International Journal of Community Medicine and Public Health
Lohani N et al. Int J Community Med Public Health. 2017 Feb;4(2):465-470
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: http://dx.doi.org/10.18203/2394-6040.ijcmph20170274

Original Research Article

Biomedical waste management practices in a tertiary care hospital: a descriptive study in Srinagar, Garhwal, India

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Received: 06 December 2016
Accepted: 02 January 2017

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ABSTRACT

Background: Biomedical waste (BMW) is generated in every health facility, which if not disposed off properly poses a risk for health and environment. Handling, segregation, mutilation, disinfection, storage, transportation and final disposal are vital steps for safe and scientific management of biomedical waste in any establishment. The objective were to assess the biomedical waste management (BMWM) practices and knowledge regarding BMWM in a tertiary care hospital.
Methods: A descriptive study was carried out in the tertiary care hospital during July and August 2014. Hospital waste management practices were observed by making visits to the waste collection sites at different sites of the hospital and for assessment of knowledge regarding waste management a total of 113 health care personnel were interviewed.
Results: The overall mean score for "Condition of waste receptacles" was 44.3%. The mean score for segregation of waste was 77%, for mutilation of recyclable waste the mean score was 88% and the disinfection mean score was 72%. There were some good practices observed like presence of posters regarding disposal of BMW in most places, availability of gloves, masks etc. to the workers collecting BMW .There was no separate route for transport of biomedical waste. The knowledge regarding BMWM was not satisfactory among the participants and scope of improvement is there.
Conclusions: While there were some good practices observed, there were inconsistencies observed regarding BMWM in the hospital.

Keywords: BMWM, Segregation of waste, Waste receptacles

INTRODUCTION

Biomedical waste (BMW) means any waste which is generated during the diagnosis, treatment or immunisation of human beings or animals or in research activities pertaining thereto or in the production or testing of biological.[1] The quantum of waste that is generated in India is estimated to be 1-2 kg per bed per day in a hospital and 600 gm. per day per bed in a general practitioner's clinic. It is estimated that only 5–10% of this comprises of hazardous/infectious waste.[2] According to WHO 85% of hospital waste is non-hazardous, 10% infective and remaining 5% non-infective but hazardous.[3] In the recent years there has been a considerable increase in the number of Government and private hospitals throughout the country. Bio-medical waste (BMW) collection and proper disposal has become a significant concern for both the medical and the general community.[4]

Handling, segregation, mutilation, disinfection, storage, transportation and final disposal are vital steps for safe and scientific management of biomedical waste in any establishment. The key to minimization and effective management of biomedical waste is segregation and identification of the waste.[5] The general waste is treated by local municipality in same way as house-hold waste, but special precautions and treatment modalities are required for BMW, so that it does not cause any harm to human beings and environment.[6] Though as many as 40 pathogens have been documented to be transmitted by BMW, its well documented propensity to cause transmission of 3 pathogens namely Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV) makes it essential that due care is exercised while handling and disposing it.[7-9] The scientific study of hospital waste management is necessary as its improper management poses risks to the health care workers, waste handlers, patients, community in general and largely the environment. Also, it is highly desirable for a Hospital Administrator to know the weak points in the chain of waste management so that these could be addressed appropriately. This is the reason why the present study is being undertaken to assess the knowledge and practices of biomedical waste management amongst the staff of The Hemwati Nandan Bahuguna (HNB) teaching hospital, Srinagar Garhwal a tertiary care hospital in Uttrakhand, India.

