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SAFE MANAGEMENT OF HEALTH CARE WASTE

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ABSTRACT

Bio Medical Wastes have become one of the most widespread and important environmental and public health issues and present day concern throughout the globe and as such, the problem has been recognized as one of the important issues towards abatement of pollution in the country along with the rest of the world. Hospital Waste Management is and important subject that needs urgent attention. It is appropriate to consider an incremental approach realizing that an improvement is of great value even if resources do not allow achievement of highest standards immediately. 'Bio-medical waste' means any solid and/or liquid waste including its container and any intermediate product, which is generated during the diagnosis, treatment or immunization of human beings or animals or in research pertaining thereto or in the production or testing thereof. Over the years there have been tremendous advancements in the health care system. However it is ironic that the health care settings, which restore and maintain community health, are also threatening their well-being. Poor waste management practices pose a huge risk to the health of the public, patients, professionals and contribute to environmental degradation.

KEYWORDS
Health care waste, Bio Medical Waste, Pollution, Safe Management.

INTRODUCTION

There are many examples and ample evidences that improper and unscientific disposal of hospital and bio-medical wastes can cause serious damage to health and environmental. Protection of health and environment is a challenging problem of this county. Environmental pollution is detrimental to human health as people and environment are interconnected (David. W. Pearce, 1993). Hospitals and dispensaries are rapidly increasing due to continuously degrading environment. However, hospitals, themselves generate large quantities of Bio-Medical Waste which is a complex mixture containing infectious, chemical, pharmaceutical and radioactive wastes that can pose health and safety hazards due to its infective and toxic characteristics. As a result there is a growing concern among public and civic bodies about storage, treatment, transportation and ultimate disposal of BMW (WHO, 1999) (A. Pruss, et al., 1999). All producers of waste are legally and financially responsible for the safe and environmentally sound disposal of the waste they produce as per the polluter pays principles. This principle also attempts to assign liability to the party that causes the damage. The costs of separate collection, appropriate packaging and onsite handling are internal to the establishment. The cost of off-site transport, treatment, and final, disposal is external and paid to the contractors who provide the service. The cost of contraction, operation and maintenance of system for managing health-care waste can represent significant part of the overall budget of a hospital or health-care establishment (A. Pruss et al., 1999). However several hospitals are generally small or medium sized and cannot afford to install expensive treatment plants due to various economic constraints.

Bio-Medical Wastes Management has been a neglected subject in India. Recently, the government of India (GOI) has promulgated the Bio-Medical Waste (Management and Handling) Rule in July 1998. As per the GOI Rules, Bio-Medical Wastes have been classified into 10 categories (Ministry of Environment Forests Notification 1998). Of utmost importance is medical waste to be managed in an environmentally sound manner. Environmentally sound management of the medical waste requires proper understanding of medical waste requires proper understanding of risks associated with the disposal of such wastes, and methods of proper segregation, storage, handling treatment and disposal. Collection, transportation and final disposal of large volumes of wastes require a high level of management and technical expertise. There is also a rising public awareness about the need for an environmentally acceptable management of solid wastes. The final disposal of solid wastes can be carried out by several methods incineration, composting, and land filling and recycling certain hazardous wastes such as hospital wastes which of course, should be positively incinerated (P.R. White, et al., 1995).

Bio Medical Wastes includes wastes generated from health care establishment (small and large; private and Government), research facilities and laboratories and also includes course of health care undertaken from residence (insulin injection and dialysis). 75% of waste generated from hospitals, clinics, research centers and laboratories are regarded non ha-zardous and only 25% of wastes are hazardous and toxic. Health Organization regional office for Europe at Bergen, Norway In 1983. The seriousness of the issue was brought to limelight during the "beach wash- ups" of summer 1988. Investigation carried out by the Environment Protection Agency (EPA) of USA in this regard culminated in the passing of Medical Waste Tracking Act (MWTA), Nov 1988.

COMPONENTS OF BIO-MEDICAL WASTE

1. Human anatomical waste (tissues, organs, body parts etc),
2. Animal waste (as above, generated during research/experimentation, from veterinary hospitals etc.),
3. Microbiology and biotechnology waste, such as, laboratory cultures, microorganisms,
4. Human and animal cell cultures, toxins etc,
5. Waste sharps, such as, hypodermic needles, syringes, scalpels, broken glass etc.,
6. Discarded medicines and cyto - toxic drugs
7. Soiled waste, such as dressing, bandages, plaster casts, material contaminated with blood etc.,
8. Solid waste (disposable items like tubes, atheters etc. excluding sharps),
9. Liquid waste generated from any of the infected areas,
10. Incineration ash,
11. Chemical waste.

