

HOSPITAL WASTE — A MAJOR PROBLEM

Mukesh Yadav MD.

1. INTRODUCTION

The World Health Organisation Regional office for Europe convened a meeting of concerned personal at Bergen, Norway in 1983, which was the first time when this issue was discussed. The seriousness of improper Bio-Medical Waste management was brought to the limelight during the "beach wash-ups" during summer 1998; which was investigated by the Environment Protection Agency (EPA) of USA; and it culminated in the passing of Medical Waste Tracking Act (MwTA) Nov. 1988. This made USA the pioneer as far as waste management is concerned.

The issue of indiscriminate Bio-Medical Waste management in India has attracted the attention of the highest judicial body at the level of Hon'ble Supreme Court of India and Apex Court has, from time to time issued instructions regarding management of Bio-Medical Waste².

In this background in persuasion to the directive of the Court, the Ministry of Environment and Forests, Government of India notified the Bio-Medical Waste (Management and Handling) Rules on 27th July 1998; under the provision of Environment Protection Act 1986. Accordingly all the hospitals in the public and private sector are now bound to follow these rules to evade legal actions³.

2. MAGNITUDE OF THE PROBLEM

2.1. Globally

The quantity of Bio-Medical Waste generated will vary depending on the hospital policies and practices and the type of care being provided. The data available from developed countries indicate a range from 1-5 Kg/bed/day, with substantial inter country and inter speciality differences⁴. Meagre data from developing countries indicates that the range is essentially similar but the figures are lower i.e. 1-2 Kg/day/patient⁵.

According to a WHO report, around 85% of the hospital wastes are actually non hazardous, 10% are infective (hence, hazardous), and the remaining 5% are non-infectious but hazardous (chemical, pharmaceutical and radioactive)⁶.

2.2. In India

There are no national level studies on quantity of hospital waste generated per bed per day; but studies have been carried out at local or regional levels in various hospitals.

Whatever data are available from these studies, it can safely be presumed that in most hospitals roughly about 1-2 Kg/bed/day of waste is generated. Some of the notable studies are shown in the table No 3.

One study claim:;, the estimated quantity of the waste generated in the hospitals varies from 2-5 kgs/bed/day with a total Bio-Medical Waste generated 11-14 tons/day in the city of Srinagar alone (with 13 hospitals, 13 nursing homes, 31 dispensaries and 88 health centres and polyclinics). (The Himalyan Mail Oct. 30, 2000: 1.)

3. Health Hazards from Indiscriminate Management of Bio-Medical Waste

There are many examples and ample evidences that indiscriminate management of Bio-Medical Waste could cause serious hazards to health and environment as follows-

- 3.1. There are many harmful agents in the Biomedical waste. The most important are Biological agents, which pollute water and food and cause alimentary infections like cholera, typhoid, dysentery, infective hepatitis, polio, ascariasis and hook worm diseases etc.
- 3.2. Wastes breed vermin and pests. Examples are:
 - a. Mosquitoes that transmit insect borne diseases like malaria and filaria.
 - b. Common house flies which transmit infections mechanically.
 - c. Many other insects and worms that cause nuisance e.g. cockroaches, ants.
 - d. Rats thriving on refuse.
- 3.3. Dust may harbour Tubercle Bacilli and other germs, which cause diseases if inhaled.
- 3.4. Soil polluted by night soil may be rich in Tetanus spores.
- 3.5. Nosocomial infections and AIDS, Hepatitis B&C etc.
- 3.6. *Aesthetic*: -Sullage water, refuse and night soil, all create intolerable nuisance of sight and smell.

4. Pathophysiology

The blood born pathogens have gained significant attention after the attack of HIV and HBV, HCV which can lead to AIDS and Hepatitis B, C etc in addition to other viral and bacterial infections. The Hepatitis B virus (HBV)

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From the Department of Forensic Medicine ACOMS and Hospitals, Sidhra Jammu (Yadav)

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Correspondence: Dr Mukesh Yadav. H No. 81, Sector-6. Trikuta Nagar. Jammu 180012 Ph. 0191-472496

carries the greatest risk of transmission as about 25% of HBV- infected persons develop acute Hepatitis with the possible complications of cirrhosis of liver and liver cancer. The HBV transmission is quite similar to HIV as it only occurs through direct contact between an open wound, non-intact skin or mucous membrane, contaminated blood and body fluids, sexual contact, **transplacental** route. The needle prick injuries and broken injection foils may cause the transmission of HBV. Similarly HIV is the most critical infection with no cure.