METHODS

The study was conducted in the 500 bedded Hemwati Nandan Bahuguna (HNB) teaching hospital, Srinagar Garhwal after taking permission from institutional ethical committee. The study was of descriptive type. The study was conducted between July and August 2014 as ICMR's STS project for medical undergraduates. Study involved observation of actual waste management practices in the hospital and assessment of knowledge regarding BMWM in hospital staff. To observe actual BMWM practices the methodology adopted was similar to study by Kumar et al[10]. Observation was done in all the patient areas of the hospital, including in patient wards (14 in numbers), intensive care units (2 in numbers), operation theatres (2 in numbers), labour room (1 in number) and emergency area (1 in number). A total of 4 visits were made in each area during working hours, each area was visited on any 2 non-consecutive days. Primarily, 4 broad functions are carried out at source viz. (i) placement of 4 colour-coded i.e. black, yellow, red and blue waste bins which are lined on inner side by similarly coloured waste bags; (ii) segregation of waste in such waste bags i.e. general waste like waste paper, wrapper of drugs, cardboard, left-over food etc. is to be put into black; soiled infected waste like dressing material, cotton swabs etc. is to be put into yellow; plastic waste like plastic syringes, dextrose bottles, intravenous sets, Ryle's tubes, urinary catheters etc. is to be put into red and sharps like hypodermic needles, surgical blades, glass etc. is to be put into blue bags, (iii) mutilation of recyclable waste like disposable syringes, and hypodermic needles and (iv) disinfection of certain categories of waste notably plastics and sharps.[10] The checklist items were as follows. Condition of waste receptacle was assessed by asking 1) Is black coloured waste bin available in ward? 2) Is yellow coloured waste bin available in ward? 3) Is red coloured waste bin available in ward? 4) Is blue coloured waste bin available in ward? 5) Has black bag been placed lining the inner side of black bin? 6) Has yellow bag been placed lining the inner side of yellow bin? 7) Has red bag been placed lining the inner side of red bin? 8) Has blue bag been placed lining the inner side of blue bin? 9) Is black bag securely fitted with the bin? 10) Is yellow bag securely fitted with the bin? 11) Is red bag securely fitted with the bin? 12) Is blue bag securely fitted with the bin? 13) Are waste bins covered? 14) If covered, is cover foot-operated? 15) Is the biohazard symbol imprinted over waste bags? 16) Are posters to guide users displayed near waste bins? Segregation of waste was assessed by asking 1) Does black bag contain only general waste? 2) Does yellow bag contain only soiled infected waste? 3) Does red bag contain only plastic waste? 4) Does blue bag contain only sharps waste? Mutilation of recyclable waste was assessed by asking 1) Are used hypodermic needles destroyed? 2) Is nozzle of used syringes destroyed? 3) Are used hypodermic needles found re-capped? 4) Are used hypodermic needles found bent? 5) Are used plastic bottles cut? 6) Are used plastic tubings cut? Disinfection of waste was assessed by asking 1) Is disinfectant solution put into red containers? 2) Is disinfectant solution put into blue containers 3) Is barrel and plunger of syringe separate before immersion into disinfectant solution?[10] Also, observations were done regarding the transport and storage of the waste collected. Observations were also done regarding the personal protective measure used by the personnel handling the biomedical waste. Each desirable observation was assigned '1' mark and each undesirable observation was assigned '0' mark. There were some parameters, observations regarding which could be in part desirable and in part undesirable in a given area, such observation was assigned '0.5' mark. As an example, if all of the used hypodermic needles in an area were found mutilated (desirable), it was assigned '1' mark; if none of the needles was mutilated (undesirable), it was assigned '0' mark and if some of the needles were mutilated and some not, such observation was assigned '0.5' mark[10]. Also, data was collected from the Health inspector regarding the average total waste collected in the study area per day. In the second part the knowledge of respondents regarding BMW management was assessed on a preformed questionnaire. Convenience sampling was done. The study units involved the members of the hospital staff including doctors, nurses and the other staff (including sweepers, health care workers etc). Sample size was calculated in advance using p value as 0.5, absolute error of 7%, at 95% confidence level and applying correction for finite population. The total staff of 113, of which 46 doctors, 47 nurses, and 20 other staff workers were included in the study.

Inclusion criteria

- Only those who gave their consent for interviewing were involved in the study.
- The staff working in the hospital for more than 6 months was only included in the study

Exclusion criteria

- Those who did not give their consent for interviewing were excluded from the study.
- Staff working in the hospital for less than 6 months was not included in the study

Data analysis

The score obtained in 4 visits for all the parameters of waste management was divided by 4 to obtain the mean score and then percentage mean score was calculated. The score of all observation units in a given area was summated and mean percentage score of the area was calculated. The knowledge and awareness of respondents regarding BMW management, was analysed in form of percentage/proportion.

RESULTS

Total 113 health care personnel were included in the study (Table 1). The average total waste collected was 264.75 kg/day in the hospital and thus average total waste collected per bed (500 beds) is 0.53 kg/day (Table 2). The overall mean score for "Condition of waste receptacles" was 44.3 %. Individually the scores Varies in different departments (Figure 1).

Table 1: Profile of study participants.

Characteristics	Categories	Number (n=113)	Percentage (%)
Age	21-30 years	68	60.2
	31-40 years	36	31.8
	41-50 years	7	6.2
	>50 years	2	1.8
Sex	Male	73	64.6
	Female	40	35.4
Work profile	Doctors	46	40.7
	Nurse	47	41.6
	Other staff	20	17.7
Working in hospital	6 months-1 year	38	33.6
	2-3 years	49	43.4
	4-6 years	21	18.6
	>6 years	5	4.4

Table 2: Average total waste collected per day.

