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Biomedical Waste Management-The Day to Day Scenario

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Abstract: - Biomedical waste management is an important aspect in public health science, the various regulatory bodies that function as safety guards for environmental health lay down regulations for industries, healthcare sectors, organisations that produce biomedical waste to safe guard the environment.

Key Words: — Biomedical Waste, Public Health, Environment.

I. INTRODUCTION

Biomedical waste or hospital waste is any kind of waste containing infectious (or potentially infectious) materials. It may also include waste associated with the generation of biomedical waste that visually appears to be of medical or laboratory origin (e.g. packaging, unused bandages, infusion kits etc.), as well research laboratory waste containing biomolecules or organisms that are mainly restricted from environmental release. As detailed below, discarded sharps are considered biomedical waste whether they are contaminated or not, due to the possibility of being contaminated with blood and their propensity to cause injury when not properly contained and disposed Waste management (or waste disposal) includes the activities and actions required to manage waste from its inception to its final disposal.[1] This includes the collection, transport, treatment and disposal of waste, together with monitoring and regulation of the waste management process.

Waste can be solid, liquid, or gas and each type has different methods of disposal and management. Waste management deals with all types of waste, including industrial, biological and household. In some cases, waste can pose a threat to human health. [2] Waste is produced by human activity, for example, the extraction and processing of raw materials. [3] Waste management is intended to reduce adverse effects of waste on human health, the environment or aesthetics.

II. DISCUSSION

A. Classification:

In the USA
The EPA – Medical Waste Guidance defines and categorizes solid medical waste in the following ways.
General Waste – The bulk of most medical waste, mostly typical household and office waste.
Infectious Waste – Any waste that could cause an infection in humans, like blood, human tissue or anything contaminated with bodily fluids.
Hazardous Waste – Waste that's dangerous, but not infectious, like sharps, discarded surgical equipment, and some chemical waste.
Radioactive Waste – Any waste generated as a result of radioactive treatments, like cancer therapies, and medical equipment that uses nuclear elements.

B. World Health Organization (WHO) medical waste classifications:

The WHO has issued its own guidelines on the different types of medical waste, which include:
Infectious Waste – Anything that's infectious or contaminated
Sharps – Waste like needles, scalpels, broken glass and razors
Pathological Waste – Human or animal tissue, body parts, blood and fluids.
Pharmaceutical Waste – Unused and expired drug or medicines, like creams, pills, antibiotics.
Genotoxic Waste – Cytotoxic drugs and other hazardous toxic waste, that's carcinogenic, mutagenic or teratogenic.
Radioactive Waste – Any waste containing potentially radioactive materials.
Chemical Waste – Liquid waste, typically from machines, batteries and disinfectants.
General/Other Waste – All other, non-hazardous waste.

III. METHODS OF COLLECTION AND SEGREGATION

Segregation refers to the basic separation of different categories of waste generated at source and thereby reducing the risks as well as cost of handling and disposal. Segregation is the most crucial step in bio-medical waste management. Effective segregation alone can ensure effective biomedical waste management.
How does segregation help?
Segregation reduces the amount of waste needs special handling and treatment.
Effective segregation process prevents the mixture of medical waste like sharps with the general municipal waste.
Prevents illegally reuse of certain components of medical waste like used syringes, needles and other plastics.

Provides an opportunity for recycling certain components of medical waste like plastics after proper and thorough disinfection.
Recycled plastic material can be used for non-food grade applications of the general waste, the biodegradable waste can be composted within the hospital premises and can be used for gardening purposes.
Recycling is a good environmental practice, which can also double as a revenue generating activity.
Reduces the cost of treatment and disposal (80 per cent of a hospital's waste is general waste, which does not require special treatment, provided it is not contaminated with other infectious waste) label.

A. Proper labelling of bins

The bins and bags should carry the biohazard symbol indicating the nature of waste to the patients and public.
Collection:
The collection of biomedical waste involves use of different types of container from various sources of biomedical wastes like Operation Theatre, laboratory, wards, kitchen, corridor etc. The containers/ bins should be placed in such a way that 100 % collection is achieved. Sharps must always be kept in puncture-proof containers to avoid injuries and infection to the workers handling them.
Storage:
Once collection occurs then biomedical waste is stored in a proper place. Segregated wastes of different categories need to be collected in identifiable containers. The duration of storage should not exceed for 8-10 hrs in big hospitals (more than 250 bedded) and 24 hrs in nursing homes. Each container may be clearly labelled to show the ward or room where it is kept. The reason for this labelling is that it may be necessary to trace the waste back to its source. Besides this, storage area should be marked with a caution sign.

B. Biomedical Waste Management

Low-heat systems (operates between 93 -177^{o}C) use steam, hot water, or electromagnetic radiation to heat and decontaminate the waste. Autoclave & Microwave are low heat systems.