The out break of TB among hospital employees and other nosocomial infections among patients are largely attributed to the low index of suspicion for TB and delayed diagnosis. The outbreak of cholera and other water born diseases are also attributed to indiscriminate management of Bio-Medical Waste.

5. Who are at more risk?

The doctors, nurses, technicians, washermans, sweepers, hospital visitors, patients, rag pickers and their relatives are exposed routinely to Bio-Medical Waste and are at more risk from the many fatal infections due to indiscriminate management.

6. Why Bio-Medical Waste needs Management?

It is needed due to health, Environmental, legal and aesthetic reasons in addition to Ethical reasons.

Ethical aspect

The ethical aspect related to the social responsibilities, which the health professions have, as a result of their status, knowledge and skills and an obligation to alert those who are at risk. This is reflected by the compulsory notification of infectious and notifiable diseases as a measure of public welfare. As regards Bio-Medical Waste management health professionals, bear a responsibility to act in such a way to prevent exposure to various health hazards and exposures to **dioxins**⁷. As Bio-Medical Waste are the major source of dioxine production during incineration, which are generally cause of incurable cancers, the Medical ethics dictate that prevention must be carried out as we all are bound by Hippocratic oath.

7. Reasons for indiscriminate management and handling of Bio-Medical Waste

- 7.1. Lack of Priority in policy on Bio-Medical Waste Management and funds on the issue.
- 7.2. Lack of Managerial skill and Training of Bio-Medical Waste Management.
- 7.3. Lack of Appropriate technologies for treatment and disposal of Bio-Medical Waste.
- 7.4. Lack of Strict implementation of infection control

- I measures like sterilization and disinfectant techniques.
- 7.5. Lack of Awareness among medical personal, patients, attendants and people at large.
- 7.6. Lack of coordination between municipality, Pollution Control Board and hospital authorities.
- 7.7. Lack of Accountability of persons involved in the management of Bio-Medical Waste. ,

8. Management of Bio-Medical Waste.

The working group on Hospital Waste Management constituted by WHO in 1983, was unanimously agreed upon that health care establishments should be held legally accountable for their waste management practices, based on the universal principle that the “generator is responsible”. As far as possible the “cradle to grave” system of notification should be followed, which implies that all stages of waste disposal are systematically controlled. The need for and nature of the control measures must be an integral part of overall hazardous waste management policy’.

9. What is Bio-Medical Waste?

The Bio-Medical Waste means any solid, fluid or liquid waste including the containers and any intermediate product, which is generated during the diagnosis treatment or immunisation of human beings or animal?. In other words, the rubbish containing human tissues, body fluids, **excreta**, unused drugs, swabs, disposable syringes and sticky bandages etc. constitutes Bio-Medical Waste.

10. Classification of Bio-Medical Waste (See Table No. 4)

This schedule of classification should be displayed at strategic locations like inside the dressing rooms, nursing stations, OT, pharmaceutical units so that doctors and nurses are made aware, preferably in local language so that patients, and attendants also benefit from it.

11. Who are the generators of the Bio-Medical Waste?

Definition

“Generator” means any person nominated on behalf of a hospital, nursing home, clinic, dispensary, laboratory, animal house, slaughter house, veterinary institutions including those established by or under, the control of Govt. which generates or cause to be generated, handles or cause to be handled any Bio-Medical Waste or where no such person is nominated the person **incharge** thereof.

Thus, all the Hospitals, nursing homes, veterinary hospitals, clinics, dispensaries, diagnostic laboratories, pathological laboratories, blood banks, mortuary and any other health care establishments are the potential generators of Bio-Medical Waste³.

To ensure a clean and healthy environment we require, segregated collection safe transportation and storage, environmentally sound treatment and disposal of **Bio-Medical Waste** in eco-friendly manner. There are following stages of Management of Bio-Medical **Waste:** •

12. Segregation of Bio-Medical Waste

Definition

Segregation means “separation of different types of wastes **by** sorting or the systematic separation of **Bio-Medical Waste** into designated **categories**”³.

Significance

It is the most important step in the entire process of **Bio-Medical Waste** management. As it needs special attention to **be** given to the relatively small quantities of infectious and hazardous waste, there by reducing not only the risks but the cost of handling, treatment and disposal. For example if general waste gets mixed with infectious waste, the whole waste has to be incinerated which may prove to be costly.

