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Health care waste management: A case study of Punjab, India

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Abstract
Medical facility is essential to protect the health and well-being of human life. However, the refuse, which produced by medical activities may be toxic, hazardous, or even lethal because of their great risk of diseases transmission. The hazardous and toxic nature of refuse from medical facilities commonly known as "Bio medical waste" consists infectious, radioactive material as well as needles, knives, scalpels etc. constitute a high risk, if these are not properly treated/disposed or allow mixing with other municipal waste. Bio medical waste has grave potential to enhance the growth of pathogen and vectors and it is capable to contaminate other nonhazardous/ non-toxic municipal waste. Hospital waste have high risk of toxic trace metals, toxic chemicals, pathogenic viruses and bacteria (Chintis *et al.*, 2004), The handlers of waste such as rag pickers and waste workers directly or indirectly come into the contact with such hazardous material for economical benefits. Reuse of this hazardous material can be harmful and even fatal due to diseases like cholera, plague, tuberculosis, hepatitis; AIDS (HIV), diphtheria etc. Therefore the main focus of the study is to know the status of awareness among the handlers of biomedical waste.

Keywords: hospitals, pathological laboratories, bio medical waste facility, awareness

1. Introduction
Safe handling of biomedical waste is a serious matter for the concerning authorities in India. Daily tones of biomedical waste generated from hospitals, clinics, pathological labs continue to be dump in open garbage bin along the roads in most part of the country. Although medical wastes represents relatively small portion of total waste generated in community, medical waste management considered an important issue worldwide. In developing country like India, bio medical waste management is now becoming a challenge not only for the government but to the people who are directly or indirectly associated with it. There are different locations or points of generation of waste in a health care establishment (figure 1)
Since, the Government of India formulate various policies and suitable laws to protect the environment, though lack of enforcement does not give vital result. The Government of India formulated the umbrella legislation in the name of environment protection act and framed many rules under this act, one such rule namely the "Bio Medical Waste (Management & Handling) Rules, (1998 Figure 3). This rule deals with the collection, segregation and disposal of hospital and clinical waste. This waste is carcinogenic in nature and its unscientific disposal could leads to life threatening problems. Keeping this gray area in mind, an exercise has undertaken under the guidance of Punjab pollution control board to undertake intensive study to know the practice adopted by the hospitals and waste management disposal facilities. The major objectives of the present investigation were to study the management of biomedical waste and to ascertain the efficiency of laws and awareness related to BMW management practices; occupational health and safety information among the hospital staff, treatment facility workers and nearby peoples.

