Biomedical Waste: A Review

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Abstract

Bio-medical wastes are produced during the analysis of a patient, during healing process or vaccination to all animals while performing research and induced into humans by the fabrication or checking of biological samples, as per the guidelines in Schedule I, of the BMW rules, 2016 (AIIMS, 2020)**.** The health care workers should be provided with proper guidance for the safe disposal of biomedical wastes. Especially rag workers are more involved in cleaning residential areas where hospitals are nearby. The awareness of mediwastes should be publicized more to the people in order to prevent from serious health hazards. The sources of mediwaste are elaborated in this review and flowcharts make the readers to easily gain knowledge of the sources and details about the category. There is various treatment method practiced in India but still residential clinics and hospitals should strictly abide by the rules and guidelines of World Health Organization (WHO). The precautionary measures and safe disposal of wastes are mentioned in this review focusing and creating awareness to the public.

Keywords: *Health care system, biomedical waste, public awareness, treatment plans.*

Introduction

Hospital systems play a vital role in producing medical waste. As per guidelines of WHO, states about precautionary measures for the biomedical waste to be disposed in a careful way for a healthy environment. Health care workers should possess an adequate knowledge for safe disposal of the waste. The hazardous and toxic waste materials produced from the hospitals which lead to spread of infections by improper disposal method. The government of India repeatedly believes in waste management by emphasizing the quote Reduce, Recycle and Reuse[1]. The medical waste should be treated initially in an ecofriendly manner rather than handling till the end point[2].

The microbes present in the waste products are easily penetrated inside an individual and causes harms in healthy bodies. The microbes may be a virus, bacteria; fungus, parasitic or even a tested animal waste can cause serious life threatening effects in humans. The safety level should be a serious concern especially in hospital workers and the cleaners which directly or indirectly affects the public[3].

Industrial waste are globally serious concern and been in media as water been contaminated, air is toxic and so many health concerns are in keen report and to the knowledge of public who mostly raises their voices for

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industrial wastes but comparatively rather than industrial waste, medical wastes are more prevalent within the residential area and public was not aware of the toxicity and hazards caused by these wastes. Contamination of underground water by medical waste causes diarrhea, cholera, plague, hepatitis and so on[4].

The real challenge of biomedical waste causes immediate health effect compared with the industrial wastes. So, to overcome the effects World Health Organisation (WHO) has published the "Blue Book" in 2014 for the safe disposal of BioMedical waste[2]. Thus our research review focuses on the sources, types and categories, treatment and precautionary measures of the biomedical wastes which are causing hazards to the residential areas affecting the public health.

Sources of Biomedical Waste: Biomedical wastes possess both solid and liquid waste present in local bodies are categorized into primary, secondary and tertiary sources. The primary sources are given in figure 1. The secondary sources are local residential clinics, Ambulance services, close contact with patients, cosmetic clinics, paramedicals. The tertiary are household wastes, home care treatments, Education centers, funeral houses, Transports etc [5].