Who are responsible for segregation?

It is universally accepted fact that segregation of **Bio-Medical Waste** is and should be the responsibility of the generator of the waste. The generators of the waste are those persons in any health care establishment who generate or produce wastes, viz. doctors, nurses, paramedical staff, patients, and their attendants. These Medical persons who are educated and trained surprisingly they are least bothered **about the amount, quantity and type** of waste they generate and the way it is disposed.

It is these persons who question the sanitation staff and pull them up for improper segregation while forgetting that if they themselves practice segregation when ever they are generating waste, is the best policy rather than blaming the sanitation staff who is generally illiterate and is likely to make mistakes.

Why Emphasis on sharps?

During segregation special emphasis should be given to **infectious**, hazardous and sharp wastes. From amongst all categories of waste, the “sharps” which include syringes, needles, trocar, canula, guide wires, broken glasswares, scalpel, blades etc. have the highest disease transmission potential. Almost 85% of sharp injuries are caused between their usage and subsequent disposal and more than 20% of those handle them encounter “stick” injuries. The emphasis should be on safe handling, rather than on the various treatment and disposal options*, However, use of needle cutter or needle malter is of great help.

The staff involved in **Bio-Medical Waste** handling should be given all personal protection measures such as caps, masks, gum boots, gloves etc. They should also be

vaccinated for Tetanus and Hepatitis B and follow up health check up along **with** record keeping regarding their health status is necessary step.

Solution

Till the doctors do not wake up to this problem, the ground reality will not improve in any way. Thus it can very well be said that “sensitising” the generators of waste to properly segregate the waste at the source of generation is the “Key” to the **successful** implementation of **Bio-Medical Waste (M&H) Rules 1998**.

13. Collection of Bio-Medical Waste

Bio-Medical Waste should be segregated at source of generation and collected in prescribed colour-coded bins according to classification as shown in Table No.4.

13.1. Containers

The dustbin should be **light with a cover** and size enough to be carried by a person.

Inner plastic bag is also used to facilitate the **lifting** of waste content for transferring

Coloured bags/dustbins should be placed in different parts of the hospital.

Segregation and collection both can be considered as being complementary to each other.

13.2. Labelling

If containers are transported inside the premises for treatment then it shall be **labelled** according to schedule III, but if a container is transported outside the premises, where **Bio-Medical Waste** treatment facility is not present, the containers shall, apart **from** the label prescribed in schedule III, also carry information prescribed in schedule IV.

Schedule for Providing Waste Treatment Facilities

Like **Incineration/Autoclave/Microwave** etc. (Schedule IV. Rule **5**)

Table No. 1

Sl. CATAGORY	EFFECTIVE DATE
1. Hospital and nursing homes in towns with population of 30 Lakh and above.	By 31st Dec. 1999
2. Hospital and nursing homes in towns with population below 30 Lakh	
a. With 500 beds and above	31st Dec. 1999
b. With 200 beds and above but less than 500	31st Dec. 2000
c. With 50 beds and above but less than 200.	31st Dec. 2001
d. With less than 50 beds.	31st Dec. 2001
3. All other institutions generating biomedical waste but not included in 1. & 2. Above	30th June, 2000

14. Storage of Bio-Medical Waste

Definition

● Storage means “ the holding of Bio-Medical Waste for such period of time, at the end of which waste is treated and disposed off”⁴.

The container in which such wastes are stored shall display promptly International Biohazards symbol label in red colour with tails of Bio-Medical Wastes as specified in schedule III. The packaging of all such wastes is done in sturdy leak proof containers conforming to specifications mentioned in schedule II.

Duration

No such waste shall be stored in any place where it is generated beyond a period of 48 hours, provided that if for any reasons it is necessary to store any such wastes beyond a period of 48 hours, the authorised person shall take necessary permission of appropriate authority and shall take such measures so that waste does not decay or putrefy so as to cause hazard to human or animals or environment.

15. Transportation of Bio-Medical Waste

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Definition

It means “movement of Bio-Medical Waste from the point of generation or collection to the final disposal”⁴.

THE FEE STRUCTURE FOR SEEKING AUTHORISATION.