Department	Red Bag	Blue Bag	Yellow Bag	Black Bag
Radiotherapy	200 gm	175 gm	150 gm	9 kg
Dermatology	275 gm	250 gm	300 gm	14 kg
Medicine	700 gm	500 gm	550 gm	25 kg
ENT	350 gm	400 gm	550 gm	17.5 kg
Orthopaedics	475 gm	200 gm	1200 gm	34 kg
TB, Chest	350 gm	900 gm	450 gm	16 kg
Paediatrics	200 gm	150 gm	300 gm	16 kg
Surgery	500 gm	350 gm	900 gm	24 kg
Gynae/Obs	960 gm	1200 gm	3 kg	17.5 kg
Operation theatre	825 gm	1050 gm	3.5 kg	19 kg
ICU	275 gm	550 gm	300 gm	22 kg
Emergency	415 gm	1300 gm	1500 gm	25.5 kg
Total	5.525 kg	7.025 kg	12.7 kg	239.5 kg

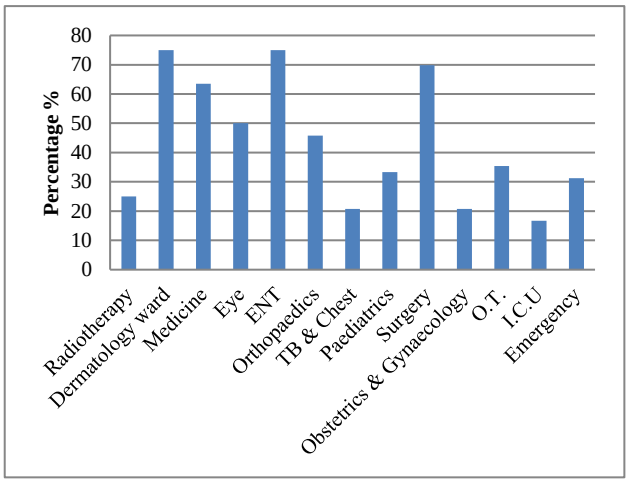

Figure 1: Assessment of biomedical waste management practices.

In the second set observations were made about Segregation of waste, Mutilation of recyclable waste and Disinfection. The mean score for segregation of waste was 77%. The waste segregation was done at collection sites by the sweepers. Daily disinfection of all bins was done. Waste was collected once in 24 hours. For mutilation of recyclable waste the mean score was 88%. In the hospital, electrically operated needle cutters were used to mutilate hypodermic needles and nozzle (hub) of disposable syringes. The disinfection mean score was 72%. 0.1% sodium hypochlorite solution was used to disinfect plastics and sharps. Observations were also made to see transport & storage of waste**.** There was no separate route for transport of biomedical waste. There was separate timing for transportation of BMW & general waste. However there were no covered trolleys used for transportation of BMW. There were no storage facilities for the BMW and the waste was disposed daily. Regarding the waste disposal, the waste was generally disposed of in the incinerator present in the hospital.

Incineration was done daily. Ash produced from incineration and the waste which could not be incinerated was buried in a secured landfill. Personal protective equipment were available in the hospital (Table 3).

Table 3: Personal protective clothing/vaccination used.

Protective measures	Used
Gloves	**Yes**
Apron	No
Long Boot	Yes
Eye shield	No
Mask	Yes

When we assessed knowledge regarding BMW 54.8% of the total respondents had received any kind of training in BMW handling. Overall the 94.7% of respondents were aware that risks are associated with BMW handling. The overall awareness regarding existence of BMW management rules was seen among 50.4 % of the study participants likewise 50.4% of the total respondents were aware that waste should not be stored for more than 48 hours and preferably disposed in 24 hours. All the 3 groups were aware of BMW generation in the hospital, a lesser number were aware of any policy regarding BMW management with most among the doctors with 56.5% and least among nurses 29.8%. Overall 42.5% of the study participants were aware of any policy regarding BMW management. 78.8% of the respondents were aware of biohazard symbol. While all the questioned nurses and other staffs were aware that different coloured bags are used to collect and dispose BMW, only 89% doctors were aware. All the interviewed nurses knew about the guideline provided for colour coding at work area while only 84.7% doctors were aware of it. Overall awareness regarding guidelines provided for color coding at work area was 92%. Overall awareness regarding use of different coloured bags to collect and dispose BMW was 95.6%. 94.7% of respondents were aware of the diseases caused by poor handling of BMW with most common answers of HIV, Hepatitis B, Tetanus, skin infections etc. Overall awareness regarding methods of segregation of waste was seen in 80.5% of the respondents. 83% nurse, 80% doctors including interns were and 75% of other staff (Sweepers, health care workers etc.) knew how to segregate the BMW (Table 4).

