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A STUDY OF HOSPITAL WASTE MANAGEMENT IN A TERTIARY CARE HOSPITAL

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ABSTRACT

The present study identifies various gaps/shortfalls in the practices adopted for collection, segregation, storage, transportation, treatment and disposal of hospital waste in a 1156 bedded tertiary care hospital setting. The study reveals that though guidelines on hospital waste management exist, yet the same were not properly printed and circulated to hospital employees. The study has further observed that the size of plastic bags was not consistent with the size of the dustbins, sharps were not being segregated properly and average quantum of waste generated in the hospital was found to be 1.45 kg per bed per day.

Hospital waste management is a systematic control of the generation, storage, collection, transport, processing and disposal of the hospital waste[7]. It is one of the important public health measures to prevent nosocomial or hospital acquired infections and various communicable diseases which spread through water, sewage, blood, body fluids and contaminated organs. With the proliferation of blood borne diseases, more attention is being focussed on the issue of infectious medical waste and its disposal. Education of the staff, patients and community about the management of infectious waste is crucial in today's health care arena.

The quantity of waste produced in India is estimated to be about 1 to 2 kg per bed per day[1], whereas in USA it is as high as 5 kg per bed per day. The collection should be made in spillage proof containers or plastic bags which should not tear during handling. Waste should be transported by trolley or handcarts

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covered from all sides to the incinerators or the initial storage site. The disposal site should be isolated from the community. While planning, the need for power supply, water supply and drainage for the waste disposal area is to be kept in mind. Keeping these things in view, the present study was carried out to (i) assess the quantum and different kinds of waste generated in a tertiary care hospital, and (ii) study the practices adopted for collection, segregation, storage, transportation, treatment and disposal of hospital waste and suggest measures for streamlining the hospital waste management in a tertiary care hospital setting.

MATERIALS AND METHOD

The study was undertaken in a tertiary care hospital setting comprising Smt. Sucheta Kriplani Hospital(SKH) and Kalawati Saran Children's Hospital (KSCH) in the premises of Lady Hardinge Medical College, New Delhi. Administratively, both the hospitals are headed by one person, *i.e.*, Principal and Medical Superintendent. There are 19 wards in SKH, dealing with various specialities and KSCH has 8 indoor wards, dealing with the paediatric specialities. These hospitals had 1,156 beds (836 beds in SKH and 320 beds in KSCH).

Various categories of personnel interviewed for the study purpose were health/hospital administrators, health care providers, (doctors and nurses, para-professionals) and supportive staff engaged in different support services (kitchen, laundry, public health engineering and sanitation).

All the hospitals/health administrators concerned with hospital waste management were interviewed. One doctor, one nurse and one safai karamchari from each ward and other departments (having no separate ward and department rendering support services) were randomly selected. Likewise, two persons each were interviewed from para-professionals and supportive staff from each of the support service departments. From the department of Public Health Engineering, three persons were randomly selected. Five patients were interviewed from each ward, selected following a systematic random sampling technique. Likewise, 10 patients each were interviewed from three OPDs selected randomly (surgery, obstetrics and family welfare). The employees interviewed were 140 and patients interviewed (indoor and outdoor) were 155.

The secondary data were collected through study of various records in regard to guidelines, consumption of disposable materials, equipment for hospital waste transportation and other related information for the last one year. The study was conducted in 1997. For quantum of waste generated in the hospital, a record

was maintained by the researchers for number of wheelbarrows coming to the incinerator plant in a period of one month. In addition, the waste coming in wheelbarrows and manually in bags was also weighed for a week separately, using a dial balance with the help of two safai karamcharis posted at the incinerator plant.

FINDINGS AND DISCUSSION

Guidelines Regarding Hospital Waste Management

As per the response of the employees, 77.3 per cent negated the existence of such written guidelines. The proportion negating the same was higher amongst the lower categories of employees. At none of the sites, written guidelines were displayed or were readily available for reference.

