

Biomedical Waste Management- Delhi Experience

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There are 2233 health care institutions with indoor facilities in public and private sector in Delhi. The average quantum of waste generated in Delhi Government Hospitals is 260 grams per bed per day whereas it is 200 grams per bed per day in hospitals other than Delhi Government. Needle stick injuries are commonest hazard of biomedical waste. There are 18 Incinerators, 18 Autoclaves and 3 Microwaves for biomedical waste management in Delhi with a total capacity of 2675 Kg/hour. The average cost involved in management of biomedical waste is Rs.5361/- per bed per annum. The institutions using on site treatment facility are spending three times more than the facilities using centralized biomedical waste treatment facilities for biomedical waste management.

Every thing is made for a defined purpose. 'Anything which is not intended for further use is termed as waste'. There are large number of health care institutions in Delhi managed by various agencies. Major stakeholders are Government of India, Delhi Government, Municipal Corporation of Delhi and New Delhi Municipal Council, Employees State Insurance

Scheme and private registered nursing homes. In Delhi, there are 72 hospitals under govt. sector, 610 registered nursing homes and 945 dispensaries. In addition to this there are about 1550 unregistered establishments with different names like Nursing Homes, Medical Centers, Dental Hospitals and MTP Centers etc. More than 41000 hospital beds are available in the public and private sector in Delhi.

LEGAL PROVISIONS

Ministry of Environment & Forest, Govt. of India issued a notification for Biomedical Waste (Management & Handling) Rules 1998 in exercise of powers conferred by section 6, 8 & 25 of the Environment (Protection) Act, 1986. Under these rules, the Delhi Pollution Control Committee has been designated as prescribed authority to implement these rules in the National Capital Territory of Delhi. The Lt. Governor of Delhi has constituted an advisory committee which has 10 members with Parliamentary Secretary (Health & FW), Govt. of Delhi as Chairman and Director Health Services as member secretary / convener (7). It is the primary responsibility of the

Table 1: Agency wise Healthcare Institutions in Delhi

| Sl.No. | Organization | Hospitals | Beds | Dispy | Allop | Homeo | Ayur | Unani | SHS | MHS | MCWC | Total |
|--------|-----------------|-----------|-------|-------|-------|-------|------|-------|-----|-----|------|-------|
| 1 | Delhi Govt | 31 | 7704 | 391 | 193 | 51 | 12 | 0 | 63 | 72 | 0 | 391 |
| 2 | MCD | 15 | 3625 | 274 | 37 | 14 | 99 | 15 | 0 | 0 | 109 | 274 |
| 3 | NDMC | 2 | 200 | 45 | 11 | 12 | 10 | | | | 12 | 45 |
| 4 | ESIC | 4 | 1000 | 34 | 34 | | | | | | | 34 |
| 5 | Central Govt. | 10 | 3840 | 99 | 84 | 11 | 3 | 1 | | | | 99 |
| 6 | Autonomous | 6 | 2994 | 0 | | | | | | | | 0 |
| 7 | Defence | 3 | 1850 | 1 | 1 | | | | | | | 1 |
| 8 | DVB | 0 | | 24 | 24 | | | | | | | 24 |
| 9 | DJB | 0 | | 15 | 14 | | 1 | | | | | 15 |
| 10 | DTC | 0 | | 27 | 27 | | | | | | | 27 |
| 11 | SBI | 0 | | 9 | 9 | | | | | | | 9 |
| 12 | RBI | 0 | | 8 | 8 | | | | | | | 8 |
| 13 | Railways | 2 | 466 | 12 | 12 | | | | | | | 12 |
| 14 | Thermal Plants | 0 | | 3 | 3 | | | | | | | 3 |
| 15 | Indian Airlines | 0 | | 3 | 3 | | | | | | | 3 |
| 16 | Regd. NH | 610 | 15079 | 0 | | | | | | | | |
| 17 | Un Regd. NH | 1550 | 5000 | 0 | | | | | | | | |
| | Total | 2233 | 41758 | 945 | 460 | 88 | 125 | 16 | 63 | 72 | 121 | 945 |

government to implement the recommendations and directions of the Supreme Court and these rules in public interest, so that biomedical waste does not cause any harm to human health, animal and environment.

