RESEARCH ARTICLE OPEN ACCESS

Assessment of Biomedical Waste Management Practices in Major Hospitals of Mysuru City

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ABSTRACT
Biomedical waste also known as infectious waste or medical waste, Wastes generated from hospitals tend to cause the fatal diseases, although understanding the techniques of medical waste management and existing practices is important, the study was therefore undertaken to investigate the medical waste categories and management practices followed by two prominent hospitals i.e Government and Private hospitals situated at mysuru city, India. The daily average waste generated in Government Hospital is 93 kg and the daily average waste generated in Private Hospital is 324 kg. The staffs of various major hospitals who handle these waste lacked the proper training, therefore study was conducted to understand the awareness amongst the employees as regards to biomedical waste management practices to study the knowledge, attitude and practice of the respondent.

Keywords – Biomedical waste, Government hospital, private hospital, colour coded bags, knowledge

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Date of Submission: 11-04-2020 Date of Acceptance: 27-04-2020

I. INTRODUCTION

Rapid urbanization and industrial diversification has led to generation of considerable quantities of municipal, plastic, hazardous and biomedical waste. Improper disposal of waste often results in spread of diseases and contamination of water bodies and soils. Biomedical wastes are defined as waste that is generated during the diagnosis and treatment of human beings or animals and in research activities. About 75% to 90% of these wastes are non risk and only 10-25% of them are regarded as hazardous. [1]

Biomedical waste management has recently emerged as an issue of major concern not only to hospitals, nursing home authorities but also to the environment. the bio-medical wastes generated from health care units depend upon a number of factors such as waste management methods, type of health care units, occupancy of healthcare units, specialization of healthcare units, ratio of reusable items in use, availability of infrastructure and resources etc.

The proper management of biomedical waste has become a worldwide humanitarian topic today. Although hazards of poor management of biomedical waste have aroused the concern world over, especially in the light of its far-reaching effects on human, health and the environment.[10]

The large volumes of health care waste if not managed properly can lead to a global hazard. This could not only lead to the spread of highly contagious diseases but the hazardous chemical waste produced by the use of items can cause considerable damage to the ecosystem and the environment. Thus health care waste, if not managed properly will be a cause in ushering of "disasters in making" by causing air, water, soil pollutions and helping in emergence of antibiotic resistant strains of microbial ingress of pollutants in the food chain and thus becoming a part of human consumption [1]

World Health Organization states that 85% of hospital wastes are actually non-hazardous, whereas 10% are infectious and 5% are non-infectious but they are included in hazardous wastes. About 15% to 35% of Hospital waste is regulated as infectious waste. This range is dependent on the total amount of waste generated. These wastes now threatens the public since, the health care foundations are situated in heart of city and therefore medical waste, if not properly managed can cause dangerous infection and posses a potential threat to the surrounding environment, persons handling it and to the public. Health and environmental effects, uncertainty regarding regulations and negative perceptions by waste handles are some important concerns in health care waste management in a country [5]

1.1 Effects of Mismanagement

The biomedical wastes when not managed properly it can pose serious risks to society and the environment through Air emissions or Contamination of Water or Physical Contacts. Improper disposal method like open dumping and unrestrained burning increases the risk of spreading infections and of exposure to toxic emissions. Mismanagement of hospital waste entails a combination of improper handling of waste during generation, collection, storage, transport and treatment. Improper handling involves some unsafe procedure followed during handling of waste i.e without wearing personal protective equipment (PPE), poor storage (e.g. high temperature, High Residence time), transporting manually for longer distances, unpacked or uncovered containers instead of closed plastic or puncture proof bags, etc. Other examples include duration of exposure, lack of knowledge on equipment decontamination procedures, etc., all of which affect hospital workers in different ways.

Following Groups of Individuals are exposed.

Inside Health Care Center: Staff (Doctors, Nurse, Auxiliaries), Stretcher- bearers, Patients, Scientific and Technical Personnel, Logistic (cleaners, Laundry, waste managers, carriers, maintenance, pharmacists, lab technicians, visitors).

