



Biomedical Waste Management Towards Minimising Environment Toxicity Parameters on Safetly Aspects

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Abstract: Biomedical waste management is a critical aspect of ensuring environmental sustainability and public health safety. With the increasing generation of biomedical waste due to advancements in healthcare facilities and population growth, the effective and safe disposal of this waste has become a pressing concern. This study aims to evaluate biomedical waste management practices, focusing on minimizing environmental toxicity and enhancing safety parameters. It explores the segregation, collection, transportation, treatment, and disposal methods employed in healthcare facilities, highlighting their impact on environmental and human health. Emphasis is placed on innovative technologies such as autoclaving, microwaving, and chemical disinfection, alongside sustainable practices like recycling and reusing non-hazardous materials. The study also examines regulatory frameworks, compliance levels, and the role of awareness and training among healthcare personnel in achieving optimal waste management outcomes. The findings underscore the need for stricter enforcement of guidelines, investment in modern waste treatment technologies, and the adoption of eco-friendly practices to mitigate toxicity risks. This research contributes to developing an integrated approach to biomedical waste management, ensuring environmental protection and safeguarding public health.

Keywords: Biomedical waste management, Environment toxicity parameters, Safetly aspects

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INTRODUCTION

The global population is growing at a rapid pace. Food, water, clothes, shelter, and medical care are the most fundamental needs of this rapidly expanding population. Every day, relevant innovations are taking place to meet the needs of this rapidly growing population. Because of this, health care institutions supported by both the public and commercial sectors have expanded rapidly around the world. The treatment of several incurable illnesses, as well as the management and eradication of some fatal disorders, have been made possible because to this. In addition, vaccination and protection against contagious illnesses have been made available worldwide via these services. The healthcare industry's meteoric rise has been a blessing for people both now and in the future. As with any coin, there is a flip side to this rapidly expanding healthcare infrastructure, and it is currently causing concern among environmentalists and health care authorities around the world. On the one hand, it is good news for the health and welfare of humans, other organisms, and the environment.

Many tons of trash is being generated by the health care industry as it strives to improve people's health and well-being. Disposal of this biomedical waste is difficult since it is both costly and time-consuming, and it is produced during medical investigations and surgical procedures. The health and safety of humans

might be jeopardized by the improper disposal of garbage. There is a clear distinction between biomedical waste and regular garbage. As a byproduct of their daily activities, medical research and treatment institutions produce radioactive materials and potentially dangerous substances. Because it is often not biodegradable, biomedical trash differs from regular municipal or home garbage. The waste products produced by healthcare institutions during patient treatment pose a threat to both the local ecosystem and any living things in the vicinity. Both the people affected and the society at large suffer when biomedical waste is not properly and promptly disposed of.

During the course of patient care, including diagnosis, treatment, laboratory testing, surgical procedures, and research, biomedical waste, also known as health care waste, is generated by healthcare institutions. A number of variables influence the amount of biomedical waste that is produced, including the nature of the medical facility, the number of patients treated there, the methods used, the available infrastructure and resources, the location of the facility, and so on. Biomedical waste is unique among wastes and poses unique risks. Biomedical waste is unique among waste types and poses special risks because of its potential toxicity, which poses a danger to human life, and contamination, which may lead to the spread of infectious illnesses. Some examples of biomedical waste include worn bandages, abandoned gloves, surgical tools, undesired microbiological cultures, recognizable body parts, human or animal tissues, sharps, and blood. Because it has the potential to spread illness and disrupt ecological balance via water and soil contamination, biomedical waste must be disposed of in an appropriate and timely manner. Research on biomedical waste has shown that some of these items include plastics and other non-biodegradable compounds that may be difficult to dispose of or not disposed of at all, endangering ecosystems.

