

## **BIOMEDICAL WASTE MANAGEMENT: A STUDY OF KNOWLEDGE, ATTITUDE, AND PRACTICES IN COIMBATORE HOSPITALS**

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### **Abstract**

*Proper handling, treatment and disposal of biomedical wastes are important elements of health care office infection control programme. Correct procedure will help protect health care workers, patients and the local community. If properly designed and applied, waste management can be a relatively effective and an efficient compliance-related practice. This review article discusses about the various types of waste, its management and the hazards of indiscriminate disposal of hospital waste and in brief about hospital waste management.*

**Keywords: Biomedical waste, dhospital waste, waste management**

## INTRODUCTION

Systematic and scientific way of managing the waste through step by step process such as segregation, storage, transportation and disposal major need of the present time. Biomedical waste (BMW) is any waste produced during the diagnosis, treatment, or immunization of human or animal research activities pertaining thereto or in the production or testing of biological or in health camps. It follows the cradle to grave approach which is characterization, quantification, segregation, storage, transport, and treatment of BMW.

The basic principle of good BMW practice is based on the concept of 3Rs, namely, reduce, recycle, and reuse. The best Biomedical Waste management (BMWM) methods aim at avoiding generation of waste or recovering as much as waste as possible, rather than disposing. Therefore, the various methods of BMW disposal, according to their desirability are prevent, reduce, reuse, recycle, recover, treat, and lastly dispose. Hence, the waste should be tackled at source rather than “end of pipe approach”. BMW treatment and disposal facility means any facility wherein treatment, disposal of BMW or processes incidental to such treatment and disposal is carried out. Only about 10%–25% of BMW is hazardous, and the remaining 75%–95% is nonhazardous. The hazardous part of the waste presents physical, chemical, and/or microbiological risk to the general population and health-care workers associated with handling, treatment, and disposal of waste.

Bio-medical wastes are of great importance due to its potential environmental hazards and health problems. The waste produced in the course of health care activities carries a higher potential for infection and injury than any other type of waste. The management of hospital waste requires its segregation and removal from the health care establishments in such a way that it will not be a source of health hazards to those who are directly or indirectly related to the hospital environment. It is estimated that annually 3 million tons of hospital wastes are generated in India and the waste generation rate ranges from 0.5 to 2.0 kg per bed per day. With a view to control the indiscriminate disposal of hospital waste/bio medical waste, the Ministry of Environment and Forest, Govt. of India has issued a notification on Bio Medical Waste Management under the Environment (Protection) Act [1]. Govt. of India has also constituted advisory committee, appellate authority in exercise of powers conferred under Bio Medical rules.

## REVIEW OF LITERATURE

A survey by **Suwannee (2002)** was carried out to review medical waste management in Phitsanulok province, Thailand in order to improve waste management. The objective of study was to classify the characteristics of waste and create the implementation structures at hospital. The research was conducted to find the average daily waste generated from hospital and clinics. Numerous factors such as type of hospital, specialization, proportion of reusable items, and waste management plan were investigated in waste generation assessment.

**Mohankumar and Kottaiveeran (2016)** studied the hospital waste management and environment problems in India. The authors estimated that there are about 6 lakhs hospital beds, over 23,000 primary health centres, more than 15,000 small and private hospitals in India. They found that a few studies on bio medical waste management from India have established that hospitals did not manage health care waste properly. Mismanagement of health care waste disposal cause dangerous infection and poses a potential threat to the surrounding environment, person handling it and to the public. The study suggested that proper hospital waste management system can help the control diseases can reduce community exposure to resistant bacteria, and could reduce HIV/AIDS and Hepatitis transmission from dirty needles and other improperly cleaned or disposed medical items. Regarding the environmental issues, a correct and sustainable management system of hospital waste will avoid the negative long term health effects, from the environmental release of toxic substances such as dioxin, mercury and others.

**Naik, Modi and Bansal (2017)** conducted a study on the biomedical waste handling knowledge and practices in urban health centres of Surat Municipal Corporation. They found that though colour bags are used in the 20 health centres under study, strict enforcement of segregation is not practised resulting in hazardous waste ending up in wrong bags which pose high risk to the health of both the handlers of the waste and general the public. Education and training coupled with ensuring commitment of the healthcare staff, management and supervisors are the major remedial measures according to authors.

