

# HANDLING AND MANAGEMENT OF BIOMEDICAL WASTE: CASE STUDY OF FOUR LEADING HOSPITALS IN KOLKATA

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## *Abstract*

The quality and quantity of various waste from different sources may adversely affect physical environment as well as human life. Among all types, one of the most dangerous is biomedical waste as this is highly toxic and hazardous in nature. But these toxicity and infectivity can be dangerous when not properly contained and disposed of. Even these infectious and bio-hazardous could lead to the spread of infectious diseases and everyday exposure to the waste results in accumulation of harmful substance or microbes in the person's body. The present initiative is to notice the current process of biomedical waste management and the condition of waste handlers in different hospitals and perception of respondents regarding handling besides management of hazardous biomedical waste.

**Keywords:** Biomedical Waste, Health Care Workers, Common Biomedical Waste Treatment Facilities, Infectious diseases

## **Introduction:**

Eminent American proponent of sustainability Annie Leonard once remarked "There is no such thing as 'away', when we through anything away it must go somewhere" (www.pinterest.com). The concept of waste depends on types of materials but these are unwanted or undesirable substances, produced from various sources. As per the sources of waste, it may be of liquid, solid, hazardous, organic, recyclable and so on. In our everyday life, almost in all places and in all time we can observe different types of waste. Among them, few types are of serious concern when those may lead to spread diseases or damage the normal process of a system. Specially, hazardous waste like hospital waste or biomedical waste is very common and produced from different medical activities and biological sources like treatment of diseases, diagnosis of diseases and similar processes. These are mainly high toxic in nature for chemical and radioactive materials. Hospital and concerned authority's administration must prepare a proper framework for its proper management as well as to keep a close watch over the waste management practices being followed by Health Care Workers (HCWs) and waste handlers.

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## **Study Area:**

The study area for this study has been selected based on its important. Study area is the capital city of West Bengal and former capital of India, Kolkata, Being the most important city of Eastern India it should have a better medical facility as it also provides medical facility not only to its own population even for its neighbouring states and countries. The health care system in Kolkata consists of 48 government hospitals, mostly under the Department of Health & Family Welfare, Government of West Bengal, and 366 private medical establishments up to 2010. But for this study, four major government hospitals have been selected, namely The Institute of Post-Graduate Medical Education and Research and Seth Sukhlal Karnani Memorial Hospital popularly known as SSKM hospital, Kolkata Medical College, Chittaranjan Cancer Institute and Sambhunath Pandit Hospital.

## **Objectives:**

The principal objective of the study is to determine the present scenario of biomedical waste from its generation to management through transportation along with the condition of health workers who collect, sort out, carry and handle the biomedical waste from the different places of hospitals to a separate location. The study also includes the opinion of respondents (mainly relatives and other patient parties) in handling and managing the hazardous biomedical waste.

## Methodology:

A survey has been conducted using questionnaire to understand the collection procedures of biomedical from waste handlers of four studied hospitals. Purposive sampling method mainly used to collect the data. For respondents' survey a total of 200 samples have been collected containing 50 samples from each hospital using random sampling within hospital premises. Secondary data of biomedical waste and other information have been collected from surveyed hospitals. After collecting the primary data different cartographic and quantitative techniques are applied to process the data and to find out the meaningful results.

## Results and Discussion:

### Management of medical waste as per norms:

WHO gave a definition in 1999 regarding the medical waste, "HCW is the by-product generated in hospitals and consists of sharps, blood, body parts, chemicals, pharmaceuticals, medical devices and radioactive materials." (Thakur, V. And Ramesh, A., 2014) In India, the Bio-medical Waste (Management and Handling) Rules, 1998 and further amendments were passed for the regulation of bio-medical waste management. On 28<sup>th</sup> March 2016 Biomedical Waste Management Rules 2016 were also notified by the Central Government. Each state's Pollution Control Board or Pollution control Committee will be responsible for implementing the new legislation. There are guidelines for duties of the occupier, duties for the operators, duties of the authorities for treatment and disposal processes, segregation, packaging, transportation and storage, monitoring of implementation of the rules in health care facilities etc. From the previous rule, this rule has expanded the generation points to include vaccination camps, blood donation camps, surgical camps or any other healthcare activity. The rule has also directed to train all the health care workers and immunize all health care workers regularly.

