CHAPTER 24

BIOMEDICAL WASTE MANAGEMENT IN DEVELOPING COUNTRIES

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Introduction

With increasing populations in most African and developing countries, there is a parallel expansion of medical and laboratory services to meet demand. But waste management has received little attention despite the potential environmental hazard and public health risk. For example, in Botswana with an estimated population of 1.4 million, the projected biological and medical wastes is estimated at 11000kg/day by the year 2004 from the current 8000 kg/day. Accordingly, if proper disposal methods are not implemented, there will be an accompanying risk to community health and environmental pollution. Consequently, *there is an urgent need for governments to enact laws and provide adequate facilities for treatment of hazardous and biomedical wastes in order to reduce associated health and environmental risks.* There is also a need for human resource training in waste management of biohazardous wastes.

General

Anthropogenic exposures to biological, medical or chemical wastes have become an important socio-economic and environmental factor, either at regional, national or global levels. The collection, storage and disposal of biomedical waste are a growing environmental problem. With increasing efforts to expand medical and laboratory services, the management of wastes has received little attention despite their potential environmental hazards and public health risk (Mato and Kassenga, 1997). Since wastes pose a danger to vital human activities, such as reproduction and health of individuals and large populations, the problem of prevention and elimination of technogenic exposures hazardous to human health has grown beyond medical competence to an environmental issue (Berry and Bove, 1997). A well-documented case of environmental pollution was the presence of mercury in Minamata Bay and Agano River in Japan. Methylmercury is a highly toxic form of pollution produced by micro-organisms from mercury accumulated in fish and shellfish. Many local inhabitants who consumed the contaminated fish were poisoned and developed neurological disorders, such as impaired vision in adults and cerebral palsy syndrome in children (World Bank Report, 1989). A study by Berry and Bove (1997) examined relationships between birth weight of children and mother's residence near hazardous waste landfill. They found that parents closest to landfills had a statistically significant lower average birth weight than the control population.

Furthermore, experience in a number of developed countries has also shown that cleaning up the "sins of the past" is much more expensive in the long term (World Bank Report, 1989)

Definitions and Biomedical Waste Classification

Biomedical waste includes preparations made from living organisms and their products such as serums, vaccines, antigens and antitoxins, **while medical waste** includes all of the following:

- ***Biohazardous Waste or Sharps Waste.*** This is waste which is generated or produced, as a result of the diagnosis, treatment, or immunisation of human beings and/or animals. Some of the medical waste generated may be infectious if it contains infectious agents such as viruses or bacteria, giving rise to ***Infectious Medical Waste.*** An infectious agent is any organism (such as a virus or bacteria) that is capable of being communicated by invasion and is able to multiply in body tissues resulting in disease or adverse health effects in humans and/or animals. ***Sharps Waste*** comprises any device having acute rigid corners or edges, or projections capable of cutting or piercing, including hypodermic needles, syringes, blades and needles. Broken glass items, pipettes and vials that are contaminated with other medical waste.

- ***Infectious Biomedical Waste*** is solid waste produced by medical and dental treatment facilities which should be specially managed because it has the potential for causing disease in humans and may pose a risk to both individuals or community health if not managed properly, and this includes the following categories:

(a) **Microbiology waste,** including cultures and stocks of etiologic agents which, due to the species, type, virulence, or concentration are known to cause disease in humans;

(b) **Pathology waste**, including human tissues and organs, amputated limbs or other body parts, foetuses, placentas, and similar tissues from surgery, delivery or autopsy procedures. Animal carcasses, body parts, blood and bedding are also included;

(c) **Human blood and blood products** (including serum, plasma, and other blood components), items contaminated by blood or blood products that are capable of releasing these materials during handling;

(d) **Potentially infectious materials** including human body fluids such as semen, vaginal secretions, cerebrospinal and amniotic fluid, saliva in dental procedures, or any body fluid where a risk of infection exists; and

(e) **Sharps**, which include hypodermic needles, syringes, biopsy needles and other types of needles used to obtain tissue or fluid specimens, needles used to deliver intravenous solutions, scalpel blades, Pasteur pipettes,

specimen slides, cover slips, glass Petri-plates, and broken glass potentially contaminated with infectious waste.

Sources of Biomedical Waste

Biomedical waste arises from establishments such as referral, district, mental, primary and private hospitals, health clinics and posts, blood transfusion centres and medical research and teaching laboratory centres (National Conservation Strategy, 1995)

Health and Environmental Risks

There are two main types of risks associated with biomedical waste. *Foremost is the risk to health due to infection or injury* (NSC, 1995), particularly health care workers involved in handling of biomedical waste. *The second type of risk is an environmental risk, if there is no proper disposal of biomedical waste.* This can lead to pollution of water, air and soil resulting in long-term exposure of the population which may lead to severe adverse health effects due to poisoning (World Bank Report, 1989, NSC, 1995). The risk to water can be due to heavy metals, such as mercury, silver or expired pharmaceuticals for disposal. Therefore, one of the major environmental risks includes leaching of chemicals and subsequent contamination of water sources (World Bank Report, 1989). The risk to air can arise from emissions from improper incineration of the pharmaceuticals, burning of metal such as mercury which creates emissions of dangerous mercury and infectious biomedical wastes to minimise the potential for infection (NSC, 1995).