Outside: In site and off Site transport personnel, waste processing personnel, general public, Rag

Pickers [4]

The rag pickers and waste workers are often worst affected, because unknowingly, they rummage through all kinds of poisonous material while trying to collect items which they can sell for reuse. At the same time, this kind of illegal and unethical reuse can be extremely dangerous and even fetal. Diseases like cholera, plague, tuberculosis, hepatitis (especially HBV), AIDS (HIV), diphtheria etc. in either epidemic or even endemic form, pose serious public health risks [14]

TABLE 1: Types of infections caused by biomedical waste

Infection Type	Pathogen Agents	Transmission Path
Gastrointestinal infections	Enterobacteria:Salmonell, Shigella spp. Vibrio cholerae Helminths	Faeces or/and vomiting liquid
Respiratory infections	Mycobacterium tuberculosis Measles virus Streptococcus pneumonae	Respiratory secretions, saliva
Eye infections	Herpes virus	Eye secretions
Genital infections	Neisseria gonorrhoeae Herpes virus	Genital secretions
Skin infections	Streptococcus spp.	Purulent secretions
Anthrax	Bacillus anthracis	Secretions of skin lesions
Meningitis	Neisseria meningitidis	LCR
AIDS	HIV	Blood, semen, vaginal secretions
Haemorrhagic fevers	Junin Viruses, Lassa, Ebola Marburg	Biological fluids and secretions
Septicemia	Staphylococcus ssp	Blood
Viral Hepatitis type A	VHA	Faeces
Viral Hepatitis type B and C	VHB, VHC	Blood, biological fluids

1.2 Bio medical Waste Management and Handling Rules

The rules framed by the Ministry of Environment and Forests (MoEF), Govt. of India, known as 'Bio medical Waste Management and Handling Rules, 1998,'notified on 20th July 1998, provides uniform guidelines and code of practice for the whole nation. It is clearly mentioned in this rule that the 'occupier' of an institution generating bio-medical waste shall be responsible for taking necessary steps to ensure that such waste is handled without any adverse effect to human health and the environment.

TABLE 2: schedules of Biomedical waste management and handling rules

Schedules	Component
Schedule I	Categories of Bio-Medical Waste
Schedule II	Colour Coding and Type Of Container for Disposal of Bio-Medical Wastes
Schedule III	Label for Bio-Medical Waste Containers/Bags
Schedule IV	Label for Transport (vehicle) of Bio-Medical Waste Containers/Bags
Schedule V	Standards for Treatment and Disposal Of Bio-Medical Wastes
Schedule VI	Schedule for Waste Treatment Facilities like Incinerator/ Autoclave/ Microwave System.

1.2.1 Categories of Bio-Medical Waste

According to Bio Medical Waste (Management and Handling) Rules, 1998, the bio-medical waste was categorized into ten categories.

TABLE 3: Categories of Bio-Medical Waste Management

Waste Category No.	Waste Category and Type	Treatment and Disposal Option
1	Human anatomical waste, human tissues, organs, body parts	Incineration at deep burial
2	Animal waste, animal tissues, organs, body parts carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospital colleges, discharge from hospitals, animal houses.	Incineration at deep burial
3	Microbiology and Biotechnology waste: Wastes from laboratory cultures, human and animal cell culture used in research and infectious agents from research and industrial laboratories, wastes from production of biological, toxins, dishes and devices used for transfer of cultures	Local autoclaving/ microwaving /incineration
4	Waste sharps: Needles, syringes, scalpels, blades, glass etc. that may cause puncture and cuts. This includes both used and unused sharps.	Disinfection chemical treatment/ autoclaving/ microwaving and mutilation/ shredding
5	Discarded medicines and cytotoxic drugs: Wastes comprising of outdated, contaminated and discarded medicines.	Incineration/ destruction and drugs disposal in secured landfills
6	Soiled waste: Items contaminated with blood, and body fluids including cotton, dressings, and soiled plaster casts.	Incineration at autoclave /microwaving.
7	Solid waste: Wastes generated from disposable items other than the waste sharps such as tubing, catheters, intravenous sets etc.	Disinfection by chemical treatment at autoclaving/ microwaving and mutilation/ shredding
8	Liquid waste: Waste generated from laboratory and washing, cleaning, housekeeping and disinfection activities.	Disinfection by chemical treatment and discharge in to drains.
9	Incineration ash: Ash from incineration of any bio-medical waste	Disposal in municipal landfill
10	Chemical waste: Chemicals used in production of biological, chemicals used in disinfection, as insecticides etc.	Chemical treatment and discharge in to drains for liquids and secured landfill for soils