According to the rule, each type of waste is carried out in separate colour coded bags to enlist it in separate treatment facility. Bio-medical waste has been classified in to 4 categories instead 10 to improve the segregation of waste at source. List of these colour coding bags and types of containers are stated in table 1.

**Table 1:** Categorisation of different types of biomedical waste according to their colour coded bags

Category	Type of Waste	Type of Bag or Container
Yellow	a) Human and Animal Anatomical Waste: human tissues, organs, body parts below the viability period including experimental parts	Yellow coloured non-chlorinated plastic bags
	b) Solid Waste: Dressings, plaster cases, cotton swabs and bags containing residual or discarded blood and blood components.	
	c) Expired Medicine	
	d) Chemical Waste used to discard infections	
	e) Chemical Liquid Waste: Silver X-ray film developing liquid, discarded Formalin, aspirated body fluid, liquid from laboratories and floor cleaning, washing and housekeeping	Separate Collection system
	f) Discarded linen, mattresses, beddings contaminated with blood or body fluid.	Yellow bag with packing
	e) Microbiology, Biotechnology and other Clinical laboratory waste:	Autoclave safe plastic bag
Red	Contaminated Waste (Recyclable): Waste generated from disposable items such as tubing, bottles, intravenous tubes and sets, catheters, urine bags, syringes and vacuoners with their gloves.	Red coloured non-chlorinated plastic bags
White (Translucent)	Waste sharps including Metals: Needles, syringes with fixed needles, blades or any other contaminated sharp object that may cause puncture and cuts	Puncture proof, leak proof, tamper proof containers
Blue	a) Glassware:	Cardboard boxes with

	Broken or discarded glass including medicine vials and ampoules b) Metallic Body Implants	blue coloured marking
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Source:- Gazette of India, 2016

#### Generation and segregation at source:

The biomedical wastes are mainly generated in different sectors of various health care facilities like hospitals, diagnostic centres, pathological laboratories even in medicinal shops. For this study four leading hospitals have been surveyed and from there daily data of generated waste of one month have been collected from the record book. Based on the new rule mentioned above the hospital authorities are themselves responsible to segregate the waste into different colour coded bags for the waste collectors of outsourcing agencies. The agencies are not allowed to reopen the bags before processing them. So it is quite clear that the roles of the hospital staffs are very important for the sake of good management processes.

Waste is mainly generated in operating room, ward room and laboratories of the hospitals. Based on the data collected from the record book of the hospitals the scene of average distribution becomes quite clear. High amount of infectious and chemical waste have been generated in operation room while the amount of sharp waste is high in ward room. Basically the role of sharp waste is very vital in the processing technique as it is fully recyclable. In the laboratory also the amount of infectious and chemical waste are high than the rest. If this variation is put under analysis then the statistical calculation shows that the calculated value is within the zone of acceptance which means that the variation of waste is dependent upon both factors- types of waste and variation in places.

The amount of waste is also dependent on number of departments in a hospitals and number of beds in the same. This relationship can be drawn based the data collected from the hospitals and websites of respected hospitals which shows that a strong relationship is created between these two where the value of R is 0.91. It is of great significance to the super speciality and multi speciality hospitals to control their waste to a large extent and with contemporary planning.

If the waste can be categorised by the researchers in three categories like infectious, recyclable and heavy, then the hospitalwise distribution of waste seem to be very significant for the future study. In major three hospital SSKM, Kolkata Medical College and Chittaranjan Cancer Hospital the waste is generated in almost equable categories that means if a three axised diagram is done based on the above mentioned categories then these three hospitals are located in an optimal position where all the different types of waste are generated in there possible amount. But in Sambhunath Pandit hospital the extent of waste is tilted towards heavy waste. The table of recorded data reveals that in this hospital the amount of sharp waste is not very regular to collect and the amount is also very low which create heavy weightage for the blue type of waste.

