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SOLID BIO-MEDICAL WASTE MANAGEMENT IN GOVERNMENT HOSPITALS OF PATIALA CITY, PUNJAB, INDIA

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Abstract: The subject of bio-medical waste (BMW) management has assumed great significance. Inadequate management of BMW has become a serious health hazard. Every day, relatively large amount of potentially infectious and hazardous wastes are generated in health care hospitals. The waste is disposed-off in an unscientific manner. The objective of the present study was to assess the variation in solid BMW per bed per day in four Government hospitals of Patiala city in the state of Punjab, India. The study was carried out for one year from January, 2016 to December, 2016. The waste generation rate ranges between 0.5 to 2.0 kg per bed per day. The results of the study demonstrate that there is an urgent need to increase awareness about rules, regulations and procedures regarding this vital issue. The BMW was treated in four categories – yellow, blue, white and red - on the basis of their segregation, collection, treatment, processing and disposal options. Our suggestions intend to create awareness amongst health care personnel to improve their BMW management practices.
Keywords: Bio-medical waste, Disposal, Hazardous, Health, Hospital, Management, Patiala city, Segregation, Treatment.
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INTRODUCTION

With increase in the global population and the rising demand for health, there has been a rise in the amount of waste being generated daily by each health care establishment. Bio-medical waste (BMW) is defined as any waste, which is generated during the diagnosis, treatment or immunization of human beings or animals. The waste generated during the health care activities carries a higher potential for infection than any other type of waste (Chauhan *et al.,* 2002; Manohar *et al.,* 1998; Joe and Krishnan, 2004). Inadequate and inappropriate knowledge of handling health care waste may have serious health consequences and a significant impact on the environment as well. A safe and reliable method for handling of BMW is essential. Safe and effective management of BMW is not a legal necessity but also a social responsibility. It has been emphasized (Summers, 1991) that for the proper disposal of BMW, introduction of laws is not sufficient. WHO (2004) reported that 85% of hospital waste are actually non-hazardous, around 10% are infectious and around 5% are non-infectious but hazardous wastes. BMW consists of solids, liquids, sharps and laboratory waste. It must be properly managed to protect the general public especially health care and sanitation workers who are regularly exposed to BMW as an occupational hazard. For proper management of health care waste, the Ministry of Environment and Forests, Govt. of India has promulgated the BMW (Management and

Handling) Rules, 1998/2016. These rules are meant to improve the overall waste management of health care facilities in India. Handling, segregation, mutilation, disinfection, storage, transportation and final disposal are vital steps for safe and scientific management of BMW in any establishment (Acharya and Singh, 2012). It is estimated that annually about 0.33 million tonnes of hospital waste is generated in India and the waste generation rate ranges from 0.5 to 2.0 kg per bed per day (Patil and Shekdar, 2001; Khajuria and Kumar, 2007). The findings of Waseem et al. (2007) and Jahnavi and Raju (2006) on BMW management suggest that there is inadequate knowledge about category of wastes, duration of wastes, type of bag used for collection and identification of biohazard symbol among the health care workers. Health care personnel should serve as a spring board to renewed activities for the health and happiness of humanity. Lack of concern, motivation, awareness and cost factor are some of the problems faced in the proper BMW management. Clearly, there is a need for education as to the hazards associated with improper waste disposal. There is significant gap observed in the knowledge, attitude and practice of the consultants, residents and scientists with regard to BMW disposal, to their knowledge/understanding on the subject. The present study has been carried out in four Government hospitals of Patiala city. Patiala is one of the fast growing cities and is located in the south-east of Punjab state. Our research will show positive attitude towards BMW management.