FEE STRUCTURE IN DELHI FOR AUTHORIZATION

All health care institutions attending more than 1000 patients per month are liable to obtain authorization from prescribed authority i.e. Delhi Pollution Control Committee. The Delhi Government has approved following fee structure for obtaining authorization from Delhi Pollution Control Committee.

Violators/defaulters are liable to be fined up to Rs.100,000/- (Rupees One Lac only) or imprisoned for five years or both. So far DPCC has taken action against 12 health care institutions.

| Sl. No. | Type of Health Care Institutions/facility | Fee in Rupees |
|---------|---|---|
| 1 | Clinics, pathological labs and blood banks | Rs.1000/- per annum |
| 2 | Veterinary institutions, dispensaries & animal houses | Rs.1000/- per annum |
| 3 | Hospitals, nursing homes and health care establishment | Rs.1000/- per annum up to 4 beds & additional Rs.100 per bed per annum from fifth bed onwards |
| 4 | Operator of the facility of bio-medical waste (excluding participation) | Rs.10000/- per annum |
| 5 | Transporter of bio-medical waste | Rs.7500/- per annum |

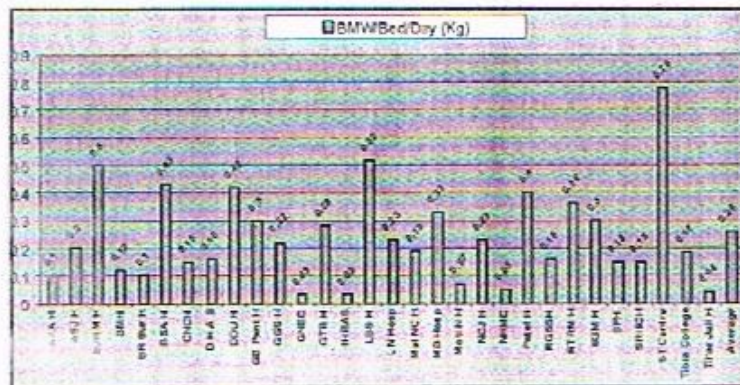


Fig. 1: Hospitals

QUANTUM OF WASTE

The quantity of waste produced in India is estimated to be 1-2 Kg per bed per day whereas in United States, it is as high as 5kg per bed per day (5). Medical waste is subset of municipal waste, and regulated medical waste comprises less than 1% of municipal waste produced in United States (10). The hospital waste generated in a tertiary care hospital of Delhi is 1.45 kg per bed per day (2).

BIOMEDICAL WASTE GENERATED IN GNCT HOSPITALS PER BED PER DAY

Delhi is generating approximately 7000 metric tons of municipal waste out of which 70 tons are expected to be biomedical waste. Biomedical waste generated in 30 Delhi govt. hospitals varies from 780 grams/bed/day (Shushruta Trauma Centre) to 30 gram /bed/day (Guru Nanak Eye Centre) with an average of 260 gram /bed /day. Similarly biomedical waste generated in 30 hospitals other than Delhi Govt. vary from 580 grams/bed/day (Infectious Disease Hospital) to 30 gram /bed/day (Venu Eye Institute and Research Centre) with an average of 200 gram /bed /day (4).

COST INVOLVED

The cost per bed per year involved in management of biomedical is Rs.5361. The institutions having on site treatment facility are spending three times more than the institutions utilizing services of Centralized facility. The average expenditure for institutions having onsite treatment facility is Rs.7228 whereas the institutions using centralized facility are spending only Rs.2100 per bed per annum (4).

COST RS/BED PER DAY ON BIOMEDICAL WASTE MANAGEMENT

Keeping in view the difficulties faced by private hospitals, nursing homes and clinics that cannot make their own arrangements due to high cost involved in treatment facilities, there is a need for centralized system for treatment. In order to facilitate the proper treatment of the biomedical waste generated from smaller nursing homes /clinics / blood banks/diagnostic

laboratories etc., the Government is taking initiatives to establish centralized waste treatment facilities. The Delhi Government has purchased land from Delhi Development Authority (DDA) for establishment of centralized biomedical waste treatment facilities at Okhla and Gazipur in Delhi. The Okhla plant has become operational on 11th November 2006. The Gazipur plant will be ready in 2009. At present there are two entrepreneurs in the market namely 'Synergy Waste Management Pvt Ltd. at Okhla, Delhi.' and 'Metro Bio-care Technological Services, 55, Railway Road, Samaipur Industrial Area, Delhi-42'.

