

Original Research Article

Biomedical waste management: assessment in health facility of a tertiary care teaching hospital in Jammu, union territory of Jammu and Kashmir, India

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ABSTRACT

Background: Biomedical waste (BMW) management has, of late, emerged as an important health as well as environmental concern. It is imperative upon all the health facilities, irrespective of their size and number of patients catered, to ensure appropriate BMW management at all levels starting from its generation to its final disposal. The study intended to assess the management of BMW generated in one health facility of a tertiary care teaching hospital.

Methods: The present cross-sectional study was conducted w.e.f. 1st January 2020 to 30th June 2020. The BMW generated in the Shri Maharaja Gulab Singh (SMGS) hospital-a health facility of government medical college (GMC) Jammu was collected at a designated place after its segregation. Then it was weighed before its transportation and final disposal. The BMW was weighed to generate monthly rates which were then converted to daily rates. Finally, BMW generation per bed per day was calculated.

Results: It was found that BMW generated per bed per day was 0.197 kg. Infectious waste comprised 15% of the total whereas non-infectious component was 85%. The color-coded bags collection rate per day was 48.8 kg, 28.4 kg, 17.02 kg and 7.75 kg for yellow, red, blue and white containers, respectively.

Conclusions: The authors found that the health facility was adhering to guidelines of BMW management. The need for continuous education and awareness promotion about BMW management among sanitation workers, nurses, technicians and doctors cannot be underestimated.

Keywords: BMW management, Assessment, Health facility, Jammu

INTRODUCTION

Hospitals are complex institutions which are frequented by people from all walks of life in the society without any distinction between caste, creed and religion. This is in addition to the normal inhabitants of the hospital, i.e., patients and staff. Hospitals produce waste which is increasing in amount and varied in type due to scientific advances and is creating its impact. Health care waste is a unique category of waste by the quality of its composition, source of generation, its hazardous nature

and the need for appropriate protection during handling, treatment and disposal. Mismanagement of the waste affects not only the generators and operators but also the common people too.¹

BMW is defined as any waste, which is generated during the diagnosis, treatment or immunization of human beings or animals, or in research activities pertaining thereto, or in the production or testing of biological substances.²

The quantity of waste generated per day and per bed differs greatly from one health facility to another and from one country to another country. The estimated biowaste from any hospital consists of about 5-10% of hazardous waste; about 15-20% of BMW and the rest of 75-80% is municipal waste.³

In undeveloped countries, average waste generated is about 1.5 Kg/bed/day, in developing countries, the quantum of waste is approximately 1-2 kg/bed/day while in developed countries, it is 4-5 kg/bed/day.

As per WHO estimates, about 85% of hospital waste is non-hazardous and only 10% waste is infectious. Remaining 5% is non-infective but hazardous.³

The hazardous part of the waste presents physical, chemical, and/or microbiological risk to the general population and health-care workers associated with handling, treatment, and disposal of waste.⁴

The basic principle of good BMW practice is based on the concept of 3 R's, namely, reduce, recycle, and reuse. The best BMW management (BMWM) methods aim at avoiding generation of waste or recovering as much as waste as possible, rather than disposing. Therefore, the various methods of BMW disposal, according to their desirability are prevent, reduce, reuse, recycle, recover, treat, and lastly dispose. Hence, the waste should be tackled at source rather than "end of pipe approach".⁴

Health facilities are important sites for the generation of waste. Healthcare waste includes infectious, chemical, expired pharmaceutical and radioactive items and sharps which can be pathogenic and harmful to environment. These items can be pathogenic and environmentally adverse. They are referred to in this article as hazardous healthcare waste. Other waste items generated through healthcare but not hazardous include medication boxes, the packaging of medical items and food, remains of food, and waste from offices.⁵

During review of literature, it was found that no study had been conducted on BMWM in Jammu and Kashmir. Considering the dearth of literature on BMWM in our region, the authors planned the present study in a health facility of a tertiary care teaching hospital in Jammu city of UT of J and K.

Objective

The study intended to assess the management of BMW generated in one health facility of a tertiary care teaching hospital.

METHODS

Jammu and Kashmir, now a UT, is one of the important states forming the crown of India. UT of Jammu and Kashmir has two divisions-Jammu division and Srinagar

Division- with each division having ten districts. Each district is catered by district hospital for health services to the patients but in case of referral, government medical college (GMC) Jammu in Jammu city is the referral tertiary care centre for Jammu division. GMC Jammu is not only catering to patients from ten districts of Jammu division but also from adjoining states and even patients from UT of Ladakh.