The hazardous medical waste unit generation rate was calculated by **Komilis et al. (2018)** in different categories of health-care facilities including public, private and seven sub-categories in Greece based on the quantities of the wastes that were regularly transferred to the specific incinerator. Results revealed that there is variance in the weights of medical waste even among hospitals of the same categories. The reason of this variance may be attributed to other parameters in medical waste generation. For example, in the public hospitals, medical waste generation rate is correlated positively with number of beds. Therefore, the number of beds is the prediction factor in medical waste generation rate.

**Ravi Kant Sehgal (2018)** this study about knowledge, attitude, and practices regarding biomedical waste management among the health-care workers in a multispecialty teaching hospital at Delhi. This study found out the knowledge, attitude and practices regarding BMW management among the health-care workers (HCWs). The result indicated correct color coding for waste disposal was known to 84.2% of respondents, and awareness about transmission of important diseases such as HIV infection and hepatitis B through BMW was known to 66.7% of the participants. The practice of recapping of used needles, which is one of the important risk factors for needle-stick injuries was found among 25.8% of respondents and was the highest among the sanitary staffs (83.3%). Awareness about the practice of initiating accident reporting pro forma on contact with blood/body fluids of HIV-infected patients was found to be 77.5% overall and only 10% among the sanitary staffs. Similarly, the awareness about the practice of post exposure prophylaxis for the prevention of HIV infection was found to be 71.7% overall and only 10% among the sanitary staffs, which could be owing to their poor literacy status. However, the attitude of all HCWs including the sanitary staffs toward BMW management was positive and favorable.

## STATEMENT OF THE PROBLEM

Waste generation encompasses activities in which materials are identified as no longer being of value and are either thrown away or gathered together for disposal. A major issue related to current bio-medical waste management in many hospitals is that the implementation of bio- Medical waste regulation is largely unsatisfactory as some hospitals are disposing waste in a haphazard, improper and indiscriminate manner Lack of segregation practices, results mixing of

hospital wastes with general waste making the whole waste stream hazardous. Inappropriate segregation ultimately results in an incorrect method of waste disposal. Most important issue is that there is no mechanism to ensure that all waste collected and segregated reaches its final destination without any pilferages which gives additional hazard including recycling of disposable.

If bio-medical wastes are not properly handled within the stipulated time period, it could strike in the form of total infections. Worse in some hospitals, there is no proper training of the employees in hazardous materials management and waste minimization aspects. This grossly indicates the lack of even basic awareness among hospital personnel regarding safe disposal of bio-medical waste. The present study deals with the procedure of handling and disposal method of Biomedical Waste Management and its cost details. It also intends to know the environmental protection and problems faced by the health care unit.

### **OBJECTIVES OF THE STUDY**

- 1) To analyse the strategies of biomedical waste system in select hospitals in Coimbatore district.
- 2) To find out the problems faced by the hospitals for the disposal of biomedical waste.

### **HYPOTHESES OF THE STUDY**

- 1) There is no significant difference in the perception of respondents about biomedical strategies based on their socio demographic factors.
- 2) There is no significant relationship between biomedical strategies, environment protection and cost associated with it.

### **METHODOLOGY**

The present study is a descriptive research. The primary data was collected from the nurses of the selected hospitals in Coimbatore city. For the purpose of collection of data, interview schedules were prepared separately to cover nurses. The interview schedules are prepared in such a way that they are simple and understandable so as to enable the respondents to express their opinions freely and frankly. Adequate care has been taken to collect unbiased data from the respondents. Hence the researcher collect data from 250 nurses i.e., 50 nurses from each

private hospital in Coimbatore district. Thus **disproportionate random sampling** was used in this study.

## RESULTS AND DISCUSSION

### RELIABILITY TEST

**Table 1**  
Indicating the reliability of the data

S.no	Name of construct	Number of items	Cronbach alpha
1	Segregation of waste	10	0.72
2	Recycling strategy	3	0.78
3	Medical waste audit	9	0.77
4	Establishment of green team for biomedical waste management	7	0.76
5	Problems faced by hospitals	11	0.80

**Source:** Primary data

The above table shows the reliability of the data collection by the researcher. According to the standard norm the cronbach alpha should be more than 0.7. It is identified that the entire **cronbach alpha** for value of the Constructs are at the satisfactory level. Hence the constructs are found to be reliable.