This scene of inequality of distribution can be analysed by another two statistical techniques. From the calculation it is cleared that the degree of skewness is almost positive in all types of waste that means the concentration lies mainly in side of low value which signifies the lower production of waste in this hospital. In the medical college the value of yellow type of segregated waste is seemed to be negative (-0.02) that means it has a high concentration rather than the rest. In the other two hospitals also there also positive values in all types of waste which signify a low amount of waste segregation in all the hospitals. High positive value means more concentration in the negative sides and the tail of the distribution curve in the positive sides. So the class distribution of these kinds of wastes has maximum frequency in the negative sides whereas the high generating values have low concentration. Especially in the red types of waste which is mainly recyclable has high positive values in Chittaranjan Cancer (3.78) and Sambhunath Pandit hospitals (3.52) which designated low generation of these kinds of waste rather than the rest types. So it can be concluded that the lacking in the generation of recyclable waste increases the fix amount of waste which can be a great as these cannot be used further and dumping of high amount of ass will be a huge problem in the near future.

If the focus comes to the co-efficient of Kurtosis then it designates the peak of different types of waste. In the SSKM hospital apart from yellow type of waste (3.30) all the other types seem to be platykurtic which means there is a less peak and high flatness in the distribution of waste. In the medical college the degree of peak is mixed up. Recyclable waste have leptokurtic distribution (6.01 and 3.90) that recognised a high peak and higher concentration of waste in the middle class of frequency distribution. In the other two hospitals, all types of waste have leptokurtic distribution. But specially again the recyclable red type of waste has very high value of leptokurtic distribution which signifies very high peaks and very high concentration of waste in the middle class of distribution. So it can be said that the higher concentration in the peak seems the low amount of equableness in the distribution as well as less amount of generation of waste which is seen in mainly Chittaranjan Cancer Hospital and Sambhunath Pandit Hospital. This type of features is seen mainly in recyclable types of waste which can be very dangerous in the future for the management and autoclaving processes for the waste outsourcing companies.

Another technique is applied to work out the inequality of distribution and that is the values of Gini's Co-efficient. From this calculation, it is clear that Kolkata Medical College has almost the same figures (colourwise 0.17, 0.18, 0.28 and 0.61) which designated the almost same amount of inequality in the generation of waste. But for Chittaranjan Cancer and Sambhunath Pandit Hospitals, the values are very much scattered and concerning white or sharp type of waste the values are near to one (0.80 and 0.88 respectively) which means complete inequality. So this inequality can create some major issues for the outsourcing agencies to process recyclable waste.

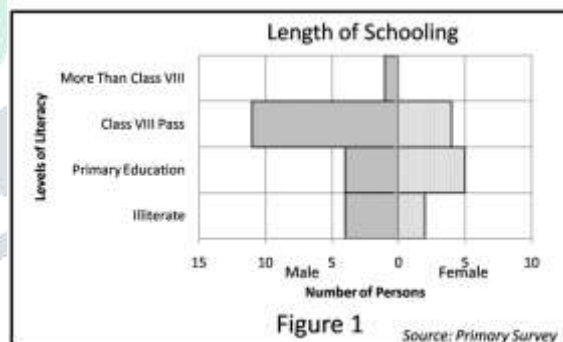
Apart from these quantifying characteristics of the biomedical waste, there are several other observations which have come across during analysis. They are-

- There are no proper measurement machines or techniques to measure weight of the waste filled bags. The handlers just lift the bag with their hands, assume the weight and record them which is perhaps very much unscientific for the recyclable processes. Moreover it is almost impossible for the management facilities to weight all the bags as the facilities are few in number and have to serve numerous hospitals at one time.
- Another complaint that has been raised for the waste handlers especially by the management facilities that the workers are not well aware while engaged in segregating waste. In most of the times plastic packets are segregated with the medical waste which should be dissociated with the municipal waste. For this during the management process huge amount the CO<sub>2</sub> and other polluted gases are generated. Moreover some explosive materials like oxygen cylinders are packed with medical waste which can be a cause of massive explosion during incineration process and loss of human lives.