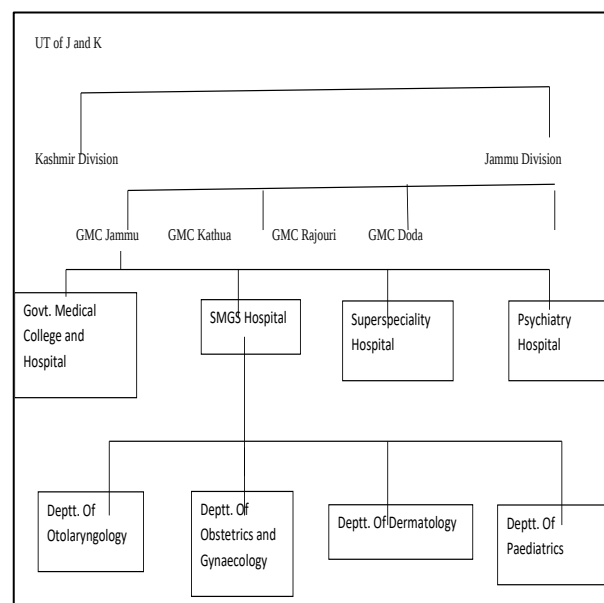


Figure 1: Flow diagram showing organization of tertiary care health services in Jammu division of UT of J and K.

The current cross-sectional study was conducted in Shri Maharaja Gulab Singh (SMGS) Hospital- a part of GMC Jammu w.e.f. 1st January 2020 to 30th June 2020 for a period of six months. SMGS Hospital is 750 bedded hospitals situated in the heart of Jammu city. Four major disciplines viz. gynaecology and obstetrics. Paediatrics, otolaryngology and dermatology are providing their services in this premier hospital. Due permission was sought from institutional ethical committee (IEC), GMC Jammu for the study.

All the waste generated in four disciplines of SMGS hospital is finally deported to central wastage storage area. The infection control team comprising of medical superintendent, microbiologist, community medicine specialist, infection control doctor and nurse, nursing superintendent and a senior physician or surgeon visited the central wastage storage area of SMGS hospital on a daily basis where waste was weighed and individual weight (both infectious and non-infectious) were documented. Mean waste generated per day/ per month was calculated by dividing the total waste produced during that month by number of days in that particular month. In the next step, the authors calculated the mean waste generated in kg per bed per day by dividing the mean waste generated per day by number of occupied

beds. The final disposal of waste from SMGS hospital is carried out by an authorized agency.

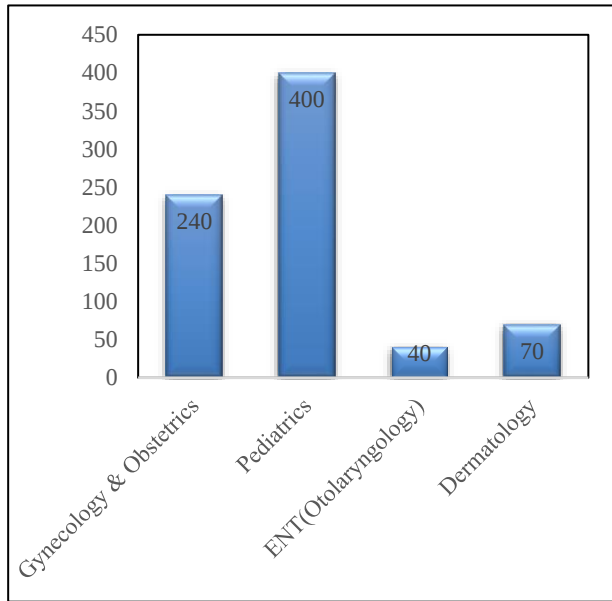


Figure 2: Bed strength of different departments in SMGS hospital.

RESULTS

In this health facility, the segregation of BMW is being done at the site of generation in color coded polythene bags as per the BMW (management and handling) rules, 2016. For the convenience of the staff, the color coded bags were placed inside similar color coded bins and colored posters showing the segregation of BMW in local language were displayed at the site of segregation of waste in the hospital.

The different types of waste generated in this health facility is comprised of: Infectious solid waste such as catheters, intravenous sets, gloves, universal containers, urine bags, syringes without needles, vacutainers, cartridge, dropper, tips and culture plates collected in red colored plastic bags. The soiled waste such as cotton, dressings, plaster casts, swabs, masks, cap, dipstick, discarded medicines, cytotoxic drugs, human anatomical waste and animal waste collected in yellow colored

plastic bags. Sharp waste such as needles, needles from needle tip burner, scalpels, blades, lancet needle, cover slips, tubes or any other contaminated sharp object that may cause puncture and cuts such as used and unused sharps (reagent/chemical bottle/IV infusion bottles) collected in puncture proof, leak proof translucent containers. All types of glassware including broken glass, glass slide, etc are collected in blue bag.

