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Review Paper

Health Care Waste Management

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ABSTRACT

Health care waste can be hazardous, if not done properly. Poor management of healthcare waste, exposes health workers, waste handlers, and the community to the toxic effects of wastes generated from health activity. The disposal of these wastes could also lead to environmental problems. This article intends to describe various health care waste and its management, as establishing good practices for proper handling and disposal of health care waste is an important part of the health care delivery system.

INTRODUCTION

Healthcare waste (HCW) is defined as the all waste generated by health care activities which includes, infectious and non-infectious waste i.e., sharps, non-sharps, blood, body parts, chemicals, pharmaceuticals, medical devices and radioactive materials. 10-25% of healthcare waste are infectious that needs special treatment and is referred to as the healthcare risk waste. Healthcare risk waste includes infectious waste, pathological and anatomical waste, hazardous pharmaceutical waste, hazardous chemical waste, and waste with a high content of heavy metals, pressurized containers, sharps, highly infectious waste, geotoxioc /cytotoxic waste and radioactive wastes1. Improper management of health-care waste poses a significant risk to patients, health-care workers, the community and the environment.

Why do we need to know about HCW?

Improper health care waste management results in infectious diseases, such as Hepatitis A, B and HIV2. WHO estimated that injections with contaminated syringes caused 21 million hepatitis B virus (HBV) infections (32% of all new infections), two million hepatitis C virus (HCV) infections (40% of all new infections) and 260 000 HIV infections (5% of all new infections) in year 2000. In addition, health-care activities generate significant amounts of hazardous waste such as mercury and expired pharmaceuticals, as well as large amounts of general waste1

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CLASSIFICATION

Categories of health-care waste3	
Waste category	**Description and examples**
Infectious waste	**Waste suspected to contain pathogens** e.g. laboratory cultures; waste from isolation wards; tissues (swabs), materials, or equipment that have been in contact with infected patients; excreta
Pathological waste	e.g. body parts; blood and other body fluids; fetuses
Sharps	**Sharp waste** e.g. needles; infusion sets; scalpels; knives; blades; broken glass
Pharmaceutical waste	**Waste containing pharmaceuticals** e.g. pharmaceuticals that are expired or no longer needed; items contaminated by or containing pharmaceuticals (bottles, boxes)
Genotoxic waste	**Waste containing substances with genotoxic properties** e.g. waste containing cytostatic drugs (often used in cancer therapy); genotoxic chemicals
Chemical waste	**Waste containing chemical substances** e.g. laboratory reagents; film developer; disinfectants that are expired or no longer needed; solvents
Wastes with high content of heavy metals	Batteries; broken thermometers; blood-pressure gauges; etc
Pressurized containers	Gas cylinders; gas cartridges; aerosol cans
Radioactive waste	Waste containing radioactive substances e.g. unused liquids from radiotherapy or laboratory research; contaminated glassware, packages, or absorbent paper; urine and excreta from patients treated or tested with unsealed radionuclides; sealed sources

MANAGEMENT:

The key to minimization and effective management of health-care waste is segregation (separation) and identification of the waste. Appropriate handling, treatment, and disposal of waste by type reduce costs and do much to protect public health. The most appropriate way of identifying the categories of health-care waste is by sorting the waste into colorcoded plastic bags or containers. It is recommended to use the biological hazard symbol on the packing to identify medical wastes.4 According to the Bio-medical waste management rules, 5 wastes can be categorized as:

Category 1: Human anatomical waste (human tissues, organs, body parts)
Category 2: Animal waste
Category 3: Microbiology and biotechnology waste
Category 4: Waste sharps
Category 5: Discarded medicines and cytotoxic drugs
Category 6: Solid wastes (Items contaminated with blood, and body fluids including cotton, dressings, solid plaster casts, linen, beddings, other materials contaminated with blood)
Category 7: Solid wastes (Wastes generated from disposable items other than the waste sharps, such as tubing, catheter, intravenous sets etc.)
Category 8: Liquid waste
Category 9: Incineration ash
Category 10: Chemical waste

Color Coding	Waste Category	Treatment Options
Yellow	Plastic bag Cat.1, Cat.2 and Cat.3, Cat. 6	Incineration/ Deep burial
Red	Disinfected container/ Plastic bag Cat.3, Cat.6 and Cat.7	Autoclaving/ Microwaving/ Chemical treatment
Blue/ White plastic	Bag/ puncture proof. Translucent Cat.4, Cat.7	Autoclaving/ Microwaving/ Chemical treatment and Destruction/ Shredding
Black	Plastic bag Cat.5, Cat.9 and Cat.10 (solid)	Disposal in secured landfill