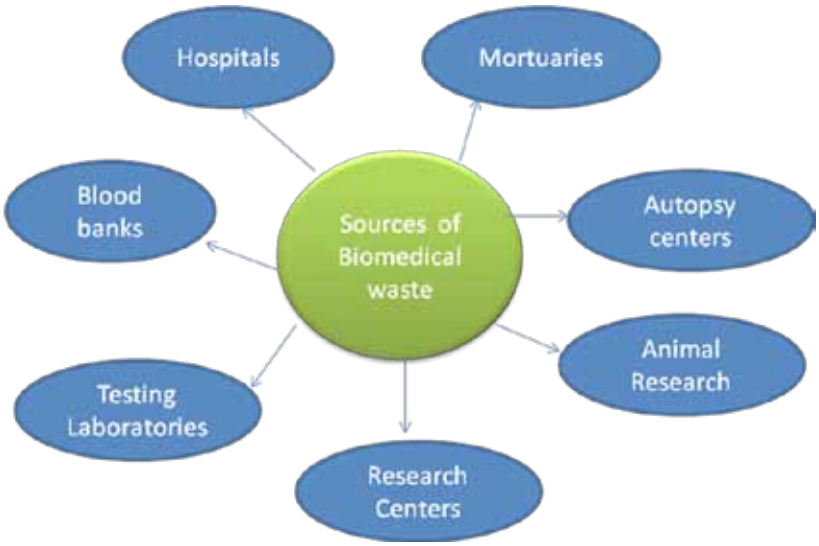

Fig. 1: Primary sources of biomedical wastes

Types of Biomedical wastes: The biomedical wastes are categorized into two types as harmful and harmless wastes. The harmless wastes are eco-friendly in nature and can be degraded in short span of time whereas the harmful wastes are classified based on the guidelines of WHO. These wastes are caused by microorganisms are referred as pathogenic wastes, human tissues and organs are categorized as Anatomical waste, mutagenic and carcinogenic chemical wastes such as alkaloids are cytotoxic wastes, heavy metal disinfectants are pharmaceutical wastes, blood and other fluid excretions are liquid wastes, radioactive wastes are radionuclide's which possess genotoxic effect and used for imaging purposes. Prickly objects are also referred in common as sharps such as needles, broken glassware, glass vials, surgical knifes, capillary blood sample tubes for example blood sugar lancets etc[6].

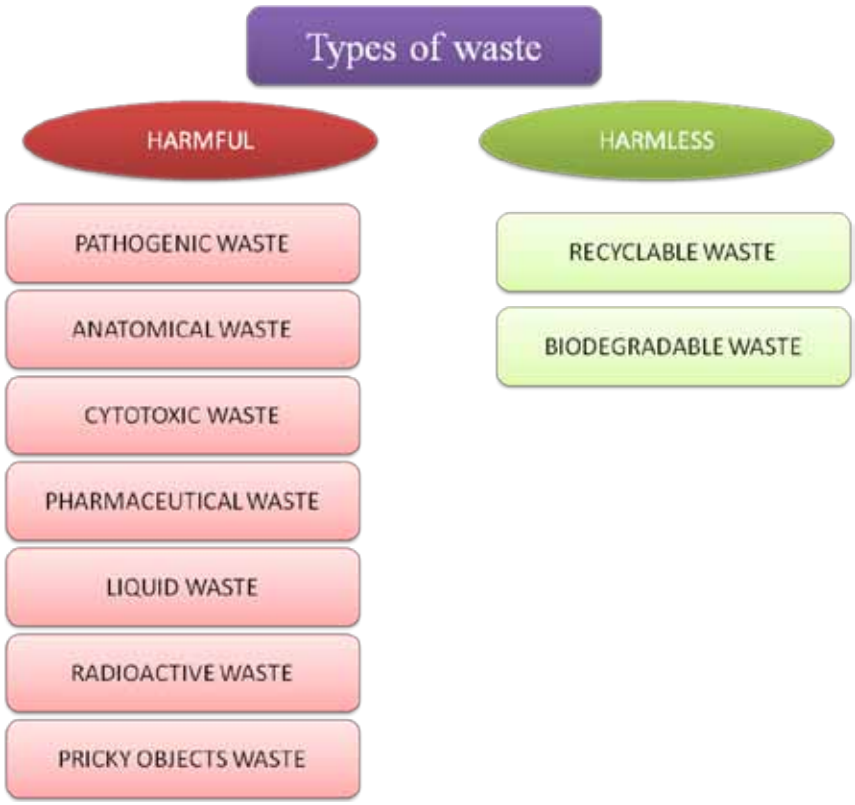

Fig. 2. Types of Biomedical wastes

Categories of Biomedical waste based on color: Hospitals can be found with different color of dustbins; now even Chennai corporation vehicles are fitted with different color dustbins. The color indicates in hospitals are yellow, red, blue and black or white. The yellow color wastes indicate for human tissues, organs, placentas at the time of delivery, animal wastes, chemical wastes. Red color indicates for contaminated recyclable waste e.g. Infectious Blood sample bags. Blue color indicates sharp objects like needles, tamper proof containers, punctures, leak proof etc and black or white color indicates for pharmaceutical wastes such as tablets, cardboard boxes[7].