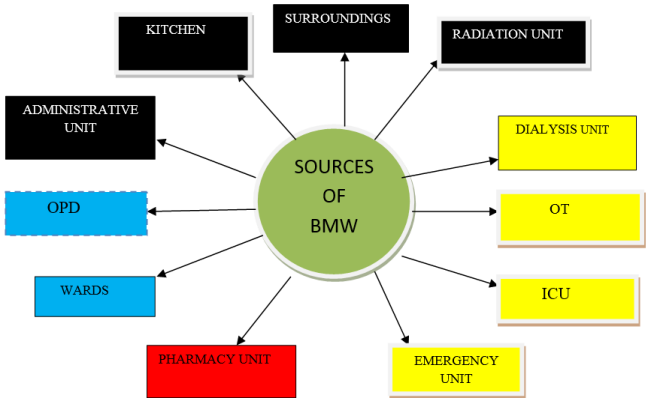

Fig 1: Sources of waste in a health care establishment

Human anatomical waste Glass waste

Containers of waste

Fig 2

1.1 Bio medical waste management

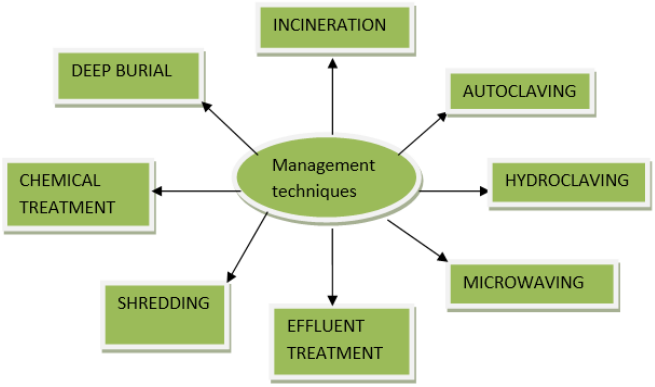

Fig 3: Biomedical waste management techniques

1.2 Study Area

Fig 4

The study was carried out in Punjab, state of India. Punjab is located in north-western India, and has an area of 50,362 km^2. It extends from the latitudes 29.30° north to 32.32° North and longitudes 73.55° east to 76.50° east. It shares its boundaries with Pakistan, Himachal Pradesh, Jammu Kashmir, Haryana and Rajasthan. Punjab is food boon state of India because of its fertile land. Punjab is also known as the land of five rivers due to the drainage of rivers such as Sutlej, Beas, Ravi, Jhelum, and Chenab. Punjab has total 22 districts.

For this study, various Bio medical treatment facilities of Punjab were visited but data was collected from Mohali and Rupnagar districts of Punjab. From these two districts a Bio medical treatment facility, four hospitals and three pathological laboratories were taken into consideration. Bio medical treatment facility is located at village Balyali in Mohali. One private hospital from Mohali, One charitable hospital and three pathological laboratories from Aanadpur sahib and two government hospitals from Nangal were taken for the study.

1.3 Material and Methods

Medical waste of small hospitals and pathological laboratories was studied. The hospitals and pathological laboratories under consideration were given name as H_1, H_2, H_3, H_4 and H_5.

Grecian hospital Mata Nanki charitable hospital

Kohli lab (Aandpur sahib)

Fig 5

H_1 (Grecian Super Speciality Hospital, Mohali): Bed capacity 120 patients. H_2, (BBMB Hospital Nangal): Bed capacity 100 patients. H_3, (Mata Nanki Charitable Hospital Aandpur Sahib): Bed capacity 50 patients. H_4 (NFL Nangal): Bed capacity 40 patients. H_5 (Kohli lab, Bhatiya lab, Brahami clinical Lab): No Bed capacity. I visited various BMWTF in Punjab but data was taken from Rainbow Environments (A Unit of Raidical Builders India Pvt. Ltd.) Mohali. All type of biomedical waste is treated (incinerated, autoclaved, shredded) here.

Rainbow Environment

Fig 6

The methodology adopted was descriptive and consists of the use of questionnaires, survey, and interview with staff of the health care facilities and with personnel involved in the management of the wastes. Questionnaire was filled by pathological laboratories, hospitals and the facility's workers. General survey of waste handling, segregation and disposal procedures practiced in the hospitals, labs and facility was assessed by visit. The supporting staffs of the hospitals and pathological laboratories were briefed on the nature of assistance and support that need in determining the quantity of waste; stickers were on the plastic containers to differentiate the waste. Questionnaire was also given to the village peoples of surrounding area of facility to know the impact of treatment facility on environment.

Facility worker Workers doing their duty

Fig 7

Hospitals were divided into two categories on the basis of their bed capacity.

1. Small hospital (bed capacity 50-120 patients)
2. Very small hospitals (bed capacity > 50 patients)

Monthly data of January 2013 were collected from small hospital (bed capacity 50-120 patients) and very small hospital (Bed capacity > 50 patients).

1.4 Result and discussion

(a) Waste production and production rate

The waste generation at medical establishment in eastern Punjab consist of infectious, glass, plastic and liquid waste (Table.1). In Grecian super speciality hospital where the bed capacity is 120 beds, the average total amount of infectious waste (yellow bag+ puncture proof container) is (519.77+46.91/31) 18.28 kg/ month. Glass waste is (284.51/31) 9.18 kg/month. Plastic waste is (644.39/31) 20.79 kg/month. And liquid waste is treated in the effluent treatment plant of the hospital. By this data we can estimate the total yearly average waste generation in a small hospital of the area is approximately: (Figure. 8)

