, nails, blades, and other items which may cause a cut or puncture.

## PHARMACEUTICALS WASTES

It includes pharmaceutical products, chemicals and drugs that have been collected back from wards.

## RADIOACTIVE WASTES

It includes materials contaminated from radio nuclides

## CHEMICAL WASTES

It includes disinfectants like hypo chlorites, iodophors, and phenol compounds.

# Percentage of W materials in In

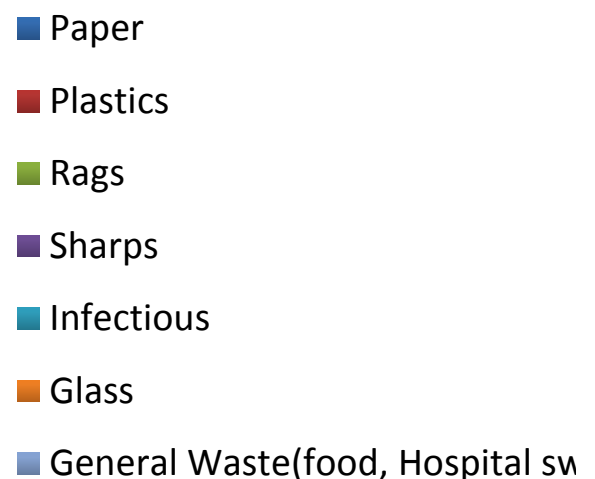


Chart 1: percentage of various types of waste generated in India

#### D. STEPS IN WASTE MANAGEMENT

Medical waste should be managed according to its type and characteristics. For minimization and effective management of biomedical waste, daily collection, identification and segregation, disinfection, storage and its safe transportation after suitable treatment processes is necessary. The category of biomedical waste can be identified easily by arranging the waste into color coded plastic bags or containers. The exhaustive waste management system is carried out in following steps: waste survey, segregation, accumulation and storage, transportation, treatment, disposal and also waste minimization.

##### ✓ WASTE SURVEY

The survey is carried out to determine the area, quantity and type of waste generated. This is helpful in determining the method of its disposal accordingly.

##### ✓ WASTE SEGREGATION

It refers to the placing of different kinds of waste in different containers or different color coded bags at its point of generation. The bags or containers are of various colors like red, orange, yellow, blue and black. This step is beneficial as it helps to reduce the bulk of infectious wastes and also the cost of its treatment. Effectively carried segregation can also prevent the mixing of medical wastes like sharps with the general municipal wastes. It also prevents illegal use of several components of medical wastes like used syringes, needles and other plastics. This process also helps to prevent the spread of infections and the risks of infecting other healthcare workers. Effective bio-medical waste management can be ensured by the effective segregation process alone.

Waste material	Category	Color coded containers
Human organs, body fluids, animal wastes	1	Red
Slaughter houses /abattoirs waste	2	Orange
Microbiological /biotechnological waste	3	Yellow
Sharps waste	4	Blue
Spare medicines	5	Blue
Solid wastes	6	Black
Disposables /chemicals	7	Black

Table 1: Color coding for segregation process

##### ✓ WASTE ACCUMULATION AND STORAGE

‘Accumulation’ generally refers to the placing of small quantities of waste material temporarily at a place nearby the point where it is generated.

On the other hand, ‘Storage’ refers to the placing of waste materials for comparatively longer period of time until it is treated at its site of generation or is transported off site for

treatment or disposal. To prevent the access of general public near storage areas, these should be posted with ‘EXPLICIT’ signs or symbols.

##### ✓ WASTE TRANSPORTATION

All medical wastes cannot be treated completely on its site of generation; therefore untreated waste is needed to be transported off site for proper treatment and disposal. To prevent direct contact with the wastes by the transportation operators, general public and scavengers, manual loading is avoided. Therefore wastes are transported in special vehicles such as trolleys or in covered wheelbarrow.

##### ✓ WASTE TREATMENT AND DISPOSAL

The term ‘Treatment’ means the process which is used to make some necessary changes or modification to the waste materials before it is to be taken for its final disposal. This process is carried out for disinfection and decontamination of the waste at its point of generation to make it free from disease causing organisms. The various methods involved in the treatment process of biomedical wastes are as follows:

###### a. INCINERATION

Most of the biomedical wastes are treated by incineration process. Incineration process involves controlled combustion process where the waste containing infectious and harmful microorganisms are destroyed under high temperature and are converted to inert mineral residues and gases. The operating temperature of an incinerator is 900-1000C and the exposure time for the waste materials should be approximately 2 seconds. Incineration is popular in countries where land is a scare resource as they cannot be consumed for landfill processes. Countries such as Japan prefer this process for disposal.

###### b. AUTOCLAVING

The autoclave process is generally used for the treatment of wastes including wastes from microbiological laboratories, human fluids, anatomical wastes and waste sharps. In this process, steam is brought into direct contact with wastes to disinfect them. It is basically the sterilization of wastes. The wastes are treated at a temperature of approximately 121 C and are kept at a pressure of 105KPa for operating period of 1 hour. To ensure ease and safety in operations, autoclave should be horizontal type and should be specifically designed for biomedical wastes. For better results, pre-vacuum based system is preferred over the gravity type system. The control panel used should be tamper-proof with well-organized display and recording devices for recording sensitive parameters like time, temperature, pressure etc.

###### c. SHREDDING

In this process, wastes such as plastics and papers are distorted or are cut into smaller pieces to prevent its reuse. It also acts as identification that the wastes have been disinfected

and safe to be disposed. After the shredding process, the shredder wastes are sold to authorized plastic molding agencies. The shredders are composed of rotating blades or shafts which are used to cut the wastes into small pieces.