EXPERIMENTAL

The study was carried out in four Government hospitals *i.e*. Rajindra Medical College and Hospital (R.M.C.&H.), Sangrur Road; Mata Kaushalaya Hospital (M.K.H.), Lohori Gate; T.B. and Chest Diseases Hospital (T.B.H.), Sheran Wala Gate and two Community Health Centres (C.H.Cs.), Tripuri and Model Town of Patiala. The bio-medical waste (BMW) per bed per day was quantified every month during the study period from January, 2016 to December, 2016. The collected waste was segregated in containers of different colours namely, yellow, blue, white and red. Yellow waste contained human tissues, organs, body parts, items contaminated with blood, body fluids, cotton swabs, plaster casts and bags containing discarded blood, expired medicines and chemical liquid wastes. Blue waste contained broken glass including medicine vials and ampoules except those contaminated with cytotoxic wastes. White waste contained needles, syringes, scalpels, blades or any other contaminated sharp objects that may cause puncture and cuts. Red waste contained disposable items such as tubing, bottles, intra venous tubes, catheters, urine bags, syringes without needles and gloves. Average BMW per bed per day at each study site was calculated as follows:

$$\frac{\text{Total BMW per year}}{12 \times 30 \times \text{Number of beds @ 80\% bed occupancy}}$$

RESULTS AND DISCUSSION

The results of variation in bio-medical waste (BMW) generated in four government hospitals from January, 2016 to December, 2016 at monthly interval have been shown in Table 1 and 2. Total BMW generated per year (Figure 1) was observed to be 35722.34 kg, 14859.19 kg, 2481.83 kg and 2731.21 kg at R.M.C. and H., M.K.H., T.B.H. and C.H.Cs. respectively. Average BMW generated per month (Figure 2) was 2976.86 kg, 1238.27 kg, 206.82 kg and 227.60 kg at R.M.C.and H., M.K.H., T.B.H. and C.H.Cs respectively. Average BMW generated per day (Figure 3) at source was found to be 99.23 kg, 41.28 kg, 6.89 kg and 7.59 kg at R.M.C. and H., M.K.H., T.B. H. and C.H.Cs respectively. Average BMW generated per bed per day (Figure 4) @ 80% bed occupancy was 0.10 kg at R.M.C. and H., 0.21 kg at M.K.H., 0.07 kg at T.B.H. and 0.16 kg at C.H.Cs. BMW generation was also assessed in four different categories – yellow, blue, white and red as depicted in Figure 5, 6, 7 and 8. The total yellow waste generated per year was observed to be 15590.18 kg at R.M.C. and H., 10384.39 kg at M.K.H., 652.38 kg at T.B.H. and 1722.38 kg at C.H.Cs. Average yellow waste generated per month

was 1299.18 kg at R.M.C. and H., 856.37 kg at M.K.H., 54.37 kg at T.B.H. and 143.53 kg at C.H.Cs. Average yellow waste generated per day was 43.31 kg at R.M.C. and H., 28.85 kg at M.K.H., 1.81 kg at T.B.H. and 4.78 kg at C.H.Cs. Average yellow waste generated per bed per day @ 80% bed occupancy was 0.04 kg at R.M.C. and H., 0.14 kg at M.K.H., 0.02 kg at T.B.H. and 0.10 kg at C.H.Cs. The total blue waste generated per year was observed to be 7842.75 kg at R.M.C. and H., 2784.64 kg at M.K.H., 646.35 kg at T.B.H. and 325.72 kg at C.H.Cs. Average blue waste generated per month was 653.56 kg at R.M.C. and H., 232.05 kg at M.K.H., 53.86 kg at T.B.H. and 27.14 kg at C.H.Cs. Average blue waste generated per day was 21.79 kg at R.M.C. and H., 7.74 kg at M.K.H., 1.80 kg at T.B.H. and 0.90 kg at C.H.Cs. Average blue waste generated per bed per day @ 80% bed occupancy was 0.03 kg at R.M.C. and H., 0.02 kg at M.K.H., 0.02 kg at T.B.H. and 0.01 kg at C.H.Cs.

