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Bio Medical Waste Management in Varanasi City, (U.P.), India

Vijai Krishna[1*], Nikita Naik[2] & Sadhana Chaurasia[3]
[1]*Assistant professor, Institute of Environment and Sustainable Development, IESD, Banaras Hindu University, Varanasi*
[2]*M.Sc. (Tech), IESD, Banaras Hindu University, Varanasi*
[3]*Associate professor, Mahatma Gandhi Chirtrakoot Gramodya University, Chitrakoot, Satna, M.P.*

Abstract:- Biomedical Waste (BMW) collection and proper disposal has become a significant concern for both the medical and the general community. The scientific "Bio Medical Waste Management" is of vital importance as its improper management poses risks to the health care workers, waste handlers, patients, community in general and largely the environment. The objective of the study is to assess current practices of Bio medical Waste management including generation, collection, transportation, storage, treatment and disposal in Varanasi city. The information/data regarding Bio-Medical Waste Management practices and safety was collected from Centre for pollution control (C.P.C.) Varanasi and through the visits which was made at the biomedical waste treatment plant of centre for pollution control located at Varanasi. About 51% of the hospitals, nursing homes and pathological laboratories of Varanasi district are actively cooperating with C.P.C i.e. these are the registered members for waste treatment whereas remaining 49% are not involved in the biomedical waste management of the city. Similarly biomedical waste of around 56% of the total hospital beds are being treated and 44% is not being treated. Overall, through the study it was found that the C.P.C. is playing a great role in biomedical waste disposal and keeping our environment clean and healthy. Biomedical waste is being properly managed in Varanasi district with only scope of improvement that more hospitals should get involved with C.P.C and cooperate with them so that biomedical waste does not remain a problem in the district.

Keywords:- Biomedical waste, Community health, Environmental health, hospital, Disease

I. INTRODUCTION

Medical care is vital for our life, health and well being. But the waste generated from medical activities can be hazardous, toxic and even lethal because of their high potential for disease transmission. Bio Medical waste contains toxic metals, chemicals, and pathogenic microorganisms like bacteria and viruses [1,2,3]. Bio medical waste can cause pathological dysfunction of the human body [4,5]. Bio Medical waste creates risk to medical professionals like doctors, nurses, technicians, visitors, and patients [6, 7]. It is clear that the reuse of syringes can create the spread of infections such as AIDS and hepatitis [8]. The hazardous and toxic parts of waste from health care establishments comprising infectious, bio-medical and radio-active material as well as sharps (hypodermic needles, knives, scalpels etc.) constitute a grave risk, if these are not properly treated/ disposed or are allowed to get mixed with other municipal waste. Its susceptibility to encourage growth of various pathogen and vectors and its ability to contaminate other nonhazardous/non-toxic municipal waste jeopardises the efforts undertaken for overall municipal waste management. The key step in the reduction of diseases and infection is the safe disposal and destruction of bio medical waste [9]. Inadequate bio medical waste management causes pollution, bad smell, and growth of insects, rodents and worms and may cause the transmission of diseases like typhoid, cholera, etc. through injuries from contaminated syringes and needles [10]. Bio Medical waste carries germs of diseases like hepatitis and AIDS etc. In developing countries, medical waste does not receive much attention and disposed with domestic waste [11,12]. The rag pickers and waste workers are often worst affected, because unknowingly or unwittingly, they rummage through all kinds of poisonous material while trying to salvage items which they can sell for reuse. At the same time, this kind of illegal and unethical reuse can be extremely dangerous and even fatal. Diseases like cholera, plague, tuberculosis, hepatitis, AIDS (HIV), diphtheria etc. in either epidemic or even endemic form, pose serious public health risks. Unfortunately, in the absence of reliable and extensive data, it is difficult to quantify the dimension of the problem or even the extent and variety of the risk involved. With a judicious planning and management, however, the risk can be considerably reduced. Therefore with a rigorous regime of segregation at source, the problem can be reduced proportionately. Similarly, with better planning and management, not only the waste generation is reduced, but overall expenditure on waste management can be controlled. Institutional/Organisational setup, training and motivation are given great importance these days. Proper training of health care establishment personnel at all levels coupled with sustained motivation can improve the situation considerably. 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' (a person who has control over the concerned institution / premises) of an institution generating bio-medical waste (e.g., hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, blood bank etc.) shall be responsible for taking necessary steps to ensure that such waste is handled without any adverse effect to human health and the environment.

