Original Article

DOI: 10.17354/ijss/2015/63

Comparing the Biomedical Waste Management Practices in Major Public and Private Sector Hospitals of Shimla City

Saurabh Kumar[1], Salig Ram Mazta[2], Anmol K Gupta[3]

[1]Assistant Professor, Department of Community Medicine, Father Muller Medical College, Mangalore, Karnataka, India, [2]Professor and Head, Department of Community Medicine, Indira Gandhi Medical College, Shimla, Himachal Pradesh, India, [3]Professor, Department of Community Medicine, Indira Gandhi Medical College, Shimla, Himachal Pradesh, India

Abstract

Purpose: Biomedical waste (BMW) management seems to be neglected and usually ends up in a blame game as the generators keep blaming the housekeeping staff for the improper management and vice versa. The generators, i.e. doctors, paramedics forget the most important step of BMW management, i.e. segregation that compounds the problem of proper management of the same. In common parlance, people say the private sector is better than the public one.

Aim and Objective: To look at the differences in BMW management practices if any between the between major public and private hospitals of the Shimla city.

Methodology: Cross-sectional study was conducted in four major public and three major private hospitals of Shimla city respectively. We collected the data through predesigned interview schedules and observational survey checklist of International Clinical and Epidemiology Network.

Results: The mean hazardous BMW generated by the private hospitals was calculated to be 51.33 g/bed/day (standard deviation [SD] 34.96) in comparison to 191.5 g/bed/day (SD 93.83) for the public hospitals. There was a significant difference in segregation of wastes in public and private hospitals with private hospitals showing results better in terms of segregation of wastes according to the guidelines. It revealed that none of the patient care areas had designated waste route inside the hospital. All the hospitals except one public hospital had central waste storage facility. None of the major private hospitals had facilities for treatment and disposal. None of housekeeping staff was using the personal protective equipment.

Conclusion: All major hospitals of Shimla city in the study area practiced poor management of BMWs. Major improvement was required in all the sectors of BMW management.

Key words: Biomedical, Hospitals, Management, Waste

INTRODUCTION

The bio-medical waste (BMW) means any solid, liquid waste material, generated during the process of diagnosis, treatment and immunization of human being or animal. These waste materials could cause serious hazards to health and environment in case of indiscriminate management. All the hospital personnel are at a risk to get many fatal infections like human immunodeficiency virus, hepatitis B virus, hepatitis C virus and injuries by these infectious materials. Wherever biomedical solid waste is generated, safe and reliable methods for its handling are therefore essential and hence due emphasis has been placed on segregation, safe collection, storage and treatment and final disposal at site to minimize if not eliminate the health hazards.

The Government of India (Notification, 1998)[1] specifies that Hospital Waste Management is part of hospital hygiene and maintenance activities. This involves management of a

Access this article online

www.ijss-sn.com

Month of Submission : 12-2014
Month of Peer Review : 01-2015
Month of Acceptance : 01-2015
Month of Publishing : 02-2015

Corresponding Author: Dr. Saurabh Kumar, Department of Community Medicine, Father Muller Medical College, Mangalore, Karnataka, India. Mobile: +91-9343606162. E-mail: docsaurabh777@gmail.com

range of activities, which are mainly engineering functions, such as collection, transportation, operation/treatment of processing systems, and disposal of waste. However, initial segregation and storage activities are the direct responsibility of doctors and nursing personnel who are engaged in the hospital. If the infectious component gets mixed with the general non-infectious waste, the entire mass becomes potentially infectious.[2,3]

The actual BMW management situation in the democratic developing country like India is grim. Even though there are rules stipulating the method of safe disposal of BMW, hospital waste generated by Government Hospitals is still largely being dumped in the open, waiting to be collected along with general waste.[4]

In common parlance, people say the private sector is better than the public one. Looking into the existing scenario of BMW management in the country and the fact that such a comprehensive study had not been done in Himachal Pradesh, this study was undertaken to look into the differences in BMW management practices if any between the between major public and private hospitals of the Shimla city.

