Secure and sustainable handling of medical waste in healthcare facilities

Abstract

Proper management of biomedical waste reflects the ethical responsibility of healthcare providers and institutions to protect public health, the environment, and the well-being of their communities. Overall, the effective management of biomedical waste is crucial for safeguarding public health, protecting the environment, ensuring occupational safety, complying with regulations, and fulfilling social responsibilities. Healthcare workers who handle biomedical waste are at risk of needle stick injuries, exposure to infectious agents, and other hazards. Addressing the challenges requires a multi-faceted approach involving government initiatives, regulatory enforcement, public awareness campaigns, investment in infrastructure and technology, training programs for healthcare workers, and collaboration with stakeholders across sectors. By addressing these issues, India can improve its capacity for biomedical waste management.

Keywords: biomedical waste, healthcare workers, public health, radioactive materials

Introduction :

Biomedical waste refers to any waste generated during medical procedures, diagnosis, or treatment of humans or animals. This waste can include sharps (needles, syringes), laboratory waste (culture dishes, glassware), blood and bodily fluids, pharmaceuticals, medical devices, and radioactive materials. Proper disposal of biomedical waste is crucial to prevent the spread of infections and protect public health and the environment. Bathma *et al.* (2012) reported that approximately 10-25% of biomedical waste was hazardous and injurious to humans and animals and deleterious environment. It is estimated that annually about 0.33 million tonnes of this hospital waste were generated in India. India is lagging behind in large-scale sorting, collection, careful storage, transfer and disposal of biomedical waste. Waste disposal companies are exposed to a variety of health risks and are not safe for waste due to lack of waste management training. Total amount of waste generated in a hospital in Karnataka was found to be 9.43 kg/day, which included 2.75 kg of non-infectious waste, 5.71 kg of infectious waste and 0.87 kg of sharp waste (Thirumala, 2013).

Why biomedical waste management is essential?

The management of biomedical waste is essential for several reasons:
1. Public Health Protection: Biomedical waste may contain pathogens such as bacteria, viruses, or parasites that can cause diseases in humans. Proper management prevents the spread of infections and protects public health.
2. Environmental Protection: Improper disposal of biomedical waste can contaminate soil, water, and air, leading to environmental pollution. Managing biomedical waste ensures that hazardous materials are handled and disposed of safely, minimizing environmental impact.

3. Occupational Safety: Healthcare workers who handle biomedical waste are at risk of needle stick injuries, exposure to infectious agents, and other hazards. Effective management practices, including proper segregation, handling, and disposal; help protect the safety and health of workers.
4. Legal Compliance: Many countries have regulations and guidelines for the management of biomedical waste to ensure public health and environmental safety. Compliance with these regulations is necessary to avoid legal penalties and maintain accreditation for healthcare facilities.
5. Social Responsibility: Proper management of biomedical waste reflects the ethical responsibility of healthcare providers and institutions to protect public health, the environment, and the well-being of their communities. Overall, the effective management of biomedical waste is crucial for safeguarding public health, protecting the environment, ensuring occupational safety, complying with regulations, and fulfilling social responsibilities.

Bhagawati *et al.* (2015) reported the current status of awareness and practices regarding Bio-Medical Waste Management (BMWM) and areas of deficit amongst the health care workers in a tertiary care teaching hospital in New Delhi, India. Some major areas of deficit found were about knowledge regarding number of BMW categories (17%), mercury waste disposal (37.56%) and definition of BMW (47%).Eshwar *et al.* (2015) depicted that in a study of biomedical waste management was conducted in tertiary care hospital among health care personnel in Puducherry 95% of the doctors had knowledge regarding biomedical waste management. However, the nursing staff (50%) and MPW's (80%) had poor knowledge regarding the colour coding for the segregation of waste. This study also stated that about 35% of nurses and 43% of Multipurpose Healthcare Workers were not vaccinated against Hepatitis B.

