



VOLUME OF PLASTICS AMONG BIOMEDICAL WASTE GENERATED IN AN INDIAN HEALTHCARE FACILITY: THE HIDDEN BURDEN

Hospital Administration

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ABSTRACT

Background- Bio-medical waste includes waste generated during medical activities, with proper management being crucial for health and the environment. Hospital waste consists mostly of non-hazardous waste, but a portion is infectious and hazardous. Plastic waste in healthcare is a significant issue, and efforts should be made to reduce its use. The objective of this research study is to investigate plastic usage in Indian hospitals and promote practices that minimize negative impacts. **Methodology:** The study was conducted at a Tertiary Care Government University using a cross-sectional and descriptive study design. The inclusion criteria encompassed all solid waste generated in specific areas, while liquid waste was excluded. Waste was categorized according to the BMW 2018 Amendment Rules. The variables of interest included assessing the total amount of waste in different categories and segregating plastics and non-plastics. Data was collected using an assessment toolkit and analyzed with appropriate statistical techniques. **Results-** The findings showed that 80.7% of the waste generated during the study period was general waste, while 19.3% was biomedical waste. The largest portion of biomedical waste was categorized as Red waste (10.4%), followed by Yellow waste (6.3%), Blue waste (2.4%) and White waste (0.13%). A segregation process was carried out to analyse the plastics present in the waste collected. The results showed that only 13% of general waste and 18% of biomedical waste consisted of plastic materials. **Conclusion-** The study's results seeks to address plastic waste in healthcare and empower professionals to reduce plastic consumption for the benefit of the environment and public health.

KEYWORDS

Bio-medical waste (BMW), Plastic, BMW Rules, Environment, Infectious

INTRODUCTION

Bio-medical waste refers to waste generated during medical activities, including diagnosis, treatment, and research, as well as the production and testing of biologicals. Proper management of biomedical waste is essential to protect health and the environment.^[1,2] According to the World Health Organization (WHO), the majority of hospital waste is non-hazardous (85%), but a portion is infectious waste (10%) and hazardous waste (5%).^[2] In India, there are over 238,000 healthcare facilities, generating approximately 559 tons of biomedical waste per day.^[3]

A study conducted in 1999 found that the average amount of waste generated per bed per day in hospitals was 1.5 kg, with only 10% classified as hazardous waste.^[4] Healthcare facilities produce a significant amount of non-biodegradable plastic waste, which can release harmful toxins. While plastics are important in healthcare, efforts should be made to reduce their use, especially single-use and hazardous plastics.^[5] Reducing plastic waste in the healthcare sector is crucial for environmental sustainability and the well-being of patients and healthcare workers. Plastic pollution has worsened during the COVID-19 pandemic, leading to a public health crisis caused by medical waste. It is essential for healthcare institutions to explore alternatives to plastic and adopt sustainable practices without compromising patient care or safety. This can involve sustainable procurement, promoting biodegradable materials, and implementing innovative recycling and waste management solutions.

The objective of this research study is to investigate plastic usage in Indian hospital and promote practices that minimize negative impacts. The findings will support policy advocacy, aiming to reduce plastic packaging in medical products and engage suppliers in adopting eco-friendly alternatives. Ultimately, the study aims to address plastic waste in healthcare, promote sustainable practices and empower healthcare professionals to drive positive change in reducing plastic consumption for the benefit of the environment and public health.

METHODOLOGY

The study was conducted at the University Environment Department

within a Tertiary Care Government Medical University using a cross-sectional and descriptive study design for a period of 6 weeks. The inclusion criteria encompass all solid waste generated in OPD/ Wards/ICUs/OTs/Labs, while the exclusion criteria involve excluding solid waste generated outside of these areas and liquid waste within them. Waste was categorized according to the BMW 2018 Amendment Rules, with infectious waste classified into Yellow, Red, White, and Blue categories, and non-infectious/general waste designated as Black. The variables of interest include assessing the total amount of waste in various infectious and non-infectious categories and segregating plastics and non-plastics within those categories. Data was collected using an assessment toolkit and analyzed with appropriate statistical techniques, utilizing literature experts and standard guidelines for interpretation.

OBSERVATIONS

The findings revealed that 80.7% of the waste generated during this period falls under the category of general waste. The remaining 19.3% of waste was classified as Bio Medical waste, further divided into different subcategories (fig. 1).



Figure 1: Waste Category in Hospital

Among the Bio Medical waste, the largest portion, 10.4%, was categorized as Red waste. The second largest portion, accounting for 6.3%, was classified as Yellow waste. A smaller percentage of the Bio

Medical waste, specifically 0.13%, fell under the White category. Lastly, 2.4% of the Bio Medical waste was categorized as Blue waste (fig. 2).

