Contemporary Issue

# Biomedical Waste Management : An Infrastructural Survey of Hospitals

Lt Col SKM Rao[*], Wg Cdr RK Ranyal[+], Lt Col SS Bhatia[#], Lt Col VR Sharma[**]

**Abtract**

**Background : The Ministry of Environment & Forests notified the Biomedical Waste (management & handling) Rules, 1998" (BMW Mgt) in July 1998. In accordance with the rules, every hospital generating BMW needs to set up requisite BMW treatment facilities on site or ensure requisite treatment of waste at common treatment facility. No untreated BMW shall be kept stored beyond a period of 48 hours. The cost of construction, operation and maintenance of system for managing BMW represents a significant part of overall budget of a hospital if the BMW rules have to be implemented in their true spirit. Two types of costs are required to be incurred by hospitals for BMW Mgt, internal and external. Internal cost is the cost for segregation, mutilation, disinfection, internal storage and transportation including hidden cost of protective equipment. External costs are off site transportation, treatment and final disposal.**

**Methods : A study of hospitals was carried out from various sectors like Govt, Private, Charitable institutions etc. to assess the infrastructural requirement for BMW Mgt. Cost was worked out for a hospital where all the infrastructure as per each and every requirement of BMW rules had been implemented and then it was compared with other hospitals where hospitals have made compromises on each stage of BMW Mgt.**

**Results : Capital cost incurred by benchmarked hospital of 1047 beds was Rs.3 lakh 59 thousand excluding cost of incinerator and hospital is incurring Rs. 656/- per day as recurring expenditure. Pune city has common regional facility for BMW final disposal. Facility is charging Rs.20 per kg of infectious waste. As on Dec 2001 there were 400 institutions including nursing homes, labs and blood banks which were registered.**

**Conclusion : After analyzing the results of study it was felt that there is an urgent need to standardize the infrastructural requirement so that hospitals following BMW rules strictly do not suffer additional costs.**

**MJAFI 2004; 60 : 379-382**

**Key Words : Biomedical waste; Cost; Hospital; Infrastructure**

## Introduction

Hospital is one of the complex institutions which is frequented by people from every walk of life in the society without any distinction between age, sex, race and religion. This is over and above the normal inhabitants of hospital i.e patients and staff. All of them produce waste which is increasing in its amount and type due to advances in scientific knowledge and is creating its impact [1]. The hospital waste, in addition to the risk for patients and personnel who handle these wastes poses a threat to public health and environment [2]. Keeping in view inappropriate biomedical waste management, the Ministry of Environment and Forests notified the "Biomedical Waste (management and handling) Rules, 1998" in July 1998. In accordance with these Rules (Rule 4), it is the duty of every "occupier" i.e a person who has the control over the institution and or its premises, to take all steps to ensure that waste generated is handled without any adverse effect to human health and environment. The hospitals, nursing homes, clinic, dispensary, animal house, pathological lab etc., are therefore required to set in place the biological waste treatment facilities. It is however not incumbent that every institution has to have its own waste treatment facility. The rules also envisage that common facility or any other facilities can be used for waste treatment. However it is incumbent on the occupier to ensure that the waste is treated within a period of 48 hours.

## Biomedical Waste Management Process

Handling, segregation, mutilation, disinfection, storage, transportation and final disposal are vital steps for safe and scientific management of biomedial waste in any establishment [3]. The key to minimisation 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 into colour coded plastic bags or containers. Biomedical waste

[*]Associate Professor, Department of Hospital Administration, Armed Forces Medical College, Pune-40, [+]Deputy Director(Hospital Services), ECHS Regional Centre, C/o Air Force Station, Begumpet, Secunderabad, [#]Research Pool Officer/Director General Medical Services-1(b), O/o Director General Medical Services(Army), New Delhi, [**]Medical Officer (Hospital Services), Military Hospital (Cardio Thoracic Centre), Pune-40.

Received : 27.7.2002; Accepted : 20.6.2003.

should 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 Table 1.

