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AREVIEW

Bio-medical waste management : an insight approach

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INTRODUCTION

Veterinary hospitals are providing health services to the livestock in rural and urban community. All over the country, unsegregated and untreated biomedical waste is being indiscriminately discarded into municipal bins, dumps sites, on roadsides, in water bodies or is being incomplete and improperly burnt in the open. During these activities the waste produced, if not properly disposed off, can result in epidemics in vast area (Jain and Aggarwal, 1998). In India, systematic approaches for the disposal of veterinary waste are few. Hospital wastes are simply thrown out on the ground or mixed with the ordinary waste or buried without any appropriate measure. Veterinary hospital wastes are categorized according to their weight, density and constituents. The veterinary waste has been classified into different categories like anatomical, infectious, sharps, pathological, chemical, radioactive and domestic (Nowlan, 1997). This type of waste has a bad effect on the environment by contaminating the land, air and water resources.

The historic neglected status of veterinary waste and has identified areas of veterinary waste management that require attention. Studies indicated that veterinarians are unaware of their legal responsibilities. Poor waste management in the veterinary practices, followed by incorrect transport and disposal measures, as well as failure to inform and equip staff sufficiently, are just some aspects of non-compliance by veterinarians. Veterinary waste was just emerging from its "neglected" status, with little or no legislation and guidelines specifically governing its handling and disposal. Recently, veterinary practices, clinics and hospitals have included as health care facilities with minimum requirements and with hazardous veterinary waste assigned the same status as human health care waste (HCW) and there can be no excuse for non-compliance (Mustafa and Anjum, 2009).

The problem of 'bio-medical waste' (BMW) disposal in the hospitals and other healthcare establishments has become an issue of increasing concern, prompting hospital administration to seek new ways of scientific, safe and cost effective management of the waste, and keeping their personnel informed about the advances in this area. The need of proper hospital waste management system is of prime importance and is an essential component of quality assurance in hospitals (Mathur *et al.*, 2012). A well designed waste policy, a legislative framework, and plans for achieving local implementation are essential (Pruss *et al*., 1999).

History and law :

An old saying says "Cleanliness is next to Godliness".

The essence of this was aptly captured by Dravidians, who in 5000 BC gave due emphasis to immaculate town planning, safe and effective sewerage systems to get rid of all solid and liquid wastes generated by the pollution. They were indeed the pioneers as far as scientific waste management is concerned; which is borne out from excavation of Mohanjo-Doro and Harapa (Sharma, 2001).

It is reported that for the first time the bio-medical waste management issue was discussed at a meeting convened by the world health organization regional office for Europe at Bergen, Norway in 1983. Investigation carried out by the Environment Protection Agency (EPA) of USA in this regard culminated in the passing of Medical Waste Tracking Act (MWTA), November, 1988 (Joseph and Krishnan, 2004). MWTA is a federal program that mandates tracking certain regulated waste. The issue of improper Hospital Waste Management in India was first highlighted in a writ petition in the Hon'ble Supreme Court; and subsequently, pursuant to the directives of the court, the Ministry of Environment and Forests, Govt. of India notified the Bio-Medical Waste (Management and Handlings) Rules on 27th July 1998; under the provisions of Environment Act 1986. The exercising powers are conferred under Sections 6, 8, 25 of 'Environmental (Protection) Act, 1986'. These rules have been framed to regulate the disposal of various categories of Bio-Medical Waste as envisaged therein; so as to ensure the safety of the staff, patients, public and the environment (Acharya and Singh, 2000).

What is Bio-medical waste :

According to the Gazette notification, Govt. of India, Ministry of Environment and Forests (1998). It may be defined as "any solid, fluid or liquid waste, including its container and any intermediate product, which is generated during its diagnosis, treatment or immunization of human beings or animals, in research pertaining thereto, or in the production or testing of biologicals and the animal waste from slaughter houses or any other like establishments".

Some Bio-medical waste related terms/definitions :

It is important to know some of the definitions of bio-medical waste terms so as to be able to understand the categorization and other steps of waste management subsequently (Sharma, 2001).