METHODOLOGY

The study was conducted in the major public and private hospitals of Shimla city. In the study area, there were 72 health facilities that fell under the jurisdiction of both the municipal corporation and Himachal Pradesh State Pollution Control Board, Shimla Head Quarter. The study comprised of cross-sectional survey of the personnel handling and monitoring the BMW and observational survey of the four major public and three major private hospitals, the criteria for major hospital being the hospitals with more than 15 beds. The data was collected in three stages. In the stage one of data collection, hospital superintendents/hospital administrators, ward sisters/sister in charge, chief lab technicians and housekeeping staff of, respective hospitals, were interviewed. Stage two of data collection, comprised of studying the waste handling and hospital waste management of the public sector and private sector hospitals as per the observational checklist of International Clinical Epidemiology Network.

In the stage three of data collection, information was gathered on the quantity of hazardous and non-hazardous waste material generated per bed per day on the basis of the three random visits conducted. An average of the three measurements gave the quantum of biomedical solid waste generated per bed per day in the public and private hospitals respectively.

The study was conducted through October 2009 to September 2010. The data so collected were entered and analyzed using SPSS 14 evaluation version. The results were expressed in percentages. The mean amount of waste generated in the various hospitals was calculated with a standard deviation under 95% confidence intervals. The results were described under segregation and collection, transport, storage, final treatment and disposal and quantification.

The study did not involve any experimental diagnostic tests or administration of medicines to participants. Written informed consent of all participants was obtained before gathering any information.

RESULTS

The study was conducted in the seven major hospitals of Shimla city namely, Indira Gandhi Medical College, Kamla Nehru Hospital, Deen Dayal Upadhyay Hospital, HP Government Dental College (Public hospitals) and Indus Hospitals, Shimla Sanitarium and Sri Ram Hospital (Private Hospitals).

During the study, 7 Hospital Superintendents/Hospital administrators/CEO/Vice President/Nodal officer, 52 nursing staff (Ward Sister/nursing in Charge), 13 lab technicians, 102 housekeeping staff, respectively were interviewed regarding the BMW management practices being followed in their respective hospitals. In order to verify the results of the interview schedules, observation survey was conducted in total 107 patient care areas of the respective hospitals.

Segregation and collection

Results of interview

Majority of the nursing staff, chief lab technician in both public and private hospitals stressed that there was strict implementation of BMW management in the patient care area but labeling the name of the patient care area was usually not done (Table 1).

The nursing in charges said that 45 (88.2%), 39 (90.7%), 46 (88.5%) and 42 (85.7%) of the patient care areas had yellow, blue, red and black waste bags in the correct position. In all the patient care areas supervised by nursing in charge in the private hospitals, the waste bags were correctly positioned. It was further told that BMW management guidelines were not present 50 (96.2%) in the areas supervised by them.

According to the chief lab technicians, in 10 (83.3%), 8 (72.7%), 8 (72.7%) and 9 (75%) of the labs supervised by them had correctly positioned yellow, blue, red and

Table 1: Components of segregation and collection (interview schedule)

Ward sisters	Private hospitals (l/c patients care areas) (*n*=7) (%)	Public hospitals (l/c patients care areas) (*n*=45) (%)	Total (l/c patients care areas) (*n*=52) (%)	*P* value
Labelled and signed				
Yes	1 (14.3)	0	1 (1.9)	0.14
No	6 (85.7)	45 (100)	51 (98.1)	
Strict implementation				
Yes	4 (57.1)	34 (75.6)	38 (73.1)	0.57
No	3 (42.9)	11 (24.4)	14 (26.9)	
Chief lab technicians	**Private hospitals (*n*=3)**	**Public hospitals (*n*=10)**	**Total (*n*=13)**	
Labeled and signed				
Yes	1 (33.3)	0	1 (7.7)	0.23
No	2 (66.7)	10 (100)	12 (92.3)	
Strict implementation				
Yes	2 (66.7)	8 (80)	10 (76.9)	1.00
No	1 (33.3)	2 (20)	3 (23.1)	

