

## Nagarlok Vol. XLIV No. 4 October - December 2011 Managing Bio Medical Waste through Public Private Partnership - A Case Study

PRITI GARG, MADHU THAWANI AND RENUKA GARG

### INTRODUCTION

Biomedical waste is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities pertaining thereto, or in the production or testing of biological components<sup>1</sup>. In India, annually about 0.33 million tonne of hospital waste is generated. Waste generated per bed per day ranges from 0.5 to 2.0 kg<sup>2</sup>. It is estimated that 80-85 per cent of biomedical waste is non-infectious, 10 per cent is infectious and five per cent is hazardous<sup>3</sup>. The hazardous and toxic parts of waste from health care establishments comprises of infectious, bio-medical and radio-active material as well as sharps (hypodermic needles, knives, scalpels, etc.). These if left untreated pose grave public health risks and a threat to environment<sup>4</sup>. Therefore Bio-Medical Waste Management (BMWM) becomes essential. The main functions of BMWM are proper handling, segregation, mutilation, disinfection, storage, transportation and final disposal of Bio-Medical Waste<sup>5</sup>. Management of biomedical waste is not only a legal necessity but also a social responsibility<sup>6</sup>. The Government of India, Ministry of Environment and Forests (MoEF) under Section 6, 8 and 25 of the Environment (Protection) Act 1986 has made the Biomedical Wastes (Management & Handling) Rules, 1998, providing for uniform guidelines and code of practice for the whole nation<sup>7</sup>. In this article we will examine the efforts being made by Surat Municipal Corporation (SMC) in managing Bio Medical Waste (BMW).

### Bio-Medical Waste Rules, 1998

According to Bio-Medical Waste (Management and Handling) Rules, 1998, it is the duty of every "occupier", i.e. a hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, blood bank to take all steps to ensure that waste generated is handled without any adverse effect to human health and environment<sup>8</sup>. Handling, segregation, mutilation, disinfection, storage, transportation and final disposal are vital steps for safe and scientific management of BMW in any establishment<sup>9</sup>. Schedule I of

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TABLE 1. CATEGORIES OF BIO-MEDICAL WASTE

Option	Waste Category	Treatment & Disposal
Cat. No. 1	Human Anatomical Waste (human tissues, organs, body parts)	Incineration / deep burial
Cat. No. 2	Animal Waste (Animal tissues, organs, body parts carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals/ colleges, discharge from hospitals, animal houses)	Incineration / deep burial
Cat. No. 3	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 infectious agents from research and industrial laboratories, wastes from production of biological, toxins, dishes and devices used for transfer of cultures)	Local autoclaving/ micro waving/ incineration
Cat. No. 4	Waste Sharps (needles, syringes, scalpels blades, glass, etc. that may cause puncture and cuts. This includes both used & unused sharps)	Disinfections (chemical treatment / autoclaving/ micro waving and mutilation shredding)
Cat. No. 5	Discarded Medicines and Cytotoxic drugs (wastes comprising of outdated, contaminated and discarded medicines)	Incineration / destruction & drugs disposal in secured landfills
Cat. No. 6	Solid Waste (Items contaminated with blood and body fluids including cotton, dressings, soiled plaster casts, line beddings, other material contaminated with blood)	Incineration, autoclaving/ micro Waving
Cat. No. 7	Solid Waste (waste generated from disposable items other than the waste sharps such as tubing, catheters, intravenous sets etc.)	Disinfections by chemical treatment autoclaving/ micro waving & mutilation shredding.
Cat. No. 8	Liquid Waste (waste generated from laboratory & washing, cleaning, house-keeping and disinfecting activities)	Disinfections by chemical treatment and discharge into drain
Cat. No. 9	Incineration Ash (ash from incineration of any bio-medical waste)	Disposal in municipal landfill
Cat. No. 10	Chemical Waste (chemicals used in production of biological, chemicals, used in disinfection, as insecticides, etc)	Chemical treatment & discharge into drain for liquid & secured landfill for solids

(Source: <http://envfor.nic.in/legis/hsm/biomed.html>)

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the Bio-Medical rules contain the categories of BMW (Table1). Schedule II contains the Color Coding and the type of container for disposal of different BMW (Table 2). The containers are to be labeled according to Schedule III of the rule.