General waste :

Includes general domestic type waste from offices, public areas, stores, catering areas, comprising of newspapers, letters, documents, cardboard containers, metal cans and floor sweepings and also includes kitchen waste.

Bio-medical waste :

May be defined as any solid, fluid or liquid waste, including its container and any intermediate product, which is generated during its diagnosis, treatment or immunization of human beings or animals, in research pertaining thereto, or in the production or testing of biologicals and the animal waste from slaughter houses or any other like establishments (Gazette notification, 1998).

Clinical waste :

It is defined as any waste coming out of medical care provided in hospitals or other medical care establishments, but does not include waste generated at home.

Pathological waste :

It is defined as waste removed during surgery/autopsy or other medical procedures including human/animal tissues, organ, body parts, body fluids and specimens along with their containers.

Hazardous waste :

Refers to that portion of bio-medical waste which has a potential to cause hazards to health and life of human beings.

Recyclable waste :

Includes the following: Glass after cleaning and disinfection, paper, corrugated cardboard, aluminium, X-ray film, reclaimed silver from X-ray developing solution, plastics after disinfection and shredding.

Types of Bio-medical waste :

Wastes in a health care facility cover a diverse range of materials that can be divided into following categories (Sahoo *et al*., 2013).

Radioactive waste :

Which includes waste contaminated with radionuclides; it may be solid, liquid or gaseous waste. These are generated from *in-vitro* analysis of body fluids and tissues, *in-vitro* imaging and other therapeutic procedures.

Pressurized waste :

Include compressed gas cylinders, aerosol cans and disposable compressed gas containers.

Infectious waste :

It refers to that portion of bio-medical waste which may transmit viral, bacterial or parasitic diseases, if concentration and virulence of pathogenic organisms is sufficiently high, e.g. include: Blood and blood products, used catheters and gloves, cultures and stocks of infectious agents, waste from dialysis and dentistry units, from isolation units, wound dressings, nappies, discarded diagnostic samples, infected animals from laboratories, and contaminated materials (swabs, bandages and gauze) and equipment (disposable medical

devices, e.g., IV fluid lines and disposable spatulas).

Anatomic wastes :

Anatomic wastes consist of body parts and tissues (e.g., placenta), waste from clinical labs and animal carcasses.

Sharps waste :

Sharps waste consists of used syringes, needles, scalpels and blades, etc.

Chemical waste :

Waste containing chemical substances e.g., laboratory chemicals, empty bottles of lab or pharmacy chemicals, disinfectants that have expired or are no longer needed, solvents, diagnostic kits, poisonous and corrosive materials, and cleaning agents and others.

Pharmaceutical waste :

Waste containing pharmaceutical substances, including: expired, unused and contaminated pharmaceuticals e.g., expired drugs, vaccines and seras.

Genotoxic waste :

Genotoxic waste consists of highly hazardous, mutagenic, teratogenic, or carcinogenic waste containing substances with genotoxic properties, e.g. include: cytotoxic, neoplastic drugs used in cancer treatment, their metabolites and genotoxic chemical.

Table 1 : Schedule–I: Categorization of Bio-medical waste

Category	Waste included
Human anatomical waste	Human tissues, organs, body Wastes parts.
Animal wastes	Animal tissues, organs, body parts carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals, discharge from hospitals and animals houses.
Microbiology and biotechnology waste	Waste from laboratory cultures, stocks or specimens of micro-organisms live or attenuated vaccines, human and animal cell culture used in research and infectious agents from research and industrial laboratories, waste from production of biological, toxins, dishes and devices used for transfer of cultures.
Waste sharps	Needles, syringes, scalpels, blades, glass, etc. that may cause puncture and cuts. This includes both used and unused sharps.
Discarded medicines	Waste comprising of outdated contaminated and discarded medicines.
Soiled waste	Items contaminated with blood, and body fluids including cotton, dressings, solid linen, plaster casts, linen, beddings, other material contaminated with blood.
Solid waste	Wastes generated from disposable items other than the waste sharps such as tubing, catheters, intravenous sets etc.
Liquid waste	Waste generated from laboratory and washing, cleaning, housekeeping and disinfecting activities
Incineration ash	Ash from incineration of any bio-medical waste.
Chemical waste	chemicals used in production of biological, chemicals used in disinfection, as insecticides, etc.