### FACTOR ANALYSIS AND ANOVA

**Table 2**  
Checking for the absence of multi collinearity issues

Model	Variables	UC		SC	T	Sig	CD	
		B	SE				Beta	TOL
Impact of various biomedical waste management strategies and environment protection strategies on the cost of biomedical waste management	(Constant)	15.37				0.001*		
	Segregation of waste	0.45	0.02	0.44	22.5	<b>0.001*</b>	0.52	1.92
	Recycling strategy	0.56	0.06	0.57	9.33	<b>0.001*</b>	0.41	2.43
	Medical waste audit	0.67	0.04	0.65	16.75	<b>0.001*</b>	0.46	2.17
	Establishment of green team for biomedical waste management	0.59	0.03	0.57	19.66	<b>0.001*</b>	0.54	1.85
	Waste management system	0.66	0.01	0.65	66	<b>0.001*</b>	0.48	2.08

	Management of hazardous substances	0.7	0.04	0.69	17.5	<b>0.001*</b>	0.56	1.78	
	Energy conservation	0.64	0.03	0.66	21.33	<b>0.001*</b>	0.55	1.81	
	Green environment	0.79	0.04	0.80	19.75	<b>0.001*</b>	0.42	2.38	
	Recyclability	0.77	0.03	0.75	25.66	<b>0.001*</b>	0.53	1.88	
	Green building initiative	0.68	0.02	0.69	34	<b>0.001*</b>	0.50	2	
<b>Dependent Variable: Cost of biomedical waste management</b>									
<b>CD: Collinearity Diagnostics, TOL: Tolerance, VIF: Variance Inflated Factor</b>									

Source: Primary data

From the above table it is identified that there is no **multi collinearity issues** among the independent variables used in the multiple regression model. To confirm the absence of multicollinearity that tolerance level should be greater than 0.2 and the variance inflated factor should be between 1 to 10. It is identified that all the Independent variables in the model satisfies this criteria. Hence the researcher proves that there is no multicollinearity issue in the multiple regression models.

**Table 3**

**Testing the sampling adequacy for factor analysis**

<b>KMO and Bartlett's test of sphericity</b>		
Kaiser –Meyer-Olkin measure of sampling adequacy	0.864	
Bartlett's test of sphericity	Approximate Chi-square	125.28
	Degree of freedom	4
	Significant	0.03

Source: Primary data

This table shows the salt of sampling adequate which is the primary conception of factor analysis. According to this test the **KMO** value should be greater than 0.8 and **Bartlett's test of sphericity** should be significant. It is identified that both the conditions are satisfied. Hence the data collected by the researcher is considered to be adequate and for factor analysis.

**Table 4**

**Communalities of data**

S. no	Measuring statements	Extraction
1	In our hospital segregation reduces the amount of waste needs special handling	0.425

	and treatment	
2	In our hospital segregation prevents the mixture of medical waste like sharps with the general municipal waste	0.426
3	Segregation prevents illegally reuse of certain components of medical waste like used syringes, needles and other plastics	0.529
4	In our hospital Segregation provides an opportunity for recycling certain components of medical waste like plastics after proper disinfection	0.614
5	In our hospital, segregation helps to reduce the cost of treatment and disposal	0.714
6	Segregation helps to recycling, and promotes good environmental practices and revenue generation	0.630
7	In our hospital Incineration and plasma pyrolysis is used for treatment and disposal of yellow waste	0.514
8	In our hospital Auto claving or micro waving followed by shredding is used for treatment and disposal of red waste	0.415
9	In our hospital Disinfection is used for treatment and disposal of blue waste(it includes glass ware, broken or discarded and contaminated glass and 8mpoules )	0.426
10	In our hospital Auto claving or dry heat sterilization is used for disposal of white waste	0.389
11	In our hospital, biomedical incinerators are available to manage bio medical waste	0.541
12	The incineration process provide environmental benefits to hospital	0.521
13	The recycling process in our hospital helps to cost reduction and further revenue generation	0.487
14	Medical waste audit in our hospital covers generation of medical waste and bio hazard waste properly	0.541
15	Medical waste audit in our hospital covers infectious waste and radioactive waste properly	0.562
16	Medical waste audit in our hospital aimed at prevent generation of waste and reuse of waste that has been generated	0.542
17	Our hospital have a clear view about how to store, transport and disposal of	0.417