**Table 1**

**Colour coding-biomedical waste (management and handling) rules, 1998 (schedule II)**

| Colour coding | Type of container | Waste categories |
|---|---|---|
| Yellow | Plastic bags | Cat 1 human anatomical waste, Cat 2 animal waste, Cat 3 microbiology waste, Cat 6 soiled waste. |
| Red | Disinfected container plastic bags | Cat 3 Microbiological Cat 6 soiled Cat 7 solid waste (Waste IV tubes catheters, etc.) |
| Blue/White | Plastic bag/puncture proof containers | Cat 4 waste sharps Cat 7 plastic disposable tubings, etc. |
| Black | -do- | Cat 5 discarded medicines<br>Cat 9 incineration ash<br>Cat 10 chemical waste |

General waste like garbage, garden refuse etc. should join the stream of domestic refuse. Sharps should be collected in puncture proof containers. Bags and containers for infectious waste should be marked with Biohazard symbol. Highly infectious waste should be sterilised by autoclaving. Cytotoxic wastes are to be collected in leak proof containers clearly labelled as cytotoxic waste [3]. Needles and syringes should be destroyed with the help of needle destroyer and syringe cutters provided at the point of generation. Infusion sets, bottles and gloves should be cut with curved scissors.

Disinfection of sharps, soiled linen, plastic and rubber goods is to be achieved at point of generation by usage of sodium hypochlorite with minimum contact of 1 hour. Fresh solution should be made in each shift. On site collection requires staff to close the waste bags when they are three quarters full either by tying the neck or by sealing the bag. Kerb side storage area needs to be impermeable and hard standing with good drainage. It should provide an easy access to waste collection vehicle [4].

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 microwave.

## Cost of Biomedical Waste Management

The cost of construction, operation and maintenance of system for managing biomedical waste represents a significant part of overall budget of a hospital if the BMW handling rules 1998 have to be implemented in their true spirit. Govt of India in its pilot project for hospital waste management in Govt hospitals has estimated Rs.85 lakh as capital cost in 1000 bedded super speciality teaching hospital which includes on site final disposal of BMW. Two types of costs are required to be incurred by hospitals for BMW mgt, internal and external. Internal cost is the cost for segregation, mutilation, disinfection, internal storage and transportation including hidden cost of protective equipment. External cost involves off site transport of waste, treatment and final disposal [5].

## Common Regional Facility For Final Disposal of Infectious BMW

Hospitals, private practitioners, emergency care centers though aware of the rules do not have the time or resources to arrange satisfactory disposal of biomedical waste. Self contained on site treatment methods may be desirable and feasible for large healthcare facilities. They will not be practical or economical for smaller institutes. An acceptable common system should be in place which will provide free supply of colour coded bags, daily collection of infectious waste, safe transportation of waste to off site treatment facility and final disposal with suitable technology.

### Material and Methods

A study was conducted at following hospitals:-

| | |
|---|---|
| A Semi Govt teaching hospital | 540 beds |
| B Charitable trust hospital | 540 beds |
| C Govt hosp (state run hospital) | 1296 beds |
| D Private hospital | 223 beds |
| E Govt hosp (service hospital) | 1047 beds |

Keeping in view the infrastructural requirement for BMW management and adherence to BMW Rules 1998, total cost in terms of capital cost as well as operational cost (per month) was worked out for BMW management.

Methods of storage and segregation at ward / department level, internal transportation, kerb side storage, external transportation and on site final disposal / off site disposal were studied for all 5 hospitals by direct observation and infrastructure for the same was studied. Informal discussion with various hospital functionaries was carried out. Common regional facility for final disposal of infectious waste was also studied.