Category of waste	Disposal methods
Category 1	Incineration/deep burial
Category 2	Disinfection/deep burial
Category 3	Autoclaving
Category 4	Shredding/deep burial
Category 5	Shredding/deep burial
Category 6	Disinfection/Machine cleaning
Category 7	Disinfection-chemical/Autoclaving, Shredding, Burial

Table 2: BMW Disposal methods

✓ WASTE MINIMIZATION

Ordinary solid and liquid wastes require more treatment prior to its disposal but all infectious wastes strictly needs to be treated before its disposal. If we consider the economical statistics, the cost for disposal of infectious waste is much higher than the cost for disposal of ordinary solid wastes. Thus, we can say that any measure through which the quantity of infectious wastes generated decreases will also lead to the minimization of cost of the infectious waste disposal. In this way, if proper methods for the minimization of the waste are used by hospitals then the reduced cost can be utilized for betterment of health facilities for the mankind.

E.GLOBAL COMPARISON OF BIOMEDICAL WASTE MANAGEMENT SYSTEM

UNITED KINGDOM

The process adopted for handling biomedical wastes in UK is carried out properly and strictly under certain applicable legislations which include The Environmental Protection Act (1990) and Waste Management Licensing Regulations (1994). In England and Wales, the Hazardous Waste Regulations are also followed whereas the Special Waste Regulations are followed in Scotland.

UNITED STATES

The Medical Waste Tracking Act was passed by the US Federal Government in 1988 according to which the biomedical wastes were regulated. But in 1991, this act was abolished and all individual states were given the responsibilities to regulate and pass laws regarding the disposal of biomedical wastes. In US, a mail back disposal option also exists in which the waste is shipped through the US postal service rather than private transport vehicles. The collection and shipping containers used in this kind of disposal must be approved by the postal service. So, it is practiced only by a few companies.

INDIA

For the regulation of biomedical waste management, the ministry of environment and forest passed the biomedical

waste management and handling rules in 1998. In March 2016, biomedical waste management rules were also notified by Union Minister of State (IC) Environment, Forest & Climate Change, Mr. Prakash Javadekar. The responsibility for implementing new legislations to the rules is given to each state's Pollution Control Board. In India, various disposal techniques are used but most of them are harmful despite of being helpful. The methods for the disposal are proper but most of the medical facilities do not follow these norms. It is often observed that the biomedical wastes are disposed of into oceans which often flow on the banks of rivers, sea-shores or in landfills due to improper segregation when it's under medical facility. These improper disposal techniques can also cause many diseases in both humans and animals.

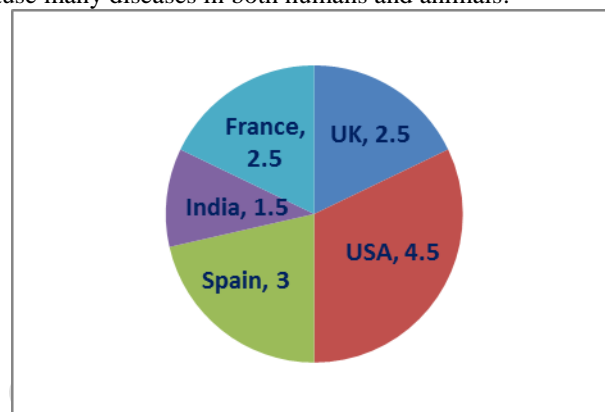


Chart 2: Amount of hospital waste generated

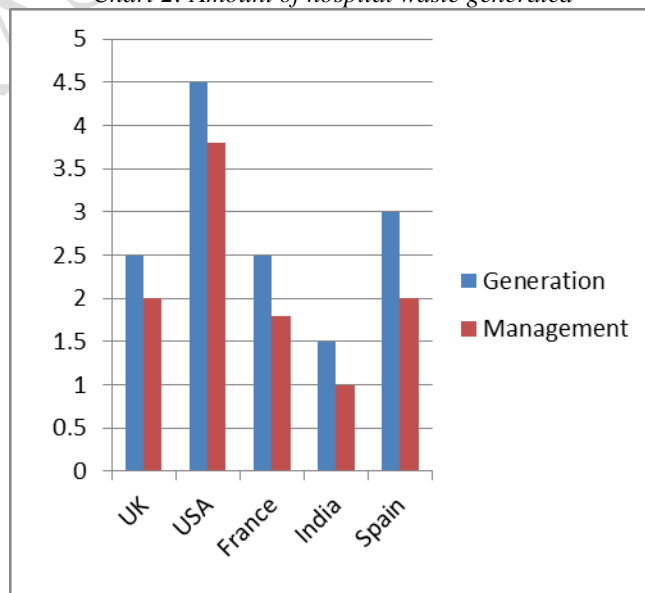


Chart 3: Ratio of generation and management of hospital waste in different countries

III. CONCLUSION

Proper management of biomedical waste is an issue of great concern for both government as well as non-government organizations. There are several toxic materials which have to be removed properly and carefully because these may cause various diseases in both humans and animals and may also pollute our environment. Therefore, all the treatments and disposal processes are done under the guidelines and norms of

central Pollution Control Board. The processes of separation and isolation must be well characterized so that it can work efficiently. Safe and effective management of biomedical waste is not only a legal necessity but it also holds a great concern of social responsibility. There are many problems faced in the proper management of hospital wastes. These problems include lack of concern of people working in that area, general awareness and cost factor. The surveys regarding the waste management processes are needed to be proper and accurate. Children should also be educated about proper handling and management of wastes because they are the future responsible generation of a country and their awareness level would be beneficial for the proper and efficient management of waste products.

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