(Providing service or treatment to more than 1000 patients per month)

TABLE NO. 2

Sl. PARTICULARS	FEE PER ANNUM
1. Clinics, Pathological laboratories, Blood Banks.	Rs.1000.00
2. Veterinary institutions, dispensaries and animal houses.	Rs.1000.00
3. Hospitals, nursing homes and health care establishments.	Rs.1000/- up to 4 beds & additional Rs. 100/-bed/annum from 5th bed onwards
4. Operator of the facility of Bio-medical Waste (Excluding transportation)	Rs.10000.00
5. Transporters of Bio-medical waste	Rs. 7500.00

QUANTITY OF WASTE GENERATED AT VARIOUS PLACES IN INDIA

TABLE NO. 3

Sl. Place of Study	Type of Hospitals	Quantity of Bio -Medical Waste generated in Kg/pt/day	#Composition of E&Medical Waste
1. Kolkata ⁸ AIIPH	Govt., Private Nursing Homes (Large Hospitals)	1.044 to 1.368	20-30% Infectious 50-75% general waste
2. New Delhi Vatavaran NIHFW ⁹ AIIMS ¹⁰	Govt. and Pvt. Hospitals Govt. Teaching Hospitals Tertiary care (research hospitals)	1.5 kg 1.4 to 1.6 Kg.	45% infectious waste
3. Mumbai TMH	Tertiary Care Cancer Hospital	1.13% KG.	46% infectious
4. Jaipur ¹¹	Large Tertiary	1.5 Kg.	

SMS MC	Care Hospital Small Hospitals	0.25-0.5% Kg.	
5. Manipal ¹² KMC Manipal	Large Tertiary Care Hospital	0.775 Kg.	16.26% infectious
6. Punjab ¹³ Amritsar	Large Tertiary Care hospital	1,051-1.30 Kg.	

15.1. Type of Vehicle

No such waste shall be transported on site or off site in any vehicle other than those specially designed and recommended for the purpose. The appropriate authority shall evolve a protocol of safe transportation of such wastes taking into account various local factors, and make available a copy of the same to every authorised person.

15.2. Timing of transportation

It should not clash with peak working hours, visiting hours and meal distribution timing. The timing of transportation of infectious and non-infectious waste should be different.

15.3. Documentation system

There should be proper documentation system in which should be recorded, the type of Bio-Medical Waste, taken by whom, for which type of disposal on a specific date/shift. This is to ensure that all such wastes are actually disposed off, as per guidelines.

Colour Coding and type of container, Treatment and disposal options of Bio-Medical Waste (Schedule No. II, Rule No.6) Table No. 4

Sl. Waste Classification and Category	Types of Container /Colour Coding	Treatment/Disposal options as per Schedule I
1. Human anatomical waste (human tissues, organs, body parts etc.) Animal Waste (animal tissues, organs, body parts, carcasses, etc. of experimental animals used in research), Microbiology and Biotechnology waste (discarded laboratory cultures, stocks or specimens of microorganisms, live/attenuated vaccines, human/ animal cell culture), and Solid waste (items contained with blood/body fluids, such as dressings, plaster casts, cotton etc.) Cat.1, Cat.2, Cat.3, and Cat.6.	Plastic bag Yellow when Collected, material to be subjected to either incineration or deep burial	Incineration/Deep Burial
2. Solid waste (disposable items other than waste sharps, such as tubings, catheters, Intravenous sets etc.), Microbiology and Biotechnology waste (as above) and Solid waste (as above). Cat.3, Cat.6 and Cat.7.	Plastic Bag/disinfected Container Red when the waste is to be steam sterilised, like autoclave Other processed microwaved/treated chemically	Autoclaving/ Microwaving/ Chemical treatment
3. Waste sharps (needles, syringes, scalpels, blades, broken glass etc) proof container and Solid waste (as above). Cat.4 and Cat.7	Plastic bag/Puncture proof container Blue	Autoclaving/ Microwaving/ Chemical treatment/ destruction and shredding
4. Discarded medicines and cytotoxic drugs, Incineration ash and Chemical waste	Plastic bag Black	Disposal in secured landfill

(chemicals used in production of biologicals or as disinfectants etc.)
Cat.5, Cat9, Cat10 (sohd)

16. Treatment of Bio-Medical Waste

Definition

Treatment means “any method, technique or process for altering the biological, chemical or physical characteristics of waste to reduce the hazards it presents and facilitate, or reduce the costs of disposals”⁴.