Schedules for bio-medical waste :

According to the Bio-Medical Waste (Management and Handlings) Rules (1998), bio-medical wastes are kept in six Schedules including their categorization (Table 1) and treatment methods in schedule I (Table 2) colour coding and types of containers in schedule II (Table 3), labels for containers in schedule III, labels for transport in schedule IV, standards of treatment methods in schedule V and schedule for waste treatment facilities in schedule VI.

Different schedules are given in Table 1 and 2.

Table 2 : Schedule–I: Treatment/disposal of Bio-medical waste

Category	Treatment/disposal
Human anatomical waste	Incineration/deep burial
Animal waste	Incineration/deep burial
Microbiology and biotechnology waste	Local autoclaving/microwave/incineration
Waste sharps	Chemical treatment/autoclaving/microwave and mutilation /shredding
Discarded medicine and cytotoxic drugs	Incineration/destruction/secured landfills
Soiled waste	Incineration/autoclaving/microwave
Solid waste	Chemical treatment/autoclaving/microwave and mutilation/shredding
Liquid waste	Chemical treatment
Incineration ash	Sanitary landfill
Chemical waste	Chemical treatment and secured landfill (for solids)

Important points to be noted :

– Chemical treatment using at least 1% hypochlorite solution or any other equivalent chemical reagent. It must be ensured that chemical treatment ensures disinfection.

- Mutilation/Shredding must be such so as to prevent unauthorized reuse.
- There will be no chemical pretreatment before incineration. Chlorinated plastics shall not be incinerated.
- Deep burial shall be an option available only in towns with population less than five lakhs and in rural areas.

Table 3 : Schedule–II: Colour coding and type of container

Colour Coding	Type of Container	BMW Category	Treatment option
Yellow	Plastic Bag	1, 2, 3, 6	Incineration/Deep Burial
Red	Disinfected Container/ Plastic Bag	3, 6, 7	Autoclave/Microwave/Chemical Treatment
Blue/White Tranlucent	Plastic Bag	4, 7	Autoclave/Microwave/Chemical Treatment and Destruction/Shredding
Black	Plastic Bag	5, 9, 10 (solid)	Secured landfill

Important points to be noted :

- Colour coding of waste categories with multiple treatment options as defined in Schedule I, shall be selected depending on treatment option chosen, which shall be as specified in Schedule I.
- Waste collection bags for waste types needing incineration shall not be made of chlorinated plastics.
- Categories 8 and 10 (liquid) do not require containers/bags.
- Category 3 if disinfected locally need not be put in containers/bags.

Schedule-III :

It includes labels for BMW containers/bags. Labels shall be non-washable and prominently visible.

Schedule-IV :

It includes labels for transport of BMW containers/bags.

Fig. 1 : Label for BMW containers/bags

Schedule - V :

It includes standards for treatment and disposal of BMW.

Schedule - VI :

It includes schedule for waste treatment facilities like incinerator/ autoclave/ microwave system.

Rationale of hospital waste management :

Hospital waste management is a part of hospital hygiene and maintenance activities. In fact only 15% of hospital waste *i.e.* 'bio-medical waste' is hazardous, rest is safe. But when hazardous waste is not segregated at the source of generation and mixed with nonhazardous waste, then 100% waste becomes hazardous. The bio-medical wastes generated from health care units depend upon a number of factors such as waste management methods, type of health care units, occupancy of healthcare units, specialization of healthcare units, ratio of reusable items in use, availability of infrastructure and resources etc. (Mandal and Dutta, 2009). The question then arises that what is the need or rationale for spending so many resources in terms of money, man power, material and machine for management of hospital waste. According to Mathur *et al.* (2012) the reasons are:

Statutory/legal obligation :

In accordance with the provisions of the Bio-Medical Waste (Management and Handling) Rules 1998, the rules must be conformed with; failing which legal action can be initiated. "Disposable" being repacked and sold by unscrupulous elements without even being washed. Drugs which have been disposed of, being repacked and sold off to unsuspecting buyers.