HAZARDS OF HEALTH CARE WASTE

In additions to the legal provisions to manage waste in safe and eco-friendly manner, there are compelling reasons to prevent the hazards of health care waste. Percutaneous needle stick injuries are very common in (27%) health care staff including 100% dentists, 81% surgeons, 32% non surgical physicians and 31% of nursing staff (1). The commonest hazards are as follows:

1. Infection: Organisms can enter in the body through a puncture, abrasion, or cut in the skin; through mucous membranes; by inhalation and ingestion.
 - a. Commonest infections are gastro enteric through faeces and/or vomit (Salmonella, Shigella spp., Vibrio cholera, Helminthes; Hepatitis A),
 - b. Respiratory infections through inhaled secretions; saliva (Mycobacterium tuberculosis; measles virus; streptococcus pneumoniae),
 - c. Ocular infections through eye secretions (Herpes virus),
 - d. Genital infections (Neisseria gonorrhoeae; herpes virus),
 - e. Skin infection through pus (Streptococcus spp.),
 - f. Meningitis through cerebrospinal fluid (Neisseria meningitides),
 - g. AIDS through blood and sexual secretions (HIV),

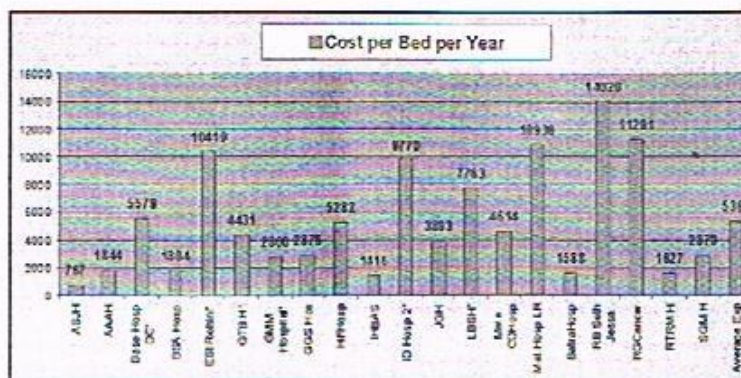


Fig. 2 : Hospitals

- h. Haemorrhagic fevers through body fluids (Junin, Lassa, Ebola and Marburg viruses),
 - i. Septicaemia and bacteraemia through blood (staphylococcus aureus, Enterococcus, enterobacter, klebsiella and streptococcus) and
 - j. Viral Hepatitis B & C through blood and body fluids (hepatitis B & C viruses).
2. Genotoxicity and Cytotoxicity: Many cytotoxic drugs are extremely irritant and have harmful local effects after direct contact with skin and eyes (alkylating agents; intercalating agents; vinca alkaloids and derivatives and epipodophyllotoxins). Many neoplastic drugs are carcinogenic and mutagenic; secondary neoplasia is known to be associated with chemotherapy.
 3. Chemical toxicity: toxic, genotoxic, corrosive, flammable, reactive, explosive and shock-sensitive. They may cause intoxication by acute or chronic exposure, injuries including burns, poisoning.
 4. Radioactivity hazards: The radioactive waste exposure may cause headache, dizziness, vomiting, genotoxicity and tissue damage.
 5. Physical injuries: May result from sharps, chemicals and explosive agents.
 6. Public sensitivity: The general public is very sensitive about visual impact of the anatomical waste, recognizable body parts including foetuses if handled improperly (12)

SOUND WASTE MANAGEMENT PRACTICES

SEGREGATED COLLECTION

Segregation need to be done at source in colour coded containers (red, yellow, blue / white translucent & black). There should be puncture proof containers for sharps. The bags once 3/4th filled should be tied. The label should be put for name of ward, date of packaging, destination (treatment site) bio hazard / cytotoxic symbol. There should be weighing & recording in separate register with separate weighing machine. The daily recording should be supervised

STORAGE

As per biomedical waste (management & handling) rules 1998, there should be no storage beyond 48 hours, and if unavoidable, information should be sent to prescribed authority and adequate measures taken so that there are no hazards to human health & environment. Storage site should be washable, rodent, animal, rag picker proof and at height of at least one foot from ground, clean smooth stone walls and flooring with proper lock & gate with guard on duty.