1.2.2 Colour Coding and Type Of Container for Disposal of Bio-Medical Wastes

The bio-medical wastes are to be carefully handled and disposed in the color-coded containers maintained by each health care unit. The color-coding for the segregation of all categories of waste at source is shown in Table 4

TABLE 4: Colour Coding and Type Of Container for Disposal of Bio-Medical Wastes

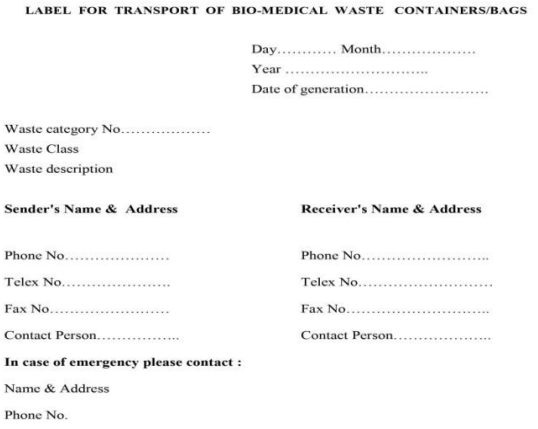
Color coding	Type of container	Waste category
YELLOW	Plastic bag	Anatomic waste, Animal wastes, Soiled wastes, Discarded medicines
RED	Disinfected container/plastic bag	Microbiological, Sharps, Solid wastes, (contaminated plastic)
BLUE	Plastic bag /puncture proof container	Chemical waste
BLACK	Plastic bag	Municipal wastes

1.2.3 Label for bio-medical waste containers/bags and transport of bio-medical waste containers / bags

Bio-medical waste shall be segregated into containers/bags at the point of generation in accordance with Schedule II prior to its storage, transportation, treatment and disposal. The containers shall be labeled according to Schedule III. (Fig 1)

If a container is transported from the premises where biomedical waste is generated to any waste treatment facility outside the premises, the container shall, apart from the label prescribed in Schedule III, also carry information prescribed in Schedule IV (Fig. 2)

Fig 1: Biohazard symbol


LABEL FOR TRANSPORT OF BIO-MEDICAL WASTE CONTAINERS/BAGS

Day..... Month.....
Year .....
Date of generation.....

Waste category No.....
Waste Class
Waste description

Sender's Name & Address | **Receiver's Name & Address**

Phone No..... | Phone No.....
Telex No..... | Telex No.....
Fax No..... | Fax No.....
Contact Person..... | Contact Person.....

In case of emergency please contact :
Name & Address
Phone No.

Fig 2: label for biomedical waste container and transportation vehicle

1.3 Biomedical Waste Management Process

For waste management to be effective, the waste should be managed at every step, from acquisition to disposal. The following are the elements of a comprehensive waste management system:

1. waste survey
2. segregation
3. accumulation and storage
4. transportation
5. treatment
6. disposal and also waste minimization

1.4 Benefits of Biomedical Waste Management

1. Cleaner and healthier surroundings.
2. Reduction in the incidence of hospital acquired and general infections.

3. Reduction in the cost of infection control within the hospital.
4. Reduction in the possibility of disease and death due to reuse and repackaging of infectious disposables.
5. Low incidence of community and occupational health hazards.
6. Reduction in the cost of waste management and generation of revenue through appropriate treatment and disposal of waste.
7. Improved image of the healthcare establishment and increase the quality of life.