Finally, the general waste such as paper, packing material, general municipal waste and leftover food was collected in black plastic bag.⁶

The segregated waste from the site of generation was being transported in color-coded bags to the carts placed at various points in the hospital premises by skilled sanitary workers taking universal precautions and taken to the storage area in the hospital. The outsource agency carried the BMW in a vehicle (minivan) labeled with bio-hazard symbol for the final disposal.

Each color-coded bags were weighed and weight was documented before transportation. During the study period the total waste generated (infectious + non-infectious) from this health facility was 18,364.90 kg. Out of which, 15% (2754.73 kg) was infectious waste and 85% (15610.16 kg) was non-infectious.

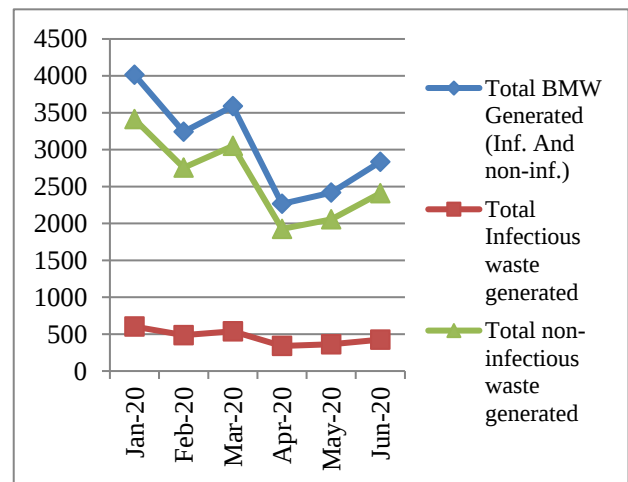


Figure 3: Infectious and non-infectious BMW generated in SMGS hospital during the study period.

Table 1: Amount of infectious and non-infectious waste generated during the study period.

Months	Total BMW collected (kg) (Infectious+ non-infectious)	Average BMW collected daily (kg)	Total infectious BMW collected (kg)	Total non-infectious BMW collected (kg)	BOR (%)
January 2020	4014.80	129.51	602.22	3412.58	111
February 2020	3242.20	111.80	486.33	2755.87	107.66
March 2020	3589.15	115.78	538.37	3050.78	94
April 2020	2266.05	75.53	339.91	1926.14	43
May 2020	2417.50	77.98	362.62	2054.87	46
June 2020	2835.20	94.51	425.28	2409.92	52
Total	18364.90	100.90	2754.73	15610.16	75.61

Figure 4 depicts that BMW generated is positively correlated to bed occupancy rate ($R^2=0.836$).

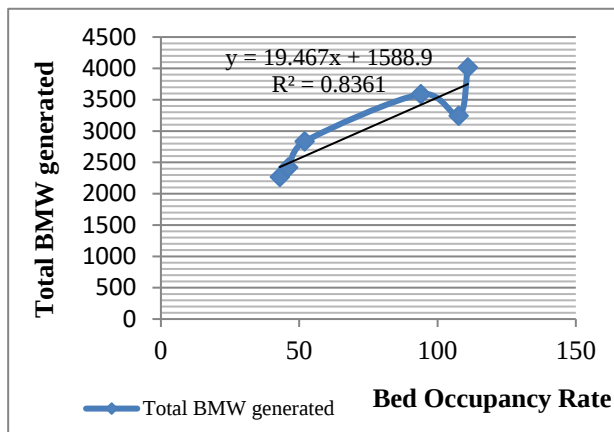


Figure 4: Relationship between amount of BMW generated during study period and bed occupancy rate.

The average infectious Waste generated in this health facility per day was calculated as 100.90 kg. To calculate waste generated per bed on a daily basis, authors randomly chose 4th January 2020 as the day and found 510 beds occupied on that particular day. Thus, per bed per day BMW generation came to be 0.197 kg.

Table 2: BMW generated per bed per day (Randomly selected on 4th Jan.2020) in SMGS hospital Jammu.

Health-care facility	Total beds	Occupied beds on a particular selected day randomly	BMW generated/day (kg)	BMW/Bed/day (kg)
SMGS hospital	750	510 (Beds occupied on 4 th Jan 2020)	100.90	0.197

As per color coding protocol, BMW generated on a daily basis was found to be 48.81 kg, 28.41 kg, 17.02 kg and 7.75 kg in yellow, red, blue and white bags, respectively.