The researcher has selected this topic for investigation because it is an emerging problem that requires immediate attention and will be useful for future studies on the same or related subjects. A number of Mumbai healthcare facilities will host the aforementioned research. The urban core and the countryside of Kalyan taluka. New Delhi One of the world's fastest-growing metros, officially known as Bombay, is located in the Indian state of Maharashtra. It is a heavily populated metropolis on the Arabian Sea coast in western India. Its fast development over the last two decades has led to claims that it is the country's financial and commercial capital. Among all industries, the medical and health care sector is expanding at a faster rate than any other. In Mumbai, you may find a wide variety of public and private institutions that cater to various medical needs. Information gathered from the Municipal Corporation of Greater Mumbai (MCGM) indicates that the city is home to around 70 public hospitals, over a thousand private hospitals, and over a thousand primary care physicians' offices, specialty clinics, and veterinary hospitals. These healthcare facilities produce a substantial quantity of biological waste daily, according to previous research. MCGM is among the biggest Asian local governments. It became the first municipal corporation in India when it was founded in 1882.

When it comes to the social and environmental development of its residents, it has been a frontrunner among municipal corporations. Solid waste management in Mumbai refers to the process of efficiently collecting and disposing of garbage. The MCGM (Municipal Corporation of Greater Mumbai) is in charge of Met City. There are a number of rules and ordinances in place to guarantee the proper disposal of waste products, but it is important to know how well they are working to achieve the goal of MCGM, which is to

reduce waste and dispose of biomedical waste correctly. Research shows that people at all social levels have a pitiful understanding of the need of properly disposing of biomedical waste, despite the fact that MCGM ensures this happens. Research has also shown that many hospitals lack the resources, expertise, and infrastructure necessary to properly dispose of biological waste, even though the government has mandated that they do so. In the Thane district of Maharashtra, over an area of 276 square miles, lies Kalyan taluka, which is a component of the Mumbai Metropolitan and Regional Development Authority, MMRDA. A multicultural population resides in the region.

According to the 2011 census, there are 279 people per square mile. The most current census data from 2011 indicates that 12,76,614 individuals call Kalyan taluka home. As part of its smart city initiative, the government of India is working to improve Kalyan and other nearby areas. Part of that improvement involves making sure that garbage is properly disposed of and treated, as well as reducing the amount of garbage that people produce. Despite government legislation and standards, there is a lack of planning and methods for managing biomedical waste, according to the findings of several research on the topic. This is likely attributable to the general public's low level of knowledge. The amount of garbage produced in India is estimated to be between one and two kilograms per bed per day in multispecialty hospitals and 600 grams per bed per day in general practitioner's clinics, according to research data. According to prior research on the subject, biomedical waste disposal and management is distinct from general trash disposal, requires a lot of work, is expensive, and requires a scientific approach. It is occasionally mixed with other types of trash, such as household garbage or municipal trash. According to previous research, only a small percentage of healthcare facilities have adequate plans for the disposal of biological waste, whereas the majority of facilities do not. The improper disposal of this trash poses a significant threat to human health. As a result, studies concerning biological waste's production, gathering, amount, kinds, disposal, and treatment are necessary.

METHODOLOGY

In the present research study, the researcher has used descriptive survey method for collection of data. The researcher has collected primary data for the study from health care units of rural and urban areas. The descriptive survey method is very useful when in gathering information relating to study in case of the topic which is related to society in some way. It helps in determining the problems and providing the solutions in proper manner as it deals directly with the personals who are in the process. The researcher could connect closely to the respondents in order to collect data in this method. As the present research problem is universal the descriptive survey method appropriately fit in as methodology. Different variables in the research study have been considered in survey which are as follows:

- The type and gender of respondents (Doctors/ nurses / auxiliary staff /)
- Experience and Training of biomedical waste handling in term of years
- Types and ways of biomedical waste handling (generation /collection / segregation /transport / treatment /disposal).
- Site of health care unit (rural / urban).

- Speciality of health care unit (maternity / dental / orthopaedic).
- Level of awareness of healthcare staff and common public as well about biomedical waste and its handling.
- Healthcare staff's attitude towards biomedical waste and its handling
- Common public's attitude towards biomedical waste and its handling

For the interpretation and analysis of data, various statistical methods are used. Two types of statistical applications are applicable for the present research study

- 1) Descriptive Analysis.
- 2) Inferential Analysis.
- 3) MANOVA- SPSS analysis.