II. MATERIALS AND METHODS

A. Location of the Study Area: Varanasi

Varanasi district is one of the districts of Uttar Pradesh state in northern India, with Varanasi city as the district headquarters. The district occupies an area of 1,535 km². According to the 2011 census Varanasi district has a population of 3,682,194. The district has a population density of 2,399 inhabitants per square kilometer (6,210 /sq mi). Its population growth rate over the decade 2001-2011 was 17.32%. Varanasi has a sex ratio of 909 females for every 1000 males, and a literacy rate of 77.05%. Varanasi is located in the middle Ganges valley of North India, in the Eastern part of the state of Uttar Pradesh, along the left bank of the Ganges between 50 feet (15 m) and 70 feet (21 m) above the river. The "Varanasi Urban Agglomeration" of seven urban sub-units – covers an area of 112.26 km ^{2}.

B. Collection of Data:

Primary and Secondary data were used in this study.

1) ***Primary Data****:* In this study the primary data was collected by observation of treatment plant of centre for pollution control and personal interview from the staff of centre for pollution control.

2) **Secondary Data:** The secondary data is collected from Centre for pollution control (CPC) Varanasi, books, journals, magazines and internet etc.

C. Method of waste collection by C.P.C.:

C.P.C. collects the waste with use of five vehicles daily from the registered bio medical waste generation centers. Vehicles have different name like 1. Ganga Service (V1) 2. Hari service (V2) 3. Shree service (V3) 4. Om service (V4) and

5. BHU Service (V5). All the vehicles are well leveled with bio medical hazard symbols. And well covered. All these vehicles collect the waste and carry it to the Common Bio medical Waste Treatment Facility (CBWTF) at Mohan Sarai, Varanasi. Here all the waste is segregated into three categories these are 1. Yellow category waste 2. Red category waste and 3. Container waste. Yellow category waste includes the category 1, 3, 5 and 6 wastes while red category waste includes the category 7 and container waste includes the category 4 waste according to bio medical waste (management and handling) rules, 1998. Yellow category waste includes the incinerable waste while red category waste is non incinerable waste while the container waste is the sharp (scissor and scalpel etc.) waste. After the segregation the incinerable waste is incinerated in the incinerator while non incinerable waste is treated by autoclaving, chemical treatment and deep burial. Container waste is also treated like red category waste. Hospitals pay according to the number of beds to the C.P.C. either monthly or annually. Major findings of the work are given below:

Table I: List of Hospitals with Maximum Number of Beds

S.N.	Name of hospital	No. of beds
1.	Sir Sunder Lal Hospital, BHU Lanka	800
2.	Heritage Hospital Ltd.BHU Road , Lanka	150
3.	Ashirwad Nursing Home,Birdopur Mahmoorganj	100
4.	Railway Cancer Institue, N.E.R, Lahartara	100

Table II. List of hospitals with minimum number of beds

S.N.	Name of hospital	No. of beds
1.	Bhardwaj Clinic,Lahartara	2
2.	Ideal hospital, Shivpur	2
3.	Meditech Laproscopic Center	4

Table III. List of Non Registered Members with Maximum Bed Strength

S. N.	Name of hospital	No. of beds
1.	**Ram Krishna Mission Hospital, Luxa road**	**125**
2.	**Apex Welcare Pvt Ltd, Sunderpur**	**100**
3.	**Lal Bahadur Shastri Rajkiya Hospital, Ram nagar**	**100**
4.	**Medwin Hospital, Maidagin**	**100**