#### Waste handling and handlers:

Aside from quantity based waste segregation approach the present study over the leading hospitals in Kolkata has been carried out mainly to know the followed procedure for handling and management of waste. Being a super speciality hospital SSKM has highest number of male and female waste handlers who generally carry and collect waste from different places of hospitals like ward room, laboratory, operating room etc to store at a room in proper colour coded bags. Likewise authorities of all others surveyed hospital also follow same procedures to manage the produced waste from their institutes. The personnel and number of waste handlers are quite sufficient in number in SSKM hospital. Here numbers of male and female workers are 10 and 8 respectively. But this number is not sufficient in the case of rest HCEs. Kolkata Medical College and Chittaranjan Cancer Hospital have a few workers mainly dominated by male, almost of 70%. Lastly come in the list, Sambhunath Pandit Hospital where surprisingly only one waste handler is found who is a lone handler for all types the waste collection and disposal within hospital premises.

Some specific parameters are taken into consideration for understanding the precaution taken by waste handlers during handling the hazardous waste- their educational profile and year of experience in the process. Education holds much importance to increase the awareness in any matter of concern. Here it is seen from figure-1 that the male workers have comparatively better length of schooling rather than female waste handlers. Mostly the female workers have passed upper primary level which is perhaps not sufficient level of schooling that make them aware about the infectious diseases, may spread by wrong method of waste handling. The situation is not better for male workers.



It has also been observed that both the category of workers are not provided the proper protective clothes i.e. gloves, aprons etc by the hospital authorities. Almost 55% male and 72% of female workers are not provided these protections (figure-2). But the matter of concern is that even waste handlers are not at all bothered by this fact. They are not well aware by the infectious diseases which can be resulted from improper handling of biomedical waste.

An experience level in terms of years of service in the same profession holds also another matter of concern regarding the safe handling of waste. The male workers have relatively high level of experience rather than female workers. Mostly the male workers have more than 10 years of experience (almost 50%) where as the dominant percentage of female workers is on less than five years of experience (45%). Basically the observations and interviews reveal that in most cases the female workers are temporary in their jobs where male workers are permanent employee

in these hospitals. This kind of discrimination does not allow women to increase their experience level that indirectly affect upon their awareness regarding proper and safe management of waste.

It was already said that the workers do not complete their duties with awareness in most of the times especially in the time of segregation. It is a very common complaint from the staffs of treatment facilities that the hospitals workers are not well trained. So they do not follow the recent guideline of biomedical waste management. But the true fact is that in the recent amendment of this guideline it is said to train the staff at least to a basic level. So for this kind of mishappening the staffs should not be criticised. It is the duty of the hospital authorities to train them and aware them for the safe and proper handling of biomedical waste.

#### Waste management:

The biomedical waste management holds a separate management techniques than other or municipal solid waste techniques. For this, separate treatment facilities have been started to establish from 2000s onwards. For our case study, West Bengal holds special significance in this article. In West Bengal the very first treatment facility registered under West Bengal Pollution Control Board is Medicare Environmental Management Pvt. Ltd. under Ramky Group in Howrah in the year 2002. Later there several branches have been established in different parts of the West Bengal. Now there are six treatment facilities which are registered in the West Bengal Pollution Control Board. Their names and collecting areas are enlisted in table 2. They are responsible to collect biomedical waste from the hospitals on daily basis or bi-weekly that depends on the amount of generated waste and that is carried using the well designed protected vehicles.

**Table 2:** Name of the Treatment Facilities in West Bengal and location of their treatment plants

SI No.	Name of the Facilities	Location	Waste Collection Districts
1	Greentech Environ Management Pvt. Ltd.	Mograhat, South 24 Parganas	Kolkata and South-24 Parganas
2	Greenzen Bio Pvt. Ltd.	Bhaktinagar, Jalpaiguri	Darjiling, Jalpaiguri, Coachbihar, Alipurduar, Uttar and Dakshin Dinajpur, Maldah
3	Medicare Environmental Management Pvt. Ltd.	Belgachia, Howrah	Howrah, Kolkata and South-24 Parganas
4	Medicare Environmental Management Pvt. Ltd.	Kalyani, Nadia	Nadia, Hugli, Murshidabad and North-24 Parganas
5	Medicare Environmental Management Pvt. Ltd.	Raniganj, Burdwan	Birbhum, Barddhaman, Puruliya and Bankura
6	West Bengal Waste Management Pvt. Ltd.	Haldia, Purba Medinipur	Industrial Waste from West Bengal, Remedial Ashes from Medicare, Medical Waste from Purba and Paschim Medinipur

