



Assessment of biomedical waste management in government hospital of Ajmer city – a study

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ABSTRACT

Biomedical waste management is one of the biggest challenges of the present day times since it has a direct impact on the health of the citizen of that city. Since it is hazardous in nature its safe and proper disposal is extremely important. For proper management of bio-medical waste the Ministry of Environment and Forests has promulgated the Bio-Medical Waste (Management and Handling) Rules, 1998. In the past health care waste was often mixed with municipal solid waste and disposed of in residential waste landfills or improper treatment facilities (e.g. inadequately controlled incinerators). In recent years, many efforts have been made by environmental regulatory agencies to better manage the waste from healthcare facilities. Medical waste incineration is identified as the most preferred disposal method. This situation requires an organized system of health care waste management to curb public health risks as well as occupational hazards among health care workers as a result of poor waste management. This paper presents an overview of the current management practices of health care waste in the Janana Govt hospital of Ajmer city. Data were collected via surveys, interviews, and on-site observations. Information regarding generation, segregation, transportation, and disposal of biomedical wastes is provided and discussed. The main treatment method used in the final disposal of infectious waste is incineration. Non-infectious waste is disposed off using land disposal method. The study showed that the hospital does not have a policy and plan in place for managing medical waste. This study was also focused on the impact of poor management of Biomedical waste management to handlers, public health and the environment. The need of comprehensive training programs regarding Bio-Medical waste management is highly recommended to all hospital staff.

Key words: Biomedical Waste, Landfills, Incinerators, Occupational Hazards, Municipal solid waste, Non- Infectious Waste

INTRODUCTION

Over the years there has been tremendous advancement in the health care system. Disposal of biomedical waste has emerged as an issue of major concern not only to the hospitals but also to environment. The management of bio-medical waste is still in its infancy all over the world. There is a lot of confusion with the problems among the generators, operators, decision-makers and the general community about the safe management of bio-medical waste. The reason may be a lack of awareness. Hence resource material on the environment for hospital administrators, surgeons, doctors, nurses, paramedical staff and waste retrievers, is the need of the hour.^{1,2} In India,

this problem has been framed to systematize implementation³. To comply with government regulations and to increase their public image hospitals in India are adopting green practices like other sectors, to address waste issues. Throughout the world, an estimated 16 billion injections are administered annually. Needles and syringes that are not disposed of properly pose a grave hazard to public health due to the risk of injury and infection and of the opportunities for re-use. Worldwide, 8-16 million hepatitis B, 2.3 - 4.7 million hepatitis C and 80 000 - 160 000 HIV infections are estimated to occur yearly from re-used unsterilized syringes and needles. The re-use of disposable syringes and needles for injections is particularly common in certain developing countries⁴.

i) Bio-medical Waste

The waste generated from healthcare facilities referred also as healthcare waste, hospital waste and infectious waste includes all types of waste generated by healthcare establishments, research facilities and laboratories in addition to hospitals and clinics including waste generated by blood banks. Hospitals in general, generate waste at an average rate of 1 Kg/bed/day. A small percentage of this waste is toxic and harmful not only to the staff and patients but also to the general public at large. The improper management of Bio-medical waste causes serious environmental problems in terms of air, water and land pollution. A study conducted by the World Health Organisation in 1996, reveals that more than 50,000 people die every day from infectious diseases in the whole world. The situation has not improved yet. One of the reasons for the increase in infectious diseases is the improper waste management ⁵.

ii) Definition of Biomedical Waste

As per Biomedical Waste (Management and Handling) Rules, 1998 of India, BMW is defined as “Any waste generated during the process of diagnosis and treatment or immunization of human beings or animals or in research activities contributing to the biological production or testing” (Govt. of India, 1998). One of the major achievements of India has been modification of the health operators’ attitudes to accommodate in waste management concerning health care nicely in their operation routinely ⁶.

a) Classification of Biological Wastes

1. **Non-Hazardous Wastes** In most of the set-ups of health-care approximately 85% of generated wastes is constituted by non-hazardous wastes. This includes wastes constituting remnants of food and peels of fruit; wash water as well as paper cartons; packaging materials etc ⁷.
2. **Hazardous Wastes:** Potentially Infectious Wastes In the scientific documents as well as in the regulations and guidance various terms for infectious wastes have been used over the years. These include: infectious as well as infective; medical and biomedical; hazardous and red bag; contaminated; infectious medical wastes; along with regulated wastes in the medical profession. Basically all these terms indicate the similar types of wastes even though the terms involved in regulation are defined usually in more specific manner. Hospital, like any other center of man’s activities, is a source for waste generation. A modern hospital is a complex, multidisciplinary system which consumes thousands of items for delivery of medical care and is part of physical environment ⁸. Hospitals in the world over generally generate a wide variety of waste, some of which are similar in many respects to that produced by hotels and restaurants. Hospital solid waste means all wastes coming out of hospitals out of which 85% are actually non-hazardous, 10% are infectious wastes and 5% are non-infectious but hazardous in nature ⁹.

