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BIOMEDICAL WASTE MANAGEMENT IN INDIA- A REVIEW

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Abstract:
India's rapid healthcare expansion generates significant biomedical waste (BMW), posing a critical public health and environmental concern. This abstract examines BMW management in India, focusing on its regulatory framework and the challenges faced in implementation.
India, with its rapidly growing population and expanding healthcare sector, grapples with a significant challenge: biomedical waste (BMW) management. This waste, generated from hospitals, clinics, research labs, and even households, harbors infectious agents, toxic chemicals, and sharps, posing a serious threat to public health and the environment if not managed effectively. Biomedical waste, generated from healthcare activities, poses a significant threat to human health and the environment if not managed properly. This waste can harbor infectious pathogens, toxic chemicals, and sharps, leading to potential disease transmission, environmental contamination, and occupational hazards. Effective biomedical waste management (BMWM) is crucial to mitigate these risks and ensure public health and environmental well-being

Keyword: *Biomedical Waste, Risk, Segregation, Colour code*

Hospital biomedical waste (BMW) poses a significant risk to patients, medical workers, and the environment if not managed properly. Here's a breakdown of the potential risks:

Risks to patients:

- Exposure to infectious agents: Improperly disposed of BMW, such as syringes, needles, and other sharps, can harbor infectious agents like HIV, hepatitis B, and hepatitis C. These pathogens can cause serious infections if they come into contact with patients through accidental cuts, splashes, or inhalation.
- Image of Syringes and needles medical waste Syringes and needles medical waste
- Chemical exposure: Certain types of BMW, such as pharmaceuticals and cytotoxic drugs, can be toxic if they come into contact with patients. This can happen through contaminated surfaces, spills, or even inhalation of airborne particles.

Risks to medical workers:

- Similar to patients, medical workers are also at risk of exposure to infectious agents and chemicals from BMW. This is especially true for workers who handle waste directly, such as nurses, waste disposal technicians, and housekeeping staff.

- Musculoskeletal injuries: Lifting and handling heavy BMW containers can lead to musculoskeletal injuries in medical workers.

Risks to the environment:
- Water pollution: If BMW is not disposed of properly, it can leach harmful chemicals and pathogens into the soil and water supply. This can contaminate drinking water sources and harm aquatic life.
- Air pollution: Incineration of BMW can release harmful air pollutants, such as dioxins and furans, which can contribute to respiratory problems and other health issues.
- Land pollution: Improperly disposed of BMW can take up valuable landfill space and release harmful toxins into the soil.

How to minimize the risks?
- Proper waste segregation and labelling: BMW should be segregated into different categories based on the type of waste and potential hazards. This helps ensure proper treatment and disposal.
- Safe handling and storage: BMW should be handled and stored in designated containers that are puncture-resistant and leak-proof.
- Proper treatment and disposal: BMW should be treated and disposed of according to local regulations and guidelines. This may involve incineration, autoclaving, or other methods.
- Training and awareness: Medical staff should be trained on the proper handling and disposal of BMW. They should also be aware of the potential risks associated with BMW exposure.

By implementing these measures, hospitals can significantly reduce the risks associated with BMW and protect the health of patients, medical workers, and the environment.

Biomedical waste (BMW) is a major issue of concern in these days. According to WHO 15 -25% of the waste generated in the hospital is dangerous and hazardous to health as it poses a risk to health of individual . Around 85% of healthcare waste is non-hazardous, similar to household waste. However, the remaining 15% is considered hazardous, containing infectious, toxic, or radioactive materials.

Health Risks: Improper management of this hazardous waste can expose healthcare workers, waste handlers, and the general public to serious health risks, including:

Infectious diseases: Needlestick injuries and contact with contaminated waste can transmit diseases like HIV, hepatitis B, and hepatitis C.

Chemical poisoning: Exposure to toxic chemicals present in some medical waste can cause respiratory problems, skin irritation, and even cancer.

