Segregation of biomedical waste in an South Indian tertiary care hospital

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Abstract

Introduction: Hospital wastes pose significant public health hazard if not properly managed. Hence, it is necessary to develop and adopt optimal waste management systems in the hospitals. Material and method: Biomedical waste generated in Coimbatore Medical College Hospital was color coded (blue, yellow, and red) and the data was analyzed retrospectively on a daily basis for 3 years (January 2010-December 2012). Results: Effective segregation protocols significantly reduced biomedical waste generated from 2011 to 2012. While biomedical waste of red category was significantly higher (>50%), the category yellow was the least. Per unit (per bed per day) total biomedical waste generated was 68.5, 68.8, and 61.3 grams in 2010, 2011, and 2012, respectively. Discussion: Segregation of biomedical waste at the source of generation is the first and essential step in biomedical waste management. Continuous training, fixing the responsibility on the nursing persons, and constant supervision are the key criteria's in implementing biomedical waste segregation process, which can significantly reduce per unit biomedical waste generated. Conclusion: We highly recommend all hospitals to adopt our protocol and effectively implement them to reduce generation of biomedical waste.

Key words: Biomedical waste, color coding, India, tertiary hospital, waste segregation

INTRODUCTION

Generation of biomedical waste is an unavoidable outcome of modern day Hospital care and practices.[1] Rapid mushrooming of hospital both in the public and private sector to meet the societal demand has collaterally increased the biomedical waste generated. The increasing use of disposable materials has significantly enhanced this problem. It is essential to optimally manage the biomedical waste to avoid any public health hazards.[1] 

In recent years, increasing public concern is raised about the management of healthcare waste throughout the globe and especially in developing nations.[2] Lack of awareness has led to the hospitals becoming epicenters of spreading disease rather than working toward eradicating them.[3] In this study, our objective was to evaluate the percentage of biomedical waste based on various color categories (as per biomedical handling rules) to evaluate the effectiveness of segregation. Further, our aim was to evaluate the biomedical waste generated per unit (per bed per day) in our organization (Coimbatore Medical College Hospital).

MATERIALS AND METHODS

The study was conducted in Coimbatore Medical College Hospital, Coimbatore, India.

Our organization is a 1,020-bed teaching hospital. Most of the patients attending our hospital are from below poverty line and treated free of cost. Biomedical waste is segregated in the color-coded bins as per biomedical waste (management and handling) rules [Table 1]. The data regarding total biomedical waste generated as per color coding was collected on a daily basis from January 2010 to December 2012 and analyzed retrospectively. The percentages of biomedical waste in blue, yellow
and red category were analyzed using the following formula.

\[ \text{Biomedical waste generated per day} = \frac{\text{Total biomedical waste generated per year}}{\text{Number of days in the year}} \]

Bed strength per day = \( \frac{\text{Total census per year}}{\text{Number of days in the year}} \)

The biomedical waste generated per day per bed = \( \frac{\text{Biomedical waste generated per day}}{\text{Bed strength per day}} \)

**RESULTS**

The biomedical waste generated in the year 2010 was 25,817 kg with an in-patient strength of 376,860 patients [Tables 2 and 3] [Figures 1-4]. In the year 2011, 26,103 kg of biomedical waste was generated with inpatient occupancy of 380,486 patients. In the year 2012, 402,208 in-patient generated 24,678 kg of biomedical waste. Our result showed a reduction in biomedical waste generated from 2011 to 2012, which we believe was achieved due to effective waste segregation practices. It is important to note that the reduction in biomedical waste generated in 2012 was achieved despite increase in in-patient numbers [Table 1] [Figures 1-4].

Regarding color coding, our study showed the potentially-infected red color category (>50%) was more than blue followed by yellow in all the years of our study [Tables 2 and 3] [Chart 1]. Further, per unit (per bed per day) biomedical waste generated was 68.5 gm in 2010, 68.8 gm in 2011 and 61.3 gm in 2012 [Table 2]. Our study showed a reduction in the biomedical waste generated per bed per day between 2011 and 2012.

**DISCUSSION**

Biomedical waste are hospital wastes generated during the diagnosis, treatment or immunization of human beings or animals or in research activities and elaborately described in Schedule I.[4] Almost 75-90% of the wastes generated by the healthcare providers are non-toxic and fall into general waste category,[4] which are predominantly generated by administrative and housekeeping activities of the healthcare establishments. These wastes are taken care managed by the local civic authorities. However, the remaining 10-25% is healthcare waste are of hazardous category and pose significant public health risks if not properly managed. [4] It is estimated that 0.33 million tones of hospital waste is generated annually in India and the average waste generation rate ranges from 0.5 kg to 2.0 kg per bed per day among various hospitals [Table 4].[5]
While the ancient times (practiced in 5th century B.C.),[6] biological waste was buried deep in not easily accessible areas of the town/city, such practices are not practical in the current times. Poor management of healthcare waste exposes healthcare workers and general public to infections and toxic hazards.[7] The Government of India (notification 1998) specifies hospital waste management to be part of hospital hygiene and maintenance protocols. This involves management of a range of activities, such as collection, transportation, operation or treatment of processing systems, and disposal of waste. However, the initial segregation and storage activities are the direct responsibility of the occupier in the healthcare establishments. If the infectious component gets mixed with the general non-infectious waste the entire mass becomes potentially infectious and hence adds to the cost of its handling.[8] Despite the fact that current medical waste management practices vary from hospital to hospital, the problematic areas are similar for all healthcare units and at all stages of management, including segregation, collection, packaging, storage, transport, treatment, and disposal.[2] Hence, proper management of healthcare waste must begin directly at the collection sites where hazardous and non-hazardous waste are segregated into specific color-coded bins and sent for final treatment sites [Table 1].[2] It is essential to train and supervise the staff for effective implementation of biomedical waste segregation and management.[8]