	medical waste	
18	In our hospital medical waste audit properly identify waste minimization opportunities and potential cost savings	0.369
19	In our hospital, Management conduct follow up activities regarding cost savings activities related with bio medical waste management	0.547
20	Our hospital conducted a detailed waste stream analysis on the part of waste audit	0.614
21	Our hospital conducting periodical assessment relating with current waste disposal costs	0.598
22	In our hospital doctor's office and outpatients clinics are part of biomedical waste auditing and they are actively supporting this system	0.555
23	In our hospital, green teams are take initiatives for Increase recycling activities	0.516
24	In our hospital, green teams are take initiatives to Reduce regulated medical waste Read-Modify-Write	0.536
25	In our hospital green teams take initiatives to Reduce hazardous chemical use	0.468
26	In our hospital, green teams ensuring environmentally preferable purchasing strategies, including preference for reusable materials	0.477
27	In our hospital, green teams are take steps for Promote energy conservation.	0.463
28	In our hospital green teams are introducing proper water conservation strategies.	0.543
29	In our hospital green teams are ensuring proper management of unused pharmaceuticals and cleaning products	0.536

**Source:** Primary data

The above table shows that communalities of each item loaded in factor analysis. This value which should be greater than 0.3 indicates the extraction or variance explained by each item. From the result it can be observed that all the values are greater than 0.3 confirming communalities of all the items.

**Table 5**  
**Rotated component matrix for identification of factors**

Factor and Variance Explained	Components	Rotated Factor Loadings
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<b>Factor 1:</b> <b>Segregation of waste</b> <b>Total Variance</b> <b>Explained = 24.70%</b>	In our hospital segregation reduces the amount of waste needs special handling and treatment	0.81
	In our hospital segregation prevents the mixture of medical waste like sharps with the general municipal waste	0.79
	Segregation prevents illegally reuse of certain components of medical waste like used syringes, needles and other plastics	0.86
	In our hospital Segregation provides an opportunity for recycling certain components of medical waste like plastics after proper disinfection	0.83
	In our hospital, segregation helps to reduce the cost of treatment and disposal	0.84
	Segregation helps to recycling, and promotes good environmental practices and revenue generation	0.82
	In our hospital Incineration and plasma pyrolysis is used for treatment and disposal of yellow waste	0.81
	In our hospital Auto claving or micro waving followed by shredding is used for treatment and disposal of red waste	0.87
	In our hospital Disinfection is used for treatment and disposal of blue waste(it includes glass ware, broken or discarded and contaminated glass and 10mpoules )	0.86
	In our hospital Auto claving or dry heat sterilization is used for disposal of white waste	0.85
	<b>Factor 2:</b> <b>Recyclability</b>	In our hospital, biomedical incinerators are available to manage bio medical waste
The incineration process provide environmental benefits to hospital		0.78
The recycling process in our hospital helps to cost reduction and further revenue generation		0.77
<b>Total Variance</b> <b>Explained= 20.895%</b>		
	Medical waste audit in our hospital covers generation of	0.69

	medical waste and bio hazard waste properly	
	Medical waste audit in our hospital covers infectious waste and radioactive waste properly	0.67
	Medical waste audit in our hospital aimed at prevent generation of waste and reuse of waste that has been generated	0.63
<b>Factor 3: Medical waste audit</b>	Our hospital have a clear view about how to store, transport and disposal of medical waste	0.65
<b>Total Variance Explained= 17.12%</b>	In our hospital medical waste audit properly identify waste minimization opportunities and potential cost savings	0.67
	In our hospital, Management conduct follow up activities regarding cost savings activities related with bio medical waste management	0.63
	Our hospital conducted a detailed waste stream analysis on the part of waste audit	0.60
	Our hospital conducting periodical assessment relating with current waste disposal costs	0.68
	In our hospital doctor's office and outpatients clinics are part of biomedical waste auditing and they are actively supporting this system	0.66
	In our hospital, green teams are take initiatives for Increase recycling activities	0.64
<b>Factor 4: Establishment of green team</b>	In our hospital, green teams are take initiatives to Reduce regulated medical waste Read-Modify-Write	0.63
<b>Total Variance Explained= 15.624%</b>	In our hospital green teams take initiatives to Reduce hazardous chemical use	0.67
	In our hospital, green teams ensuring environmentally preferable purchasing strategies, including preference for reusable materials	0.68
	In our hospital, green teams are take steps for Promote	0.66

	energy conservation.	
	In our hospital green teams are introducing proper water conservation strategies.	0.65
	In our hospital green teams are ensuring proper management of unused pharmaceuticals and cleaning products	0.64
<b><i>Cumulated sum of rotated factor loadings= 78.339%</i></b>		

**Source:** Primary data

The above table represents this factor extracted by the researcher. A total of 29 statements were loaded and four factors were identified each indicating biomedical waste management strategies adopted by select hospitals. The four factors were named based on the review of literature and the strategies followed by hospitals. All the four factors together yield cumulated some of rotated factor loading at 78.339%. This percentage is considered to be adequate since it is greater than 50 %.