Hazards of biomedical wastes

There was a poor level of knowledge and awareness of biomedical waste generation hazards legislation and management among health care personnel (Sharma *et al.* 2013). It was surprising that 36% of the nurses had an extremely poor knowledge of biomedical waste generation and legislation and just 15% of sweepers had an excellent awareness of biomedical waste management practice. Singh *et al.* (2014) revealed that the knowledge concerning the importance of biomedical waste, its relationship with the ecosystem, the environmental toxins used in hospitals and the impact of cruelty on public health, remain very minimal. For better result we need to increase the level of education and training regarding biomedical waste and environment-friendly hospitals with optimum priority, under rules and legislation.
Biomedical waste can have several harmful effects:
1. Public Health Risks: Biomedical waste may contain infectious agents such as bacteria, viruses, and parasites, posing a risk of disease transmission to healthcare workers, waste handlers, patients, and the general public if not properly managed.

2. Environmental Pollution: Improper disposal of biomedical waste can contaminate soil, water bodies, and the air, leading to environmental pollution. Chemicals and pharmaceuticals present in biomedical waste can leach into the environment, affecting ecosystems and potentially entering the food chain.
3. Occupational Hazards: Healthcare workers and waste handlers who come into contact with biomedical waste are at risk of needle stick injuries, exposure to hazardous chemicals, and other occupational hazards. These risks can lead to infections, injuries, and long-term health consequences.
4. Community Impact: Improper management of biomedical waste can negatively impact communities living near healthcare facilities or waste disposal sites. Foul odors, visual pollution, and the spread of diseases can decrease the quality of life for residents and damage the reputation of the healthcare facility.
5. Spread of Drug Resistance: Improper disposal of pharmaceuticals in biomedical waste can contribute to the development of antimicrobial resistance. Residues of antibiotics and other medications can enter the environment, promoting the growth of drug-resistant bacteria and making infections harder to treat. Overall, the harmful effects of biomedical waste underscore the importance of proper management practices to mitigate risks to public health, the environment, and occupational safety.

According to the World Health Organization (WHO), healthcare activities generate a significant amount of waste, with approximately 85% being general, non-hazardous waste and the remaining 15% being hazardous, including biomedical waste. This proportion may vary by region and healthcare setting. Some studies and reports provide estimates of biomedical waste generation in specific countries or regions. For example, a study published in the Journal of Environmental Management estimated that hospitals in India generate around 0.5 to 2.0 kg of biomedical waste per bed per day, highlighting the considerable volume of waste generated in healthcare facilities. Overall, while precise global figures may be challenging to determine, it's evident that biomedical waste generation is a significant issue worldwide, underscoring the importance of effective waste management practices to protect public health and the environment.

Biomedical waste generation in any region depends on factors such as population size, healthcare infrastructure, the prevalence of medical facilities, and waste management practices. Haryana, being a populous state with a significant healthcare sector, likely generates a substantial amount of biomedical waste. The state government, along with local authorities and healthcare facilities, would implement measures to manage and dispose of biomedical waste safely and in compliance with regulations to mitigate potential health and environmental risks.

Types of biomedical waste management

Biomedical waste management involves several key steps and methods to ensure safe handling, transportation, treatment, and disposal of biomedical waste.

Some common types of biomedical waste management include:

1. Segregation: Proper segregation of biomedical waste at the point of generation is essential. This involves separating different types of waste (e.g., sharps, infectious waste and

pharmaceutical waste) into designated containers or bins to prevent cross-contamination and facilitate safe handling. Sengodan (2014) reported that the biomedical waste generated in the year 2010 was 15,875 kg with in-patient strength of 376,660 patients. In the year 2011, 26,103 kg of biomedical waste was generated with in-patient occupancy of 380,486 patients. In the year 2012, 402,208 patients generated 24,678 kg of biomedical waste. The result showed reduction in biomedical waste generated from 2011 to 2012, which was achieved due to effective waste segregation practices.

2. Collection and Storage: Biomedical waste should be collected and stored in leak-proof, puncture-resistant containers that are colour-coded and labelled according to waste categories. Storage areas should be secure, well-ventilated, and equipped with safety measures to prevent unauthorized access and minimize odour and pest infestation.

3. Transportation: Biomedical waste must be transported from healthcare facilities to treatment and disposal facilities using specialized vehicles that comply with safety and regulatory requirements. Transport containers should be durable, leak-proof, and properly labelled to prevent spillage and contamination during transit.