Source:- <http://www.wbpcb.gov.in/pages/display/38-biomedical-waste-management>

From the surveyed hospitals SSKM and Sambhunath Pandit Hospital are served by Greentech Environ Management Pvt. Ltd. and Kolkata Medical College and Chittaranjan Cancer Hospital are served by Medicare Environment Management Pvt. Ltd., Howrah branch.

State Government has to provide them land to establish the facility. Apart from this all the expenditures like building, machineries, transport, labour etc should be funded by private entrepreneurs. Health care establishments are charged to take the facilities from them as per the rate fixed by respective state government. In West Bengal, hospitals are charged Rs.6.3/bed in North Bengal and Rs.5.7/bed in rest of the states. All the clinics and laboratories are charged at the rate of Rs.1012 to 3542 per month based on its size fixed by State Government. Dental Clinics are charged Rs.15/chair and blood banks at a monthly rate of Rs.10122. These rates will be implemented till the end of current financial year and are incremented at a rate of 4% per year based on the previous year's charges.

For the detailed knowledge of this intense process, the researchers have visited the oldest treatment facility of West Bengal, Medicare Environment Management Pvt. Ltd. of Howrah branch. From the in-depth interview of the DGM, Finance of this branch, the researchers are able to know several technical details regarding this whole process. This facility have been set up in two acres land consisted of twenty two transport vehicles of Tata Ace and Tata 470 which are engaged in the transportation activity from the health care facilities registered to them. They have two incinerators and one autoclave machine. But they have no facility to dispose the remedial ashes produced in the incineration process. For this they have to depend upon the land filling disposal ground of West Bengal Waste Management Pvt. Ltd. in Haldia.

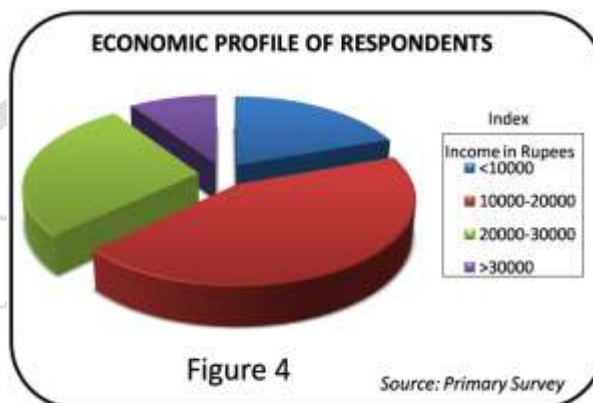
While observing the whole process, some striking problems are noticed within their treatment premises. They are-

- This facility reuse the water used in Quencher Ventury Scrubber during incineration process to release the heat from the processed substances which are chambered in almost 850 to 1050°C temperature. But this polluted and putrid smelled water are stored in open tanks which can be easily over poured in the time of high rainfall.
- The machine buildings are extremely heated and dirty with full of flies and other insects which do not suit with the healthy working conditions for the labours.

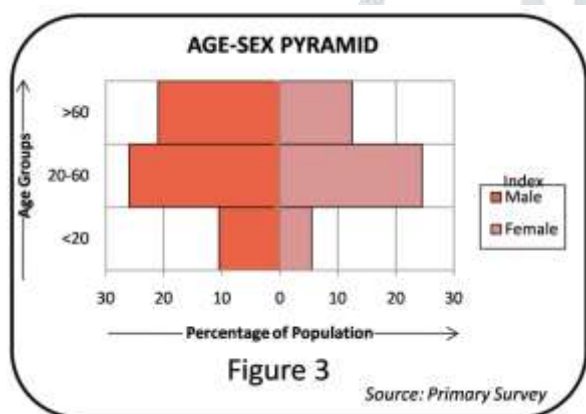
But it should be said that they provide proper safety measures like glyphs, masks and vaccination to their labours and arrange proper training season regularly to aware the workers about the proper and safety processes of waste handlings.