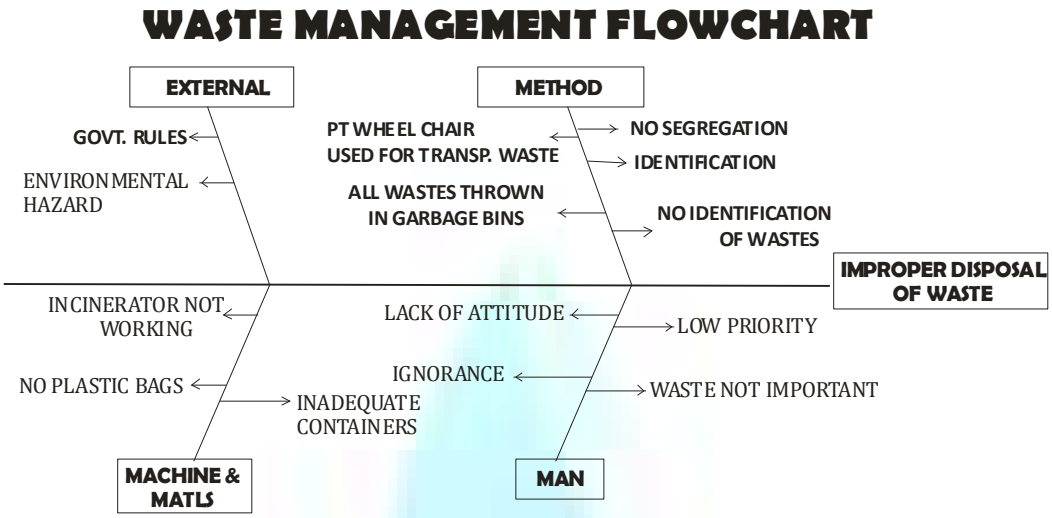
HEALTH HAZARDS ASSOCIATED WITH POOR MANAGEMENT OF BIO-MEDICAL WASTE

a) Injury from sharps to staff and waste handlers associated with the health care establishment.
b) Hospital Acquired Infection (HAI) (Nosocomial) of patients due to spread of infection.
c) Risk of infection outside the hospital for waste handlers/scavengers and eventually general public.
d) Occupational risk associated with hazardous chemicals, drugs etc.
e) Unauthorized repackaging and sale of disposable items and unused / date expired drugs.

HOW TO HANDLE MEDICAL WASTE

Medical waste can be pathogenic, infectious, or physically injurious. These wastes must be handled carefully to prevent personal injury and the spread of disease. Appropriate handling, packaging, marking, and disposal procedures are available to reduce the risk of injury or illness. A medical waste management

plan should be developed based upon the type and quantity of wastes generated. Using good personal hygiene, especially frequent hand washing and sanitizing, is one of the more effective ways of controlling hazards and reducing the risk of infection. Using gloves and other required protective equipment further ensures safety during medical waste handling.



1. Develop a medical waste management plan based upon an inventory of wastes generated. The inventory should include actual and potentially infectious and pathological materials. Disposable materials that have been contaminated with blood or other body fluids must be treated as medical waste. Broken glassware, needles, scalpel blades, and other contaminated sharps should be included in this inventory.
2. Educate and test personnel in the recognition and safe handling procedures for all medical wastes that may be generated. Train people handling medical wastes to use personal protective equipment; sharps containers, proper hand-washing techniques, and surface sanitizing procedures. Be sure medical waste generators and handlers know how to properly don, doff, maintain, and dispose of personal protective equipment.
3. Distribute puncture-proof sharps containers and medical waste "biohazard" bags to waste generating areas. Use red bags with a recognized biohazard warning symbol for collecting medical wastes. Store and ship medical wastes in more durable, leak-proof containers recommended by the transportation and disposal company you use.
4. Segregate infectious and pathological medical wastes from general and hazardous wastes. Store wastes awaiting disposal in a secure area with limited access. This area should contain leakage and be easily cleaned and sanitized.
5. Dispose of medical wastes through a permitted infectious and pathological waste disposal facility. Ensure that the facility uses incineration, steam sterilization, or another approved destruction method for treating medical wastes. Be sure to check with authorities to assure compliance with local waste handling and management requirements.
6. After handling medical wastes, clean and sanitized your hands with antiseptic soap and alcohol-based sanitizing solutions. Sanitize horizontal surfaces and areas that have been in contact with medical wastes frequently. A 10 per cent bleach solution is effective for sanitizing most surfaces.