## Discussion

1. Comparison of five hospitals studied in terms of bed strength, waste generation, method of final disposal

**Table 2**

**Comparison of hospitals surveyed in Pune: method of disposal of BMW**

| | Beds | Waste | Infectious waste | Plastic waste | Final disposal |
|---|---|---|---|---|---|
| A Hosp Semi Govt teaching | 540 | 500 Kg | 10% | Sold without shredding | Sent to off site facility |
| B Hosp private | 540 | 510 Kg | 10% | Given to PMC for selling | Onsite incineration |
| C Hosp State Govt | 1296 | 735 Kg | 9% | Picked up by rag pickers | Onsite incineration |
| D Hosp charitable | 223 | 180 Kg | 10% | Mutilated and sold | Sent to off site facility |
| E Hosp service | 1047 | 821 Kg/day | 15.9% | Shredded & sold | Onsite incineration |

**Table 3**

**Cost of biomedical waste management capital cost**

| Capital cost | A Hosp | B Hosp | C Hosp | D Hosp | E Hosp |
|---|---|---|---|---|---|
| (a) Plastic drums | 54000/- | 56400/- | 52650/- | 20260/- | 45580/- |
| (b) Metal drums for kerb sites | Same are being used | Same are being used | Same are being used | 9000/- | 33600/- |
| (c) Protective gear for waste handlers | 1000/- | 7500/- | 1584/- | 1000/- | 21250/- |
| (d) Syringe and needle destroyers | 9500/- | 13000/- | 24000/- | 13600/- | 48000/- |
| (e) Plastic shredder | - | - | - | - | 180000/- (10-20 Kg/hr) |
| (f) Hand carts | 20000/- | Not being used | 23500/- | 9000/- | 40000/- |
| (g) Weighing scale | 500/- | Not being used | Not being used | 1000/- | 3250/- |
| Total | 85000/- | 76900/- | 101734/- | 53860/- | 371680/- |

etc. has been tabulated in Table 2.

2. Total cost of BMW management at each hospital in terms of capital cost and recurring expenditure is depicted in Table 3 & 4. Hospital E is following BMW Rules in totality, and hence has incurred high capital costs. Recurrent expenditure was found to be less in Hospital C vis a vis the quantity of waste due to non adherence to BMW Rules.

3. It was observed that Govt service hospital where BMW management was implemented as per BMW 1998 rules had process of segregation of waste at generation level into various colour coded bags and plastic drums, internal transportation of waste through trolleys to kerb site, storage at kerb site in various colour coded metallic drums, movement of plastic disposable waste to plastic shredders and transportation of infectious waste to on site incinerator was found to be completely in place. Safai karmacharis were using complete protective equipment like gloves, masks, shoes etc while handling waste and also sodium hypochlorite was available in each and every sharp generating site in wards as well as departments. The capital and recurring cost worked out for complete process thus was found to be high as compared to other hospitals as other hospitals had some shortcomings at every step of BMW management.

4. Plastic waste receptacles of different colour codes were being used in other non Govt hospitals without any consideration of rules. However, all these hospitals were collecting infectious waste into yellow colour coded bags (biodegradable) provided by Image India, a central facility. No plastic bags were being used for lining plastic buckets / receptacles for other type of wastes and other waste was being collected in single container. All the 3 hospitals were using needle destroyers for disposable needles. Plastic iv bottles, catheters and disposables were being mutilated physically and then either were sold to contractor or donated. Hospital B, a private hospital was utilizing facility of onsite incineration for infectious waste disposal. Incinerator was found to be twin chambered oil fired with regular checks from pollution control board. Hospitals A & D were sending their infectious waste to central facility of incineration. No hospital safai karmacharis were found to be using complete protective equipment, some of them were using latex gloves. In hospital A, waste destined for incineration is physically checked by laying out the waste and manual segregation is carried out which can result in injury to health care workers and should be avoided at any cost. Sodium hypochlorite is being very sparingly used and fresh solution was not available at most of the hospitals.