Health hazards :

They are associated with improper hospital waste management: a number of hazards and risks are associated with this. They are given as under:

- Injuries from sharps to all categories of hospital personnel and waste handlers.
- Nosocomial infections in patients from poor infection control and poor waste management.
- Risks of infections outside hospitals for waste handlers, scavengers, and (eventually) the general public.
- Risks associated with hazardous chemicals, drugs, being handled by persons handling wastes at all levels.

Environmental hazards :

Improper hospital waste management also results in air, water and soil pollution, especially due to imperfect treatment and faulty disposal methods like defective incineration

emissions and ash.

General prinicipals of waste management :

A clear policy for waste management should be prepared and made available for proper implementation of waste management system. The policy should describe in detail the methods of waste segregation, collection, storage, and disposal, according to the resources available. Roles and responsibilities of different team members should be clarified. One key person should be assigned the responsibility of waste management. All used sharps must be discarded without resheathing in a puncture-resistant container that is readily accessible. All clinical waste e.g., waste contaminated with blood and/or bloody fluids should be discarded into a colored bag (e.g. red or yellow). Segregation of waste should take place at its site of origin. Following points should be considered (Sahoo *et al*., 2013).

Points to remember for waste management in the hospital :

- Segregation of waste at point of generation in to:
  - Infectious
  - Non-infectious/garbage
  - Sharps/needles.
- Collection of waste in specified color coded containers/bags.
- Decontamination of all sharps and plastic waste by chemical/autoclave.
- Shredding of plastic waste (cul all tubings into pieces by scissors).
- Use of syringe and needle destroyer.
- Incineration of blood soaked dressings/body parts etc.
- Covering of waste collection containers.
- Transportation through covered trolleys/wheel barrows.
- Provision of protective wearing (mask, gloves, plastic aprons, gum boots to transporters and handlers.
- Immunization of all waste handlers.

Dont's for handling and disposal of hospital waste :

- Infectious waste should not be mix with non-infectious waste.
- Sharps should not throw in the trash or into non-puncture proof containers.
- Needle or bend or break needles should not be by recapped hand.
- Waste container should not be filled more than 3/4th of capacity.
- Unauthorized persons should not be allowed in access to waste collection/storage areas.
- Open buckets should not be used for infectious waste or sharps.
- Plastic waste should not be incinerated.

Chemical treatment of bio-medical waste :

- It should be done for all sharp or infected plastic waste.
- 1% hypochlorite or equivalent disinfectant should be used. Proper concentration is essential.
- All surfaces should come in contact with chemical (including lumen).
- Contact time should be at least 30 minutes.
- Chemical solutions should frequently be changed (with every shift).
- Protective clothing must be used while handling.
- Incinerable waste should not be chemically treated

Average composition of hospital waste products in india :

According to Jain (2012), the average composition of hospital waste products in India is as under :

Paper	:	15%
Plastic	:	10%
Rags	:	15%
Metals (sharps, etc.)	:	1.5%
Infectious waste	:	1.5%
Glass	:	4.0%
General waste	:	53.5%

Approach fopr hospital waste management :

It is based on Bio-Medical Waste (Management and Handling) Rules 1998, notified under the Environment Protection Act by the Ministry of Environment and Forest, Government of India.

Segregation of waste :

Segregation is the essence of waste management and should be done at the source of generation of bio-medical waste e.g. all patient care activity areas, diagnostic services areas, operation theaters, labour rooms, treatment rooms etc. The responsibility of segregation should be with the generator of biomedical waste *i.e.* doctors, nurses, technicians etc. (medical and paramedical personnel). The bio-medical waste should be segregated as per categories mentioned in the rules (Joseph and Krishnan, 2004).