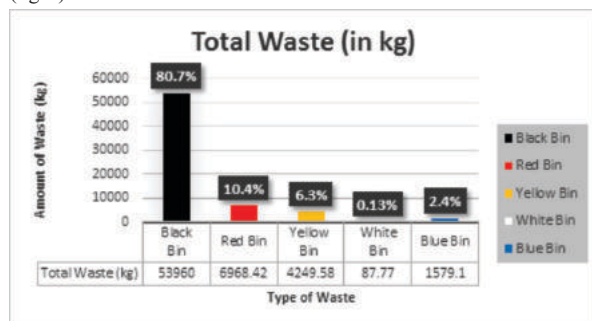


Figure2: Amount of Waste generated (in Kg)

In order to conduct an analysis of the plastics present in the general waste and biomedical waste that was collected, a segregation process was carried out. The findings revealed that among the total general waste collected, only 13% consisted of plastic materials. The remaining portion of the general waste, which accounted for the majority, was categorized as non-plastics (41%) or Inert Waste (46%) i.e., building construction material (fig. 3).



Figure3: Components of General Waste

Similarly, when examining the collected biomedical waste, it was discovered that out of the total biomedical waste, only 18% comprised plastic materials. A significant proportion of the biomedical waste, specifically 46% was categorized as non-plastics. Additionally, 36% of the biomedical waste was attributed to the presence of residual fluids, drugs or liquids left inside IV bottles, vials and other such containers (fig. 4).

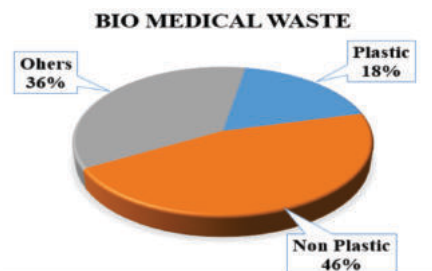


Figure4: Components of Bio Medical Waste

Fig 5 & 6 below shows the general waste, the waste materials have been categorized into plastics and non-plastics. Plastics refer to any waste items made of plastic, such as plastic food ware, packaging materials, bottles and other plastics. Non-plastics encompass all other waste materials that are not made of plastic, including paper, cardboard, food and other biodegradable waste.

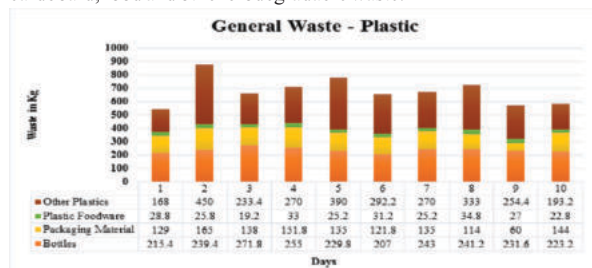


Figure 5: Categorization of Plastics generated among General Waste



Figure6: Categorization of Non Plastics generated among General Waste

Fig. 7 & 8, on the other hand, focuses specifically on biomedical waste. The waste is again divided into plastics and non-plastics. Plastics in biomedical waste may consist of items like IV catheters, tubing, used syringes, IV bottles and gloves. Non-plastics in biomedical waste comprise items such as cotton, gauze, bandages, needles, scalpels, mask, gowns, linen, beddings, metallic body implants, glassware etc.

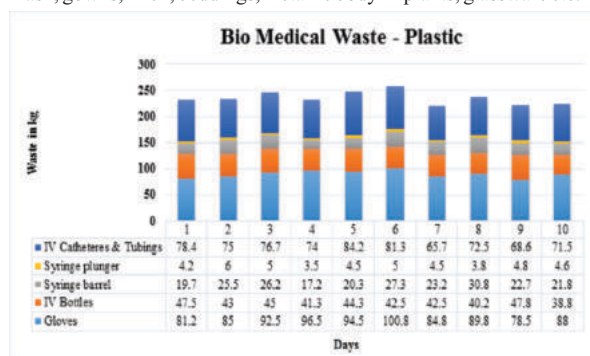


Figure 7: Categorization of Plastics generated among Bio Medical Waste

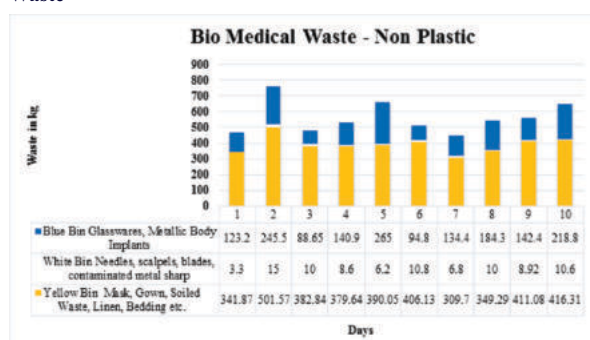


Figure 8: Categorization of Non Plastics generated among Bio Medical Waste

DISCUSSION

I. Waste Composition:

The study aimed to assess biomedical waste generation in a healthcare facility. Results showed that 80.7% of waste was general waste and 19.3% was biomedical waste.

ii. Biomedical Waste Categories:

Among the biomedical waste, the largest portion (10.4%) was categorized as Red waste, followed by Yellow waste (6.3%). A smaller percentage of the biomedical waste fell under the categories of Blue waste (2.4%) and White waste (0.13%).

iii. Plastic Waste in General Waste:

The study analyzed the presence of plastics in general waste and found that only 13% of the total waste was made up of plastic materials. The majority of the waste was categorized as non-plastics (41%) or inert waste (46%), which includes building construction materials.

iv. Plastic Waste in Biomedical Waste:

In the collected biomedical waste, only 18% was made up of plastic materials, while a considerable portion (46%) fell under non-plastics. Additionally, 36% of the biomedical waste contained residual fluids, drugs, or liquids found in IV bottles and similar containers.