DATA ANALYSIS

TYPES OF RESPONDENT UNDER THE STUDY

The study that is being conducted right now is an exploratory survey. There were three groups of people who filled out the survey: medical professionals/administrators, nurses, and support workers. The information was gathered from both public and private institutions in both urban and rural regions, with a focus on maternity, dentistry, and orthopedic services. The researcher had the respondents fill out a questionnaire. When participants' ability to interpret the questionnaire was an issue, the researcher would sometimes provide assistance. The following table shows the different sorts of respondents and the total number of respondents who provided useful feedback for this study.

Table 1: Respondents of city areas of Mumbai metropolitan city in the government and private health care units of speciality wise health care units

	City Government			City Private			Total
	Maternity	Orthopaedic	Dental	Maternity	Orthopaedic	Dental	
Doctors/ administrators	5	5	5	5	5	5	30
Nurses	5	5	5	5	5	5	30
Auxiliary staff	5	5	5	5	5	5	30

Total	15	15	15	15	15	15	90
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A total of 90 respondents were included in the research; 45 were from the government and 45 were from the rural areas around Mumbai metropolitan metropolis. This includes medical professionals, administrators, nurses, and support personnel.

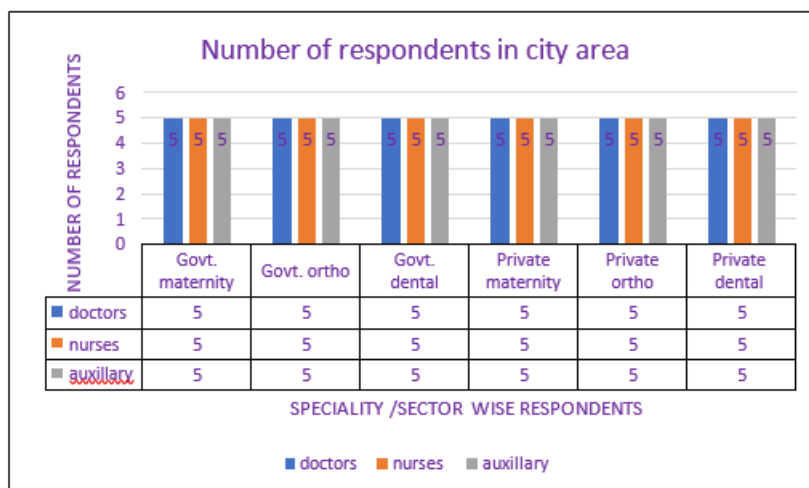


Figure 1: Respondents of city area in the government and private health care units of speciality wise and sector wise in health care units

The figure above shows the number of respondents included in present research study. In the city area, the respondents for the study were as follows:

Table 2: Respondents of rural area of Kalyan taluka in the government and private health care units of speciality wise and sector wise health care units

	Rural Government			Rural Private			Total
	Maternity	Orthopaedic	Dental	Maternity	Orthopaedic	Dental	
Doctors/ administrators	5	5	5	5	5	5	30
Nurses	5	5	5	5	5	5	30
Auxiliary staff	5	5	5	5	5	5	30

Total	15	15	15	15	15	15	90
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In rural area of Kalyan taluka, 45 respondents of government and 45 respondents of rural area were included in the study, the sum of which is 90. This includes doctors and administrator of health care facility, Nurses and auxiliary staff.

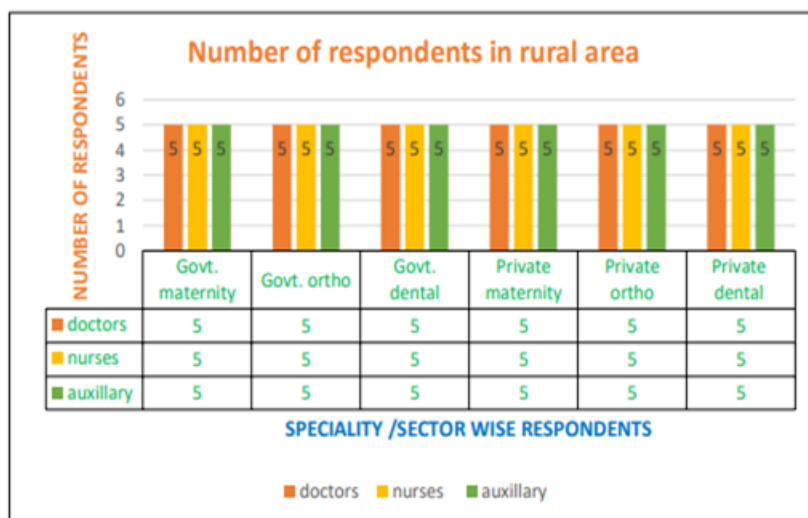


Figure 2: Respondents of rural area of Kalyan taluka in the government and private health care units of speciality wise and sector wise in health care units.