Collection of bio-medical waste :

Collection of bio-medical waste should be done as per Bio-medical waste (Management and Handling) Rules. At ordinary room temperature the collected waste should not be stored for more than 24 hours.

Transportation :

Within hospital, waste routes must be designated to avoid the passage of waste through patient care areas. Separate time should be earmarked for transportation of bio-medical waste to reduce chances of its mixing with general waste. Desiccated wheeled containers, trolleys or carts should be used to

transport the waste/plastic bags to the site of storage/ treatment.

Trolleys or carts should be thoroughly cleaned and disinfected in the event of any spillage. The wheeled containers should be so designed that the waste can be easily loaded, remains secured during transportation, do not have any sharp edges and is easy to clean and disinfect. Hazardous bio-medical waste needing transport to a long distance should be kept in containers and should have proper labels. The transport is done through desiccated vehicles specially constructed for the purpose having fully enclosed body, lined internally with stainless steel or aluminium to provide smooth and impervious surface which can be cleaned. The driver's compartment should be separated from the load compartment with a bulkhead. The load compartment should be provided with roof vents for ventilation.

Treatment of hospital waste :

Treatment of waste is required:

- To disinfect the waste so that it is no longer the source of infection.
- To reduce the volume of the waste.
- Make waste unrecognizable for aesthetic reasons.
- Make recycled items unusable.

World Health Organization states that 85% of hospital wastes are actually non-hazardous (general waste), rest 15% comes under bio-medical waste in which 10% are infectious and 5% are non-infectious but they are included in hazardous wastes. The total range of infectious waste is depending on the total amount of waste generated in the hospital (Glenn and Garwal, 1999).

The safe disposal of general waste is the responsibility of the local authority.

Methods used for bio-medical waste management :

Following methods are of suggestive for the proper disposal of different types of category biomedical waste (Park, 2009).

Mechanical processes :

Inertization :

The process of 'Inertization' involves mixing bio-medical waste with cement and other substances before disposal, so as to minimize risk of toxic substances contained in waste to contaminate ground/surface water. Inertization is especially suitable for pharmaceuticals and for incineration ashes with high metal content. This method is relatively inexpensive but it is not applicable to infectious waste.

A typical composition of mixture for Inertization is given as under:

Pharmaceutical waste	-	65%
Lime	-	15%
Cement	-	15%
Water	-	5%

Compacting :

It is the process of reducing size and volume of waste (useful for general non-hazardous wastes).

Shredding :

It is the process of breaking the material into smaller pieces by grinding/cutting/granulation (useful for plastic, rubber and soft metals). The plastic I/V bottles, I/V sets, syringes, catheters etc.), sharps (needles, blades, glass etc.) should be shredded but only after chemical treatment/ microwaving/autoclaving. Needle destroyers can be used for disposal of needles directly without chemical treatment.

Landfill :

It is the oldest method of disposal, two types- Open dump or Sanitary landfill. The incinerator ash, discarded medicines, cytotoxic substances and solid chemical waste should be treated by this option.

Encapsulation :

It is the process of filling containers with waste, adding an immobilization material (plastic foam/bituminous sand/ cement mortar/clay material) and sealing containers.

Deep burial :

The waste under category 1 and 2 only can be accorded deep burial and only in cities having less than 5 lakh population.

Thermal processes :

Heat disinfection :

It is done by boiling for 20 minutes (useful for pre-treatment of sharps and plastic waste).

Hot air oven :

It causes sterilization and mutilation at 160°C (used for glassware, powders and oils impermeable to steam).

Autoclave and microwave :

Standards for the autoclaving and microwaving are also mentioned in the Bio-Medical Waste (Management and Handling) Rules, 1998. All equipment installed/shared should meet these specifications. The waste under category 3, 4, 6, 7 can be treated by these techniques. The treated residue can be land filled (Thornton *et al.*, 1996). Autoclaving is done by steam-sterilization under pressure; is a low-heat thermal process; waste is subjected to 121°C or 135°C. In microwave method volumetric heating is done for microbial hazardous waste using frequency of 2450 MHz and wavelength 12.24 nm; waste destruction occurs by 'heat conduction'.