The first factor identified as “**segregation of waste**” consist of 10 stage statements. This factor represents 24.70 percentage of total variance. This factor consist of statement such as “In our hospital segregation reduces the amount of waste needs special handling and treatment, In our hospital segregation prevents the mixture of medical waste like sharps with the general municipal Waste, Segregation Prevents illegally reuse of certain components of medical waste like used syringes, needles and other plastics, In our hospital segregation provides an opportunity for recycling certain components of medical waste like plastics after proper disinfection, In our hospital segregation to reduce the cost of treatment and disposal, Segregation helps to recycling, and promotes good environmental practices and revenue generation, In our hospital incineration and plasma pyrolysis is used for treatment and disposal of yellow waste, In our hospital autoclaving and microwaving followed by shredding is used for treatment and disposal of waste, In our hospital disinfection is used for treatment and disposal of blue waste (It includes glass were broken or discarded and contaminated glass and ampoules), In our hospital autoclaving or dry heat sterilization is used for disposal of waste. The second factor identified as “**Recyclability**” consist of three statements this factor represents 20.895 % of total variance this factor of statement such as “In our hospital biomedical incinerators are available to manage biomedical waste, The incineration process provide environmental benefits to hospital, The recycling process in our hospital helps to cost production and further revenue generation”. Third factor identified as “**Medical Waste Audit**” consist of nine statements. This factor represents 17.12 % of total variance. This factor consist of statements such as “Medical waste audit in our hospital covers generation of medical waste and biohazard waste properly, Medical waste audit in our hospital covers infectious waste and radioactive waste properly, Medical waste audit in our hospital aimed at prevent generation of waste and reuse of waste that has generated, Our hospital have a clear view about how to store, transport and disposal of medical waste, In our

hospital medical waste audit properly identify waste minimization opportunities and potential cost savings, In our hospital management conduct follow-up activities regarding cost savings activities related with biomedical waste management, Our hospital conducted a detailed waste stream analysis on the part of waste audit, Our hospital doctors office and outpatients clinics are part of biomedical waste auditing and they are actively supporting this system. The fourth factor identified as “**Establishment of Green Team**” consist of seven statements. This factor represented 15.624% of total variance. This factor consist of seven statement such as “In our hospital green teams are take initiative for increase recycling activities, In our hospital green teams are take initiative to reduce regulated medical waste Read-modify-write, In our hospital green teams take initiative to reduce Hazardous chemical use, In our hospital green team is ensuring environmentally preferable purchasing strategies including preference for reusable materials, In our hospital teams are taking steps for promote energy conservation, in our hospital green teams are introducing proper water conservation strategies, In our hospital green teams are ensuring proper management of unused pharmaceutical and cleaning products”. Hence had identified four factors namely segregation of waste, recycle ability, waste audit, establishment of green team which are considered to be major biomedical waste management strategies in Coimbatore district.

**Table 6**  
**Problems faced by hospitals in managing biomedical waste**

S.No.	Statements	Mean score	Ranking
1	Sometimes improper segregation of waste at source, is not happened in our hospital	4.08	4
2	Sometimes mixing of sharp waste with other recyclable waste is happened and that leads to improper waste management	4.17	2
3	Our Hospital team have an ambiguity about final disposal of sharps and plastics	4.11	3
4	inadequate information about the use of landfill and deep burial pits leads to practical difficulties in storage and disposal	3.98	5
5	In our hospital inappropriate location of bins is exist and it creates confusions	3.14	11
6	Our hospital experienced untrained contractual waste handlers handling the waste in efficient way	4.19	1

7	Our hospital experienced ineffective disinfection of waste. These deficiencies were attributed to the attitudes of the administrative medical officers and staff involved in HCW (Health Care Works) management	3.78	7
8	Green Procurement Policy in our hospital is ineffective	3.48	9
9	Lack of Top Management Commitment exist in our hospital relating with bio medical waste management	3.63	8
10	In our hospital institutional arrangements for bio medical waste management is poor	3.24	10
11	We felt that management Reluctant to Adoption of innovative bio medical waste management practices	3.79	6
	<b>Average mean score =</b>	<b>3.78</b>	