Injuries: Sharps waste like needles and syringes pose a risk of cuts and punctures.

Variability in Waste Management: Practices vary significantly across countries and healthcare facilities. Some places have robust waste management systems, while others lack proper infrastructure and training.

Exposure Levels: The risk depends on individual exposure levels, influenced by occupation, proximity to waste, and adherence to safety protocols.

Data Limitations: Comprehensive data on healthcare worker injuries and community health impacts attributable to biomedical waste is scarce.
However, the WHO emphasizes that even seemingly small risks can translate to significant public health burdens when considering the vast healthcare workforce and populations potentially exposed.

WHO (1999) reported that, about 85% of health hazard to the health workers, public and air hospital waste is non-hazardous, 10% infective and 5% flora on the area not infective but hazardous.[6] The Government of India (notification, 1998) specifies that Hospital Waste Management is a part of hospital hygiene and maintenance activities. This involves management of range of activities, which are mainly engineering functions, such as collection, transportation, operation or treatment of processing systems, and disposal of wastes.[7]

Classification of Bio-Medical Waste according to World Health Organization

The World Health Organization (WHO) has classified medical waste into eight categories: ´

1. General Waste
2. Pathological
3. Radioactive
4. Chemical
5. Infectious to potentially infectious waste
6. Sharps
7. Pharmaceuticals
8. Pressurized containers

Major Sources of bio-medical waste.

- Govt. hospitals/private hospitals/nursing homes/ dispensaries.
- Primary health centres.
- Medical colleges and research centres/ paramedic services.
- Veterinary colleges and animal research centres.
- Laboratories and research centres
- Mortuary and autopsy centres
- Animal research and testing laboratories
- Blood banks and collection services
- Nursing homes for the elderly
- Biotechnology institutions.
- Production units.

Minor Sources of bio-medical waste.

• Physicians/ dentists' clinics
• Animal houses/slaughterhouses.
• Blood donation camps.
• Vaccination centres.
• Acupuncturists/psychiatric clinics/cosmetic piercing.
• Funeral services.
• Institutions for disabled person

Need of biomedical waste management in hospitals:

The reasons due to which there is great need of management of hospitals waste such as:

1. Injuries from sharps leading to infection to all categories of hospital personnel and waste handler
2. Nosocomial infections in patients from poor infection control practices and poor waste management.
3. Risk of infection outside hospital for waste handlers and scavengers and at time general public living in the vicinity of hospitals.
4. Risk associated with hazardous chemicals, drugs to persons handling wastes at all levels.
5. Disposable being repacked and sold by unscrupulous elements without even being washed.
6. Drugs which have been disposed of, being repacked and sold off to unsuspecting buyers.
7. Risk of air, water and soil pollution directly due to waste, or due to defective incineration emissions and ash.[8]

Benefits of Biomedical Waste Management

1. Cleaner and healthier surroundings.
2. Reduction in the incidence of hospital acquired and general infections.
3. Reduction in the cost of infection control within the hospital.
4. Reduction in the possibility of disease and death due to reuse and repackaging of infectious disposables.
5. Low incidence of community and occupational health hazards.
6. Reduction in the cost of waste management and generation of revenue through appropriate treatment and disposal of waste.

Improved image of the healthcare establishment and increase the quality of life

Biomedical Waste Management Process

Biomedical waste management is the process of collecting, treating, and disposing of waste generated from healthcare activities. This waste can be infectious, hazardous, or both, and poses a significant risk to human health and the environment if not managed properly.

Here is a general overview of the biomedical waste management process:

1. Segregation: The first step is to segregate the waste at the point of generation. This means separating the different types of waste into different containers. This is essential to ensure that each type of waste is treated and disposed of in the appropriate way.

2. Collection: Once the waste has been segregated, it is collected and transported to a storage facility. The containers used for collection must be leak-proof and puncture-resistant, and they must be labeled with the type of waste they contain.