Health Care Waste (HCW) is a by-product of health care that includes sharps, non-sharps, blood, body parts, chemicals, pharmaceuticals, medical devices and radioactive materials. Medical waste refers to clinical waste materials that are produced from healthcare facilities such as doctors’ offices, research laboratories and nursing homes. These materials may include used syringes, soiled dressings, chemicals used to treat illnesses, equipment and facility cleanser, radioactive materials and other waste streams generated in hospital environment¹⁰. Recently as a major concern biomedical waste management has emerged as an issue both to hospitals as well as authorities of nursing home and so also to the environment. From health care units the biomedical wastes that is generated depend upon several factors viz., methods of waste management; various types of units of health care; health care unit occupancy; health care unit specialization; reusable items and their ratio in use; infrastructure and resources and their availability ¹¹. As a humanitarian topic the biomedical waste and their proper management has become a global issue. Worldwide hazards of biomedical wastes and their poor management have raised a concern especially on the ground of its far reaching effects on human as well as health and environment ¹².

b) Current Biomedical Waste Management Scenario in city

World Health Organization states that the total hospital waste generated, approximately 10% is hazardous, 85% is general (non risk) waste while a small percentage (5%) is labelled as highly hazardous. Currently, most of the biomedical waste is being disposed along with municipal solid waste. The untreated liquid waste from the health institutions is let into drainage. The prevalent solid waste management practices in the city are highly deficient. Storage of wastes at source is generally not attended to. Households, commercial establishments, industries, hospitals, and nursing homes, etc. keep on throwing the waste on the streets, footpaths, drains, etc. The biomedical waste has been grossly neglected in Ajmer. Large number of hospitals, nursing homes, health care centres has been identified by the State Pollution Control Board in Ajmer but do not take any measure for the safe disposal of the biomedical wastes. The biomedical wastes sometimes get mixed up with the municipal solid waste and deposited at the common disposal site. Wastes from operation theatres, wards and pathological laboratories are disposed of without any disinfection/sterilization.

c) Biomedical Waste Management Process

Some of the waste management process that is applied till now is summarized as beneath. Handling, segregation, mutilation, disinfection, storage, transportation and final disposal are vital steps for safe and scientific management of biomedical waste in any establishment ¹. The key to minimization and effective management of biomedical waste is segregation (separation) and identification of the waste. The most appropriate way of identifying the

categories of biomedical waste is by sorting the waste based on color. This has to be segregated into containers/bags at the point of generation in accordance with Schedule II of Biomedical Waste (management and handling) Rules 1998 as given in below Table I.

Table 1 - Color coding-biomedical waste (management and handling) rules, 1998 (Schedule II)

Color Coding	Type of Containers	Waste Category	Treatment Options as per Schedule 1
Yellow	Plastic bag	1,2,3,6	Incineration/deep burial
Red	Disinfected Container/ Plastic bag	3,6,7	Autoclaving/Micro waving/ Chemical Treatment
Blue/ White translucent	Plastic bag/puncture proof container	4,7	Autoclaving/Micro waving/ chemical treatment and destruction/shredding
Black	Plastic bag	5,9,10 (Solid)	Disposal in secured landfill

Biomedical waste should be transported within the hospital by means of wheeled trolleys, containers or carts that are not used for any other purpose. The trolleys have to be cleaned daily. Off site transportation vehicle should be marked with the name and address of carrier. Biohazard symbol should be painted. Suitable system for securing the load during transport should be ensured. Such a vehicle should be easily cleanable with rounded corners. All disposable plastic should be subjected to shredding before disposing off to vendor. Final treatment of biomedical waste can be done by technologies like incineration, autoclave, hydroclave or microwave¹³. Biomedical waste categories and their disposal methods are tabulated in below Table 2.

Table 2 – Waste categories: their treatment and disposal methods

Option	Treatment & Disposal	Waste Category
Cat. No. 1	Incineration /deep burial	Human Anatomical Waste
Cat. No. 2	Incineration /deep burial	Animal Waste
Cat. No. 3	Local autoclaving/ microwaving/ incineration	Microbiology & Biotechnology waste
Cat. No. 4	Disinfections (chemical treatment /autoclaving/microwaving & mutilation shredding	Waste Sharps
Cat. No. 5	Incineration / destruction & drugs disposal in secured landfills	Discarded Medicines and Cytotoxic drugs
Cat. No. 6	Incineration, autoclaving/microwaving	Solid Waste (Items contaminated with blood and body fluids
Cat. No. 7	Disinfections by chemical treatment autoclaving/microwaving& mutilation shredding.	Solid Waste (waste generated from disposable items