Handling of Biomedical Wastes

Biomedical wastes, for the potential health danger associated with it, requires special procedures for its management. The indicated establishments and premises, at which biomedical waste is produced, also generate general waste that is disposed by normal waste disposal methods without pre-treatment. This includes garbage and rubbish. Garbage being putrescible waste resulting from handling, preparation, cooking, or serving food, while rubbish is the non-putrescible solid waste which falls into two categories; combustible and noncombustible, such as paper and metal respectively (DDEAMC, 1993).

For these reasons, *biomedical waste requires segregation both between the different categories and from general waste.* Biomedical waste should be segregated from general waste at the point of origin into red biohazard bags conspicuously labelled with the words "biohazard waste" or the international

biohazard symbol with the word "biohazard". While sharps containers must be rigid, puncture and leak resistant when sealed, and cannot be reopened without great difficulty, and properly labelled. Sharps containers may be placed in the red biohazard bag (Coast Community College District, 1997).

Storage

Storage enclosures must be secured to deny access to unauthorised persons, preferably posted with a sign "caution - Biohazardous waste storage". Biohazardous waste and sharps containers may be stored up to 7 days above 0 degC.

Treatment of Biomedical Waste

This relates to *any method, technique or process designed to render infectious biomedical waste non-infectious, such as use of an autoclave, incinerator or microwave technology.* Any department treating biomedical waste on-site using autoclaves or similar forms of sterilisation must establish treatment procedures. The following biological and medical waste treatment protocol using an autoclave is after the Coast Community College District (1997):

1. Standard written operating procedures for steam steriliser, including time, temperature, pressure, and type of waste, type of container, method of loading, water content and maximum load quantity;

2. Check the recording during each cycle to ensure 121 degC for 30 minutes or longer. The thermometers should be checked annually for calibration;
3. Operating parameters for each autoclave must be documented;

4. Use heat sensitive tape for each container that is processed to indicate attainment of adequate sterilisation conditions;

5. Use of *Bacillus stearothermophilus*, a thermophile capable of growth at deC (Van Demark and Batzing, 1987) placed at the centre of a load processed under operating conditions at least monthly to check adequate sterilisation;

6. An emergency action plan must be in place at locations where biomedical waste is being treated.

Biomedical waste that has been treated becomes solid waste, which is not hazardous.

Table 24.1: Treatment Methods and Methods of Disposal of Biomedical Waste.

Type of Biomedical Waste		Method of Treatment	Method of Disposal
1.	Microbiological.	Steam. Sterilisation. Chemical disinfectant. Incineration.	Municipal solid landfill (MSLF).
2.	Pathological.	Incineration. Cremation.	MSLF. Burial.
3.	Bulk Blood.	Incineration. Steam sterilisation.	Wastewater. Treatment Plant.
4.	Suction Canister.	Steam Sterilisation.	Waste Water. Treatment Plant.
5.	Sharps in Sharp Containers.	Steam Sterilisation.	MSLF.

Note 1 : Bulk blood known to be infectious must be treated by incineration or steam sterilisation before disposal.

Regional Experience

The Republic of South Africa uses extensively low technology incinerators combined with one medium technology plant located in Durban and one planned for Johannesburg as of 1995. In Zimbabwe, by 1995, there was no national policy and no legislation on medical wastes. Essentially, individual hospitals developed their own system of disposal. Biological and infectious waste being packed in plastic bags and incinerated. This is a similar situation obtaining in Botswana. In Zambia as of 1995, there was no national policy, nor legislation nor standards with most medical waste being dumped (NCS, 1995).

Record Keeping

Departments with on-site waste treatment must have information on-site, an emergency action plan for spills on-site and treatment facility operating records for three (3) years.

However, if a department is using a hazardous waste hauler for off-site waste treatment, they must have; information document on-site, records of quantity,

type of waste and date of transport and the name of a hazards waste hauler. Similar to on-site treatment, tracking documents must also be kept for three (3) years.

Conclusion

There is an urgent need for governments to enact laws, train skilled manpower in waste management, provide guidelines and standards for proper disposal of biological and medical wastes. At establishments where biomedical wastes is generated, proper segregation of wastes should be implemented and use of steam sterilisers, such as autoclaves and low technology incinerators encouraged. If the current haphazard waste management continues, there is likely to be an increased health risk to the community and pollution of the environment from improper disposal of biohazardous wastes within a foreseeable future.

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