- **Highest paying hospital (monthly)** – Sir Sunder Lal Hospital BHU Lanka (Rs.1,04,000)
- **Highest paying hospital (promoter)** – Singh medical and research centre (Rs.60,000)

Table IV. Lowest Paying Hospital (Monthly)

S. N.	Name of hospital	Monthly (Rs.)
1.	**Saurabh Pathology Center, Chitaipur**	**416**
2.	**Rangoli Patient Care Center, Mahmoorganj**	**400**
3.	**SS Diagnostic Center, Durgakund**	**400**

Table V. Lowest Paying Hospital (Promoter)

S. N.	Name of hospital	Promoter (Rs.)
1.	**Chopra Orthopedic Clinic, Faatman Road.**	**3600**
2.	**Sameer Diagnostic Teliabagh**	**3000**

- Total number of registered members of CPC = 297
- Total number of non- registered members = 288
- Total number of beds covered at present = 3911
- Total number of beds whose waste is not being treated = 3087
- Total amount of waste collected by vehicles = (V1+V2+V3+V4+V5)
  = 2,60,839.91 kg/year app.
- Amount of waste collected by vehicles per month = 21736.66 kg/month
- Amount of waste collected by vehicles per day = 724.56 kg/day app.
- Therefore, waste collected per bed per year = 260839.91/3911
  = 66.69 kg/bed/year
- Waste collected per bed per month = 66.69/12
  = 5.56 kg/bed/month
- Waste collected per bed per day = 5.55/30
  = 0.185 kg/bed/day
  = 185.33 gm/bed/day app.
- Total number of beds treated + non treated = 3911 + 3087
  = 6998
- If 3911 beds produce waste = 260839.91 kg/year

Then, 3087 beds produce waste = 66.69 X 3087
= 205872.03 kg/year

- Therefore, waste which is not treated per year = 207971.19 kg/year
- Waste which is not treated per month = 17156.00 kg/month
- Waste which is not treated per day = 571.87 kg/day app.
- Total amount of waste treated + non treated = 260839.91+205872.03
  = 466711.94 kg/year app.
  = 38892.66 kg/month app.
  = 1296.42 kg/day app.
- Percentage of beds treated = (3911/6998) X 100 = 56%
- Percentage of beds non treated = (3087/6998) X 100 = 44%
- Percentage of waste treated = (260839.91/466711.94) X 100 = 56%
- Percentage of waste not treated = (205872.03/466711.94) X 100 = 44%

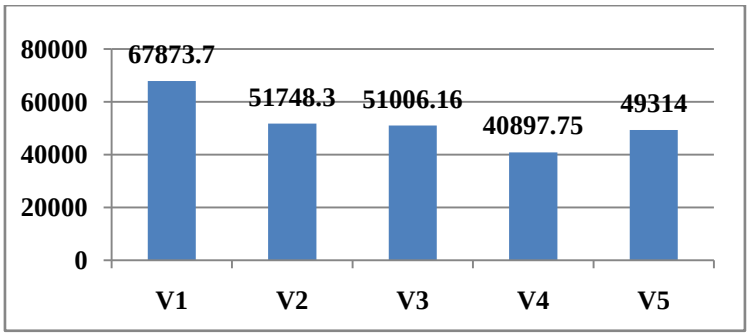

Fig. 1: Total waste collection by vehicles (kg/year)