II. METHODOLOGY

2.1 Study Area: The study was carried out in two-selected hospital, (government and private owned hospital) in mysuru city. Mysuru city is located in the southern part of the Deccan Plateau; it is geographically located between 12° 18" 26 North Latitude and 76° 38' 59" East Longitude. It is located at an altitude of 2427 feet. The city covers a total area of 128.42 sq. km. Government hospital has 1050 bed capacity and private hospital is having 1800 bed capacity

Fig 3: Location of hospitals in mysuru city

2.2 Biomedical Waste Data Collection

Biomedical waste data collection involves two parts

1. classification of waste, segregation and collection of different categories of waste and their quantification
2. Assessment of knowledge about various aspects of biomedical waste management by conducting a survey.

2.2.1 Qualitative and Quantitative Analysis of Biomedical Waste

The study consists of collection of data related to the generation, administration, collection, transportation and disposal of solid wastes generated. The data regarding the generation and disposal of solid wastes have been collected from the different localities in the study area by using personal investigation, questionnaire and interview regarding the segregation and disposal and transportation.

2.2.2 Assessment of Knowledge

A semi structured questionnaire related to Knowledge, Attitude and Practices of Biomedical waste management was used for data collection A questionnaire was formulated with reference to the awareness among medical and paramedical staff about the biomedical waste management The staff included doctors, nurses and housekeeping employees of operation theatres, laboratories,laundry and central sterilization departments of the hospital.

III. RESULTS AND DISCUSSION

3.1 Waste generation rate

Composition of different categories of waste generated in Government and Private Hospital is presented in Table 5 & Figure 4.

TABLE 5: Composition of Different Categories of Waste Generated in Government and Private Hospital

Hospital	Month	Total Bed Strength	Yellow Bags (kg)	Blue Bags (Kg)	Red Bags (Kg)	Waste Sharps (Kg)	Grand Total (Kg)	Average Waste Generation (Kg/day)
Govt. Hospital	January	1050	1076	887	948	33	2944	93.14
	February		1051	792	946	24	2813	
	March		1081	648	823	36	2588	
	April		1110	679	924	39	2752	
	May		1156	851	1036	46	3089	
	June		1114	763	757	40	2674	
Private Hospital	January	1800	3800	1275	4180	630	9885	324.10
	February		4410	2360	4970	590	12330	

	March		**3391**	**1410**	**3067**	**1090**	**8958**	
	April		**3629**	**1688**	**3503**	**750**	**9570**	
	May		**3195**	**1490**	**3275**	**695**	**8655**	
	June		**3375**	**1990**	**3615**	**285**	**9265**	