black bags respectively. In all the labs supervised by chief lab technicians private hospitals, only 2 (66.7%) and 1 (50%) of the labs had correctly positioned red and black bags respectively, whereas other colored waste bags were correctly positioned in 100 % of the labs of private hospitals. They also told that guidelines regarding BMW management were displayed in only 4 (30.8%) labs.

Observation survey findings

There was significant difference in segregation of wastes in public and private hospitals with private hospitals showing results better in terms of segregation of wastes according to the guidelines, segregation of wastes at the site of generation and collection of plastic waste unmixed in red bags (Table 2).

It was revealed that in nearly half the patient care areas of the hospitals, containers with colored bags were not located at the site of generation. There was no significant difference in private and public hospitals as far as the position of containers with colored bags at the site of generation was concerned. Observational survey revealed that only 7 (6.5%) of the patient care areas had guidelines/charts displayed.

On Site Transport

Interview schedule results

All the housekeeping staff interviewed in the various hospitals told that they closed the waste bags by tying the knot and carried them to the central waste storage facility in hands.

According to Hospital superintendents, all the hospitals except one were having separate/specific time schedule

Table 2: Components of segregation and collection (observational survey)

Components	Private hospitals (patients care areas) (*n*=16) (%)	Public hospitals (patients care areas) (*n*=91) (%)	Total (patients care areas) (*n*=107) (%)	*P* value
Segregation of wastes				
No	6 (37.5)	85 (87.9)	91 (85.1)	NA
As per guidelines	6 (37.5)	4 (4.4)	10 (9.3)	
NA	4 (25)	2 (2.2)	6 (5.6)	
Segregated at the site of generation				
No	6 (37.5)	80 (87.9)	86 (80.4)	NA
Yes	6 (37.5)	9 (9.9)	15 (14)	
NA	4 (25)	2 (2.2)	6 (5.6)	
Biohazard labels				
No	1 (6.3)	8 (8.8)	9 (8.4)	1.00
Present	14 (87.5)	75 (82.4)	89 (83.2)	
NA	1 (6.3)	8 (8.8)	9 (8.4)	
Bags not 3/4th full				
No	0	12 (13.2)	12 (11.2)	0.34
Yes	12 (75)	70 (76.9)	82 (76.6)	
NA	4 (25)	9 (9.9)	13 (12.2)	
Syringe plunger collected in red bags				
No	1 (6.3)	5 (5.5)	6 (5.6)	0.57
Yes	11 (68.8)	73 (80.2)	84 (78.5)	
NA	4 (25)	13 (14.3)	17 (15.9)	
Plastic waste collected in red bags				
No	2 (12.5)	3 (3.3)	5 (4.7)	NA
Yes	8 (50)	9 (9.9)	17 (15.9)	
Mixed	5 (31.3)	65 (71.4)	70 (65.4)	
NA	1 (6.3)	14 (15.4)	15 (14)	

NA: Not applicable

to remove infectious waste and general wastes from the wards. BMW was being removed from the patient care areas for storage/treatment and final disposal in more than once a week, and the remaining hospitals were removing it as and when sufficient quantity of BMW accumulated. A dedicated waste route designated to avoid the passage of wastes through patient care areas was only in two of the hospitals one in a private and public sector each.

Observation survey findings

It revealed that none of the patient care areas had designated waste route inside the hospital. Even the time of removal of infectious waste from non-infectious waste was different only in 8.4% (n=9) patient care areas and those 9 patient care areas belonged to public hospitals. In 6.5% (n=7) patient care areas only that too of private hospitals (43.8% [n=7]) small buckets were being used to carry the wastes to the central storage facility but they were not labeled with the biohazard symbol.