- Autoclaving is a low heat thermal process and it uses steam for disinfection of waste. Autoclaves are of two types depending on the method they use for removal of air pockets. They are gravity flow autoclave and vacuum autoclave.
- Microwaving is a process which disinfects the waste by moist heat and steam generated by microwave energy.

High-heat systems employ combustion and high temperature plasma to decontaminate and destroy the waste. Incinerator & Hydroclaving are high heat systems.

C. Mechanical processes

These processes are used to change the physical form or characteristics of the waste either to facilitate waste handling or to process the waste in conjunction with other treatment steps. The two primary mechanical processes are
Compaction - used to reduce the volume of the waste.
Shredding - used to destroy plastic and paper waste to prevent their reuse. Only the disinfected waste can be used in a shredder.
Irradiation processes: In these processes, wastes are exposed to ultraviolet or ionizing radiation in an enclosed chamber. These systems require post shredding to render the waste unrecognizable.
Biological processes: Biological enzymes are used for treating medical waste. It is claimed that biological reactions will not only decontaminate the waste but also cause the destruction of all the organic constituents so that only plastics, glass, and other inert will remain in the residues.

D. Points to remember in processing the waste

Incineration: Incinerators should be suitably designed to achieve the emission limits. Wastes to be incinerated shall not be chemically treated with any chlorinated disinfectants.
Toxic metals in the incineration ash shall be limited within the regulatory quantities.
Only low sulphur fuel like diesel shall be used as fuel in the incinerator.
Autoclaving: The autoclave should be dedicated for the purpose of disinfecting and treating biomedical waste.
When operating a gravity flow autoclave, medical waste shall be subjected to:
A temperature of not less than 121o and pressure of about 15 pounds per square inch (psi) for an autoclave residence time of not less than 60 minutes; or
A temperature of not less than 135 oC and a pressure of 31 psi for an autoclave residence time of not less than 45 minutes; or
A temperature of not less than 149 oC and a pressure of 52 psi for an autoclave residence time of not less than 30 minutes.
When operating a vacuum autoclave, medical waste shall be subjected to a minimum of one per vacuum pulse to purge the autoclave of all air. The waste shall be subjected to the following:
A temperature of not less than 121degreeCelcius and a pressure of 15 psi per an autoclave residence time of not less than 45 minutes; or
temperature of not less than 135^{o}C and a pressure of 31 psi for an autoclave residence time of not less than 30 minutes; or

Medical waste shall not be considered properly treated unless the time, temperature and pressure indicate stipulated limits. If for any reason, these were not reached, the entire load of medical waste must be autoclaved again until the proper temperature, pressure and residence time were achieved.

Microwaving: Microwave treatment shall not be used for cytotoxic, hazardous or radioactive wastes, contaminated animal carcasses, body parts and large metal items. The microwave system shall comply with the efficacy tests/routine tests.

The microwave should completely and consistently kill bacteria and other pathogenic organism that is ensured by the approved biological indicator at the maximum design capacity of each microwave unit.

Deep Burial: A pit or trench should be dug about 2 m deep. It should be half filled with waste, and then covered with lime within 50 cm of the surface, before filling the rest of the pit with soil. It must be ensured that animals do not have access to burial sites. Covers of galvanised iron/wire meshes may be used. On each occasion, when wastes are added to the pit, a layer of 10cm of soil be added to cover the wastes.

Burial must be performed under close and dedicated supervision. The site should be relatively impermeable and no shallow well should be close to the site. The pits should be distant from habitation, and sited so as to ensure that no contamination occurs of any surface water or ground water.

The area should not be prone to flooding or erosion. The location of the site will be authorized by the prescribed authority. The institution shall maintain a record of all pits for deep burial.

Disposal of sharp materials:

Blades and needles waste after disinfection should be disposed in circular or rectangular pits. Such pits can be dug and lined with brick, masonry, or concrete rings. The pit should be covered with a heavy concrete slab, which is penetrated by a galvanized steel pipe projecting about 1.5 m above the slab, within internal diameter of upto 20 mm. When the pipe is full it can be sealed completely after another has been prepared.

Radioactive waste from medical establishments:

It may be stored under carefully controlled conditions until the level of radioactivity is so low that they may be treated as other waste.

Special care is needed when old equipment containing radioactive source is being discarded. Expert advice should be taken into account.

Mercury control:

Wastes containing Mercury due to breakage of thermometer and other measuring equipment need to be given attention.

Proper attention should be given to the collection of the spilled mercury, its storage and sending of the same back to the manufacturers. Must take all measures to ensure that the spilled mercury does not become part of biomedical wastes

Waste containing equal to or more than 50 ppm of mercury is a hazardous waste and the concerned generators of the wastes including the health care units are required to dispose the waste as per the norms.

Waste minimization:

Waste minimization is an important first step in managing wastes safely, responsibly and in a cost effective manner. This management step makes use of reducing, reusing and recycling principles.

IV. Conclusion

It is the duty of every individual to follow biomedical waste management principle, the complete process can only be achieved from intersectoral co-operation and participation.

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