Waste Handling Practices

Collection: Interview of hospital administrators revealed that every ward and department had been provided with adequate number of dustbins for collection of the waste in three sizes of 5-7 kg capacity, 15 kg capacity and 25 kg capacity respectively. All the three sizes of dustbins were found in different wards and departments of SKH whereas only large 25 kg iron dustbins were seen in KSCH. Frequency of collection of hospital waste from various wards/departments varied from once in a day to thrice a day. Three size of dustbins were found to be in use in the hospital but neither the available literature nor hospital guidelines on waste management specify the size of dustbins. The meaning of adequate size will vary from person to person. There is a need to specify the size of the dustbins. Ideally the size of the bags should be in consonance with the size of the dustbins. In the hospital, though dustbins were of different sizes, the colour bags were of uniform size suitable for bigger dustbins only. The Ministry of Environment and Forest Notification[4] mentions about colour coding of containers. This can be adopted for both coloured bags as well as for dustbins. However, in Smt. Sucheta Kriplani Hospital, there was only specification for coloured bags to be used and not about the dustbins. The same needs to be done for dustbins also.

Segregation: According to 26.4 per cent of hospital employees the waste was not being segregated (Table 1) and another 17.1 per cent had no idea about it. Amongst doctors, 41.6 per cent had no idea about segregation of waste. In the column of health administrators/public health engineers, three employees who did not have any idea about segregation of hospital waste were public health

TABLE 1

METHODS OF SEGREGATION OF HOSPITAL WASTE

Method of Segregation	HA/PHE n=12	Doctors n=36	Nurses n=32	Para/Supp n=20	Safai K. n=40	Total empl. n=140
1. Colour bags	7(58.3)	11(30.5)	21(65.5)	9(45)	24(60)	72(51.4)
2. Separate Dustbins for sharps	1(8.3)	-	1(3.1)	-	2(5)	4(2.8)
3. Manual	-	2(5.5)	1(3.1)	-	-	3(2.1)
4. Not Segregated	1(8.3)	8(22.2)	8(25)	9(45)	11(27.5)	37(26.4)
5. No Idea	3(25)	15(41.6)	1(3.1)	2(10)	3(7.5)	24(17.1)
Total	12(100)	36(100)	32(100)	20(100)	40(100)	140(100)

HA = Hospital Administrators; PHE = Public Health Engineers; Para = Para-professionals; Supp. = Supportive Staff
K = Karamcharis
Figures in parentheses indicate percentages.

engineers. Various methods employed for segregation of hospital waste were found to be (i) use of coloured bags, (ii) separate dustbins for sharps, and (iii) manual segregation. The Central Pollution Control Board[3] and the Gazette notification by the Government of India[4], specify that segregation of infectious waste should be in colour coded bags. As per the guidelines available in the hospital, the black coloured bags should be used for general waste whereas, yellow coloured bags for infectious waste. The colour coding was not strictly adhered to. Only 18(47.36%) observation sites had yellow and black coloured bags whereas 10(26.3%) sites had only black coloured bags.

Light blue coloured bags suggested in hospital guidelines for waste needing autoclaving (*e.g.* Microbiology Department) before disposal were found missing altogether. Thus, there is a need to introduce coloured bags at all places in the hospital. In regard to manual segregation of soiled linen, 45.9 per cent of employees say that linen is manually segregated, put into one per cent bleach and then washed by female safai karamcharis on duty.

However, other employees either expressed ignorance or said that the linen was not segregated. Most significant problem for laundries is not the linen but the gifts that arrive with linen ranging from human tissue to surgical instruments, clinical waste and patients' hearing aids and spectacles[8]. It leaves laundries with no alternative but hand sorting (manual segregation), because instruments and waste damage machinery and spoil the finished linen.

Transportation: The methods employed for transportation were found to be wheelbarrow and manual lift to carry bags and cardboard boxes. At least one functional wheelbarrow was found at 33(86.8%) observation sites, whereas at 3(7.89%) sites no wheelbarrow was found. Two (5.26%) wards and departments shared wheelbarrows with other wards and departments. There is a need to provide wheelbarrows to every ward and department to prevent any delay in transportation.

Storage: Out of the two waste storage sites, the one is covered and meant for clinical waste which was not being used. Contrary to this, the open ground in front of incinerator plant was found in use of storage of waste from areas of clinical activities. The waste was not always coming in bags. As it is difficult to handle the loose waste, all waste needs to be brought in bags, and then only it will be possible to use this covered waste storage site. The Health Services Advisory Committee, Britain[5] guidelines also suggest that waste should be stored in leakproof plastic bags of 0.1 M^2 capacity.