5. State run hospital was having plastic buckets of assorted variety at ward and department levels for waste collection, however most of them were in broken condition and no replacement was provided. Use of hypochlorite solution for sharps was non-existent. Proper segregation was not being carried out. Plastic waste was taken by rag pickers and sold to contractors at hospital waste dump itself. Trolleys for transportation of waste were being used for other purposes like carriage of linen and stores etc. Needles were being destroyed at source, however most of the needle destroyers were

**Table 4**

**Cost of consumables in BMW management per month (In rupees)**

| | A Hosp | B Hosp | C Hosp | D Hosp | E Hosp |
|---|---|---|---|---|---|
| Plastic bags | 6000 | 12000 | 9750 | 1800 | 20000 |
| Hypochlorite Rs.50/lit | 5000 | 6750 | 7500 | 5000 | 7500 |
| Gloves/Masks | 2000 | 2000 | 2000 | 2000 | 7000 |
| Outsourcing/ incineration | 20000 | 4500 | 9000 | 24000 | 2000 |
| Total | 33000 | 25250 | 28250 | 32800 | 36500 |

non-functional and physical mutilation was being resorted to which can prove to be dangerous for health care worker (HCW). Onsite incinerator is available and is oil fired double chambered type of very old vintage, however it remains non functional most of the time resulting in all the infectious waste finding its place in main municipality dump. Local municipal body as well as state Pollution Control Board do not check existing waste disposal arrangements of this hospital.

6. This city has implemented common regional facility for final disposal of biomedical waste generated by health care establishments. It has appointed M/s Image India to, offer the services of handling BMW on pay and use basis. The services include provision of bags, collection of bags containing infectious waste from all the hospitals with more than 20 beds, their transportation to the incinerator site, its incineration and final disposal of ash. They are collecting infectious waste from 446 nursing homes / hospitals all over the city. Approximately 1000 kg per day collection of waste is made with the help of two modified Tata 407 trucks. Three incinerators of twin chamber variety with approved chimney size with a total capacity of 40 kg/hr burning capacity each are functional. They are charging Rs.20 / kg of waste. Billing is done through municipal body and facility is being monitored by Municipality / State Pollution Control Board regularly.

7. Municipal Corporation / State Pollution Control Board checks only common waste facility. Nursing homes / hospitals registered with this facility are under constant scrutiny and are punished by levying fine, if any disposable plastic / sharps are found in yellow bags leading to forced re-checks of their waste which can result in injuries to HCWs. Other nursing homes, dental practitioners, hospitals, research facilities and private practitioners continue to dump their waste into main municipal garbage. Use of central incineration facility should be made compulsory for those hospitals who have defective incinerators as they are a source of pollution.

## Recommendations

1. After analysing the results of the study it was felt that there is an urgent need to standardise the infrastructural requirement so that hospitals following BMW handling rules meticulously do not suffer additional costs.

2. Hospitals having defunct / defective incinerators should be made to utilise central incineration facility as efforts of Govt are towards reducing the number of incinerators in cities to prevent rise in air pollution.

3. Small health care establishments in city which have still not registered with central facility should be encouraged to register thereby bringing down the operating cost of contractor and decrease the cost of incineration per kg.

4. Govt hospitals which at present are totally left on their own, should be brought into net of rigorous checking as far as BMW management is concerned and a corpus grant can be allotted to them to improve their infrastructural requirements for which provision exists in Govt of India Rules.

5. Community is utilising the services of hospitals and by “Polluter Pays” principle, it needs to contribute in building infrastructure for BMW mgt. This contribution can be in the form of assistance in sharing the cost of consumables and capital cost of BMW mgt by Municipality, State Govt, Public bodies and Voluntary bodies like Rotary Club etc.

## References

1. Rao SKM, Garg RK. A study of Hospital Waste Disposal System in Service Hospital. Journal of Academy of Hospital Administration July 1994;6(2):27-31.
2. Singh IB, Sarma RK. Hospital Waste Disposal System and Technology. Journal of Academy of Hospital Administration, July 1996;8(2):44-8.
3. Acharya DB, Singh Meeta. The book of Hospital Waste Management. Minerva Press, New Delhi 2000;15,47.
4. Srivastava JN. Hospital Waste Management project at Command Hospital, Air Force, Bangalore. National Seminar on Hospital waste Management: a report 27 May 2000.
5. A study of Hospital Waste Management System in Command Hospital (Southern Command), Pune; a dissertation submitted to University of Pune. Wg Cdr RK Ranyal Dec 2001;page 37.