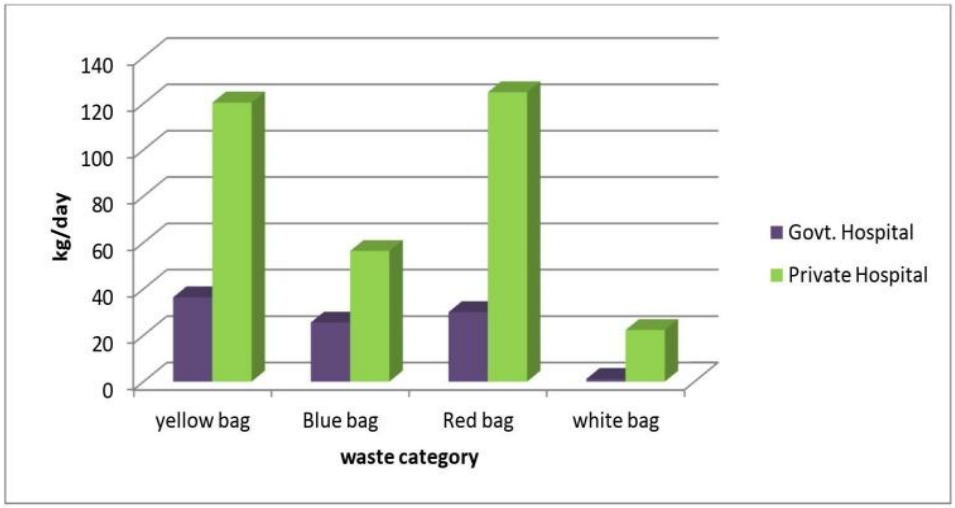


Fig 4: waste composition of government and private hospital

With reference to the Figure 4, the wastes collected in yellow bag are the incinerable wastes which come under the Category 1, 2, 3 and 6. The quantity of waste collected in the yellow bag in Government hospital and Private Hospital are approximately 36 and 120kg/day respectively. The incinerable wastes that are found in these hospitals are human anatomical waste, microbiology and bio-technology waste and soiled waste. The wastes collected in blue bag are the autoclavable wastes which come under the Category 4 and 7. The quantity of waste collected in the blue bag in Government hospital and Private Hospital are approximately 25.52kg/day and 56.42kg/day respectively. The wastes collected in red bag are the infectious wastes which come under the Category 3, 6 and 7. The quantity of waste collected in the red bag in Government hospital and Private Hospital are approximately 30.02kg/day and 124.91kg/day respectively. The wastes collected in white color coded container are the sharp waste which includes syringes, blades, needles and discarded glass. The quantity of waste collected in

Government hospital and Private Hospital are approximately 1.20kg/day and 22.32kg/day respectively.

With reference to the table 5, Private hospital with 1800 bed capacity generated large quantity of biomedical waste when compared to government hospital i.e approximately 324kg/day and 93kg/day respectively, corresponding to 0.18kg/bed/day and 0.08kg/bed/day. This large quantity of biomedical waste in private hospital may be due to higher bed capacity and more percentage of occupancy which leads to more surgeries and operational activities leading to the increase in the amount of cotton, tubing's and laboratory culture of stock specimens consequently leading to more quantity of waste. The sharp waste found in the private Hospital is slightly more may be because of the local reputation and easy access, patients from local area can visit the private Hospital frequently and also some of the items which can be reused are completely discarded leading to more quantity of waste

3.2 Waste management system in Private Hospital

The segregation of waste is done at the source of generation and in each ward the bins lined with colour coded plastic bags are placed at corners or near the nursing station and care is taken that the waste bins are away from the patient care areas. Each category of waste has been segregated in a proper container with lid with necessary labels containing the brief information about the waste that must be put into that particular bin. In all the wards, the colour coding chart is placed which provides the descriptive information of segregation of various waste generated. The sharps such as needles will be destroyed using needle destroyer and also other sharps such as blades and scalpels are collected in white translucent puncture proof container half filled with 1% sodium hypochlorite solution which acts as

a disinfecting agent and it is followed in every segregation area at the hospital.

Once the plastic colour coded bags are filled 3/4th, the bags will be tied and tags are attached to each bag which contains the information of respective ward names. OTTO bins trolley facility is available for the transportation of the waste from different floors to the storage area. Housekeeping members will collect the tied bags from different wards into trolley at each floor and transports to storage area from side of the hospital avoiding the passage through the patients, staffs and visitor's area. While transferring the waste to the storage area, the housekeeping staff will use all the PPE such as mask, gloves, aprons and gum boots.

Storage area is situated away from the hospital main building to avoid the adverse effects from the waste to all categories of staffs, patients and visitors and other healthcare personnel's. Separate rooms are available for the storage of different category of waste which are coloured with same colour according the colour coding of BMW bags.

Fig 5: process of Segregation, collection and storage of BMW in private hospital

3.3 Waste management system in Government Hospital

The segregation of waste is done at the source of generation and the bins lined with colour coded plastic bags are placed at corners of each ward. Each category of waste has been segregated in a container without lid. In all the wards, the colour coding chart is placed which provides the descriptive information of segregation of various waste generated. The sharps such as needles will be destroyed using needle destroyer and also other sharps such as blades and scalpels are collected in puncture proof container without any disinfectant solution inside it.