16.1. Objectives

The basic treatment objectives of Bio-Medical Waste include volume reduction, disinfections, neutralisation or other change of composition to reduce hazards to health and environment. After such treatment the residues can be handled safely, transported, stored and disposed off.

16.2. Site

As prescribed by the competent authority.

16.3. Technology options for Treatment

There are mainly five technology options available for the treatment of Bio-Medical Waste, which are as follows

163.1. Chemical treatment

163.2. Thermal treatment

- a. Autoclaving
- b. Hydroclaving
- c. Incineration
- d. Pyrolysis
- e. Plasma and plasma pyrolysis systems
- f. Microwave

1633. Mechanical treatment

- a. Compaction
- b. Pulverisation
- c. Grinding and shredding

163.4. Irradiation

163.5. Biological method

17. Disposal of Bio-Medical Waste

Definition

It means “burial, deposit, discharge, dumping, or release of any Bio-Medical Waste into or on any air, land, or water”⁴. After treatment of the Bio-Medical Waste, it becomes non infectious or non hazardous and depending upon the quantity of the solid waste generated the following disposal options are available

17.1. Site

As prescribed by competent authority.

17.2. Disposal of solid waste

- a. Landfill
- b. Use of pills
- c. Composting
- d. Biogas

17.3. Disposal of liquid waste

- a. Discharge into sewers
- b. Soakage pits
- c. Waste stabilising pond

18. DUTIES OF BIO-MEDICAL WASTE MANAGEMENT FACILITY OPERATOR

Definition

Operator of a Bio-Medical Waste facility means an “authorized person or an institution owing or providing the Bio-Medical Waste facility”.

18.1. Authorisation

If you are a generator of Bio-Medical Waste and treating more than one thousand patients per month then it is mandatory to register with State Pollution Control Board/Committee before specified date as shown in table No. 1. You are required to submit the following with the appropriate application form.

Duly filled application form with prescribed fee (see table No.2) Payable for three years.

Affidavit regarding proof of beds.

Copy of the agreement if any with operator of a facility/transporters of Bio-Medical Waste.

The occupier (owner) of a Bio-Medical Waste management facility shall be responsible for proper collection, reception, treatment, storage and disposal of Bio-Medical Waste due to following reasons: •

18.2. Legal Obligation

- a. To manage Bio-Medical Waste according to the standard prescribed failing which legal action can be initiated.
- b. To prevent health hazards associated with indiscriminate Bio-Medical Waste Management
- c. To prevent environmental hazards especially due to inadequate treatment and faulty disposal methods.
- d. To provide necessary information to the concerned person, make arrangements of training for creating awareness.

18.3. Maintenance of Records.

- a. Every authorised person shall maintain record related to the generation, segregation, collection, storage, transportation, treatment, disposal and/or any form of handling of Bio-Medical Waste in accordance with these rules and guidelines issued in appropriate Form V.

- b. All records shall be subject to inspection and verification by the prescribed authority at any time.

18.4. Submission of Annual Report

Every Occupier/operator shall submit an annual report to the prescribed authority, in prescribed Form I by 31st January every year, to include information about the categories and quantities of Bio-Medical Waste handled during the preceding year. The prescribed authority (SPCB) shall send this information in a compiled form to the Central Pollution Control Board by 31st March every Year.

18.5. Accident reporting

When any accident occurs during handling at any site where Bio-Medical Waste is handled or during transportation of such waste, the authorised person shall report the accident in Form VI to the prescribed authority forthwith.

19. Legal implications

19.1 Violations of Rules

As per law, it is mandatory for all types of medical services provider to ensure proper implementation of Bio-Medical Waste (M&H) Rules 1998. **Installation** of incinerator is mandatory for hospitals with more than 50 beds.

It may be kept in mind that any person can report any alleged negligence in Management and Handling of Bio-Medical Waste to the appropriate authority. The state Pollution Control Board/committees have been asked to take action against the defaulting hospitals or nursing homes under section 15(1) of the Environment (Protection) Act, 1996 which reads as "Whoever fails to comply with or contravenes any of this act, or the rules made or orders or directions issued hereunder, shall, in respect of each such failure or contravention, be punishable with imprisonment for a term which may extend to five years or with fine which may extend to one lakh rupees, or with both, and in case of failure or contravention continues, with additional fine which may extend to five thousand rupees for every day during which such failure or contravention continues after the conviction for the first such failure or contravention."