Storage

All the hospitals except one public hospital had central waste storage facility. So it was excluded from the further analysis.

Storage areas were secured by lock and key in the hospitals except for one private hospital. Proper log book was not maintained for receipt and register of the BMW at any of the hospitals although a designated person was there for the storage area. It was observed that the waste bags were not labeled with the site of generation and were stored together except in one private hospital where they were stored separately.

Functional facility to weigh the waste was there in 4 (57.2%) of the hospitals with the three public hospitals having it. The state of cleanliness in the central storage facilities in all the public hospitals was poor. The private hospitals fared better in this aspect as 2 (66.7%) had central storage facility in a relatively better condition compared to the public hospitals.

Treatment and Final Disposal

Sharps management

Totally, 29 (56.9%) of the nursing staff said that in their patient care areas sharps were destroyed individually. The major reason behind the destruction of sharps in bulk was found to be excess workload. Though sufficient disinfectant was available in 41 (80.4%) of the patient care areas supervised by nursing staff, in only 5 (9.8%) patient care areas, the disinfectant solution was being replaced in each shift as per the guidelines.

In 3 (42.9%) of the patient care areas of the private hospitals supervised by nursing staff sharps were destroyed individually whereas it was seen in 26 (57.8%) of the patient care areas of public hospitals according to the interview of the nursing in charge. Only in 11.1% (n=5) of the patient care areas supervised by nursing staff of the public hospitals disinfectant solution for treating the plastic wastes was replaced as per guidelines. There was no significant association with various aspects of sharps treatment with type of hospitals in relation to ward sisters/nursing in charge.

Observational survey findings

Totally, 74 (69.2%) of the patient care areas had a functional needle destroyer easily available and 64 (59.8%) of the patient care areas (Figure 1) were destroying the needles after every injection. Higher proportion of the public hospitals patient care areas were performing better regarding sharps management.

Only two of the hospitals (public hospitals) had a central storage cum treatment facility. Autoclave and shredder were available in both the settings. Only the plastic waste was treated with the machine, i.e. autoclaved and shredded and then it was being sold to a contractor for recycling measure. One of the hospital was operating the machine twice weekly, and the other hospital was operating the machine on a daily basis for nearly 5 h.

There were no reports of scavenging from these sites in any of the two central storagecum treatment facilities. At only one of the central storage cum treatment facilities, an open pit was there for sharps disposal of the size of 10 × 10 × 12 Cubic feet. A new pit had been constructed which was provided with a pipe for putting the sharps inside the pit and adding disinfectant to it.

Quantification of BMW

The mean weight of hazardous BMW/per bed/day came to be 131.42 g/bed/day (SD 102.09) of all the hospitals. The mean hazardous BMW generated by the private hospitals was calculated to be 51.33 g/bed/day (SD 34.96) in comparison to 191.5 g/bed/day (SD 93.83) for the public hospitals. There was no significant difference between the mean hazardous waste generated in public and private hospitals.

DISCUSSION

BMW management requires diligence and care from a chain of people, starting with the nurse or doctor who use the equipment and supplies that become waste, continuing through housekeeping staff who carries away the waste, on to off-site transport companies, and finishing with the technology operator responsible for ensuring that residues are disposed of in the correct way. If any of these are careless in their work or allow scavengers access to the waste, the chain is broken, and dangers follow.

The present study was conducted to compare the BMW management practices in public and private hospitals.

Segregation and collection

Difference was observed in the interview schedule results and the results of the observational survey regarding various components of segregation and collection except for labeling and signing on the waste bags. The difference clearly indicated the lack of attitude on the part of the nursing staff in charge and chief lab technicians in managing the segregation and collection in their respective supervised patient care areas.