Once the bins with plastic colour coded bags are filled, bins are replaced with new colour coded plastic bags and filled bags are kept aside untied which will be transported to storage area. These untied plastic bags are transported to the storage area through open cart wheel which may lead to the spillage of some waste on the way to the storage area. The Microbiology waste is disposed once in 2-3 days. The sharps are disposed once in 3-5 days. The remaining categories of waste are disposed daily. While transferring the waste to the storage area, few of the housekeeping staff will not use PPE.

Storage area is situated away from the hospital main building to avoid the adverse effects from the waste to all categories of staffs, patients and visitors and other healthcare personnel's. Separate cabins are not bifurcated for the storage of different category of waste in the storage area. All the different category of waste bags is placed together in a single cabin inside the storage area and also sometimes even outside the storage area.

Fig 5: process of Segregation, collection and storage of BMW in government hospital

2.4 Assessment of knowledge

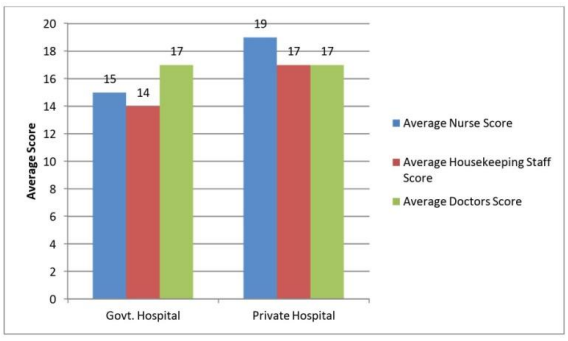


Figure 6: Graphical representations of average scores of nurses, doctors and housekeeping staffs of govt. and private hospitals

It was observed that, majority of nursing staff and housekeeping staff were conscious about measures for the safe collection and final disposal of BMW in private hospital. This may be due to the fact that, on safe collection and disposal of BMW, private Hospital has got better knowledge than government Hospital. It is observed that, practice of biomedical waste management at the private hospital was found to be good and it was found that, 52 % to 78 % of the participants were aware of the practices to be followed in the hospitals. Majority of the hospital staff knows how to dispose BMW carefully and properly. Their work mainly focused on segregation, decontamination, transport, and storage, which was monitored by medical professionals of concerned department. From these studies, it is observed that, the BMW management knowledge is found to be good in private hospital compared to government hospital. This may due to more advanced equipment facilities available at private hospital when compared with government hospitals studied.

IV. CONCLUSION

The daily average waste generated in Government Hospital is 93 kg and the daily average waste generated in Private Hospital is 324 kg. The staff education particularly for the workers involved in collection, segregation and in house management in BMW can minimize the quantity in many situations like collection of recyclable plastic comprising of glucose bottles, spirit bottles etc. The study revealed that in private hospital the study subject had positive attitude regarding their acceptance, hazardous effect, feasibility to adopt the biomedical waste. Effective waste management can be seen in private hospital against government hospital. The government hospital is severely lacking in actions to dispose of its waste and uphold its statutory responsibilities. This is due to the lack of education, awareness and trained personnel to manage the waste in the hospital. The staff of the private Hospital is trained to handle the waste but in government hospital the staff is not aware about the training. The transport and disposal facilities of solid waste are not up to the mark in government hospital.

It is the responsibility of the health care units to provide segregated waste to the CBWTF. They must provide adequate training for all the staffs involved in handling waste and keep them updated on the amendments in the rules. The managements must conduct pre-tests to the staffs to assess the need and emphasis of the training and post-tests after the training. The authorities must ensure proper care in handling and transporting these wastes. These wastes have to be collected regularly based on their categories. The bio-medical waste must be managed with utmost care so that the waste of the sick shall not contaminate the lives of the healthy.

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Kishor Kumar S,etal. "Assessment of Biomedical Waste Management Practices in Major Hospitals of Mysuru City." *International Journal of Engineering Research and Applications (IJERA*), vol.10 (04), 2020, pp 08-15.