Statutory warning to all hospitals for installation of Bio-Medical Waste treatment and disposal systems is already issued according to schedule given in table No. I, by appropriate authority.

19.2. Appeal against punishment

Any person aggrieved by an order made by the

prescribed authority under these rules may within thirty days **from** the date from which the order is communicated to him, prefer an appeal to such authority as the government of state/ Union Territory may think fit to constitute; Provided that the authority may entertain the appeal after the expiry of the said **period of** thirty days if it is satisfied that the appellant was prevented by **sufficient cause from** filing the appeal in time. The appropriate authority shall dispose of such appeal within a period of six months **from** the date of its receipt.

20. Conclusion

- 20.1. We must understand the gravity of the issue and difference between hospital waste and general waste.
- 20.2. We must ensure proper segregation at the source of generation, collection in prescribed **coloured** containers, safe transportation, appropriate treatment and environmentally sound disposal of Bio-Medical Waste.
- 20.3. Health education of everyone involved in the management and handling of Bio-Medical Waste.
- 20.4. Motivation and **sensitisation** of waste generators and health care providers to make environment safe for living and to protect them from legal actions for violation of Bio-Medical Waste (M&H) Rules 1998.
- 20.5. Make use of common facility treatment for economic reasons and keep Bio-Medical Waste management in priority list **of** policy making, starting from the **very** beginning.
- 20.6. Last but not the least is effective implementation of rules by surprise visits and inspection by appropriate authorities and fixing the accountability of each and every person involved in management of Bio-Medical Waste.

Bio-Medical Waste Management programme cannot successfully be implemented without the willingness, devotion, self-motivation, cooperation and participation of all sections of employees of any health care establishment. If we want to protect our environment and health of community we must **sensitise** our selves to this important issue not only in the interest of health managers but also in the interest of community.

References

1. Investigation: source of beach wash-ups in 1988. New York State, Deptt. Of Environmental Conservation Report, Albany, New York.
2. **B.L.Wadhwa v/s** Union of India and others: Judgment Today 1996 (3) SC: 38-51.
3. The Bio Medical Waste (Management and Handling) Rules, 1998.

4. Report of High Power Committee on urban Solid Waste Management, Planning Commission, Govt. Of India, 1995; Hospital Waste Management: 35-47.
 5. **Grovers PD.** Management of Hospital Wastes- An overview. Proceedings of National workshop on Management of Hospital Waste, 1998 Apr. 16th to 18th; Jaipur, **IIRD** and Shristi, 1998.
 6. Management of Waste from Hospitals and **Other** health care establishments. Euro Reports and Studies No. **97,WHO**, 1985: **1-61**.
 7. Thornton J, Mc. **cally M, Orris P, Wentreg J.** Hospitals and plastics Dioxin prevention and Medical Waste Incineration; Public Health Reports; **Vol. III**, July-Aug., 1996: 299-3 13.
 8. Nobel J. J. Waste Disposal Units: **Paediatrics** Emergency Care; 1995 April; **11(2): 118-120**.
- Further Reading:**
1. **Acharya D.B.** et al "The Book of Hospital Waste Management" 1st edition, 2000.
 2. **Basu RN.** Issues involved in Hospital Waste Management; an experience from a large teaching institution. Journal of Academy of Hospital **Administration**, 1995, July 1996, Jan; **7(2), 8(1): 79-83**.
 3. Baghotia KS. "Study of Waste Management Practices in tertiary care hospital" Thesis work submitted for **M.D.Community Health Administration at NIHFW**, 1998.
 4. Pathak S. Management of Hospital Waste: A Jaipur Scenario., Proceedings **of National** workshop on Management and Hospital Waste, April 16th -18th 1998: 31-33.
 5. **Singh R., Mahajan S.L.** Management of Hospital Waste in Hospitals of Govt. Medical College, **Amritsar**, Journal of Academy of Hospital Administration, 1998, Jan; **10(1): 33-37**.
 6. **Sharma RK., Mathur S.K.** Management of Hospital Waste, Journal **of Academy of Hospital** Administration, 1989 July; **1(2): 55-57**.
 7. Waste **characterisation** and quantification; "**Parivesh**" News **letter on Hospital Waste; Vol.4 (iv) March** 1998,CPCB. Ministry of Environment & Forest, Govt. of India, New Delhi: 3-4.