STATEMENT OF THE PROBLEM

In recent years the mismanagement of hospital waste has become critical in urban areas. In addition to transmission of communicable diseases such as gastro-enteric infections, respiratory infections through air, water, direct human contact with the blood and infectious body fluids could be responsible for transmission of hepatitis B and C and AIDS in the metropolitan cities (P. Rush brook, 1999). The waste generated in these institutions essentially comprises solid and liquid waste estimated to be 80-85% of the waste generated in the hospitals and are not hazardous, while the rest is hazardous or likely to cause infections (Lakshmi Raghupathy, 1998). The waste generated in a hospital will be in the range of 1 to 4.5 kg per bed per day (R.Murali, 1999). The wastes generated from hospital and medical health institutions are a major source of environmental and public health problems thus requiring safe handling and secure disposal.

HOW TO DISPOSE OF HOSPITAL WASTE

Hospitals must dispose of and manage their waste properly. This is done to prevent the *spread* of diseases that *are* borne by hospital waste. According to the World Health Organization, hospital waste is categorized as: infectious, sharps, radioactive, pathological, pharmaceuticals and other waste, which includes contaminated bed linen and utensils. Depending on the type of hospital waste, various methods of disposal have to be adopted.

Waste Category	Treatment & Disposal
Human Anatomical Waste (human tissues, Organs, body parts)	Incineration/ Deep burial
Animal Waste (animal tissues, organs, body parts carcasses, bleeding parts, fluid, blood, and experimental animals ised in research, waste generated by veterinary hospitals colleges, discharge from hospitals, animal houses)	Incineration/ Deep burial
Microbiology & Biotechnology Waste (Wastes from laboratory cultures, stocks or specimens of micro organisms live or attenuated vaccines,human and animal cell culture used in research and infection agents from research and industrial laboratories, wastes from production of biological, toxins, dishes and devices used for transfer of cultures)	Local autoclaving/ microwaving/ Incineration @
Waste Sharps (needles, syringes, Scalpels, blades, glass, etc., that cause puncture and cuts. This includes both used and unused sharps.	Disinfection (chemical treatment/ Autoclaving/ Microwaving and Mutilation shredding
Discarded Medicines and Cytotoxic Drugs (Wastes comprising of outdated, contaminated and discarded medicines)	Incineration / Destruction and drugs disposal in secured landfills.
Soiled Waste (Items contaminated with blood, and body fluids including cotton, dressings, soiled plaster casts, lines, beddings other material)	Incineration/ Autoclaving/ Microwaving
Solid Waste (wastes generated from disposable items other than the waste sharps such as tubings, catheters, intravenous sets, etc.)	Disinfection by chemical treatment/ Autoclaving/ Microwaving and Multilation shredding
Liquid Waste (Wastes generated from laboratory and washing, cleaning, housekeeping and disinfecting activities)	Disinfection by chemical treatment and discharge into drains
Incineration Ash (ash from incineration of any biomedical waste)	Disposal in municipal landfill
Chemical Waste (Chemicals used in production of biological, chemicals used in disinfection, as insecticides, etc.,)	Chemical treatment and discharge into drains for liquids and secured landfill for solids.

1. Prepare a plan to dispose of hospital waste. This plan should take into consideration proper ventilation and premises for disposal. This plan should also find opportunities to minimize, recycle, and perhaps, even reuse waste material if possible. Conduct a waste survey at the hospital. Evaluate various options and estimate the cost of implementing various strategies.
2. Train employees regarding the different types of waste and the way to handle to each type. This should be done for new and old employees alike.
3. Segregate waste material based on the type of waste. The waste should be stored in separate storage containers for each type and should be clearly labeled. Hazardous material should be stored according to regulations. Waste should be stored in a central storage unit before being transported to the disposal plant.
4. Dispose of the waste using a steam autoclave. Shred biohazard as well as normal wastes after being treated by steam autoclaving. Animal pathological waste, chemotherapy wastes and radioactive wastes cannot be treated with a steam autoclave. Pathological wastes like body

HANDLING: PACKAGING, STORAGE & TRANSPORTATION

Handling medical wastes - including initial handling, storage, and transportation-involves issues of potential occupational risks and potential operational problems. Improper handling of medical wastes is closely linked to problems resulting from inadequately packaged and contained wastes as they move about the hospital and then are transported off-site for disposal. The integrity of packaging, particularly of such items as sharps, is critical to ensuring the containment of wastes during their collection, storage, and transportation.