4. Treatment: Biomedical waste undergoes treatment processes to reduce its volume and mitigate potential health and environmental risks. Common treatment methods include autoclaving (steam sterilization), incineration, chemical disinfection, and mechanical shredding. Treatment facilities must adhere to regulatory standards and environmental guidelines to ensure safe and effective waste treatment.

5. Disposal: Once treated, biomedical waste may be disposed of through various methods, including land filling, deep burial, or recycling (e.g., metal sharps). Disposal methods should comply with local regulations and environmental standards to prevent pollution and protect public health.

6. Training and Education: Healthcare workers and waste handlers require training and education on proper biomedical waste management practices, including segregation, handling, and disposal. Training programs help ensure compliance with regulations, reduce occupational hazards, and promote environmental sustainability.

7. Monitoring and Compliance: Regular monitoring and compliance audits are essential to assess the effectiveness of biomedical waste management practices and identify areas for improvement. Compliance with regulatory requirements helps mitigate risks and maintain

public health and environmental safety. By implementing these types of biomedical waste management practices, healthcare facilities can effectively mitigate the risks associated with biomedical waste and protect the health and safety of individuals and communities.

Awareness about the legislations regarding biomedical waste management

Arora *et al.* (2011) stated that majority of the respondents had unsatisfactory knowledge, attitude and inadequate practices related to bio-medical waste management. There is a need to improve knowledge about bio-medical waste management to protect the environment from its negative effect. Need based training programmes for health care professionals at college and hospital, was recommended. Mathur *et al.* (2011) reported that doctors, nurses and lab technicians had better knowledge than sanitary staff regarding biomedical waste management. Knowledge regarding the colour coding and waste segregation at source was found to be better among nurses and laboratory staff s compared to doctors. Gupta *et al.* (2012) analyzed that the health care professionals reported that the hospital waste should be segregated and needs to be disposed properly. Total 47.5 % professionals knew about the categories and the treatment of health care waste properly, of which 81.9% were nurses, 76.8% were doctors, 38.5% were interns, 27.3% were technicians and 19.3% were keeping staff. Majority of the study subjects i.e., 95.8% had knowledge about various health care problems caused by health care workers, of which 38.8% were nurses. Majority of the workers i.e., 96.1% were aware of the colour coding for waste segregation but they did not have any clear idea of what should be disposed in which bin. Overall, it was observed that the knowledge and practices adopted for biomedical waste by the doctors and the nursing staffs was good. Bansal *et al.* (2013) in research carried out in a hospital to collect information on knowledge possessed by the staff regarding biomedical waste management practices. Out of these 44.30% were medical, 29.74% were para-medical and 25.95% were non-medical staff. The knowledge of medical staff was higher than para-medical staff and while it was least among non-medical workers.

Chudasama *et al.* (2013) observed that majority of (79.6%) sanitary staff had heard about bio-medical waste, only (3.7%) were actually aware about the Biomedical Waste Management and Handling Rules, 1998. Very few (28.5%) resident and intern doctors and (25.9%) sanitary staff received training for biomedical waste. Awareness related to various disease transmitted by biomedical waste among the staff was poor. Majority of health care personnel were aware about the availability of different coloured bags used for collection of waste but for identification of coloured bags used as per biomedical waste act, except doctors (98.4%)

awareness among other health care personnel was very poor. Ismail *et al.* (2013) reported that the knowledge regarding biomedical waste management was poor among all the four groups of hospital staff i.e., doctors, nurses, lab-technicians and sweepers. Most of the doctors (98%) and nurses (70%) were aware that the segregation of biomedical waste has to be done at the point of generation. There was adequate knowledge regarding the risk of disease transmission through biomedical waste in all the groups except the sweepers. Patil *et al.* (2013) concluded that the biomedical waste has been a growing concern due to increased awareness in public regarding infectious diseases. Good biomedical waste disposal practices lead to reduction in medical expenditure, unsightly scenes at various disposal bins and dumping sites. Improper biomedical waste management practices and indiscriminate disposal of hospital waste causes spread of illness leading to financial burden to society. Therefore, it is necessary to educate the staff, patients and community about the management of infectious biomedical waste. Rathod *et al.* (2013) stated that inadequate knowledge about management of biomedical waste can be associated with the risks to healthcare workers, communities and patients at large. Hospital infection control committee and team are responsible for monitoring of proper implementation of biomedical waste management rules. It is not only related to quality waste management but also to safety of health care workers that is universal precautions and immunization.