3. Treatment: Depending on the type of waste, it may need to be treated before it can be disposed of. Some common treatment methods include:

- Autoclaving: This involves using steam under pressure to kill microorganisms.
- Incineration: This involves burning the waste at high temperatures to destroy it.
- Microwaving: This involves using microwaves to heat the waste and kill microorganisms.
- Chemical disinfection: This involves using chemicals to kill microorganisms.

4. Disposal: Once the waste has been treated, it can be disposed of in a landfill or other appropriate facility. The disposal method must be chosen carefully to ensure that the waste does not pose a risk to human health or the environment.

Safeguarding the health care workforce against occupational health risks arising from hospital-waste management calls for effective infectious waste control measures. In addition to protecting workers health, such control measures protect public health and the environment from the hazards posed by hospital waste. Proper management ensures that infectious waste is handled in accordance with established and acceptable procedures from the time of generation through treatment of the waste and its ultimate disposal.

Salient Features of Biomedical Waste Rules 2016

1. The scope of the rules have been expanded to include various health camps such as vaccination camps, blood donation camps, and surgical camps[9]
2. Duties of the occupier of HCFs have been revised. Occupier is the person having administrative control over the HCF that is generating BMW[10]

a. Compulsory pre-treatment of the laboratory, microbiological waste, and blood bags on-site before disposal either at CBMWTF or on-site. The method of sterilization/disinfection should be in accordance with National AIDS Control Organization (NACO) or WHO
b. The use of chlorinated plastic bags, gloves, blood bags, etc. should be gradually stopped and this phasing out should be within 2 years from the date of notification of these rules
c. To provide training to all its HCWs and protect them against diseases such as hepatitis B and tetanus by immunization
d. Liquid waste to be separated at source by pre-treatment before mixing with other liquid waste
e. To set up a barcode system for BMW containing that is to be sent out of the premises for treatment and disposal
f. All major accidents including accidents caused by fire hazards, blasts, during handling of BMW, and remedial action taken by the prescribed authority should be reported
g. The existing incinerator should be upgraded/ modified to achieve the new standard within 2 years from the date of this notification
h. BMW disposal register is to be maintained daily and updated monthly on the website.

3. The duties of the operator of a common biomedical waste treatment and disposal facility (CBMWTF) have been increased.[9] They should assist in training of HCW from where the waste is being collected. Furthermore, there should be barcoding, and global positioning system established for handling of BMW within 1 year. Maintain all records for operation of incineration/ hydroclaving / autoclaving for a period of 5 years
4. The segregation, packaging, transportation, and storage of BMW have been improved. Biomedical waste has been classified into four categories based on colour code-type of waste and treatment options. In addition, untreated human anatomical waste, animal anatomical waste, soiled waste, and biotechnology waste should not be stored beyond a period of 48 h. In case, there is a need to store beyond 48 h, the occupier should take all appropriate measures to ensure that the waste does not adversely affect human health and the environment.[9]
5. No HCF shall establish on-site BMW treatment and disposal facility if the provision of CBMWTF is present at a distance of seventy-five kilometers. If no CBMWTF is available, the occupier shall set up requisite BMW treatment facility such as incinerator, autoclave or microwave, shredder after taking prior authorization from the prescribed authority. After confirming treatment of plastics and glassware by autoclaving or microwaving followed by mutilation/shredding, these recyclables should be given to authorized recyclers
6. Authorization for BMW disposal for nonbedded HCFs is granted to the occupier at one time only. The validity of authorization shall be synchronized with validity of consent orders for bedded HCFs
7. Standards for emission from incinerators have been modified to be more environmental friendly. These are permissible limit for SPM-50 mg/nm3 ; residence time in secondary chamber of incinerator – two seconds; standard for dioxin and furans – 0.1 ng TEQ/Nm3
8. Ministry of Environment, Forest, and Climate change will monitor the implementation of rules yearly. The responsibility of each state to check for compliance will be done by setting up district-level committee under the chairpersonship of District Collector or District Magistrate or Additional District Magistrate. In addition, every 6 months, this committee shall submit its report to the State Pollution Control Board.