## Managing Biomedical Waste through PPP Mode- A Case Study of Surat Municipal Corporation

### Genesis

Bio-medical waste (Management and handling) Rules - 1998 emphasized that it is the responsibility of every generator to handle the Bio-medical waste as per its Category till its final disposal within 24 hours. However, it is not possible for small nursing homes, dispensaries, clinical laboratories and other small organizations or individual medical professionals to carry out treatment and disposal of biomedical waste generated as per the methods prescribed in the Rules on its own. Even for bigger hospitals it would not be economical to have their own treatment facilities. Recognizing this problem Surat Municipal Corporation (SMC) took initiative for setting up a Common Bio Medical Waste Treatment Facility (CBMWTF) in September 1999, and convened a meeting of all medical practitioners associations of Surat. In the meeting it was unanimously decided to establish a common Bio-medical waste treatment facility on Build Own Operate and Transfer (BOOT) basis. Immediately a pilot survey was initiated in some leading hospitals of Surat city to know the exact quantum of biomedical waste generated in the city. The first tender which was floated for setting up CBMWTF only included incineration as the treatment technology to be set up on turnkey basis. After many revisions the final form of tender evolved by the end of the year 2001 which demanded that a CBMWTF be set up on BOOT basis. Treatment technologies specified were incineration and sterilization (autoclaving) followed by shredding. Envision Enviro Engineers Pvt. Ltd. quoted the lowest rates and was selected as the facility operator. The facility for managing BMW was set up and commissioned by the agency in December 2002.

### Features

Management of Bio Medical waste is being done by SMC under Public Private Partnership (PPP) mode. The PPP mode is being executed on BOOT basis. The private sector company, Envision Enviro Engineers Pvt. Ltd., has been selected through a process of open competitive bidding. Contract agreement has been signed by both the

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parties - SMC and Envision Enviro Engineers Pvt. Ltd. Initially the contract was for seven years. This contract expired on 21<sup>st</sup> Dec 2009. The contract has been renewed for a period of 14 years.

Under the agreement the private agency has to incur the cost for setting up the facility for BMW management. The facility to be set up has to strictly adhere to Bio Medical Waste Management Handling Rules. Bio medical waste generators have to deposit their BMW at the designated urban health centers. The agency has to collect all BMW from the designated health centers and from the premises of big hospitals and transport the waste up to the treatment facility plant. The collection and transportation of waste has to be carried out as per the Bio medical Waste Rules. The total cost of the operation of the facility has to be born by the agency. The treated BMW has to be disposed by the private operator at the sanitary landfill site of the SMC. There is provision for collecting user charges from the generators of BMW.

To make the project viable for the agency, the agency has been given permission to collect bio medical waste from the generators outside SMC limits for treatment and disposal.

The other features of the agreement are that the hospitals have to segregate and pack BMW as required by BMW rules. Bags have to be of standard size, design and with labels. Different bags have to contain different category of waste. The liability of the generator comes to an end on handing over the properly segregated packed and labeled BMW to the agency. The agency has to collect the waste on a daily basis. For such days on which the generator fails to deposit BMW the generator has to pay an average amount based on previous month billing.

The service provider as per the agreement has incurred all expenditures relating to purchase and maintenance of machines like Incinerator, Autoclave and Shredder and Vehicles for collecting and transporting BMW. SMC has allotted 2400 sq mt. land at Bhatar disposal site at a token annual rent of Rs. One per sq. mt. to the agency.

Envision Environ collects and transports BMW from SMC run hospitals / maternity homes, laboratories and urban health care centers. In the initial stages SMC was paying Rs. 10 per kg. for the BMW. Irrespective of the actual quantity of BMW generated per day SMC had to pay kg for 200 kg per day. Other private generators in Surat city were charged Rs. 10 per kg. Out of Rs. 10 per kg collected by the service provider Rs. 2.50 were paid by it to SMC- being administrative charges. Under the new agreement the agency can

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collect Rs. 18 per kg of BMW from private generators and does not have to pay administrative charges. It is now collecting and treating BMW collected from SMC health care units free of cost. Outside Surat city Envision Pvt. Ltd charges Rs. 14 per kg from Government health care centers and Rs.275 per bed per month from private generators. The agency collects Rs. 200-300 as transportation charges from big hospitals and maternity homes. Small clinical units deposit the BMW on their own at designated 37 urban health care centers and therefore do not pay transportation charges. For door to door collection of waste the agency has 15 vehicles and has employed 30 workers for collecting and transporting BMW.