Table 1. BMW generated per bed per day by Government Health Care Units in Patiala City (January to December, 2016)

Name of Health Care Unit	Total Number of Beds	Number of Beds @ 80% occupancy	Total BMW generated per year	Average BMW generated per month	Average BMW generated per day	Average BMW generated per bed per day @ 80% bed occupancy
R. M.C. and H.	1226	980	35722.34	2976.86	99.23	0.10
M.K.H.	250	200	14859.19	1238.27	41.28	0.21
T.B. H.	121	96	2481.83	206.82	6.89	0.07
C.H.Cs	60	48	2731.21	227.60	7.59	0.16

Table 2. BMW (category wise) generated per bed per day by Government Health Care Units in Patiala City (January to December, 2016)

Colour code	Bio-Medical Waste (kg)	R. M.C. and H.	M.K.H.	T.B.H.	C.H.Cs
Yellow	Total waste generated per year	15590.18	10384.39	652.38	1722.38
	Average waste generated per month	1299.18	865.37	54.37	143.53
	Average waste generated per day	43.31	28.85	1.81	4.78
	Average waste generated per bed per day	0.04	0.14	0.02	0.10
Blue	Total waste generated per year	7842.75	2784.64	646.35	325.72
	Average waste generated per month	653.56	232.05	53.86	27.14
	Average waste generated per day	21.79	7.74	1.80	0.90
	Average waste generated per bed per day	0.03	0.02	0.02	0.01
White (Translucent)	Total waste generated per year	9236.74	1082.36	835.83	211.20
	Average waste generated per month	769.73	90.20	69.65	17.60
	Average waste generated per day	25.66	3.01	2.32	0.59
	Average waste generated per bed per day	0.01	0.01	0.01	0.03
Red	Total waste generated per year	3052.66	607.79	347.27	471.91
	Average waste generated per month	254.39	50.65	28.94	39.33
	Average waste generated per day	8.48	1.69	0.96	1.31
	Average waste generated per bed per day	0.01	0.01	0.08	0.02

The total white waste generated per year was observed to be 9236.74 kg at R.M.C. and H., 1082.36 kg at M.K.H., 835.83 kg at T.B.H. and 211.20 kg at C.H.Cs. Average white waste generated per month was 769.73 kg at R.M.C. and H., 90.20 kg at M.K.H., 69.65 kg at T.B.H. and 17.60 kg at C.H.Cs. Average white waste generated per day was 25.66 kg at R.M.C. and H., 3.01 kg at M.K.H., 2.32 kg at T.B.H. and 0.59 kg at C.H.Cs. Average white waste

generated per bed per day @ 80% bed occupancy was 0.01 kg at R.M.C. and H., 0.01 kg at M.K.H., 0.01 kg at T.B.H. and 0.03 kg at C.H.Cs. The total red waste generated per year was observed to be 3052.66 kg at R.M.C. and H., 607.79 kg at M.K.H., 347.27 kg at T.B.H. and 471.91 kg at C.H.Cs. Average red waste generated per month was 254.39 kg at R.M.C. and H., 50.65 kg at M.K.H., 28.94 kg at T.B.H. and 39.33 kg at C.H.Cs. Average red waste generated per day was 8.48 kg at R.M.C. and H., 1.69 kg at M.K.H., 0.96 kg at T.B.H. and 1.31 kg at C.H.C. Average red waste generated per bed per day @ 80% bed occupancy was 0.01 kg at R.M.C. and H., 0.01 kg at M.K.H., 0.08 kg at T.B.H. and 0.02 kg at C.H.Cs. The BMW produced in different health care units are found within limit (0.5-2 kg/bed/day) as described in CPCB (2000) guidelines. This waste is either dumped without proper disposal or incinerated. According to the WHO (1996), the global life expectancy is increasing year after year. However, deaths due to infectious disease are increasing. One of major causes for the increase in infectious diseases is improper waste management. Health of the general public can also be adversely affected by BMW. Improper practices such as dumping of BMW in municipal dustbins, open spaces and water bodies leads to the spread of diseases. Emissions from incinerators and open burning also lead to exposure to harmful gases which can cause cancer and respiratory diseases (Manohar *et al.,* 1998; Da silva *et al.,* 2005). Fikru (2004) and, Yemane and Millogo (2000) observed that the open burning of waste in holes or similar enclosures and incineration were the most common types of methods for disposal of sharps wastes. Plastic waste can choke animals, which scavenge on openly dumped waste. Injuries from sharps are common feature-affecting animals. Harmful chemicals such as dioxins and furans can cause serious health hazards to animals and birds. Certain heavy metals can affect the reproductive health of the animals (Code and Christen, 1999). Incineration technology is the best method of disposal of BMW. This is a high temperature thermal process employing combustion of the waste under controlled conditions for converting them into inert material and gases.