Hydroclave :

In this method steam-sterilization under pressure causes fragmentation of waste. Waste is subjected to 121^0C or 132^0C.

Incineration :

It is high temperature dry oxidation process which reduces waste volume and weight; waste is subjected to 850 ± 50^0C and 1050 ± 50^0C. All the types can have primary and secondary combustion chambers to ensure optimal combustion (Gravers, 1998).

The incinerator should be installed and made operational as per specification under the BMW rules 1998 and a certificate may be taken from Central Pollution Control Board/ State Pollution Control Board and emission levels etc. should be defined. In case of small hospitals, facilities can be shared. The waste under category 1, 2, 3, 5, 6 can be incinerated depending upon the local policies of the hospital and feasibility. The polythene bags made of chlorinated plastics and red bags should not be incinerated as they contain cadmium (heavy metal). Incineration does not require pre-treatment. In the incinerator, there are issues with:

- Burning of plastics that release dioxin and other harmful chemicals into the environment. Bio-medical waste when incinerated is the third largest contributor of dioxin.
- Release of heavy metals, including mercury, into the environment.
- Energy used to burn the trash- some operations have heat recovery processes.

Plasma arc :

In this process ionized gas (electrical discharges) at high temperature causes gasification and molecular dissociation of organic wastes. Waste is subjected to 2000^0C (Katoch, 2007).

Gamma irradiation :

This method is useful for re-usable medical equipments and clothing.

Chemical processes :

Disinfectants :

A disinfectant is a chemical agent, which destroys or inhibits growth of pathogenic micro-organisms in non-sporing or vegetative state. Disinfectants are applied to inanimate objects and materials such as instruments and surfaces to control and prevent infection.

Antiseptics :

An antiseptic is a type of disinfectant, which destroy or inhibits growth of micro-organisms on living tissues without causing injurious effects when applied to surfaces of the body or to exposed tissues.

Biological processes :

Composting :

Land and cow dung (gobar) are used in this method.

Vermi-composting :

Earth worms (Eisenia foetida), land, matured cow dung (khad) and coconut husk are used (not useful for non-biodegradable wastes).

Bio-digestion :

Biodegradable kitchen waste or leftover food of a hospital is used, which leads to production of manure and methane. It is useful for rural health care institutions.

It may be noted that there are options available for disposal of certain category of waste. The individual hospital can choose the best option depending upon the facilities available and its financial resources. However, it may be noted that depending upon the option chosen, correct colour of the bag needs to be use.

Safety measures :

Following safety measures should be considered during handling and disposal of biomedical waste (Suess and Huisman, 1983).

All the generators of bio-medical waste should adopt universal precautions and appropriate safety measures during therapeutic and diagnostic activities and also while handling the bio-medical waste.

It should be ensured that drivers, collectors and other handlers are aware of the nature and risk of the waste.

- The written instructions, provided regarding the procedures to be adopted in the event of spillage/ accidents.
- The protective wears should be provided and instructions regarding their use should be given.
- The workers should be protected by vaccination against tetanus and hepatitis B.

Personnel safety devices :

The use of protective wears should be made mandatory for all the personnel handling waste.

Gloves :

Heavy-duty rubber gloves should be used for waste handling by the waste retrievers. This should be bright yellow in colour. After handling the waste, the gloves should be washed twice. The gloves should be washed after every use with carbolic soap and a disinfectant. The size should fit the operator.

Aprons, gowns, suits or other apparels :

Apparel is worn to prevent contamination of clothing and protect skin. It could be made of cloth or impermeable

material such as plastic. People working in incinerator chambers should have gowns or suits made of non-inflammable material.

Masks :

Various types of masks, goggles, and face shields are worn alone or in combination, to provide a protective barrier. It is mandatory for personnel working in the incinerator chamber to wear a mask covering both nose and mouth, preferably a gas mask with filters.