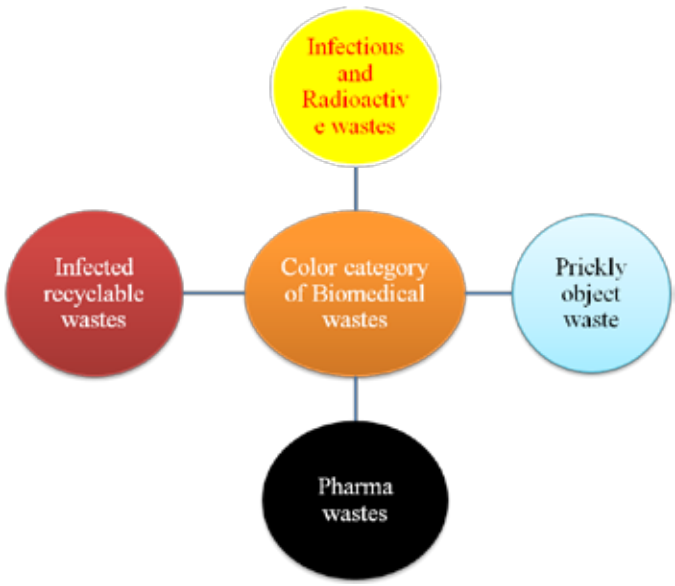

Fig. 3. Color coding for Biomedical wastes

Overview of Biomedical waste treatment method:

The waste products from these sources are efficiently treated by performing various method. They are

1. **Autoclaving:** Autoclaving is a steam sterilization method in which the infectious pathogens like bacteria, virus, fungi, spores are present in materials like forceps, blades, glassware's are sterilized at 121◦C for 20 minutes which kills harmful pathogens present in that material.
2. **Microwave:** This method is also similar to autoclave uses electromagnetic rays to produce heat and disinfect the materials. The advantage of using microwave in hospital is absence of liquid discharge and considerable volume reduces[10].
3. **Hydroclave:** This method is similar to autoclave but the difference is the vapor that is present inside the jacket and not into the vessel where the biomedical wastes are sterilized and therefore the vapor does not have a direct contact with waste. This facilitates the apparatus to retain the steam inside the boiler[9].
4. **Incineration:** Incineration is one mode of treatment method where high-temperature is produced due to arid corrosion process in which organic and explosive wastes are reduced to form inorganic, in explosive matter. Incineration technology is more useful where medical wastes cannot follow 3R's (Reduce, Reuse and Recycle)[8].
5. **Pyrolysis:** It is a thermal method in which the biomedical wastes are burnt completely in the absence of oxygen at 800 °F. As a result of decomposition by thermal method the wastes are completely burnt and the result is to produce gases and charcoal.
6. **Encapsulation:** Encapsulation is the process in which the biomedical wastes are coated with inert materials like High-density polyethylene (HDPE) and polybutadiene as these chemicals are stable, stick to the waste, and resist biodegradation[11].
7. **Chemical Disinfectants:** The wastes to be shredded and small pieces of wastes are in direct contact with chemical agents such as mercuric chloride ($HgCl_2$), sodium hypochlorite (NaOCl), chlorine dioxide (ClO_2), peracetic acid (CH_3CO_3H), glutaraldehyde ($C_5H_8O_2$), quaternary ammonium compounds and disinfect the hazardous wastes[12].

Precautionary measures[13]:

1. Employees working on biomedical wastes should strictly wear gloves, goggles and masks.
2. Waste materials should be placed in appropriate bins with labels.
3. Treatment method should be strictly followed depending upon the category of biomedical wastes.
4. Segregated materials should be cleaned without any damage and spillages.
5. Sanitizers with 70% alcohol should be in hand to all biomedical waste workers.
6. Prickly objects should be handled with great care by wearing gloves without piercing the objects.
7. Broken materials like glasses, vials are to be cleaned with brooms and tongs.
8. Place contaminated PPE in closable, leak proof bags or containers for disposal or decontamination.
9. Wash hands frequently with soap and water.
10. Take bath after exposing to hazardous materials and get frequent medical attention.

Conclusion

Our review focuses on the manmade biomedical waste and its treatment plan are major demanding issues in the country. The rules & guidelines by Govt. of India should be more strictly followed as a matter of concern. To develop a healthy and environment safe practice each and every citizen should abide the rules and rag workers should be given adequate knowledge and awareness to keep the environment greener. The residents should also have interest in maintaining the hospitals and other laboratories for the safe disposal of biomedical wastes.

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Conflict of Interest: Nil

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