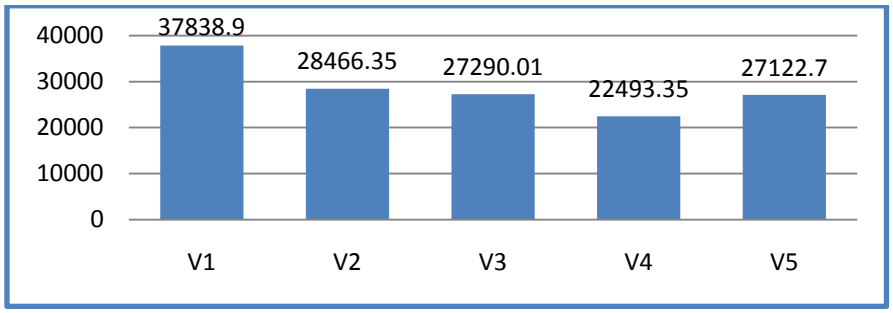

Fig. 2: Total yellow category waste collected by vehicles (kg/year)

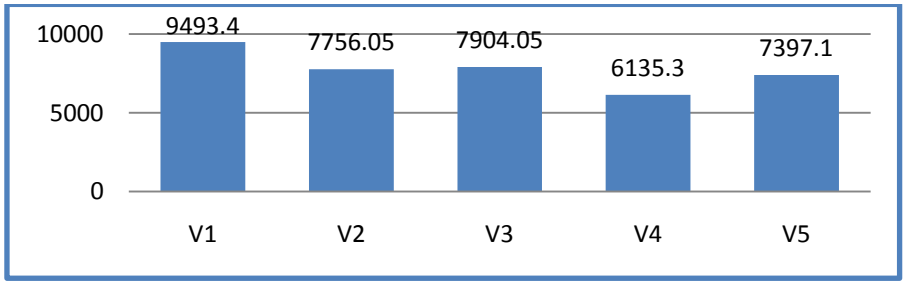

Fig. 3: Total Container (sharp) category waste collected by vehicles (kg/year)

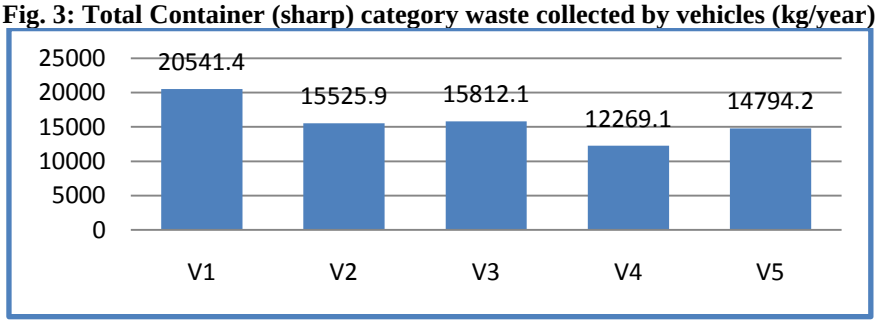

Fig. 4: Total red category waste collected by vehicles (kg/year)

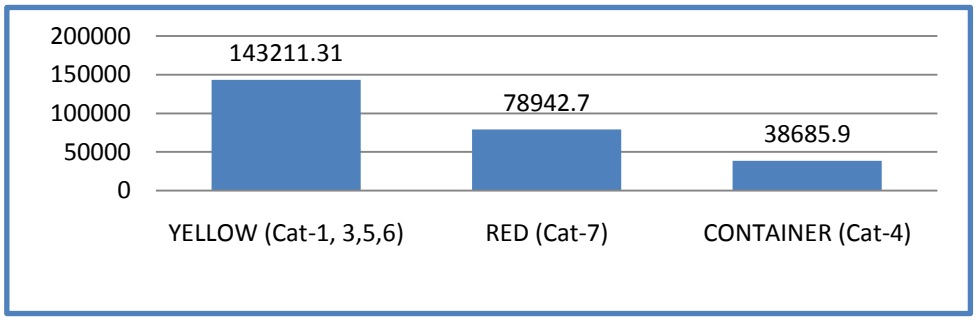

Fig. 5: Different categories of waste collected by vehicles (kg/year)