Treatment: No use of syringe crushers was found in the hospital, whereas Central Pollution Control Board[3] guidelines say that all hospitals shall install suitable shredders/crushers for preliminary treatment of sharps, discarded glassware and disposables. The soiled linen was manually segregated, dipped into bleach (1%) for half an hour to one hour and then manually washed by female safai karamcharis. No other method for treatment of hospital waste was found, like Mircowaving and Pyrolysis in the hospital. Hoffman P.N[6]. *et al.* stated that microwaving method may be used to take care of the bulk of waste generated in clinical wards.

Disposal: The methods of hospital waste disposal are (1) incineration of infectious and hazardous waste, and (2) lift of general waste by NDMC vehicle for landfilling. In regard to incinerator ashes, these were found lying near the incinerator plant. The Central Pollution Control Board[3] and WHO Working Group on Health Care Waste Management[9] say that incinerator ashes should be taken by authorised person for secured landfilling.

QUANTUM AND DIFFERENT KINDS OF WASTE

Quantum of Waste: As there was no record available for quantum of waste generated in hospital, it was decided to measure the same. A record of number of wheelbarrows coming to incinerator and waste storage site was maintained by the researchers during November 2, 1996 -November 27, 1996. The average number of wheelbarrows coming to the waste storage site and incinerator plant was 32.4 per day. The waste coming in wheelbarrows as well as coming manually in bags was also weighed for a week.

Therefore, quantum of waste generated in the hospital per day was found to be:

Average No. of Wheelbarrows	X	Average weight of waste in a wheelbarrow	+	Average weight of waste coming manually

= (32.4 x 48.8) + 96 = 1677.12 kg.

The number of beds in the hospital = 1156

Therefore, waste generated per bed per day = 1677.12/1156 = 1.450 kg

Kinds of Waste: Various kinds of waste generated in the hospital were (1) General waste, (2) Infectious waste, (3) Pathological waste, (4) Chemical waste, (5) Pharmaceutical waste, and (6) Sharps.

MISCELLANEOUS ASPECTS

98.5 per cent of employees and 81.9 per cent of patients expressed that hospital waste is hazardous (Table 2).

It can also be seen in Table 2 that 80.7 per cent of employees and 75.4 per cent of patients stated that hospital waste can cause infection or disease whereas 1/4th of the doctors and 6.2 per cent of nurses had no idea about the hazards of the hospital waste. It was also found that 13(65%) of para-professionals and supportive staff and 38(95%) of safai karamcharis said that while handling waste, safai karamcharis wear the gloves. On observation it was found that only on 21(55.2%) occasions, safari karamcharis were found to be wearing gloves in wards and departments. Whereas on 2(5.26%) occasions safai karamcharis found wearing gloves and face mask were in operation theatre and labour room. In regard to safai karamcharis posted at incinerator plant, the study revealed that on 20(80%) occasions safai karamcharis were found wearing gloves, face masks and gumboots while handling waste or while feeding the waste to incinerator. Gumboots were not seen in any other parts of the hospital.

With reference to accidental needle stick injuries, during the last one year, it was found that 62.5 per cent of safai karamcharis, 25 per cent of para-professionals and 15 per cent of patients had accidental needle stick injury while handling hospital waste. 10 per cent of safai karamcharis and 5 per cent of para-professionals and supportive staff stated that they had more than 10 times accidental needle stick injury during the last one year. In regard to satisfaction of hospital employees and patients with sanitation and hospital waste management, it was found that 55 per cent of safai karamcharis and 72.9 per cent of the patients were satisfied with the sanitation and waste management in the hospital. Contrary to this, all of the hospital administrators and public health engineers, 86.1 per cent of doctors, 84.3 per cent of nurses and 80 per cent of para-professionals and supportive staff said that they are not satisfied with the present sanitation and waste management practices in the hospital and this needs definite improvement.