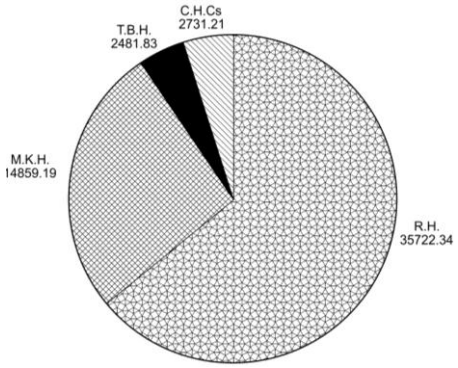

Figure 1. Total BMW generated (kg) per year

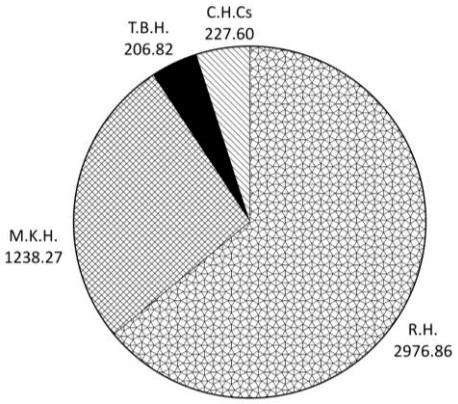

Figure 2. Total BMW generated (kg) per month

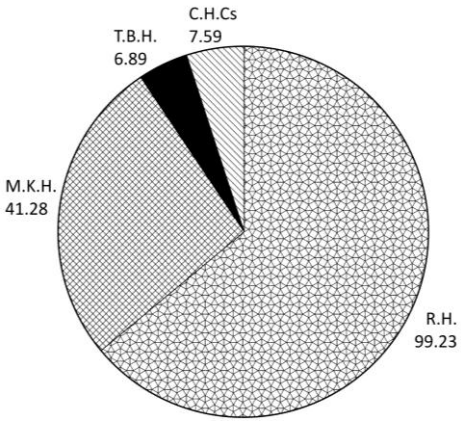

Figure 3. Average BMW generated (kg) per day

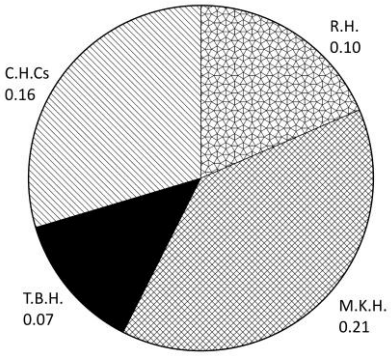

Figure 4. Average BMW generated per bed per day @ 80% bed occupancy

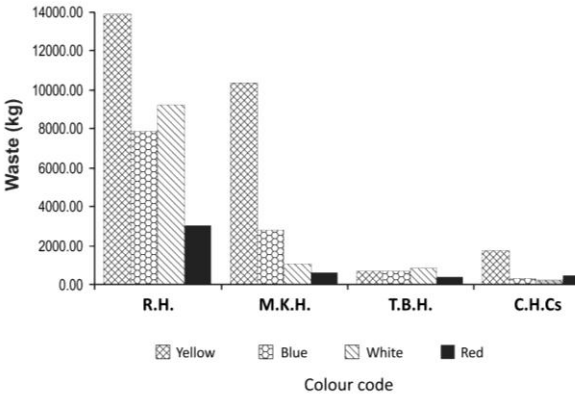

Figure 5. Total BMW (category wise) generated (kg) per year

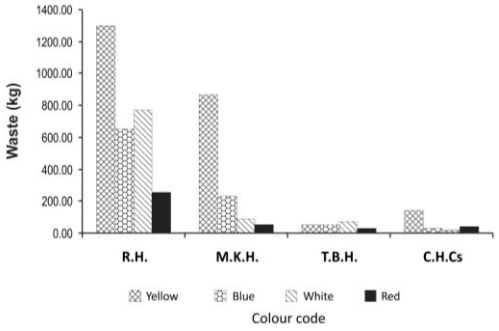

Figure 6. Average BMW (category wise) generated (kg) per month

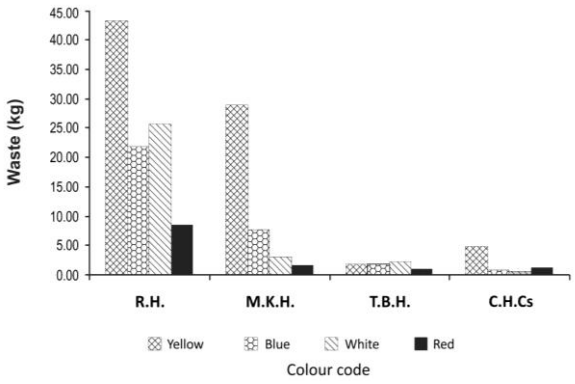

Figure 7. Average BMW (category wise) generated (kg) per day

Studies carried out in India showed that awareness and practices on BMW management among health care personnel is far below the acceptable level (Mathur *et al.,* 2011; Bansal *et al.,* 2011; Sharma, 2010; Saini *et al.,* 2012). The key to minimization and effective management of BMW is segregation and identification of the waste. The most appropriate way of identifying the categories of BMW is by sorting the waste into colour coded plastic bags or containers. No appropriate strategy exists for proper management of BMW. The segregation of BMW is the key to successful BMW management. We all must remember that it is our moral duty to take care of the waste so that we all are protected from the risks of hazards of BMW. BMW programme cannot be successfully implemented without the willingness, self-motivation, and cooperation from all sections of employees of any health care setting (Chitnis *et al.,* 2005).