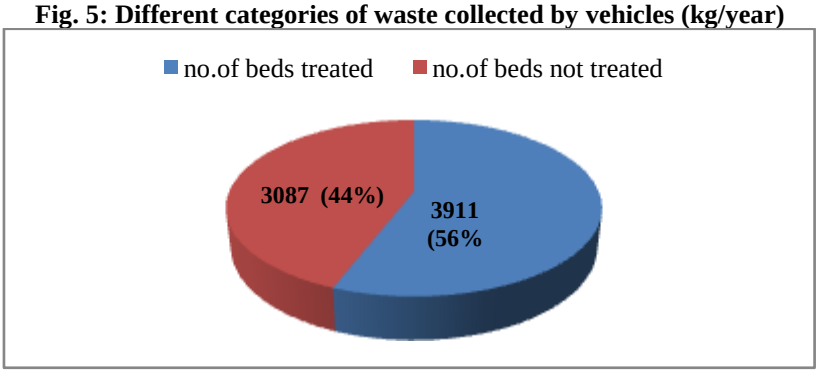

Fig. 6: Total number and percentage of beds treated and not treated

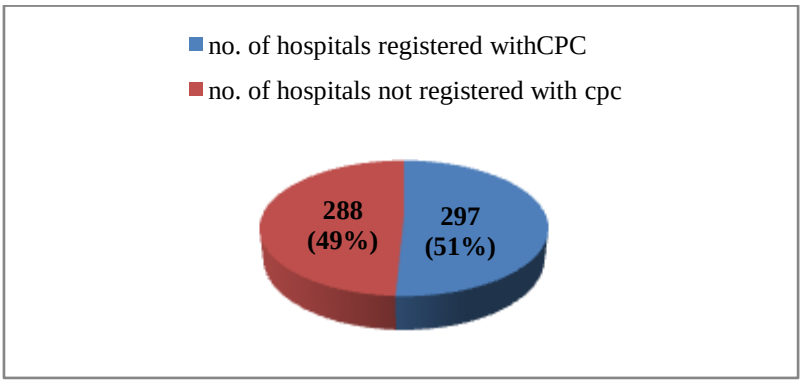

Fig. 7: Total number and percentage of hospitals registered and not registered with CPC

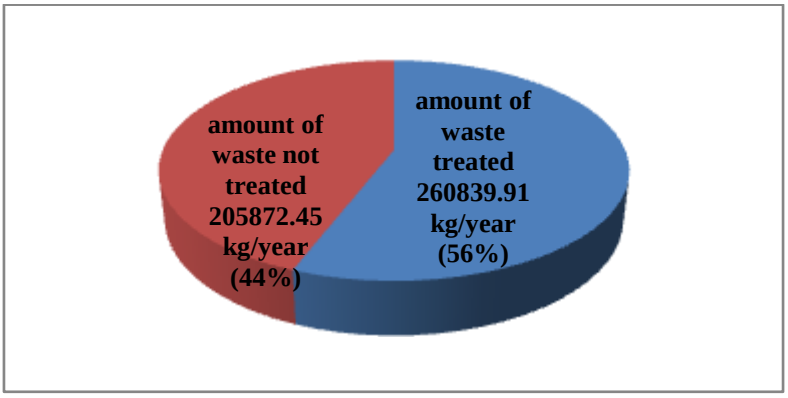

Fig. 8: Amount and percentage of waste treated and not treated (kg/year)