To address the issue of plastic waste, the organization is sterilizing it through autoclaving, followed by shredding and segregating the different types of plastic for recycling. Additionally, they have sanctioned 6 Effluent Treatment Plant (ETP) projects to handle liquid waste. 2 of these ETPs are currently being installed.

It is noteworthy that the percentage of plastic waste in the general waste and biomedical waste collected in this study is lower than the estimation provided by Practice Greenhealth, which suggested that approximately 25% of hospital waste consists of plastic materials.^[6]

Additionally, the study conducted by Anurag V Tiwari indicates that infectious waste, a subcategory of biomedical waste, typically comprises a higher proportion of plastics (20-60%) compared to the overall biomedical waste observed in this study (18%).^[7]

CONCLUSION

The study provided insights into the volume and composition of waste generated in a healthcare facility. Understanding the composition of waste in healthcare facilities is crucial for implementing effective waste management strategies. By identifying the types and proportions of waste materials, healthcare facilities can develop appropriate disposal methods and recycling programs. This study's findings can contribute to the development of sustainable waste management practices in healthcare settings.

Limitations of the Study:

1. The study was conducted in a specific healthcare facility, which may limit the generalizability of the findings to other healthcare settings.
2. The study only assessed the volume of biomedical waste generated for a short period, which may not be representative of long-term waste generation patterns.
3. The study did not explore the potential environmental impacts or disposal methods of the generated plastic waste.

Recommendation

Recommendation for Short Term basis

1. Waste Management:
 - a. Develop strategies to reduce volume of general waste generated, particularly inert building materials that constitute a significant portion of the general waste stream.
2. Training:
 - a. Educate staff and promote awareness about the environmental impact of plastic waste and the importance of reducing its usage.

Recommendation for Long Term basis

1. Reducing Plastic Waste:
 - a. Identify opportunities to minimize the use of plastic materials within the healthcare facility like assessing the feasibility and potential benefits of shifting back to use of glass syringes as an alternative to plastic syringes to reduce the plastic waste load.
 - b. Explore the viability of using bioplastics, like Polybutylene Adipate Terephthalate (PBAT) or Polybutylene Succinate (PBS) or recycled plastics, like Polyethylene terephthalate (rPET) as alternative options to traditional plastics in biomedical applications ensuring it does not compromise viability or show reactivity.
 - c. Explore innovative recycling methods for biomedical plastics and identify alternative applications beyond the present application (ex. Road construction).
2. Collaboration and Stakeholder Engagement:
 - a. Foster collaboration with waste management authorities, environmental agencies, and other healthcare facilities to share best practices and knowledge.

Ethical considerations:

In accordance with ethical guidelines and principles, the study was conducted.

Conflicts of interests: None

Source of funding: Nil

REFERENCES:

1. Biomedical waste (management and handling) rules 2016, New Delhi, ministry of Environment, Forest and climate change, GOI.
2. Radha KV, Kalaivani K, Lavanya R; A case study of Biomedical Waste management in Hospitals; Global journal of Health science; 2009 April, 1(1). Available at: https://www.researchgate.net/publication/41940664_A_Case_Study_of_Biomedical_Waste_Management_in_Hospitals
3. Annual report on Biomedical Waste Management; Central Pollution Control Board and Ministry Of Environment And Forest And Climate Change; 2017.
4. Chandra H. Hospital waste: An Environmental hazard and its management. International society of environmental Botanists, 1999 July, 5(3). Available at: https://isebindia.com/95_99/99-07-2.html
5. Rasheed FN, Walraven G. Cleaning up plastics in healthcare waste: THE TRANSFORMATIVE POTENTIAL OF LEADERSHIP. BMJ Innovations. 2022;9(2): 103–8. doi:10.1136/bmjinnov-2022-000986. Available at: <https://innovations.bmj.com/content/9/2/103>
6. Can medical care exist without plastic? 2019. Available at: <https://www.nationalgeographic.com/science/article/can-medical-care-exist-without-plastic>
7. Tiwari A, Kadu P. Biomedical Waste Management Practices in India-A Review. International Journal of Current Engineering and Technology. 2013;3(5):2030-2033. Available at: https://www.researchgate.net/publication/262523529_Biomedical_Waste_Management_Practices_in_India-A_Review