Infectious waste = 6672.2 kg/year
Glass waste = 3350.7 kg/year
Plastic waste= 7588.35 kg/year

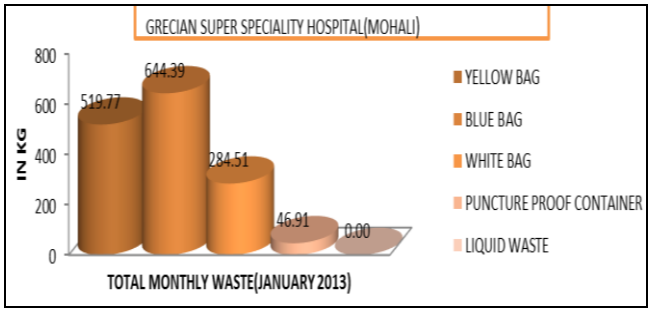

Fig 8

(b). In NFL hospital where the bed capacity is 40 bed, the average total amount of infectious waste (yellow bag+ puncture proof container) is (9.75+15/31) 0.79 kg/ month (Table.2). Plastic waste (Blue Bag) is (13/31) 0.41 kg/month. And liquid waste is (472/31) 15.22 kg/month. In this hospital, glass waste (Blue bag) does not segregated differently. (Figure 9)

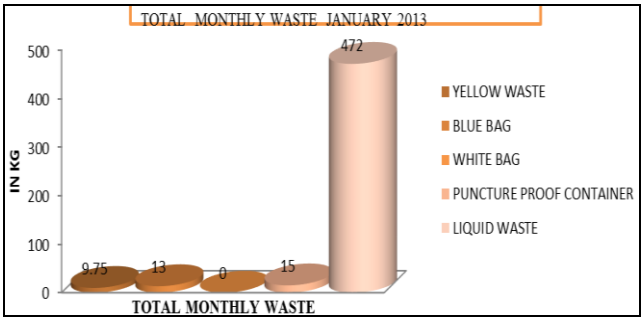

Fig 9

By this data we can estimate the total yearly average waste generation in very small hospitals of the area is approximately:

Infectious waste = 288.35 kg/year
Liquid waste = 5558.95 kg/year
Plastic waste= 149.65 kg/year
Monthly Data (January 2013) (Table.1)

Table 1: Grecian super speciality hospital (Mohali)

Date	Yellow Bag	Blue Bag	White Bag	PPC	Liquid Waste	Total
	IN KG	IN KG	IN kg	IN kg	IN Kg	
01.01.2013	18.68	31.58	0	0.37	0	50.63
02.01.2013	18.64	20.97	0	0.00	0	39.61
03.01.2013	27.37	16.27	0	0.00	0	43.64
04.01.2013	26.29	20.86	11.66	9.23	0	68.04
05.01.2013	17.58	28.35	3.94	0.00	0	49.87

06.01.2013				Sunday		
07.01.2013	0	0.00	0	9.67	0	9.67
08.01.2013	72.51	66.22	28.26	0.00	0	166.99
09.01.2013	11.57	45.26	0	0.00	0	56.83
10.01.2013	10.43	16.89	0	0.00	0	27.32
11.01.2013	15.81	26.15	0	0.00	0	41.96
12.01.2013	14.52	20.13	0	0.00	0	34.65
13.01.2013				Sunday		
14.01.2013	0	0.00	0	0.00	0	0
15.01.2013	14.23	7.24	9.68	9.82	0	40.97
16.01.2013	14.13	28.76	0	0.00	0	42.89
17.01.2013	11.74	25.42	0	0.00	0	37.16
18.01.2013	14.53	21.06	0	0.00	0	35.59
19.01.2013	8.77	14.57	0	0.00	0	23.34
20.01.2013				Sunday		
21.01.2013	26.58	35.46	8.8	4.47	0	75.31
22.01.2013	15.1	17.30	0	0.00	0	32.4
23.01.2013	22.34	21.42	0	0.00	0	43.76
24.01.2013	22.78	24.90	0	0.00	0	47.68
25.01.2013	17.8	21.74	0	0.00	0	39.54
26.01.2013	21.16	40.14	3.80	0.00	0	65.10
27.01.2013				Sunday		
28.01.2013	38	26.62	0	0.00	0	64.62
29.01.2013	21.71	22.18	15.77	8.24	0	67.9
30.01.2013	19.85	19.49	14.6	0.00	0	53.94
31.01.2013	17.65	25.41	188	5.11	0	236.17
Total	519.77	644.39	284.51	46.91	0.00	422.63