Cat. No. 8	Disinfections by chemical treatment and discharge into drain	Liquid Waste
Cat. No. 9	Disposal in municipal landfill	Incineration Ash
Cat. No. 10	Chemical treatment & discharge into drain for liquid & secured landfill for solids	Chemical Waste

MATERIALS AND METHODS

i) The Study Area

The area under investigation Ajmer, formerly written Ajmer, is the city in Ajmer District in India’s Rajasthan state. It is bordered by Nagaur District in the north, Jaipur and Tonk district in the east, Bhilwara district in the south and Pali district in the west. Surrounded by the Aravallis Mountains, Ajmer is also known as Ajaymeru, was the city once ruled by prithviraj Chauhan. Its population was approximately 500,000 in 2001.

Table 3 - General location of Ajmer City

AJMER	
Coordinates	26°16'N 74°25' E / 26.27°N 74.42°E
Country	India
State	Rajasthan
District(s)	Ajmer
Time Zone	IST (UTC +5:30)
Elevation	486 m (1,594 ft)

Now at present there is a big network of Health Care Institutions in Ajmer City. There are many Government, Non- Government Hospitals, Dispensaries, Research Laboratory, Clinics etc in the city where large amount of biomedical waste is generated daily. Until recent times, hospital waste in Ajmer city was not properly segregated before disposal to the dump or incinerator. This case study has been carried out in Janana Govt Hospital of Ajmer City.

Table 4 – Showing final disposal method adopted by the hospital according to the type of waste generated

Type of Wastes	Site of Generation	Final Disposal By
Non-Hazardous (General)	Office, Kitchen, Cafeteria, Billing, Administration, Cashier, Rest rooms, Pantries in wards, Stores, etc	Municipal Authorities
Hazardous (Infectious and toxic)	Wards, Treatment, room, nursing station, Isolation rooms, Operation theatres, Intensive Care Units and post operative recovery room, Minor OTs, Blood Bank Pharmacy and Medical Stores, All laboratories, Pharmacology OPDs’ Injection rooms.	Common biomedical waste treatment facility (Private Waste Management Company.

ii) Survey of the study area:

Survey of the hospital was done in order to assess the types of facilities available in the hospital. The survey includes to gather information about current disposal practices and to understand the present situation of the hospital waste management by personnel observation.

Table 5 - Facilities available in Janana Govt. Hospital

S. No	Wards
1.	Operation theatre
2.	Intensive care
3.	Emergency
4.	Radiology
5.	Laboratories
6.	Maternity ward
7.	Blood bank
8.	Kitchen
9.	Children ward
10.	Gyneic ward
11.	Labour Room
12.	Sonography

iii) Study Sample Area

A study was conducted in Janana Govt hospital of Ajmer City. Data were collected from the hospital. The hospital studied, were considered to be large hospital of Ajmer City based on the number of beds, as the hospital is of 200 beds capacity.

Table 6 - Showing Total No of beds in the hospital

S. No	Name of Hospital	Beds Capacity
1	Janana Govt Hospital, Ajmer	200

A questionnaire was prepared that included questions regarding number of inpatients/day, outpatients/day, number of beds (total), awareness about biomedical waste (management and handling) rules, 1998, categories of biomedical waste produced and estimated quantity (kg/day), waste segregation, collection, labelling, transport and disposal, financial and personal resources. The views and suggestions of working personnel over existing conditions/methods of biomedical waste management in the hospitals were also recorded.

iv) Quantities of waste generated in the hospital

The quantity of waste generated in health care settings should be known while making a good waste management system. Hence, the quantities of different categories of waste have to be estimated by discussions and interviews. The quantities generated vary from hospital to hospital and depend on the type of health-care facility and local economic conditions. The average values are presented in Table below. The waste quantities are estimated by assuming 100% bed –occupancy in the hospital. Health care wastes are categorized into two types such as infectious and non-infectious ¹⁴.

Table 7 - Total Amount of waste is generated segregated according to colour coding in Janana Hospital Ajmer

S.No	Category of waste	Average amount of waste (Kg)/ Month
1.	Yellow	314 kg
2.	Blue	191 kg
3.	Black	300 kg
4.	Red	83 kg
	Total amount	888 kg

The survey result show that the average amount of waste generated per month in the hospital is Total waste collected 888 kg/month, Yellow bag 314 kg/month, Blue bag 191

kg/month, Black bag 300 kg/month and Red bag contains 83 kg/month.

Table 8 - Total Amount of Waste as Hazardous & Non-Hazardous in Hospital.