MEDICAL WASTE TREATMENT METHODS

1. Medical waste generally refers to waste generated as a result of health-care activities, most often from hospitals and other types of medical facilities. It includes a wide range of materials, such as needles, chemicals, syringes, body parts, medical instruments and radioactive substances. Lack of medical waste disposal management can increase the risk of infections and diseases to the public and can pollute the environment. Numerous methods are available to treat medical waste and render it less hazardous and noninfectious.
2. Steam Sterilization, also known as autoclave, is a commonly used method of decontaminating hazardous clinical waste. Steam sterilization is an economical method in which medical waste is kept in a specialized sealed chamber and exposed to steam at a specified temperature and pressure for a specified amount of time. Steam sterilization is an excellent alternative to incineration (in which waste deposits are burned under controlled conditions) and also helps to diminish the cost of disposing untreated medical waste.
3. Gas sterilization is not as common as steam sterilization for treating medical waste. In this method, medical waste is put in an evacuated air-tight chamber and treated with a sterilizing agent (such as ethylene oxide or formaldehyde). The gas that comes into contact with the waste penetrates and kills any harmful infectious agents.
4. Grinding of medical waste before exposing it to a liquid chemical disinfectant (such as chlorine bleach) is another medical waste treatment. Grinding ensures sufficient exposure of the chemical agent to all parts of the waste and helps in easy disposal of any residues. The resulting liquids are dropped into the sewer system; solid residues are disposed in landfills,
5. Thermal inactivation is used for treating large volumes of liquid clinical waste. It involves heating waste to temperatures at which infectious agents are killed. The chamber is preheated to a specific temperature at which the waste is held for a specified time, and then released.
6. Irradiation involves sterilizing waste by exposing it to a cobalt source. Cobalt gives out gamma radiations that destroy all microbes in waste.
7. Microwave treatment also can disinfect waste. Waste is shredded, then mixed with water and internally heated to neutralize all biologicals.

Packaging: Polyethylene bags are frequently used for containing bulk wastes (e.g., contaminated disposable and residual liquids); they may have to be doubled bagged with polypropylene bags that are heat resistant if steam sterilization (see below) is used. These bags, however, must be opened or of such a nature as to allow steam to penetrate the waste. Color coded bags are frequently used to aid in the segregation and identification of infectious wastes. Most often red or red-orange bags are used for infectious wastes (hence the term "red bag' waste). An ASTM Standard (#D 1709-75) for tensile strength based on a dart drop test and the mil gauge thickness of the plastic determine its resistance to tearing. Use of the biological hazard symbol on appropriate packaging is recommended by the EPA to assist in identifying medical wastes. In addition, EPA recommends that all of these packages close securely and maintain their integrity in storage and transportation. In general, compaction or grinding of infectious wastes is not recommended by EPA before treatment. Even though it can reduce the volume of waste needing storage, compaction is not encouraged due to the possibility of packages being violated and the potential for aerosolization of microorganisms. Commercially available grinding systems that first involve sterilization before shredding or compaction may alleviate this latter concern .Sharps are of concern, not only because of their infectious potential, but also because of the direct prick/stab type of injury they can cause. For sharps, puncture-proof containers are currently the preferred handling package. In the past, needles were re-capped, chopped, or disposed of by other practices that are no longer common due to their potential for worker injury and, in the case of chopping, for aerosolization of microorganisms during the chopping procedure new technologies for containing needles and facilitating their safe handling continue to emerge.

Storage: Storage of the waste needs to be in areas which are disinfected regularly and which are maintained at appropriate temperatures (particularly if wastes are being stored prior to treatment) EPA recommends that storage time be minimized, storage areas be clearly identified with the biohazard symbol, packaging be sufficient to ensure exclusion of rodents and vermin, and access to the storage area be limited. The importance of the duration and temperature of storing infectious wastes is noted, due to their association with increases in rates of microbial growth and putrefaction. The recommendation by EPA for storage of infectious waste is limited, however, to suggesting that "storage times be kept as short as possible'. EPA does not suggest optimum storage time and temperature because it finds there is "no unanimity of opinion' on these matters. As the EPA Guide notes, there is State variation in specified storage times and temperatures. State requirements often stipulate storage times of 7 days or less for infectious wastes that are unrefrigerated. Sometimes longer periods are allowed for refrigerated wastes.