Table 2: NFL Nangal hospital biomedical waste generated in January 2013. (Table.2)

Date	**Yellow Bag**	**Blue Bag**	**White Bag**	**PPC**	**Liquid Waste**	**Total**
	In kg	**In kg**	**In kg**	**In kg**	**In kg**	**In kg**
01.01.2013	0.20	0.20	0	0.40	10	10.8
02.01.2013	0.90	0.60	0	0.50	40	42.0
03.01.2013	0.20	0.50	0	0.30	10	11.0
04.01.2013	0.20	0.30	0	0.20	10	10.7
05.01.2013	0.20	0.70	0	0.60	20	21.5
06.01.2013				Sunday		
07.01.2013	0.20	0.00	0	0.60	0	0.8
08.01.2013	0.20	0.80	0	0.50	10	11.5
09.01.2013	0.40	1.00	0	0.80	10	12.2
10.01.2013	0.10	0.40	0	0.60	20	21.1
11.01.2013	0.10	0.20	0	0.70	10	11.0
12.01.2013	0.10	0.40	0	0.50	10	11.0
13.01.2013				Sunday		
14.01.2013	0.85	0.40	0	0.40	20	21.7
15.01.2013	0.20	0.40	0	0.50	16	17.1
16.01.2013	0.10	0.20	0	0.50	16	16.8
17.01.2013	0.10	-	0	0.40	20	20.5
18.01.2013	0.20	0.30	0	0.40	10	10.9
19.01.2013	0.40	0.50	0	0.90	30	31.8
20.01.2013				Sunday		
21.01.2013	0.90	0.80	0	1.00	40	42.7
22.01.2013	1.20	1.00	0	1.50	30	33.7
23.01.2013	1.00	0.90	0	0.40	30	32.3
24.01.2013	0.30	0.90	0	0.60	20	21.8
25.01.2013	0.10	0.60	0	0.40	20	21.1
26.01.2013	0.00	0.00	0	0.00	0	0.0
27.01.2013				Sunday		
28.01.2013	1.00	0.80	0	0.50	30	32.3
29.01.2013	0.20	0.60	0	0.90	10	11.7
30.01.2013	0.10	0.40	0	0.30	10	10.8
31.01.2013	0.30	0.40	0	0.60	20	21.3
Total	9.75	13	0	15	472	510.05

(c) Hospital staff information

Various hospitals' staff of Mohali and Rupnagar district was given the questionnaire to know the awareness among them. Total 34 doctors, nurses, technicians and administrative staff were taken in the study. Maximum number of staff (97%) know about the guidelines lead by govt of India on bio medical waste. 82% staff admit that bio medical waste management is the responsibility of team work of the staff. 90% staff know that the improper handling of biomedical waste can lead to various health hazards. 100% staff think that, there should be regular educational programme to enhance the awareness about the management of this waste. Only 52% staffs know about the disposal of waste in different coloured plastic bags. 70% staffs know about that plastic waste disposed of in blue bag. 50% staffs know that soiled waste disposed in yellow begs.