Observational survey revealed that in the majority of the patient care areas waste segregation was not done at the site of generation, and even the guidelines were not followed in most of the patient care areas. But the private hospitals performed significantly better in regarding onsite waste segregation. Similar results were observed by Askarian *et al.*,[5] Pandit *et al.*,[6] Gupta *et al.*,[7] Tsakona *et al.*,[8] Pandit *et al.*,[9] Bdour *et al.*[10] and Abor and Bouwer[11] respectively.

One of the probable reasons may be the absence of the containers with colored bags at the site of generation as revealed in the observational survey.

In the present study, it was found that neither the guidelines were displayed in the majority of the patient care areas nor were the waste bags labeled and signed before being transported to the central waste storage facilities. Similar findings were seen by Verma *et al.*[12] in Delhi.

Onsite Transport

There were contrasting results obtained from the interviews of the hospital superintendents and the observational survey with the latter depicting that none of the hospitals had designated waste route for the transportation of BMW. Even the time of removal of infectious waste from non-infectious waste was not different in the majority of the patient care areas.

In the present study, it was revealed that all the housekeeping staff used to transport the waste bags manually without using any trolleys (Figure 2). This practice exposed visitors and patients to possible contamination. Contrary to our finding better onsite transport facilities were observed in many studies.[8,10,13,14]

Storage

The characteristics of storage locations have a direct impact on the environment and potential health risks at the hospital. Evidently, they must be well-disinfected and secured so that only authorized personnel can have access to them.[15]

Proper log book was not maintained for receipt and register of the BMW at any of the hospitals although a designated person was there for the storage area. Tsakona *et al.*[8] and El Salam MMA[16] also found the similar thing that all the central storage chambers had a limited access to only the personnel responsible of waste handling.

It was observed that the waste bags were not labeled with the site of generation and were stored together except in one private hospital where they were stored separately. Similar findings were observed by Tsakona *et al.*[8] and Rouyan *et al.*[17]

Functional facility to weigh the waste was there in 4 (57.2%) of the hospitals with the three public hospitals having it. The central storage areas of private hospitals were found to be better than that of public hospitals in terms of overall hygiene. But sufficient cleaning was not done in any of the hospitals that was found to be similar to other studies.[10,16,17]

Treatment and Final disposal

Encouraging results were seen in the sharps management in the present study as the sharps (needles) were being destroyed individually in large number of the patient care areas. But in spite of the sufficient availability of the disinfectant, its solution was not being replaced as per the guidelines in almost all the patient care areas.[18]

Only two of the hospitals (public hospitals) had a central storage cum treatment facility. Autoclave and shredder were available in both the settings (Figure 3). Only the plastic waste was being treated with the machine, i.e. autoclaved and shredded and then it was being sold to a contractor for recycling measure.

Wastes from other hospitals in the present study used to come to the regional incinerator plant run by Municipal Corporation. The yellow bags containing soiled wastes was, of the above-mentioned hospitals were also transported to this plant for incineration. Mixed waste was being treated incinerated daily and hence putting at risk the lives of not just the technology operators but also the people living in the vicinity. Similar results were seen by Tsakona *et al.*[8] and Bendjoudi *et al.*[19] as large amount of municipal wastes and liquids were incinerated with the infectious waste.

Quantitative analysis

The amount of medical waste and the risks to waste handlers can be reduced effectively with proper waste handling, such as proper segregation and resource recycling.[20,21,22]

The waste generation rates ranged from 0.25 to 7.0 kg/bed/day[23] in seven European countries and the US, 0.4-5.5 kg/patient/day[24] in 12 developing and developed countries and 0.11–3.9 kg/bed/day[25] at hospitals of Japan, Turkey, US, Canada, India, Thailand, and Bangladesh.