- Colour coding of BMW

Category	Types of Waste	Colour and type of Container

Yellow	Human Anatomical waste Animal Anatomical waste Soiled waste Discarded or expired medicine Laboratory waste Chemical waste Chemical liquid waste	Yellow colour non chlorinated plastic bags having thickness equal to more than 50microns or containers.
Red	Contaminated waste (Recyclable)	Red colour non chlorinated plastic bags having thickness equal to more than 50microns or containers.
White	Waste sharps including metals	White colour translucent, puncture proof, leak proof, temper proof containers.
Blue	Glassware Metallic body implants	Cardboard boxes with blue coloured marking or blue coloured puncture proof, temper proof containers.

The Suggestions:

Solutions to Remove Obstacles in Hospital Waste Management: Hospital waste management faces various obstacles, but several solutions can help achieve significant progress:

Strengthening Infrastructure and Systems: Invest in proper segregation and storage facilities: Implement color-coded bins and designated areas for different waste categories (infectious, chemical, non-infectious, etc.).

Upgrade treatment and disposal technologies: Explore solutions like incineration (with efficient emission control), autoclaving, and microwave disinfection for safe treatment.

Implement robust tracking systems: Integrate electronic waste tracking systems to monitor movement and ensure proper disposal by authorized facilities.

Enhancing Knowledge and Practices:

- Comprehensive training programs: Train medical staff on waste segregation, handling, and safe disposal practices.
- Awareness campaigns: Educate patients and the public about responsible disposal of medications and personal care products.
- Promote sustainability: Encourage the use of eco-friendly and recyclable materials in healthcare settings.

Policy and Regulatory Frameworks:

- Review and strengthen existing regulations: Ensure clear, comprehensive, and enforceable regulations for waste management.
- Promote collaborative efforts: Facilitate inter-departmental and governmental collaboration for effective implementation and enforcement.
- Incentivize best practices: Offer financial or other incentives to hospitals that adopt sustainable and efficient waste management practices.

Financing and Investment:

- Allocate sufficient budget: Earmark specific budget allocations for waste management infrastructure, training, and technology adoption.
- Explore public-private partnerships: Encourage collaboration between government and private entities to share costs and expertise.
- Seek international funding: Look for grants and funding opportunities from international organizations and development agencies.

Additional Solutions:

- Promoting research and development: Invest in research to develop innovative and cost-effective waste treatment and disposal technologies.
- Empowering waste management workers: Provide proper training, safety equipment, and fair compensation to waste management personnel.
- Building community engagement: Encourage community involvement in waste management initiatives and awareness campaigns.

By implementing these solutions, hospitals can overcome the obstacles and achieve significant progress in managing their waste responsibly, safeguarding public health and protecting the environment

Conclusion

Healthcare Professionals should have a training program regarding Biomedical waste management so that they know everything about BMW and how to dispose of it. Training the healthcare worker with checklists and regular observation can create accountability among them. Inappropriate Biomedical waste management can cause to environmental pollution, lead to growth of dipheriaphor like insects, rodents & worms which cause to transmission of diseases like typhoid, cholera, plague, hepatitis & AIDS. Recycling of disposable syringes, needles, intravenous sets, and glass bottles without proper sterilization cause to hepatitis, tetanus, HIV & viral diseases. Proper disposal of Biomedical Waste is very beneficial for healthcare professionals and other, it gives many benefits such as healthy surroundings, reduction in hospital acquired infections & cost of infection control, reduction in reuse of infectious disposables & prevention of occupational health hazards. To live a healthy and joyful life everyone should have proper awareness about hazard of biomedical waste.

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