People’s perception regarding waste management:

Concerning the perception study on overall situation of waste collection procedure, mainly patient’s relative and others members were interviewed to know their opinion on that This study holds an important role specially to assess the of facilities and level of handling standard of the hazardous within the premises of hospitals that could be effective



matter. status waste information for improving the



situation in future. So the people’s concept, their need, their approach should be known by the planners for any kind of improvement. Demographic and economic structure always holds certain importance in perception study. Age-sex composition in figure 3 shows that most of the male and female respondents are within 20-60 and >60 years which is very significant for this study their views hold much importance to the researcher for this kind of study for their experience.

Regarding economic profile of respondents (figure 4), almost 50% of the respondents belong within category of Rs. 10000-20000 monthly income which may be taken into consideration for understanding the diverse views in handling and management option of biomedical waste.

A few questions were asked to the respondents about the condition of waste management in respective hospitals if they had visited the hospitals before. In that case, 42% of respondents of Sambhunath Pandit hospital agree that the situation of this hospital is far better in waste clearance and processing techniques whereas, in medical college the situation is completely reversed. Here the respondents have several complaints regarding the dirtiness and waste handling processes than earlier times. They assume that number of waste handlers is more or less same with the increasing number of patients in both indoor and outdoor sections.



With respect to number of waste disposal boxes used in four surveyed hospitals that differ from one hospital to another. Most of the cases (48.5%) the respondents have seen about 5 to 10 disposal boxes within hospital premises which are perhaps not sufficient for the whole hospital according to the perception of respondents (figure 5).

A question has asked before the respondents about the overall problems of the hospitals related directly and indirectly with the waste handling processes. From their opinion a Combination analysis has been done to work out the most important problems of each hospital. The combinations are described in table 3.

**Table 3:** Combination analysis of problems in hospitals

Name of Hospitals	Best Combination of Problems
SSKM	Lack of safe guards+ Bad behaviour of hospital staffs+ Irregular collection of waste+ Untrained staffs
Medical College	Bad behaviour of hospital staffs+ Lack of safe guards+ Irregular collection of waste
Sambhunath Pandit	Lack of safe guards+ lack of awareness among public+ Bad behaviour of hospital staffs
Chittaranjan Cancer	Bad behaviour of hospital staffs+ lack of awareness among public+ Lack of safe guards+ Untrained staffs

Source: Primary Survey Data, July 2016

To remove hospital wise distributional error weightage has been given to different problems based on their position in best suited combination. From this quantitative analysis the most important three problems that can be obstacles to the proper management of medical waste are-

- Most of the respondents have complained that the hospital staff and waste collectors even the nurses do not wear any proper safe guards specially gloves. They have touched the disposable waste with the bare hands and later treated the patients with the same. Patients' parties have therefore raised a question about the affectivity of hand washing only of the hospital staffs for the sake of health of the patients.
- A very common problem of the government hospitals is the ignorance of the staffs. Some respondents think that this can be a drawback in their awareness to the waste as well as patients.
- The waste is not collected from the hospitals regularly. The waste handlers are very much irregularly in their daily job which should be maintained by the authorities concerned in order to clean the hospital premises.

The perception of the people is not always correct as they are sometimes diverted by some external and mental situations. Still they should be an important part of the study for their regular arrival and time spending in the hospitals.

### Conclusion:

This study report remains incomplete if it does not involve some remedial measures. The situation is quite clear that the condition of hospitals staffs is not enough good at all. For the waste handling process the authorities need to be more conscious. The doctors and nurses should be given proper training about the methods of waste handlings. The authority must ensure the supply of protective clothes and accessories to waste handlers in order to keep them secure from the harmful impacts of biomedical waste. Proper campaign within hospital premises on the effects of bio-medical waste is required for all section of people using poster, placard, restriction and so on. This study does not propose any new planning or processes. If the concerning authorities just look after the ongoing processes and regulate it at a regular basis then the system will be perfect for all concerned people in the hospital and its premises.

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