In the present study, the mean weight of hazardous solid BMW/per bed/day came to be 131.42 g/bed/day (SD 102.09) of all the hospitals. The mean hazardous solid BMW generated by the private hospitals was calculated to be 51.33 g/bed/day (SD 34.96) in comparison to 191.5 g/bed/day (SD 93.82) for the public hospitals. There was no significant difference between the mean hazardous solid BMW generated/bed/day in public and private hospitals. Similar findings were seen in a study of rural and urban areas of U.T. Chandigarh, where the rate of generation of BMW varied from 0.06 kg/bed/day to 0.25 kg/bed/day.[26] Jang *et al.*[27] also found similar BMW generation rates in Daejeon, South Korea. Even the other medical college in Himachal Pradesh i.e. Dr. R.P.G.M.C. Tanda had also reported a similar average waste generation/bed/day.[28] Bdour *et al.* and Abdulla *et al.* found higher BMW generation rate in their respective studies.[10,14] The probable reason could be the availability of data on infectious BMW only in the hospitals under study.

Figure 1: Investigator looking into the waste bins to observe segregation process

Figure 2: Inadequate use of personal protective equipment's by housekeeping staff

Figure 3: Autoclave and shredder at waste treatment facility of a public hospital

CONCLUSION

All major hospitals of Shimla city in the study area practiced poor management of BMWs. Typically, handling of these wastes was assigned to housekeeping staff who performed all activities without proper training or guidance, and with insufficient personal protective measures. However, there were significantly higher number of needle/sharp induced injuries in housekeeping staff of public hospitals. Poor segregation and classification procedures of the generated wastes were observed at all of the surveyed hospitals but the private hospitals performed significantly better in relation to segregation of wastes at the site of generation. The infectious BMW was still being dumped and mixed with the domestic waste. Collection, internal transportation and storage facilities in the hospitals failed to meet the BMW (management and handling) rules 1998. Onsite treatment facilities (autoclave and shredder) were available in only two of the hospitals that were operated by contractual staff having incomplete personal protective measures.

The most frequently used treatment for solid BMW was incineration; all the hospitals of Shimla city. The efficiency of incineration practices was still questionable which might be adversely reflected on the health of the technology operators and surrounding communities.

Average generation rate of hazardous BMW in the major hospitals of Shimla city was found to be 131.42 g/bed/day (SD 102.09) of all the hospitals. There was no significant difference between the mean hazardous BMW generated/bed/day in public and private hospitals.

ACKNOWLEDGMENT

Author wants to acknowledge the funding by Indian Council of Medical Research as a part of MD/MS thesis grants (2010) for this research study. He also wants to acknowledge the International Clinical Epidemiology Network for providing him the data collection tools. Also, Author acknowledges Dr. Anjali Mahajan, Assistant Professor, Department of Community Medicine, IGMC Shimla, who helped him in the statistical analysis.

REFERENCES

1. Info Nugget, Hospital Waste Management and Bio-degradable Waste. Government of India, Press Information Bureau. Available from: http://www.pib.nic.in/infonug/infaug.99/i3008991.html. [Last cited on 2014 Nov 4].
2. Patil GV, Pokhrel K. Biomedical solid waste management in an Indian hospital: A case study. Waste Manag 2005;25:592-9.
3. Chaerul M, Tanaka M, Shekdar AV. A system dynamics approach for hospital waste management. Waste Manag 2008;28:442-9.
4. Biomedical Wastes. Available from: http://www.swachdelhi.comNew.htm. [Last cited on 2014 Nov 4].
5. Askarian M, Vakili M, Kabir G. Results of a hospital waste survey in private hospitals in Fars province, Iran. Waste Manag 2004;24:347-52.
6. Pandit NB, Mehta HK, Kartha GP, Choudhary SK. Management of bio-medical waste: Awareness and practices in a district of Gujarat. Indian J Public Health 2005;49:245-7.
7. Gupta S, Boojh R, Mishra A, Chandra H. Rules and management of