TABLE 2

OPINION REGARDING HAZARDS OF HOSPITAL WASTE

Category	Employees						Patients			Emp+Pt.
Hospital waste is hazardous	HA/PHE n=12	Doctors n=16	Nurses n=12	Para/ Supp. n=20	Safai K. n=40	Total empl. n=140	Indoor n=125	Outdoor n=30	Total n=155	G. Total n=295
No	-	-	1(3.1)	1(5)	-	2(1.4)	25(20)	3(10)	28(18)	30(10.1)
Yes	12(100)	36(100)	31(96.8)	19(95)	40(100)	138(98.5)	100(80)	27(90)	127(81.9)	265(89.8)
1. Causes infection	12(100)	22(61.1)	25(78.1)	16(80)	38(95)	113(80.7)	90(72)	27(90)	117(75.4)	230(77.9)
2. Dangerous to life	-	-	1(3.1)	-	-	1(0.71)	3(2.4)	-	3(1.9)	4(1.3)
3. Aesthetic nuisance	-	-	1(3.1)	-	-	1(0.71)	2(1.6)	-	2(1.2)	3(1.0)
4. Injuries	-	-	-	1(5)	-	1(0.71)	-	-	-	1(0.33)
5. More than one	-	5(13.8)	2(6.2)	2(10)	1(2.5)	10(7.1)	-	-	-	10(3.3)
6. No idea	-	9(25)	2(6.2)	-	1(2.5)	12(8.5)	5(4)	-	5(3.2)	17(5.7)
Total	12(100)	36(100)	32(100)	20(100)	40(100)	140(100)	125(100)	30(100)	155(100)	295(100)

HA = Hospital Administrators; PHE = Public Health Engineers; Para = Para-professionals; Supp. = Supportive Staff; K = Karamcharis; Emp. Employees; Pt. = Patients

Figures in parentheses indicate Percentages.

In regard to awareness of different methods of treatment and disposal of hospital waste, it was found that 60 per cent of employees stated incineration as one of the methods. 19.2 per cent of employees also stated bleaching as a method of treatment. However, 27.8 per cent of hospital employees and 91.6 per cent of patients did not have any idea about the methods of treatment and disposal of hospital waste.

Regarding training/reorientation undergone by employees in hospital waste management, Table 3 indicates that 22.2 per cent of hospital administrators. 21.8 per cent of nurses and 13.8 per cent of doctors have undergone some training/reorientation regarding hospital waste management. Whereas, 97.5 per cent of safai karamcharis, who are actual waste handlers and 95 per cent of para-professionals and supportive staff denied to have undergone any training or reorientation related to hospital waste management.

TABLE 3

TRAINING/REORIENTATION UNDERGONE BY THE EMPLOYEES IN HOSPITAL WASTE MANAGEMENT

Training Undergone	HA n=9	Doctors n=36	Nurses n=32	Para/Supp n=20	Safai K. n=40	Total employees n=137
No	7(77.7)	31(86.1)	25(78.1)	19(95)	39(97.5)	121(88.3)
Yes	2(22.2)	5(13.8)	7(21.8)	1(5)	1(2.5)	16(11.6)
Total	9(100)	35(100)	32(100)	20(100)	40(100)	137(100)

HA = Hospital Administrators, Para = Para-professionals, Supp. = Supportive Staff, K = Karamcharis

Figures in parentheses indicate percentages.

Regarding uses of the hospital waste (Table 4), 27.8 per cent of employees and 12.2 per cent of patients felt that the hospital waste can be put to use.

Regarding various uses of the hospital waste, 10.7 per cent of employees and 3.2 per cent of patients expressed that non-infectious paper and plastic can be recycled. Another 6.4 per cent of employees said that manure/fertiliser can be prepared out of non-infectious (general waste). 4.2 per cent of employees advocated for heat recovery.

The study has further observed that 42.8 per cent of employees and 26.4 per cent of patients expressed that incineration is the method which can be

considered as eco-friendly method of waste management. Another 8.5 per cent of employees and 36.1 per cent of patients expressed that secured landfilling or burying underground is an eco-friendly method. 39.2 per cent of employees and 32.9 per cent of patients expressed to have no idea about eco-friendly methods of hospital waste management.

Various methods in actual practice were found to be autoclaving in the department of microbiology, incineration of clinical waste, lift of general waste by NDMC for landfilling, partial use of protective material and segregation of hospital waste at about 50 per cent observation sites.

RECOMMENDATIONS

1. Every hospital should have written guidelines/manual on hospital waste management and should be freely circulated both in Hindi, English and regional language to all categories of staff in the form of a booklet and should be updated from time to time.