At present 5622 BMW generators are taking benefit of the services being provided by the agency. Daily about 3.5 tonnes of BMW is collected. From Surat city BMW is collected everyday while from remote areas BMW is collected every second day.

#### Main Functions for Managing Bio- Medical Waste

The main functions of BMW are proper handling, segregation, mutilation, disinfection, storage, transportation, treatment and final disposal of Bio-Medical waste

#### Handling and Segregation

BMW generated has to be segregated and packed in different coloured bags as per the Biomedical Wastes (Management & Handling) Rules, 1998. These are Yellow, Red, Blue and Black. The category of waste to be put in different bags is shown below:

##### Yellow Bag

- a) Human Anatomical Waste (human tissues, organs, body parts)
  - b) Animal Waste (animal tissues, organs, body parts carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals, colleges, discharge from hospitals, animal houses) .
  - c) Microbiology and Biotechnology Waste (wastes from laboratory cultures, stocks or specimens of micro- local autoclaving/micro-organisms live or attenuated vaccines, human and animal cell waving culture used in research and infectious agents from research and industrial laboratories, wastes from production of biologicals, toxins, dishes and devices used for transfer of cultures)
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- d) Solid Waste (Items contaminated with blood, and body fluids including cotton, dressings, soiled plaster casts, lines, beddings, other material contaminated with blood)

##### Red Bag

- a) Microbiology and 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 infectious agents from research and industrial laboratories, wastes from production of biological, toxins, dishes and devices used for transfer of cultures)
- b) Solid waste Items contaminated with blood, and body fluids including cotton, dressings, soiled plaster casts, lines, beddings, other material with blood.
- c) Solid Waste (wastes generated from disposable items other than the waste sharps such as tubing's, catheters, intravenous sets etc.)

##### Blue Bag

- a) Waste sharps (needles, syringes, scalpels, blades, glass, etc. that may cause disinfection. This includes both used and unused sharps
- b) Solid Waste (wastes generated from disposable items other than waste sharps such as tubings, catheters, intravenous sets etc).

##### Black Bag

- a) Discarded Medicines and Cytotoxic drugs (wastes comprising of outdated, contaminated and discarded medicines)
- b) Incineration Ash (ash from incineration of any bio-medical waste)
- c) Chemical Waste (chemicals used in production of biological, chemicals used in chemical treatment and disinfection, as insecticides, etc.)

However, in practice, only Yellow, Red and Black bags are provided.

Yellow Bags are used to store - Human Anatomical Waste, Animal Waste, Microbiology and Biotechnology Waste and Solid Waste items.

Red Bags are used to store - Plastic Waste

Black Bags are used to store - General Waste and Jar for sharps.

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Due to shortage of the staff , carelessness on the part of the staff and in some instances lack of awareness segregation is not being done as per BMW rules.

#### Mutilation and Disinfection

As per the BMW rules mutilation is to be done of tubing's, catheters intravenous sets etc. to prevent unauthorized reuse. Needles, sputum blood and urine samples are to be disinfected by sodium hypo chloride. However in practice mutilation and disinfection process is normally not followed because of lack of time and cost of sodium hypo chloride and fear among staff to handle blood, urine samples, needle, tubing's, catheters and intravenous sets.

#### Storage Facility

No untreated bio-medical waste can be kept or stored beyond a period of 48 hours. The waste actually is stored for more than 48 hours. Generally waste is deposited at urban health centers and collected twice a week .Storage room facility is not available in many cases for storing waste. This leads to waste being kept in open. In some instances the storage room due to the negligence of the personnel remains open which makes way for dogs to enter the room and spill the waste.

#### Transportation

Small clinics transport waste on their own to designated 37 urban health care centers. The agency collects the waste from big generators of waste and from the urban health care centers and transports the waste through its own vehicles to the treatment plant.

#### Process of Treating BMW

BMW collected is treated by two different techniques according to the category of waste- 1 Incineration; 2. Sterilization (auto-claving).