Table 3: Distribution of different categories of BMW generated during study-period in a tertiary care hospital.

Color-coding	Amount of BMW generated during the study period (kg/month)	Amount of BMW generated during the study period (kg/day)
Yellow	1465	48.81
Red	852.5	28.41
Blue	510.66	17.02
White (translucent)	232.75	7.75

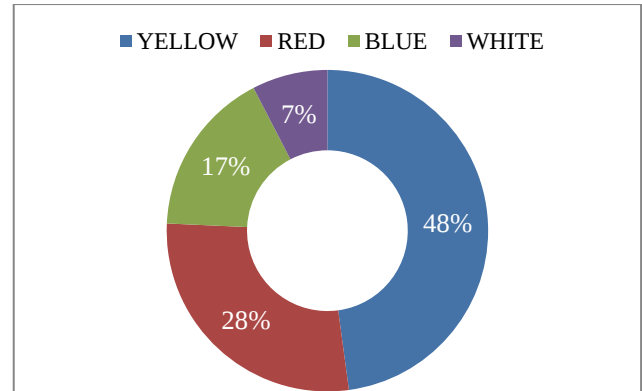


Figure 5: Proportion of BMW generated as per colour coding protocol.

DISCUSSION

The findings of the present study have revealed that average BMW collection was 100.90 kg/day and further it was found that BMW generated was 0.197 kg/bed/day and these findings are in agreement with those reported by Abdulla et al from northern Jordan, Ruoyan et al from Binzhou district of China and Khan et al from Pakistan.⁷⁻⁹ In contrast to the results of the present study, Sadeghi et al reported a higher generation of BMW with a mean healthcare waste (HCW) generation rate of 2.12 ± 0.37 kg/bed/day.¹⁰

Countries like USA and Italy reported still higher HCW generation rate ranging from 5-7 and 3-5 kg/bed/day, respectively.^{11,12}

The varied rates reported by authors from studies conducted in different parts of the world clearly reflect role of various factors in HCW generation. These factors include number of beds as well as number and types of services offered, cultural and socio-economic status of patients besides use of instruments and general condition of the area where the health facility is situated. In highly affluent countries like USA and Italy, higher rates are probably due to increasing trend towards use of disposable healthcare materials. The HCW generation also depends on the presence of sections in a health institution which are likely to contribute more to HCW generation like surgery, obstetrics and gynaecology, dialysis unit, otolaryngology, etc. These findings were well documented by Sadeghi et al who reported that highest weight of medical wastes generated per bed on a daily basis was from hospitals located in posh areas and was calculated to be 3.22 ± 0.4 kg/bed/day.¹⁰

Other factors like capacity of the facility, number of patients- both outdoor and indoor, policy and legislation and modes of treatment- all have a role in medical waste generation in a hospital.

The results of the present study elicited that proportion of infectious and non-infectious waste was 15% and 85% respectively, which is in consonance with the estimates of

Ali et al and Mbarki et al from France.^{13,14} An earlier study by Patwary et al reported that infectious wastes could be in the range of 15-35%.¹⁵ Higher rates of infectious waste were reported by Sadeghi et al, Dehghani et al and Sapkota et al.^{10,16,17} Authors advise that to minimize HCW generation rate, participation of the staff in specialized training program in BMW is the topmost priority.

The healthcare waste so generated in the health facility was finally collected at the designated storage area whereby it was weighed before its transportation to the final destination. This transportation is done on a daily basis except on Sunday. Sadeghi et al reported that 77.7% hospitals waste is transported daily while 22.2% were doing it on alternate days.¹⁰ Dehghani et al reported that stay time in storage sites was about 12-24 hours and 92% of medical wastes were transported by covered trucks.¹⁶

Limitation

Since the study was conducted in a single facility of GMC Jammu i.e., SMGS hospital which caters to only four specialties viz. paediatrics, obstetrics and gynaecology, otolaryngology and dermatology, the results lack generalizability. Another limitation is that the study was conducted in the initial stages of pandemic during which first lockdown was also in operation and this may have led to lower levels of biomedical waste generation.

CONCLUSION

Main findings of the present study have elucidated that average biomedical waste collected on a daily basis was 100.90 kg. When this was further calculated on the basis of per bed per day, it came to be 0.197 kg. Of the total waste collected, 15% was found to be infectious and rest was non-infectious. Yellow colored bags were found to be collecting maximum healthcare waste on a daily basis at the rate of 48.8 kg. Since all the departments of government medical college and hospital were not included in this study, authors advise caution in the extrapolation of results.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee- ECR/454/Inst/JK/2013/RR-20.

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