biomedical waste at Vivekananda Polyclinic: A case study. Waste Manag 2009;29:812-9.
8. Tsakona M, Anagnostopoulou E, Gidarakos E. Hospital waste management and toxicity evaluation: A case study. Waste Manag 2007;27:912-20.
9. Pandit NA, Tabish SA, Qadri GJ, Mustafa A. Biomedical waste management in a large teaching hospital. JK Pract 2007;14:57-9.
10. Bdour A, Altrabsheh B, Hadadin N, Al-Shareif M. Assessment of medical wastes management practice: A case study of the northern part of Jordan. Waste Manag 2007;27:746-59.
11. Abor PA, Bouwer A. Medical waste management practices in a Southern African hospital. Int J Health Care Qual Assur 2008;21:356-64.
12. Verma LK, Mani S, Sinha N, Rana S. Biomedical waste management in nursing homes and smaller hospitals in Delhi. Waste Manag 2008;28:2723-34.
13. Mohamed Soliman S, Ibrahim Ahmed A. Overview of biomedical waste management in selected Governorates in Egypt: A pilot study. Waste Manag 2007;27:1920-3.
14. Abdulla F, Abu Qdais H, Rabi A. Site investigation on medical waste management practices in northern Jordan. Waste Manag 2008;28:450-8.
15. Cheng YW, Sung FC, Yang Y, Lo YH, Chung YT, Li KC. Medical waste production at hospitals and associated factors. Waste Manag 2009;29:440-4.
16. Abd El-Salam MM. Hospital waste management in El-Beheira Governorate, Egypt. J Environ Manage 2010;91:618-29.
17. Ruoyan G, Lingzhong X, Huijuan L, Chengchao Z, Jiangjiang H, Yoshihisa S, *et al*. Investigation of health care waste management in Binzhou District, China. Waste Manag 2010;30:246-50.
18. Infection control for viral haemorrhagic fevers in the African Health Care settings. Available from: http://www.cdc.gov/vhf/abroad/vhf-manual.html. [Last cited on 2014 Nov 20].
19. Bendjoudi Z, Taleb F, Abdelmalek F, Addou A. Healthcare waste management in Algeria and Mostaganem department. Waste Manag 2009;29:1383-7.
20. Almuneef M, Memish ZA. Effective medical waste management: It can be done. Am J Infect Control 2003;31:188-92.
21. Lee BK, Ellenbecker MJ, Moure-Ersaso R. Alternatives for treatment and disposal cost reduction of regulated medical wastes. Waste Manag 2004;24:143-51.
22. Tudor TL, Barr SW, Gilg AW. Strategies for improving recycling behaviour within the Cornwall National Health Service (NHS) in the UK. Waste Manag Res 2007;25:510-6.
23. Liberti L, Tursi A, Costantino N, Ferrara L, Nuzzo G. Optimization of infectious hospital waste management in Italy Part II. Waste characterization by origin. Waste Manag Res 1996;14:417-31.
24. Chung SS, Lo CW. Evaluating sustainability in waste management: The case of construction and demolition, chemical and clinical wastes in Hong Kong. Res Conserv Recycling 2003;37:119-45.
25. Mohee R. Medical wastes characterization in healthcare institutions in Mauritius. Waste Manag 2005;25:575-81.
26. Singh K, Arora SK, Dhadwal PJ, Singla A, John S. Biomedical waste management in the Union territory of Chandigarh. J Environ Sci Eng 2004;46:55-60.
27. Jang YC, Lee C, Yoon OS, Kim H. Medical waste management in Korea. J Environ Manage 2006;80:107-15.
28. Biomedical waste management in Himachal Pradesh. Available from: http://www.cpcb.nic.in/oldwebsite/highlights/ch10htm. [Last cited on 2014 Nov 29].

How to cite this article: Kumar S, Mazta SR, Gupta AK. Comparing the Biomedical Waste Management Practices in Major Public and Private Sector Hospitals of Shimla City. Int J Sci Stud 2015;2(11):112-118.

Source of Support: Nil, **Conflict of Interest:** None declared.