VARIOUS PARAMETERS RELATED TO BMW HANDLING

A number of factors concerning the management of biological waste are addressed in this section. Awareness, collecting, segregation, and storage are the aspects covered here. Disposal of Treatment The public's perception of health care workers varies by location (rural vs. urban), industry (public vs. private), and speciality (dental, orthopaedic, maternity).

Annexure B - Awareness

Staff knowledge of proper biological waste management in the investigated healthcare facilities is the focus of this section. The production of biomedical waste has been the subject of a great deal of research. There is a noticeable difference in the amount and kind of trash generated by various healthcare facilities. If you work in the healthcare industry and are responsible for handling biomedical waste, you are required by law to wear protective gear and adhere to all safety protocols outlined by the World Health Organization (WHO). As an additional requirement of these standards, healthcare facilities should provide an area on the premises that is secure, well-ventilated, and shielded for the purpose of storing biomedical waste in bags or containers with corresponding colors. During induction and annually thereafter, waste management professionals are also obliged to get training on how to properly handle biological waste. In a dedicated

book, the healthcare facility should document the whole lifecycle of biological waste, from generation to collection, treatment, and disposal. It is important to consistently update and examine the document. The disposal of biological waste will be made more effective, safe, and timely with this. (Govt. of India, Ministry of environment and forest, Biomedical waste treatment regulations 2016, Page 86).

The following health care unit respondents were surveyed using a questionnaire in order to gather primary data for the research. Both urban and rural health care facilities participated in this investigation. The survey included administering questionnaires and collecting answers from administrative, medical, nursing, and support staff members. The researcher also interacted with healthcare facility personnel in both official and informal capacities.

Table 3: Total Number of respondents in city and rural area under the study for finding out the level of awareness

Between-Subjects Factors			
		Value Label	N
Hospitals from city or rural areas	1	City	90
	2	Rural	90

You can see how many healthcare facilities participated in the survey in the table up there. There were 90 people that filled out the survey for the urban and rural areas, respectively. In both urban and rural areas, there are health care facilities that cater to specific needs, such as those associated with maternity care, orthopaedics, and dentistry.

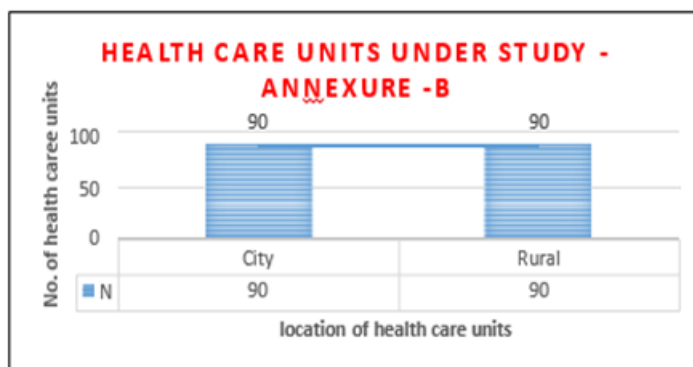


Figure 3: Number of Health care units under the present study in city area of Mumbai and rural area of Kalyan taluka

The figure shows the participants from both the urban and rural areas who participated in the current study. In both urban and rural areas, there are health care facilities that cater to specific needs, such as those associated with maternity care, orthopaedics, and dentistry.

Annexure - B Combined Sector Specialization Cross-tabulation

The procedures used for collecting, sorting, and storing biomedical waste in city and rural health care facilities are shown in the image above. The chart clearly shows that health care facilities in the city region have better techniques for collecting, sorting, and storing biomedical waste.