Table 3: Hospital's staff information (Table.3) (R-right, W-wrong)

Questions	No. of Staff Nurses 08		Technician 03		No. of GNM 07		Doctors 03		Medi. Officers 03		Admin 06		ANM 04	
	R	W	R	W	R	W	R	W	R	W	R	W	R	W
Are different coloured bags used to dispose different types of waste?	6	2	1	2	7	0	1	2	1	2	1	5	1	3
Used disposable plastic items (e.g., catheter) are disposed of in:	6	2	2	1	7	0	1	2	3	-	2	4	3	1
Soiled dressings and used impression materials are disposed of in:	6	2	2	1	2	5	3	-	3	-		6	1	3
Used sharps and needles are disposed of in:	7	1	0	3	7	0	3	-	3	-	6		4	0
Extracted teeth and human tissue are disposed of in:	8	0	2	1	5	2	3	-	3	-	5	1	4	0
Plaster of Paris is disposed of in:	8	0	1	2	0	7	3	-	3	-	4	2	1	3

(d) Facility workers data analysis

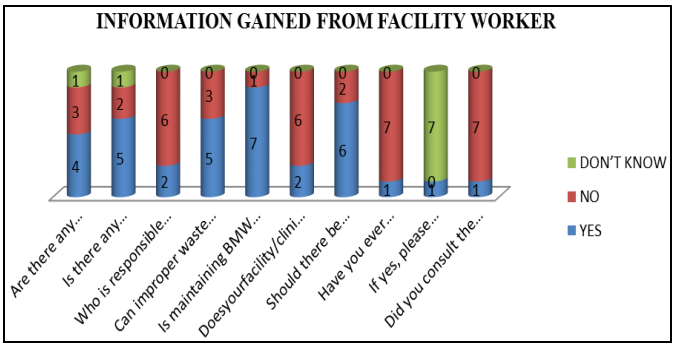

Fig 10

The questionnaire was filled by 8 workers of the facility. By the analysis of their answer, it can be conclude that approximately 57% workers know about the guidelines of govt. of India about the bio medical waste. Only 20% people think that bio medical waste management is the responsibility of team work (Figure 10). 71% workers admitted that improper management of this waste can lead to various health hazards. Approximately 15% people suffered with chronic diseases. 75% people admit that there should be regular educational programmes to create the awareness among the staff (Figure 11). 75% staffs of the facility were aware about the colour coding of the management of waste. 100% staffs know about the disposal of human anatomical waste in yellow bag. 87% workers know about the disposal of sharps in puncture proof container.

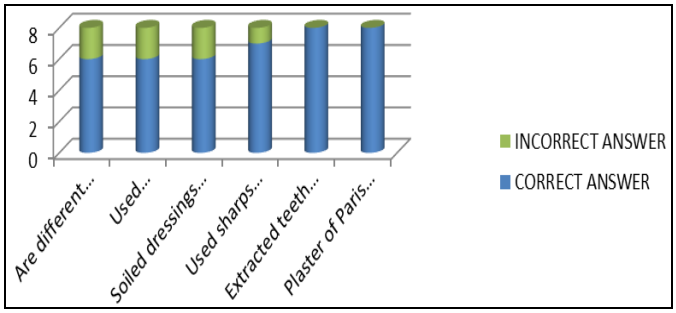

Fig 11

Table 4: Data analysis of village people

Questions	No. of person say yes	No. of person say no	No. of person say don't know
Are you a permanent resident of the area/town ?yes/no	7	0	0
No. of members in the family	3(1),5(3), 7(2), 8 (1)		
Is the factory/ plant nearby?	4	3	0
Do you Know the Product manufactured in plant: Yes/No/don't know	5	2	0
Does any member of family work in the factory?	0	7	0
Have you ever gone inside the plant yes /no	1	6	0
Source of drinking water well / hand pump/ tap water/ storage nearby	4 (Tube well)	2 (Well)	1 (Hand pump)
Is the source near the working unit of plant / factory?	1	6	0
approximate distance	3 (3 KM)	2 (2 KM)	1-1.5 (2)
Is the same source used by plant/factory	0	6	1
How do you irrigate your fields	2 (Tube well)	5 (No Field)	0

In summer do you feel any scarcity of water?	2	5	
Is the drainage of plant used by you for irrigation purpose?	0	7	0
Time of establishment of plant?	10-15 YEARS	0	4
After the establishment of plant have you observe any change in environment?	2	4	1
Is cleanliness campaign organised by the factory/plant?	0	6	1
Is health awareness campaign organised by the factory/plant yes/no	0	7	0