S.No	Waste	Average amount of waste (Kg)/Month
1	Hazardous	588 kg
2	Non- Hazardous	300 kg

v) Segregation, Collection & Transportation

The waste is segregated according to their characteristics mainly into the following categories: sharps, infectious waste, pathological waste & pharmaceutical waste. Although a system of colour coding or labelling of waste containers/bags has been adopted, not all services strictly follow the national regulations to practices the colour coding system. The biomedical waste is segregated into:

1. Infectious waste, pharmaceutical waste & chemical waste (Red bag)
2. Sharps (yellow bag)
3. Domestic waste (black bag)

Wastes are collected daily and transported to the designated central storage site. Transportation of waste within the establishment utilizes wheeled trolleys that are dedicated solely for the purpose. Not all workers transporting the waste are equipped with appropriate personnel protective equipment including heavy duty gloves, coveralls thick soled boots and leg protectors.

vi) Treatment and Incineration

The infectious waste was treated via incineration. The benefits of controlled incineration of infectious wastes include volume reduction and the removal of pathogenic risk, as long as the system operates correctly. The drawbacks to incineration include the large capital and operating costs for modern technologies, the need for skilled labour to operate and maintain the system, the potential lack of local access to materials for incinerator construction, the required supplies (e.g. fuels) and the potential for toxic emissions to the air where there is no emission control equipment. Open burning (uncontrolled incineration) should be avoided, because of risks to workers, not only from uncontrolled toxic gas emissions to the air, but as well from infectious wastes that are only partially burned. After incineration, the final waste is deposited in a site and they are taken by the vehicle of the municipality for the landfill. However, non-infectious waste was discarded directly in a sanitary landfill of the city of Ajmer.



Figure 1 – Incineration

RESULTS AND DISCUSSION

1. **Waste Production:** Waste is generated from the various activities performed in the hospital. Wastes produced in the hospital include general and medical wastes. The amount of waste generated in hospitals depends upon various factors such as number of beds, types of health services provided, economic, social and cultural status of the patients and the general condition of the area where the hospital is situated.
2. **Waste Segregation:** The hospital basically separates medical waste from general waste stream at the waste production points. Therefore they are stored and disposed off separately. However, the hospital does not segregate medical wastes into different categories. In the wards, doctors and nurses who use sharps are required to drop them into different containers but this is not diligently followed. During our interview it was revealed that segregation of medical wastes into infectious medical waste and non-infectious medical waste is not conducted according to definite rules and standards. Separation of medical waste and general waste is however practiced to a satisfactory extent.
3. **On-site Transport of Medical Waste:** Medical wastes generated in the hospital are on a daily basis collected and transported to a temporary storage area by hospital's staff. It is mandatory for medical waste to be transported within the hospital by means of wheeled trolleys, containers or carts that are not used for any other purpose. The staff employed for handling waste in the hospital use almost complete personal protective equipment, including overall gown and protective boots and gloves. Most of the hospital does not maintain a record/ register for medical waste disposal properly. The wastes are kept in this temporary storage area until it is time for off-site transport.
4. **Temporary Storage:** The wastes are kept in this temporary storage area until it is time for off-site transport. The infectious and non-infectious wastes are kept in separate containers and are not mixed together in the hospital's own temporary storage area. Incineration is the main method for the treatment of medical waste especially infectious and sharp wastes for the hospital. Autoclaves are used for treating part of the wastes.
5. **Off-site Transport of Medical Waste:** Offsite transport of the hospital waste is undertaken by a waste management company and waste is transported daily.

Shortcomings in the existing system of Hospital

- Color-coding for various categories of waste is not followed properly.
- The storage of bio-medical waste is not in isolated area and proper hygiene is not maintained.

- Personal protective equipment and accessories are not provided properly.
- The hospital does not have proper waste treatment and disposal facilities. In the cities where common treatment facilities have come up, many medical establishments are yet to join the common facility.
- Most of the incinerators are not properly operated and maintained, resulting in poor performance.
- Sometimes plastics are also incinerated leading to possible emission of harmful gases.
General awareness among the hospital staff regarding bio-medical waste is lacking.

CONCLUSION

During the past few years, there has been an increase in the level of public concern about the management of healthcare wastes (HCW) on a worldwide basis. Healthcare activities lead to the production of wastes that may cause adverse health effects. Despite the efforts for the management of wastes, the current system of healthcare waste management in the hospital of Ajmer city is under development and is in dire need of immediate attention and improvement. There is still a lack of specialized services for the collection and final disposal of health care wastes in the hospital of Ajmer. Thus, the wastes are not properly segregated, collected and disposed in all the services of the hospital, which may lead to a negative impact on public health and on the environment. Finally, the storage, transport and treatment of HCW will have to comply with current regulations and all personnel involved must be properly trained to avoid injuries and accidents. This can reduce accidents due to a poor management of hospital waste.

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