TRANSPORTATION

Inside hospitals, we can use wheel barrow/ trolley. It should be covered, washable with rounded corners. It should be separate for general & bio-medical waste, preferably colour coded, spillage proof. There should be separate cleaning facility for daily disinfection. For transportation outside the hospital there should be special vehicle authorized by DPCC/ SPCB/ prescribed authority. Vehicle should have separate compartments for

temperature in primary chamber 800 ± 500 C and secondary chamber 1050 ± 500 C. Waste treated

| Cate-gory | Waste type | Treatment /disposal |
|-----------|--|--|
| Cat. 1 | Human anatomical waste | Incineration @ deep burial* |
| Cat. 2 | Animal waste | Incineration @ deep burial* |
| Cat. 3 | Microbiology & bio-technology waste: | Local autoclaving/ micro waving/incineration @ |
| Cat. 4 | Waste sharps | Disinfection by chemical treatment @@@ / autoclaving / microwaving and mutilation/ shredding # # |
| Cat. 5 | Discarded medicines and cytotoxic drugs: | Incineration @/destruction & drugs disposal in secured landfills |
| Cat. 6 | Soiled waste : | Incineration @ autoclaving/ micro waving |
| Cat. 7 | Solid waste (disposables): | Disinfection by chemical treatment @@ /autoclaving/ microwaving and mutilation/ shredding # # |
| Cat. 8 | Liquid waste | Disinfection by chemical treatment @@ and discharge into drains |
| Cat. 9 | Incinerator ash | Disposal in municipal landfill |
| Cat.10 | Chemical waste | Chemical treatment @@ & discharge into drains for liquids and secured landfill for solids |

driver & waste. It should be pollution free, small or medium size with easy maneuverability, aesthetically good and preferably air conditioned. The diagnostic specimens must be packed in a triple packaging consisting of primary receptacle, a secondary packaging and an outer packaging. The completed package must be capable of passing the drop testing 178.603 of the drop height of at least 1.2 meters or 3.9 feet (9).

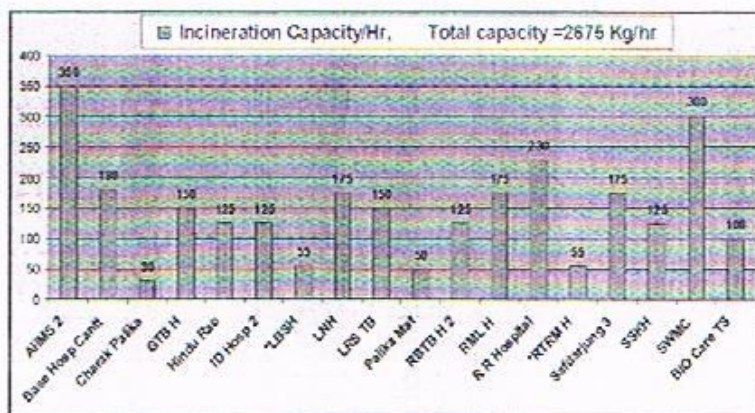


Fig. 3 : Hospitals

TREATMENT & DISPOSAL

There are ten categories mentioned under the rules. The biomedical waste management and handling rules 1998 (11) have suggested the following treatment and disposal:

INCINERATOR

The quality of incinerator depends on the capacity, make and its type. Today only double chambered incinerators are allowed with

with chlorinated disinfectants/ chlorinated plastics should not be incinerated. The fuel used is low sulphur Diesel/ LDO. The Stack Height should be more than 30 meters. The incinerator should be fitted with scrubber / pollution control device. Ashes need to be disposed of properly in the secured land fill. Aesthetics of Treatment Facilities should always be highest.

INCINERATORS CAPACITY IN DELHI:

The Government hospitals and major private hospitals have their own arrangement for treatment of biomedical waste. At present there are 18 incinerators, 18 autoclaves and 3 microwaves in operation in Delhi. Delhi has total incinerator capacity of 2675 kg per hour (figure3) Delhi has total incinerator capacity of 2675 kg per hour (figure3) which is more than sufficient if proper segregation is done at source of generation of biomedical waste(4).