Selvaraj *et al.* (2013) conducted a study among the medical practioners using questionnaire and reported that 70% of the practitioners have not undergone any training in biomedical waste management. Though most 98% felt that biomedical waste should be segregated, 30.2% of them were still dumping it with general waste. 31% of the practitioners didn't know what ultimately happens to the biomedical waste. The study highlighted the need for programs that not only impart knowledge to the doctors but also motivate them to actively practice proper biomedical waste management

Malini *et al.* (2015) stated that most of the paramedical staff and Class IV worker had poor knowledge regarding colour coding of the containers as compared to medical officers. This might be due to the fact that the medical officers had previously received the training of biomedical waste management. However, more that 90% of the health care personnel were aware about the biomedical waste management expects Class IV. Though, the major concern was inadequate knowledge about universal precautions. Gupta *et al.* (2016) reported that only one fourth of the Class IV workers had knowledge regarding the biomedical waste management legislations and generation. While (93.3%) of the doctors had knowledge

regarding the same. Knowledge about segregation and colour coding of biomedical waste was much lower in Class IV workers. Only one out of twenty-two Class IV workers could currently identify the biohazard symbols. Ranjan *et al.* (2016) stated that a higher percentage of participants (61%) were completely unaware about recycling and reusing of biomedical waste.Similarly, 44% of the dental students didn't have any awareness about the management of biomedical waste, 22% were moderately aware, 21% slightly aware, 7% very aware, and 5% fell in extremely aware category. Kumar (2017) reported that cross sectional study was conducted among 250 medical students in two professionals. They were sub grouped as 1st and 2nd professionals. 1st professional students were less knowledgeable and aware as compared to 2nd professional regarding segregation, colour coding about biomedical waste management. So, intensive training and orientation classes can be provided for new medical students to improve the attitude and knowledge about disposal for future practical application.

Kumar *et al.* (2019) reported that there is a significant association between "Attended in Service Education Program" and "Level of Knowledge". The result of the study concluded that 75% of staff nurses were having insufficient knowledge, 25% of the staff nurses were having moderate knowledge and none of the staff nurses were having adequate knowledge on biomedical waste management.

Reason for poor disposal of biomedical waste in India

India faces several challenges in effectively managing biomedical waste on a large scale:

1. Infrastructure and Resources: Many healthcare facilities in India, especially in rural areas, lack adequate infrastructure and resources for proper biomedical waste management. This includes the availability of appropriate waste segregation bins, storage facilities, transportation vehicles, and treatment plants.

2. Awareness and Training: There may be a lack of awareness and training among healthcare workers and waste handlers regarding proper biomedical waste management practices. Without sufficient education and training, there is a higher risk of improper segregation, handling, and disposal of biomedical waste.

3. Regulatory Compliance: While India has regulations in place for biomedical waste management (such as the Biomedical Waste Management Rules), enforcement and compliance monitoring may be lacking, particularly in remote or underserved areas.

Inconsistent enforcement of regulations can lead to non-compliance and improper waste management practices.

4. Financial Constraints: Many healthcare facilities, especially smaller ones and those in the public sector, may face financial constraints that limit their ability to invest in proper biomedical waste management infrastructure and services. Lack of funding can hinder the establishment of treatment facilities and the procurement of necessary equipment.

5. Population Density and Urbanization: India's high population density and rapid urbanization exacerbate the challenges of biomedical waste management. The concentration of healthcare facilities in urban areas, coupled with inadequate waste management infrastructure, can lead to increased generation and improper disposal of biomedical waste.

6. Informal Sector Involvement: In some cases, the informal sector, including waste pickers and recyclers, may be involved in the collection and handling of biomedical waste, leading to unsafe practices and health risks for workers and the community. Addressing these challenges requires a multi-faceted approach involving government initiatives, regulatory enforcement, public awareness campaigns, investment in infrastructure and technology, training programs for healthcare workers, and collaboration with stakeholders across sectors. By addressing these issues, India can improve its capacity for biomedical waste management.

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