2. There should be a separate department of sanitation and waste management in each hospital. Till the time a separate department is established, there is a need to designate one nodal officer to monitor the activities related to sanitation and hospital waste management.

3. Proper record should be maintained for the amount of hospital waste collected from each ward/department and transported to waste storage site/incinerator plant.

4. A review can be carried out at least annually regarding usage of disposable material and equipment for hospital waste management.

5. The size of dustbins and plastic bags for collection of hospital waste should be in consonance.

6. The colour coding should be for dustbins as well as for collecting bags.

7. All hospital waste needs to be segregated. Black bags should be used for general waste and yellow bags for infectious waste.

8. There is a need to introduce blue coloured bags in areas where waste requires autoclaving before disposal, specially Department of Microbiology.

TABLE 4

USES OF HOSPITAL WASTE AS SUGGESTED BY EMPLOYEES AND PATIENTS

Category	Employees						Patients			Emp+Pt.
	HA/PHE n=12	Doctors n=36	Nurses n=32	Para/ Supp. n=20	Safai K. n=40	Total empl. n=140	Indoor n=125	Outdoor n=30	Total n=155	G. Total n=295
Cannot be used	8(66.6)	22(61.1)	23(71.8)	13(65)	35(87.5)	101(72.1)	108(86.4)	28(93.3)	136(87.7)	237(80.3)
Can be used	4(33.3)	14(38.8)	9(28.1)	7(35)	5(12.5)	39(27.8)	17(13.6)	2(6.6)	19(12.2)	58(19.6)
Different uses:										
1. Recycling of paper, plastic	1(8.3)	7(19.4)	3(9.3)	2(10)	2(5)	15(10.7)	5(4)	-	5(3.2)	20(6.7)
2. Heavy metal extraction	1(8.3)	2(5.5)	-	1(5)	-	4(2.8)	-	-	-	4(1.3)
3. Landfilling	-	-	1(3.1)	1(5)	-	2(1.4)	8(6.4)	1(3.3)	9(5.8)	11(3.7)
4. Fertiliser/manure	1(8.3)	3(8.3)	3(9.3)	1(5)	1(2.5)	8(6.4)	-	-	-	9(3.0)
5. Kitchen waste feed to cattle	1(8.3)	1(2.7)	-	-	1(2.5)	3(2.1)	2(1.6)	1(3.3)	3(1.9)	6(2.0)
6. Heat recovery	-	1(2.7)	2(6.2)	2(10)	1(2.5)	6(4.2)	2(1.6)	-	2(1.2)	8(2.7)
Total	12(100)	36(100)	32(100)	20(100)	40(100)	140(100)	125(100)	30(100)	155(100)	295(100)

HA = Hospital Administrators; PHE = Public Health Engineers, Para = Para-professionals;
Supp. = Supportive Staff; K = Karamchara; Emp. Employees; Pt. = Patients
Figures in parentheses indicate percentages.

9. All sharps should always be collected and segregated in puncture proof containers made of sturdy plastic/metal. The dustbins used for collection and segregation of sharps should be of distinct (blue) colour.

10. Every bag should be taken out when it is 3/4th full. It should be sealed and labelled with name of the ward/department, date, time and type of contents.

11. There should be a frequent (at least twice a day) collection of waste from each ward and department.

12. The plastic bags should have biohazardous symbol in red colour with a yellow background.

13. There is also a need of scintillation detectors to detect and segregate radioactive waste.

14. A separate cleaning and washing facility for wheelbarrows with an adequate drainage system should be provided.

15. General waste and infectious waste need to be transported separately and should not be mixed.

16. Every waste storage site should be covered, washable, rodent and animal proof with adequate ventilation system.

17. There is a need to use needle destroyers in areas of clinical activity and centralised shredders/crushers for preliminary treatment of sharps, discarded glassware and disposables.

18. Every incinerator needs to have meter/gauge for measurement of temperature in its chambers and the pollution level of effluent from the incinerator stack. Wherever possible, a standby incinerator should be provided.

19. Metal detectors are recommended for use in areas like operation theatre and labour room to detect metallic instruments going into the hospital waste. These should also be used at waste storage site/incinerator plant.