Transportation: EPA recommendations with respect to the transportation of infectious wastes briefly address the movement of wastes while on-site and in an even more limited way address the movement of wastes off-site. The recommendations are largely limited to prudent practices for movement of the wastes within a facility, such as placement of the wastes in rigid or semi-rigid and leak-proof containers, and avoidance of mechanical loading devices which might rupture packaged wastes. Broader issues, such as record keeping and tracking systems for infectious or medical wastes once they are taken off-site, and the handling and storage of wastes at transfer stations, have not yet been addressed. EPA does recommend that hazard symbols Yet, State and Federal agencies have promulgated conflicting or incompatible guidelines with respect to the use of the biohazard symbol and other transportation specifications. States often follow the EPA guidance on the use of the biohazard symbol, but application of 11 regulations and policies of the Department of Transportation (DOT) and Department of Energy (DOE) may suggest more limited use of the symbol, creating confusion for commercial handlers of medical wastes. DOT has issued regulations for the transportation of etiologic agents. These regulations may apply to most medical wastes contained in packages bearing the biohazard symbol, as a result of the DOT's definition of "etiologic agent" in the Code of Federal Regulations. This is a result of the fact that the precise content of most medical waste boxes with a biohazard symbol is not known, but is likely to contain a defined etiologic agent. Further, the DOT regulations specify that packages of this sort be a maximum of one liter in size. Further, the various classifications of medical, and specifically infectious, wastes by different States complicate the interstate shipment of wastes. Depending on the State, a waste may be designated either as a hazardous, solid, or special waste or simply as freight for the purposes of interstate commerce. Some States have manifest systems, others do not. These factors complicate, but do not prevent, the shipment of wastes within (and outside of) the country. If more medical wastes are shipped between States, which is the apparent trend, the likelihood of accidents will increase. The desirability of more consistent and complete guide lines or regulations regarding the off-site transportation of infectious wastes should be considered in this context.

SUGGESTIONS & CONCLUSIONS

The following suggestions are given in order to improve the performance of the facilities:

1. Practice of basic hygiene and cleanliness in all the medical institutions and hospitals is a fundamental mandatory necessity.
2. It is important to segregate the waste. Segregation must ensure that plastics and metals do not enter incinerator. Non incinerable waste (60% of total waste) can be suitably steam sterilized
3. Collection should be made in separate color coded bags and identified containers. Sharps should be collected separately.
4. Main storage units must be provided near the entrance. These store rooms can be located nearby the entrance which will facilitate the storage of the waste while entering into the premises. The container should be washed and it is directed out of the facility without entering into the treatment unit.
5. Improve the destruction efficiency of incinerator with respect to temperature and residence time.
6. Incinerator should be provided for automatic feeding devices for inlets as provided by CPCB guidelines without inducing back pressure and minimizes the air ingression to avoid the spillage of wastes and also preventing from labor injuries and also preventing sudden temperature fall.
7. Excessive air flow system should be modified to starved air flow system because of 50% of emission controls for without cleaning devices.
8. The temperature at the fully mixed height in the final combustion zone of the incinerator shall be measured and recorded continuously. Temperature sensors shall be located such that flames from the auxiliary burners do not impinge on the sensors.
9. Sharp pit are filled with shredded plastics and sharps. It is recommended plastic shredded material should be segregated and only the sharps should be filled in the sharp pit at both the facilities.
10. A glass recycling unit should be installed in the plant which will reduce the land degradation greatly.
11. The persons handling the waste should use protective gears like apron, thick rubber gloves long boot and face mask. They should be immunized against communicable diseases.
12. The workers should be checked for respiratory disorders at least once in six months, Wearing of personal protective equipments should be encouraged in awareness programme.
13. The prevailing mosaic flooring is to be replaced with white glazed tiles which will enable to identify the spillage easily.
14. For both facilities Logbook data should be entered properly, clearly with actual works carried out. When there is breakdown in treatment units it should be properly recorded.
15. PLC system (Program Logic Control) has to be provided and it should be interlinked with all the unit operations.
16. Operation Management System - A data logger with controller based on solid state microprocessor shall be provided for both incinerator and autoclave at both the facilities.
17. Burners should be maintained in operating condition and conformity about the burners to be noted in the records (log book).
18. Secured landfill coverage should be improved.
19. Each hospital has to make a waste audit and identify the type and quantity of waste that is being generated. It is advisable to over classify the waste rather than under classify. Segregation can reduce the risk waste generation to a great extent.
20. Simple low cost equipment can be used to disfigure the sharps before disposal.

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