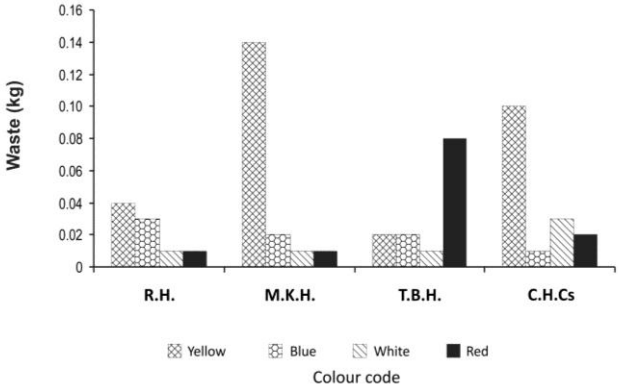

Figure 8. Average BMW (category wise) generated (kg) per bed per day

CONCLUSION

Bio-medical waste (BMW) is increasing in quantity and diversity due to advances in science and technology. The proper handling and disposal of BMW is very imperative. The present study proposes that appropriate measures should be taken to reduce the risk of infection, to control the cost of disposal and to aware the public regarding BMW management. There is a need to conduct training and retraining workshops on BMW management. All the health care personnel should be vaccinated against infectious diseases. Untreated BMW should not be stored beyond a period of forty-eight hours. Disposable items should be shredded or mutilated to prevent reuse. All hospitals should maintain records regarding quantity and category of all BMW, which are subject to inspection and verification by Government prescribed authority at any time. Infectious waste should be transported in closed leak proof vehicles. BMW should be segregated into different colored containers/bags at the point of generation in accordance with schedule II of BMW. As

provided by BMW rules, the whole of the waste should be fragmented into colors due to their hazardous nature. All health care units should be brought into the net of rigorous checking for BMW management so that they could improve their infrastructural requirements to save handling and disposing off the waste.

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