Boots :

Leg coverings, boots or shoe-covers provide greater protection to the skin when splashes or large quantities of infected waste have to be handled. The boots should be rubber-soled and anti-skid type. They should cover the leg up to the ankle.

Training :

Training programme should be conducted to understand the need and importance of the proper bio-medical waste management. According to Chandra (1999), following points should be taken into consideration:

– Each and every hospital must have well planned awareness and training programme for all categories of personnel including administrators (medical, paramedical and administrative).

- All the medical professionals must be made aware of Bio-Medical Waste (Management and Handling) Rules, 1998.
- It should be done to institute awards for safe hospital waste management and universal precaution practices.
- Training should be conducted to all categories of staff in appropriate language/medium in an acceptable manner.

Management and administration :

Heads of each hospital will have to take authorization for generation of waste from appropriate authorities as notified by the concerned State/U.T. Government, well in time and to get it renewed as per time schedule laid down in the rules. Each hospital should constitute a hospital waste management committee, chaired by the head of the institute and having wide representation from all major departments. This committee should be responsible for making hospital specific action plan for hospital waste management and its supervision, monitoring and implementation. The annual reports, accident reports, as required under BMW rules should be submitted to the concerned authorities as per BMW rules format (Basu, 1995).

The Bio-Medical Waste Management policy at an institution has to be framed to meet the following broad objectives (Sharma, 2001):

- Changing an age old "mind set" and attitude through knowledge and training.
- Defining the various categories of waste being generated in the hospital/health care institution.
- Segregation and collection of various categories of waste in different containers, so that each category is treated in a suitable manner to render it harmless.
- Identifying and utilizing proper "treatment technology" depending upon the category of waste.
- Creating a system where all categories of personnel are not only responsible, but also accountable for proper waste management.
- Changing the use patterns from single usage to multiple usages whenever possible.

Measures for waste minimization :

As far as possible, purchase of reusable items made of glass and metal should be encouraged. Select non PVC plastic items. Adopt procedures and policies for proper management of waste generated, the mainstay of which is segregation to reduce the quantity of waste to be treated. Establish effective and sound recycling policy for plastic recycling and get in touch with authorised manufactures (Sharma and Mathur, 1998).

Co-ordination between hospital and outside agencies :

- Co-ordination between hospital and outside agencies is the essential element and it should be done as per the following points (Chandra, 1999):
- Municipal authority: As quite a large percentage of waste (in India up to 85%), generated in Indian hospitals, belong to general category (non-toxic and non-hazardous), hospital should have constant interaction with municipal authorities so that this category of waste is regularly taken out of the hospital premises for land fill or other treatment.
- Co-ordination with pollution control boards: Search for better methods technology, provision of facilities for testing, approval of certain models for hospital use in conformity with standards aid down.
- To search for cost effective and environmental friendly technology for treatment of bio-medical and hazardous waste. Also, to search for suitable materials to be used as containers for bio-medical waste requiring incineration/autoclaving/ microwaving.
- Development of non-PVC plastics as a substitute for plastic which is used in the manufacture of disposable items.

Conclusion :

Several types of waste generated in the typical clinical

veterinary-medical practice *i.e.* discarded needles, syringes, other sharps, vaccines and vials that contained certain live or attenuated vaccines, cultures, stocks of infectious agents, culture plates, research animals that were exposed to agents that are infectious to human beings, their associated waste and other animal waste that is known to be potentially harmful to human beings should be handled carefully.

There should be bio-medical waste label on waste carry bags and waste carry trolley and also poster has put on the wall adjacent to the bins (waste) giving details about the type of waste that has to dispose in the baggage as per biomedical waste management rule. The segregation of waste at source is the key step and reduction, reuse and recycling should be considered in proper perspectives. To protect our environment and health of the community, the issue of BWM should be given due attention.

Contingency planning and staff training are other important elements of a veterinary-medical waste management program. Hospital waste management training programme should be initiated for veterinarian and para-veterinary staff. Protocol for waste management should be made and widely discussed with the staff of the veterinary hospitals. Bio-medical waste management board can be established in each district with the judicial powers or special court should be established by any means.

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