STORAGE

Storage should be done in a place that is disinfected regularly and that is maintained at an appropriate temperature. Storage time should be as short as possible and the storage area should be clearly identified with a bio hazard symbol. 4 Within the hospital, bio-medical wastes should be transported by wheeled trolleys or carts that are not used for any other purpose. The trolleys have to be cleaned daily. For offset transportation, the vehicles should be easily cleanable with rounded corners. 6

SOLUTIONS

Various treatment options include incineration, autoclave, microwave, chemical disinfection and plasma pyrolysis depending on type of waste. (Table 1) Infectious waste is suspected to contain pathogens (bacteria, viruses, parasites, or fungi) in sufficient concentration to cause disease in susceptible hosts. Cultures and stocks of highly infectious agents, waste from autopsies, animal bodies, and other waste items that have been inoculated, infected, or in contact with such agents are called highly infectious waste. 3 Autoclaving is a preferred treatment method for microbiological laboratory cultures and to sterilize medical wastes prior to disposal in a landfill. Bags containing wastes are kept in a chamber and steam is introduced into it for 15-30 minutes. The temperature is usually maintained at 250°F.4 Chemical disinfection is used to treat liquid wastes like blood, urine, stool or hospital sewage.8 Disinfection can also be done with microwave irradiation. Microwave of a frequency of about 2450 MHz and a wave length of 12.24 nm is used to destroy most micro-organisms. The water present within the waste is rapidly heated by microwaves and the infectious agents are destroyed by heat conduction.8 Sharps can cause a prick / stab type of injury and these wastes should be carried in puncture-proof containers.4 Sharps should not be subjected to cutting, bending or any other manipulation that would generate aerosols or splatter contaminated fluids.5 They cause many injuries if not collected in safety boxes. The medical staffs, workers in support services and in waste disposal facilities are at potential risk of being infected or injured. The general public can also be infected either directly or indirectly. 1 it is important to manage and dispose off needles, lancets, and syringes (sharps) safely to prevent injuries After use, the contaminated syringe with needle is inserted in the destroyer which generates a high temperature above 1600 degrees centigrade, thereby completely burning the needle and reducing it to ashes. Incinerators, which are commonly used, cause significant reduction in volume of wastes, but is also expensive and causes potential pollution risks. They are used to treat wastes that cannot be recycled, reused or disposed off in a landfill. The three types of incinerators used are double-chamber pyrolytic incinerators, single chamber furnaces with static grate and rotary kilns operating at high temperatures.8

Incinerators are usually of a double-chamber design, with an operating temperature of 800°C in the first combustion chamber and gas combustion in the second chamber at temperatures of, typically, 1000– 1200°C. Small-scale incinerators used in hospitals, of capacity 200–1000kg/day, are operated on demand. They are manually loaded and de-ashed daily or every 2–3 days, and off-site regional facilities will have large-scale incinerators of capacity 1–8 tonnes/day, operating continuously and equipped with automatic loading and de-ashing devices. In any case, incinerators must be located at a minimum distance of 500 metres from any human settlement. 3 Plasma pyrolysis is a new widely used economical and environment-friendly method, which can be used instead of incineration. Pyrolysis is the thermal disintegration process of carbonaceous material in an oxygen starved environment. By means of plasma, electrical energy is converted into heat energy efficiently. Plasma pyrolysis retards the POP (Persistent Organic Pollutants) formation.5 The shredding indicates the process by which wastes are cut into smaller pieces. It prevents reuse of biomedical wastes and acts as an identifier that the waste has been disinfected. 6 Screw-feed technology is used in a non-burn, dry thermal disinfection process by which waste is shredded and heated in a rotating auger. This method can be used to treat infectious waste and sharps.8 Mercury is highly toxic and can cause fatal poisoning, when inhaled. It evaporates readily and can remain for about 1 year in the atmosphere.9 Mercury must be collected and stored separately under water, glycerine or x-ray fixer in tightly capped jar. 6 It should be taken back to the supplier or delivered to a registered recycling firm that is authorized to receive mercury waste.9 As radionuclides used in the hospital mostly have short half-life, they are stored on site until it is considered to be inactive9. X-ray fixer, developer and cleaner solutions are hazardous because of its high silver content. These must be sent to silver recovery syste

CONCLUSION

Effective health care waste management is essential for safeguarding public health, protecting the environment, and ensuring occupational safety within health care facilities. This review highlights the growing challenges associated with the increasing volume and complexity of health care waste, particularly in the wake of global health crises. Key strategies for improving waste management include strict regulatory compliance, staff training, segregation at the source, and the adoption of environmentally sustainable disposal technologies. A collaborative approach involving health care providers, policymakers, and the public is crucial to achieving a safer and more sustainable waste management system. Continued research, investment, and innovation will play vital roles in addressing emerging challenges and enhancing current practices.

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