II. RESULTS

For Bio-medical Waste (BMW) treatment & disposal, Centre for Pollution Control (CPC) an ISO 9001:2008 certified company started in February 2004 with the support of Varanasi Nagar Nigam by establishing the Common Bio medical Waste Treatment Facility (CBWTF) at 310- Mohan Sarai, National Highway, Varanasi with many machineries (ISO certified) for treatment facilities and well equipped team of experienced technicians, operators, skilled and semiskilled staff. CBWTF acquires land of one acre. The plants and machineries which are installed at CBWTF are incinerator, mechanical shredder/grinder and autoclave. Segregation of biomedical waste is also done at the treatment plant. Land filling options are available at the treatment plant. Collection of waste is done from those hospitals, nursing homes, diagnostic centers, pathological laboratories of the Varanasi district which are the registered members of CPC. The means of transportation for waste collection are BMW marked covered vehicles. The waste is collected by the vehicles and delivered to the treatment plant where it is treated. The hospitals are supposed to pay some amount of

money to CPC for waste treatment depending upon the amount of waste generated and the numbers of beds of hospitals.

III. DISCUSSION

Different kinds of therapeutic procedures are carried out in hospitals which results in the production of infectious wastes, sharp objects, and chemical materials etc. [13]. Different types of medical waste management systems are in practice in different countries [12, 14, 15, 16, 17, 18]. Disposal of medical waste is not risk free but can be minimized [19]. A Common Bio-medical Waste Treatment Facility (CBWTF) is a set up where bio-medical waste, generated from a number of healthcare units, is imparted necessary treatment to reduce adverse effects that this waste may pose. The treated waste is then land filled or recycled. The present study is based on the CBWTF of Varanasi. The study reveals some interesting facts about the biomedical waste management system of Varanasi i.e. number of hospitals, diagnostic centers and pathological labs which are registered under CPC are almost equal in number as compared to the non registered members so one clearly has an idea of the total quantity of waste generated in Varanasi. If this waste is not treated properly it can be highly hazardous. Around 56% of the waste is being treated at CBWTF as compared to 44% of the non treated waste. This result may be due the fact that many hospitals are not interested in actively cooperating with Centre for pollution control and are not willing to be a member of it. They do not want to pay any amount for biomedical waste treatment. Another major problem associated with the biomedical waste treatment in Varanasi is the lack of knowledge of segregation among the staff members of various hospitals. Since segregation of waste is not done this makes the treatment work tedious and time taking. Other minor problems associated are leave taken by the vehicle drivers and problems associated with vehicles. This sometimes delays the treatment work. Overall, through this study it was revealed that biomedical waste management in Varanasi is satisfactory with a large scope of improvement. With the effort C.P.C. more than 50% of the biomedical waste is being treated in the Varanasi city.

IV. CONCLUSION

It has been seen in the study that the bio medical waste management governed by a private organization very efficiently in the Varanasi city. Number of guidelines for the management of infectious waste materials from medical institutions are present [20, 21-25]. CPC is not only collecting the waste but also segregating and treating the waste in possible suitable manners. Waste is not only being managed but is also being documented at every step of treatment including record of wait, type, category etc. the management is well planned keeping in mind every step to remove hazard during the collection and treatment of the bio medical waste.. Some suggestions for the future prospects are following:

- More number of hospitals and other biomedical waste generation centers should be a registered member of C.P.C.
- The number of BMW marked vehicles should be increased.
- Other alternative measures should be adopted for waste collection in case drivers are absent or there is problem in the vehicle.
- At the treatment plant number of skilled staff should be increased.
- For the use of incinerator periodically training should be given to staff members of the plant.
- At the level of hospital, knowledge of segregation should be given.
- Every hospital should have special boxes to use as dustbin for bio-medical waste.
- Bio-medical waste should not be mixed with other waste of Municipal Corporation.
- Bio-medical waste Management Board can be established in each District.
- Either judicial powers should be given to the management board or special court should be established in the matters of environment pollution for imposing fines and awarding damages etc.
- Housekeeping staff should wear protective devices such as gloves, face masks, gowned while handling the waste.
- There should be biomedical waste label on waste carry bags and waste carry trolley and also poster on the wall adjacent to the bins (waste) giving details about the type of waste that has to dispose in the baggage as per biomedical waste management rule. Carry bags should also have the biohazard symbol on them.
- Regular training programs should be organized for the staff.

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