AUTOCLAVE

There are two kinds of autoclave available in the market: gravity flow and vacuum flow. This works on the wet heat sterilization mechanism. Gravity flow Autoclave works on following parameters:

- Temp. >121 degree C; Pressure 15 psi; Residual Time >60 minutes. (OR)
- Temp. >135 degree C; Pressure 31 psi; Residual Time >45 minutes (OR)
- Temp. >149 degree C; Pressure 52 psi; Residual Time >30 minutes

Vacuum Autoclave works on following parameters:

- Temp. >121 degree C; Pressure 15 psi; Residual Time >45 minutes (OR)
- Temp. >135 degree C; Pressure 31 psi; Residual Time >30 minutes (6).

Sterilization monitoring and validation test are done to verify the efficacy of the autoclave. Wet heat sterilization is considered to be cost effective and pollution free treatment technology for infectious waste.

MICROWAVE

It cannot to be used for cytotoxic, hazardous or radioactive wastes, contaminated animal

carcasses, body parts & large metal items. Use of metal detectors and scintillators is required for microwaves. Efficacy test / routine test are similar to autoclave. Performance Guarantee by supplier before operation is essential as it may go out of order more frequently.

MUTILATION

The waste should be disposed of after proper mutilation to make it unrecognizable. The shredder should be covered, spillage & sound proof and ergonomically designed. There should be no illegal recycling / reuse of waste. For sharps and needles in side the wards there should be needle destroyer. We need to ensure its availability, working conditions, usage, electric supply, proper connections, ergonomics, adequate quantity purchased, issued and service points and continuous maintenance & repair. The shredders in Delhi government hospitals lack conveyer belts.

ERGONOMICS OR HUMAN ENGINEERING

It refers to the design of machines, machine systems, work methods, and environments to take into account the safety, comfort, and productiveness of human users and operators. It is mutual adjustment of man and machine, seeking to ensure that the tools and machines man uses and the work he performs are in accordance with his physical characteristics. The equipment need to be ergonomically designed and aesthetically used.

EFFLUENT TREATMENT PLANT (ETP)

Effluent Treatment Plant is required to maintain the Standards of Liquid waste. The quantum of liquid waste generated in Europe is 1000liters per patient per day (3-5 times more than standard citizen) (8) whereas quantum of liquid waste generated in Delhi is 1470 liters per bed per day (3). The effluent generated from the hospital should confirm to the following limits (11):

| Parameters | Permissible Limits |
|------------------|--|
| PH | 6.5-9.0 |
| Suspended Solids | 100 mg/l |
| Oil and Grease | 10 mg/l |
| BOD | 30 mg/l |
| COD | 250 mg/l |
| Bio-assay test | 90% survival of fish after 96 hours in 100% effluent |

CENTRALISED BIOMEDICAL WASTE TREATMENT FACILITIES (CBWTF)

Total number of CBWTF operating in the country is about 143. The average no. of health care facilities per CBWTF are 508 and average No. of beds catered by CBWTF are 6606. There are three largest operators of CBWTF in the country:

Maharashtra: M/s. E.A. Infrastructure Operation Pvt. Ltd., Mumbai,

Punjab: M/s. SembRamky Environmental Management Pvt. Ltd. Ludhiana,

Delhi: Synergy Waste Management Pvt. Ltd, Delhi

The directorate of health services has recently proposed to amend the Delhi Nursing Homes Registration Rules to incorporate such clauses by which it becomes mandatory for nursing homes to implement the Biomedical Waste (Management & Handling) Rules 1998.

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ISHWM - INTERNATIONAL CONFERENCE ON HEALTH CARE WASTE MANAGEMENT - 2010

With the objective of promoting and strengthening information exchange between countries, the decennial conference of Indian Society of Hospital Waste Management (ISHWM) is being designed as an International conference on Health Care Waste Management at New Delhi in October 2010. The event will have distinguished participants from across the South East Asia Region and other parts of the world and will focus on all facets of health care waste management – legislations, system development, training and capacity building, worker safety, patient safety, hospital acquired infection, alternative technological options and best practices. Coupled with Continuing Medical Education workshops as pre-conference events, exhibitions on alternative technologies it will be a resourceful event.

Suggestions, collaborations, sponsorships, participation in the exhibition, participation in the conference, CME, exhibition is most welcome. Please visit website medwasteind.org for details.