Table 4: Comparison of following correct collection methods in sector, locality and speciality wise health care units

Annexure C Combined Sectors Specialization Cross-tabulation					
Hospital type	Response	Government or private hospital			
		Govt. City	Private City	Govt. Rural	Private Rural
Maternity	Don't Know	27.27	18.20	32.92	21.61
	Nos	17.81	22.92	27.44	31.82
	Yes	30.21	27.23	22.38	20.18
Orthopedic	Don't Know	33.33	19.78	27.19	19.78
	No	16.23	22.13	29.16	32.47
	Yes	31.01	27.69	21.59	19.71
Dental	Don't Know	26.48	19.15	22.07	32.39

No	17.70	21.82	28.61	31.87
Yes	30.58	27.93	22.40	19.09
Percentages and totals are based on respondents.				

Public and private hospitals in urban and rural areas are shown in the following table, which shows a combined specialty cross-sectional analysis. For maternity specialty health care units, several employees were unaware of the procedures used in the field. In maternity care facilities run by the local government, 27.27 percent of employees did not know how to properly dispose of biological waste, and 17.81 percent did not follow proper procedures. The percentage of employees that strictly adhere to protocols for the collection, sorting, and storage of biomedical waste is only 30.2%.

While 22.9% of personnel at private city maternity health care facilities did not follow the proper procedures for collecting, sorting, and storing biological waste, 18.27% did not know what they were doing. The percentage of employees that strictly adhere to protocols for the collection, sorting, and storage of biomedical waste is low, at 27.2%.

In government-run rural health care institutions for pregnant women, 32.9% of workers were unaware of proper procedures, and 27.4% were not segregating and storing biomedical waste properly. It was discovered that just 22.3% of the workforce adhered strictly to the protocols for collecting, sorting, and storing biomedical waste.

Annexure – C

Various approaches to biological waste disposal are discussed in this section, including the healthcare units that were part of the research. Various healthcare facilities generate diverse types and quantities of biomedical waste, necessitating specialized disposal strategies. Therefore, the method of disposal is likewise different. Healthcare facilities or waste management companies are responsible for disposing of biological waste. Healthcare facilities and waste management companies use a variety of methods for disposing of garbage. It is optimal to dispose of biological waste in accordance with its kind. Prior to disposal, the bio-medical waste must to undergo appropriate treatment. When it comes to the safe disposal of biological waste, the instructions further specify that healthcare facilities should have a designated area on the grounds where the trash may be securely disposed of. At the time of induction and annually afterward, all employees who will be handling biological waste should get training on the proper disposal of this kind of waste. The organization should also adhere to all applicable safety standards. It is recommended to keep track of discarded garbage in a separate book and to update and examine it often. Biomedical waste treatment guidelines 2016, Government of India, (Ministry of environment and forest, 2016).

The current study's sample contains the following individuals that filled out the survey. The data was

gathered from the following healthcare facilities in order to examine biological waste disposal methods:

Table 5: Case summary of the respondents- for study of effective Disposal of biomedical waste

Between-Subjects Factors			
		Value Label	N
Hospitals from city or rural areas	1	City	90
	2	Rural	90

The table shows the number of respondents under the study for following effective methods of biomedical waste disposal in city and rural area.

Table 6: Number of respondents in city and rural area included in survey for annexure E- Disposal of biomedical waste

	Rural /Urban Government			Rural/Urban Private			Total
	Maternity	Orthopaedic	Dental	Maternity	Orthopaedic	Dental	
Doctors/ administrator	5+5	5+5	5+5	5+5	5+5	5+5	60
Nurses	5+5	5+5	5+5	5+5	5+5	5+5	60
Auxiliary staff	5+5	5+5	5+5	5+5	5+5	5+5	60
Total	30	30	30	30	30	30	180

CONCLUSION

One of India's most prominent environmental initiatives, "Swachh Bharath Abhiyan" (Clean India Movement), places a premium on proper garbage disposal. To make the world a better and healthier place, everyone from lawmakers to regular people must do their part. We can reach our aim of minimizing

pollution caused by biomedical waste if authorities take further actions and society contributes equally. In this approach, hospitals and other healthcare facilities will not become breeding grounds for contaminants and diseases, notwithstanding their good intentions as healing spaces for patients. To lessen the environmental toll, individuals must work together to manage biomedical waste in a way that is effective, safe, and completed in a timely manner.

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