#### Incineration

For treating anatomical waste incineration process is used. There are two chambers. In the first chamber which is the primary chamber BMW bags are treated at 900 degree centigrade. The gases which are generated here then go to the second chamber. In the second chamber the gases are burnt at 1150 degree centigrade. The gases - mainly consist of carbon dioxide- go into the scrubber where they are treated with chemicals. From the scrubber the gases are sent to droplet separator. Moisture is removed here and clean dry air is released in the

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atmosphere via chimney whose height is 30mt. Ashes which remain in the primary chamber are sent to secured land fill site. Ninety nine per cent of BMW waste is destroyed through incineration and only one to 2% of inert is left. The capacity of the incineration plant is 200kg per hour. The cost of incineration process is Rs. 18 to 20 per kg.

#### Sterilization

All other BMW is sterilized. Steam is passed through the waste at 135 degree centigrade. About 125 kg of waste can be sterilized per cycle. One cycle takes about 45 minute. Thereafter shredding of the waste takes place. Plastic is sent for recycling and other waste to the disposal site. The sterilization process costs Rs eight to nine per kg. Average cost for treating BMW comes to about Rs. 15 per kg.

#### Achievements

The PPP mode is a win win situation for all concerned. Daily about 3.5 tonnes of BMW is treated and disposed of scientifically. Municipal Corporation and private generators are relieved of the responsibility of treating and disposing BMW. Private Generators do not have the tension of erecting individual treatment plant the cost of which would have been very high. The Corporation had just to give a piece of land to the private agency and it could utilize the expertise of private agency in disposing of BMW as per the provisions contained in the rules. Capital cost and cost of treatment and disposal for a kilogram of biomedical waste would have been exorbitant, if such common facility was not set up. Hospitals in Surat city are paying the lowest rate in the country. The public at large has also benefited by the installation of centralized treatment facility which has reduced the risk of the unhygienic situation which would have been created by the unsafe disposal of BMW. The private agency has been able to put to use its expertise and also generate income for itself and also fulfill its social responsibility. The private agency did not have to approach individual generators as consolidated base of customers was provided by SMC to it. Training is also provided by the agency at the nominal rates for managing BMW

#### Areas that need attention

##### Lack of awareness/lethargy among staff

There is fear in handling or disposing blood samples and urine samples. Many a times they are not diluted as per requirement before disposing them off. Needles are not broken before disposing. Waste many a times is not segregated as per the requirement.

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## Bio Medical Waste Management Rules

Rules are also a bit confusing regarding segregation of waste and putting them in different bags. There is overlapping regarding waste to be put in different bags. There is still lack of awareness/lethargy among the staff. Further, strictly following BMW rules would require lot of money, manpower and also consume lot of time which also discourages the staff.

## Shortage of Bags

Different sizes of bags are not available because of which waste is not deposited daily and generators wait till the bag is full. Only red and black bags are provided. To save cost the generators use low quality bags and do not use sodium hypo chloride for disinfecting waste as they find it costly.

## Storage Room Facility

Storage room facility is not available in many cases. This leads to waste being kept in open. In some instances the storage room, due to the negligence of the personnel, remains open making way for dogs to enter the room and spill the waste. Many a times as the BMW is not collected regularly due to shortage of space the waste spills over.

## Timely action by SMC

Due to shortage of manpower SMC many a times, fails to take action against violators.

## Suggestions

BMW should be collected on a regular basis. Bags of different sizes (small, medium and big) should be made available in time. All colors, bags should be made available for proper segregation of waste. Training should be given to doctors and other paramedical personnel's for identifying and segregating the waste and sensitizing them to handle the hazardous waste. Personnel handling waste should be provided gloves and boots. Sodium hypo chloride and bags should be provided free of cost to private practitioners. Jars should be provided for storing sharp instruments. Strict action should be taken against those violating the rules.

In developed countries Plasma technology is being used wherein segregation of waste is not required. Feasibility study could be carried out to know about the viability of this technology here.

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## To Sum Up

Managing Biomedical waste is very essential as it may otherwise be harmful to the society and environment. Surat Municipal Corporation has adopted the PPP model for collecting, treating and scientific disposal of BMW. Though there are number of areas requiring attention and rectification, still this model cannot be rejected as it has proved to be a win win situation for all the concerned stakeholders.

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