To address this issue the government of Tamil Nadu, India, has implemented health care waste management plan through Health Systems Development Project (HSDP) with the World Bank assistance in 2008 through a “Project for Upgrading Safety in Healthcare” (PUSH) to train 150 health care providers as trainers in biomedical waste management. Trainers will in turn train 40,000 additional healthcare providers in Tamil Nadu, India.[9]

Although education on such waste management is included in undergraduate medical courses, it may be essential to make it a part of continued professional education and strictly implemented with 100% compliance.[10] In Tamil Nadu, India, among the government sector, biomedical waste management training is conducted routinely. The staff nurses are responsible for segregation of biomedical waste.
Table 5: Amount of biomedical waste generated in various places in India

| Place of study | Type of hospital                      | Biomedical waste generated in kg per bed per day | Percentage composition of biomedical waste |
|----------------|---------------------------------------|--------------------------------------------------|--------------------------------------------|
| Kolkata        | Govt, private, larger hospitals       | 1.044-1.368                                      | 20-30% infectious                          |
| New Delhi      | Govt and private                      | 1.5-1.8                                          | 45% infectious                             |
| Mumbai         | Tertiary care cancer                  | 1.13                                             | 46% infectious                             |
| Manipal        | Large tertiary care                   | 0.775                                            | 16-26% infectious                          |
| Punjab         | Large tertiary care                   | 1.05-1.50                                        | 15-30% infectious                          |

waste and maintain biomedical waste register and needle stick injury register in the respective wards and other workstations. It is the duty of the nursing supervisors to check the status of segregation of biomedical waste and sign the biomedical waste register in the wards and other work stations every day. Additionally, the medical officer in-charge of biomedical waste (infection control) will also supervise and sign the hospital biomedical waste register daily. Previous studies have reported generation of 0.52\(^{[11]}\)-1.5\(^{[12]}\) kg biomedical waste per bed per day in tertiary care hospitals and the biomedical waste generated in our hospital is within this range. Disappointingly few hospitals have recorded much higher (2.31 or 2.02 kg/day) biomedical waste generation\(^{[8,13]}\). While one hospital has reported significantly less biomedical waste generation (0.25 kg per bed per day; and 0.20 kg of red color waste per bed per day)\(^{[14]}\) suggesting our hospital practices has room for improvement. Such reduced and low levels of biomedical waste generation are also reported by other hospitals in central India.\(^{[15]}\) It is important to note that very limited studies are reported in India regarding segregation of biomedical waste in healthcare institutions with the collective range being 0.71-2.31 kg per bed per day. However, as per World Health Organization (WHO) report the biomedical waste generated per bed per day in India range from 0.06 kg to 0.40 kg\(^{[16]}\) which we believe is very much under reported. Nevertheless, reducing biomedical waste generation necessitates effective segregation of waste at the source of generation with careful utilization of disposable items in the health care sector. We also hope that our study will encourage other hospital to take necessary initiatives to biomedical waste segregation and report the per unit biomedical waste generated. In our study, the biomedical waste generated per bed per day ranged from 61.3 gm to 68.5 gm which is within the range of other reports [Table 5] in India.\(^{[17]}\) Most importantly, our study showed the reduction of biomedical waste generated per bed per day in the year 2012 [Figures 2 and 3] despite increase in in-patient numbers, this task was only possible due to effective segregation of waste at the source of generation. Additionally, we also recommend the following for further improvement:

- Continuous training of healthcare workers regarding biomedical waste segregation to improve their knowledge.
- Occupational health and safety audiovisual aids in the regional language to achieve effective communication to healthcare workers.
- Responsibility to be assigned to staff nurses and nursing supervisors in all workstations regarding “segregation of waste at source”.
- Providing the color category charts near the color-coded bins in all workstations for immediate reference.
- Constant monitoring by the state level officials to know and scrutinize the ground reality.

CONCLUSION

A safe and reliable method for handling of biomedical waste is essential. The objective of biomedical waste management is to reduce waste generation. This will be possible only by proper segregation of waste at the source of generation. Our study showed a reduction of biomedical waste generation in Coimbatore medical college, Coimbatore similar to WHO study in India due to effective segregation. To save mankind from the “adverse effects of healthcare waste” effective management of biomedical waste is not only a legal necessity but also a “social responsibility”.

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How to cite this article: Sengodan VC. Segregation of biomedical waste in an South Indian tertiary care hospital. J Nat Sc Biol Med 2014;5:378-82.

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