Table 4: Assessment of knowledge regarding biomedical waste management.

Questions	Doctors (including interns) n=46		Nurses n=47		Other staff (including sweepers, health care workers etc.) n=20		Total	
	n	%	n	%	n	%	n	%
Had received any sort of training in BMW handling	22	48	32	68	8	40	62	54.87
Aware of the risks of BMW handling	42	91.3	47	100	18	90	107	94.7
Aware of existence of BMWM rules	26	56.5	18	38.3	13	65	57	50.4
Aware of BMW production in the hospital	46	100	47	100	20	100	113	100
Aware that waste should not be stored for >48 hours	17	37	29	61.7	11	55	57	50.4
Aware of any policy regarding BMW management	26	56.5	14	29.8	8	40	48	42.5
Can identify the biohazard symbol	41	89	30	64	18	90	89	78.8
Aware that different coloured bags are used to collect and dispose BMW	41	89	47	100	20	100	108	95.6
Aware of any guideline provided for colour coding at work area	39	84.7	47	100	18	90	104	92
Aware of diseases associated with poor BMW handling	44	96	45	96	18	90	107	94.7
Can identify all coloured bags for BMW collection	44	96	47	100	20	100	111	98.2
Aware of methods for segregation of waste	37	80	39	83	15	75	91	80.5

DISCUSSION

In the present study, the waste generated per bed daily was 0.53 kg. This was much lesser than seen in study done in SRMS-IMS bareily where the waste generated was 1.5 kg.[9] The overall mean score for "Condition of waste receptacles" was 44.3%. The mean score for segregation of waste was 77%, for mutilation of recyclable waste the mean score was 88%, The disinfection mean score was 72%. These scores are poor as compared to the research study in North India, in which the score was 87%, 96%, 88%, and 81% respectively.[10] Our study recorded condition of waste receptacle better as compared to study in a south Indian city, where only white receptacles were used for all types of BMW, for aesthetic reasons.[11] We observed that waste was segregated at each area of BMW generation. This coincides with a study in a 350-bedded polyclinic at Lucknow, India.[12] A good finding was that personal protective equipments were provided to all workers. The similar findings were reported in Delhi.[13] Regarding the knowledge assessment, 100% of our study population was aware of the generation of BMW in the hospital. In a study among paramedical workers at Andhra Pradesh, this rate was only 53.2%.[14] While only 50.4% of the study population was aware about BMW (Management and Handling) rule 1998. The figures are less as compared to other studies.[15,16] 78.8% of study population was aware of the biohazard symbol. In a study at Puducherry, only 15% of healthcare workers knew about bio-hazard symbol.[19] Regarding the segregation of waste 80.5% of respondents were aware of it. Different color-coding bags for segregation were one of the most important parts of BMW management rule which was known by 96% of our respondents. Very low knowledge was reported by some other studies.[18,19] 94.7% of the respondents in the study were aware of the diseases caused by poor handling of BMW. The practice of reporting of injuries resulting from improperly disposed biomedical waste was found to be 39.8% which was comparatively better than in a study where it was miserably low among the other staff (including sweepers, health care workers etc.) and was found to be completely absent among the sanitary staff.[20] Low reporting of injuries may be attributed to the fact that most of the doctors and other staff (including sweepers, health care workers etc.) are unaware about a formal system of injury reporting which should be established within all the health facilities.

CONCLUSION

The present study was done to assess the practices of BMWM in a tertiary care hospital. While there were some good practices observed like presence of posters regarding disposal of BMW in most places, availability of gloves, masks etc. to the workers collecting BMW along with awareness regarding BMWM seen among many of the staff included in the study, there were deficiencies seen in the practices observed, which should be addressed. Also there were inconsistencies seen among the staff regarding the knowledge assessment of BMWM. The capacity building exercise of the staff should be adequately and regularly done so as to avoid the potential threats from biomedical waste.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Lohani N, Dixit S. Biomedical waste management practices in a tertiary care hospital: a descriptive study in Srinagar ,Garhwal, India. Int J Community Med Public Health 2017;4: 465-70.