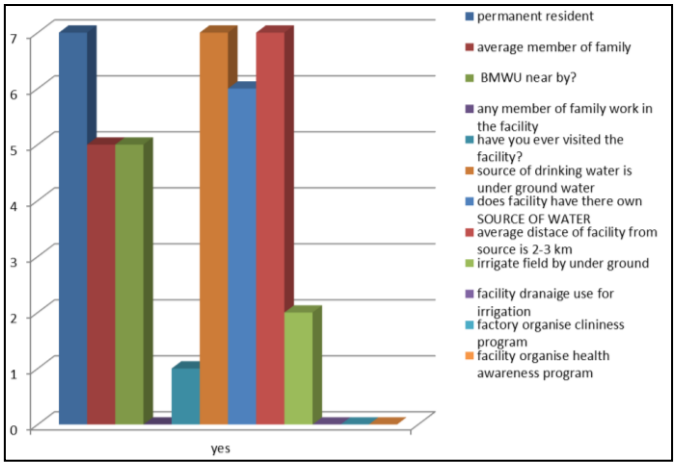

Fig 12

From the above information it can be concluded that maximum people was the permanent resident of that area. People were aware about the functioning of treatment plant. Permanent resident was not the employee of the plant. Factory has its own source of water. Maximum people were landless and those who have their own land do not feel any decrease in the fertility due to plant. According to village peoples, factory does not organise any health and cleanliness related programme ever. People feel bad odour and suffocation due to the functioning of plant. People feel the changes in the environment of surrounding area due to the existence of facility. (Figure. 12) (Table 4)

2. Conclusion

The management of waste from hospitals and bio medical waste treatment facility was studied. The waste was segregated into various categories in the hospitals according to Bio Medical Waste (Management & Handling) Rules, 1998 (Schedule 1). The daily operations imply a high cost for waste management at medical establishment. The capacity of the medical establishment limits the resources for recycling and handling of waste. In this study, it was found that small level hospitals maintained somewhat proper segregation and management channel. But in the very small level hospitals waste production is less yet there is lack of proper management system. Some of very small level hospitals do not have record of the waste production. Even medical staff has not proper knowledge of waste segregation. Administrative staff and some other personnel think that it is the responsibility of government to deal with and manage the Bio medical waste rather than the responsibility of team or team work. Some time staff does not bother about the segregation and mix the waste, which create serious problem to the workers of BMWTF, where waste is managed or treated. After the segregation, waste sent to Bio medical Treatment Facility for the disposal. The waste incinerated, autoclaved and shredded there. Human Anatomical waste, Animal waste, discarded medicines and cytotoxic drugs, soiled waste incinerated. After incineration, produced ash sent for its disposal in land filling and waste sharps like needles, scalpels blades etc. treated with hypochlorite solution in the sharp pits. Infected plastic waste autoclaved and shredded into small pieces. After shredding, waste sent for recycling.

The awareness among the facility workers was good though some of worker was illiterate or less educated. Some of workers said that it is the responsibility of management to manage the waste. The tenure of maximum worker was less than one year. The workers those, who working from a long time in the facility suffered with respiratory problems. The village people were aware of treatment of Bio medical waste in the facility but people do not have any problem with the existence of the facility. Most of people feel the suffocation and bad odour due the functioning of facility and they feel the change in the surrounding after its establishment. We can conclude at last that there should be regular education programmes to create the awareness among the people, medical, administrative and technical staff. More concerned should be on the small structure because they are the base for big structure. If once problem on the small level will be solved, it will be sort out automatically at large scale. Since the introduction of Biomedical Waste (Management and Handling) Rules, 1998, it achieved a lot. But lack in enforcement might have not yielded the desired results. The enforcement authority must concern with following things:

1. Continuous supervision and monitoring mechanism should be developed for effective management of Bio medical waste at hospital as well as BMWTF level.
2. A continuous training programmes should be organised for the workers who handle the waste.
3. A dedicated committee should be at facility level, which will organise the regular meetings.
4. All the paramedical staff should have complete knowledge on Bio Medical Waste Management.
5. Streaked punishments should for guilty and faulty.

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