**Source:** Primary data

The Above table depicts the major **problems faces by the select hospitals in managing biomedical waste**. The researcher has been used score and ranking to identify the major problems faced by the hospitals. The statement “Our hospital experienced untrained contractual waste handlers handling the waste in efficient way” Was ranked the major issue [Mean Score = 4.19]. The second rank is scored by “Sometimes mixing of sharp waste with other recyclable waste is happened and that leads to improper waste management” [Mean score = 4.17]. The third rank is scored by “Our hospital team have an ambiguity about final disposal of sharps and plastics” [Mean score = 4.11]. The fourth rank is scored by “Sometimes improper segregation of waste at source is not happened in our hospital” [Mean score = 4.08]. The fifth rank is the scored by “inadequate information about the use of landfill and deep burial pits leads to practical difficulties in storage and disposal” [Mean score = 3.98]. The sixth rank is scored by “We felt that management reluctant to adoption of innovative biomedical waste management practices”. [Mean score = 3.79]. The statement “ Our Hospital experience day ineffective disinfection of waste. These Deficiencies were attributed to the attitude of the administrative medical officers and staff involved in healthcare works management” was ranked seventh major issue. [Mean score = 3.78]. The statement “Lacks of top management commitment exist in our hospital leading with biomedical waste management” was ranked the eighth major issue. [Mean score = 3.63]. The statement “In our hospital institutional arrangements for biomedical waste management is poor” was ranked 10<sup>th</sup> major issue. [Mean score = 3.24]. The statement “in our hospital in appropriate location of bins is exist and it creates confusions” was ranked least major issue.

**Table 7**

**Perception of respondents towards various strategies of biomedical waste management system based on gender- Independent sample t test**

Variables	Labels	N	Mean	S.D	t	Sig
Segregation of waste	Female	219	1.89	1.23	12.47	<b>0.001*</b>
	Male	115	1.84	1.12		
Recycling of waste	Female	219	1.72	0.78	18.45	<b>0.001*</b>
	Male	115	1.70	0.74		
Medical waste audit	Female	219	1.14	1.26	14.65	<b>0.001*</b>
	Male	115	0.75	0.14		
Establishment of green team	Female	219	1.19	0.25	8.97	<b>0.001*</b>
	Male	115	0.78	0.04		

**Source:** Primary data

This table shows the **perception of respondents towards various strategies of biomedical waste management system based on gender**. The result shows that there is a significant difference in the perception of respondents towards all the biomedical waste management strategies. Since all the P values are less than 0.05. Hence the null hypothesis is rejected and the researcher concludes that, there is a significant difference in the perception of respondents based on gender. These results are significant at 5% level of significance.

**Table 8**

**Perception of respondents towards various strategies of biomedical waste management system based on age- One way ANOVA**

Variables	Label	Sum of Squares	D.O.F	Mean Squares	F	Sig
Segregation of waste	Between group	36.24	3	12.08	7.37	<b>0.001*</b>
	Within group	542.35	331	1.63		
	Total	578.59	334	13.71		
Recycling of waste	Between group	3.45	3	1.15	0.70	0.12
	Within group	536.54	331	1.62		

	Total	539.99	334	2.77		
<b>Medical waste audit</b>	Between group	2.45	3	0.81	0.52	0.10
	Within group	512.36	331	1.54		
	Total	514.81	334	2.35		
<b>Establishment of green team</b>	Between group	4.68	3	1.56	0.96	0.18
	Within group	533.45	331	1.61		
	Total	538.13	334	3.17		

**Source:** Primary data

The above table shows the results of one way ANOVA that test the **perception of respondents towards various strategies of biomedical waste management system based on age**. The result shows that there is a significant difference in the perception only towards segregation of waste. Since the P value is less than 0.05. There is no significant difference towards the perception about Recycling of waste, medical waste audit, establishment of green team. Since all the P values are greater than 0.05. Hence the null hypothesis rejected only for segregation of waste and accepted for all other variables. These results are significant that 5% level of significance.

**Table 9**

**Perception of respondents towards various strategies of biomedical waste management system based on hospital- One way ANOVA**

<b>Variables</b>	<b>Label</b>	<b>Sum of Squares</b>	<b>D.O.F</b>	<b>Mean Squares</b>	<b>F</b>	<b>Sig</b>
<b>Segregation of waste</b>	Between group	45.21	5	9.042	6.08	0.001*
	Within group	489.25	329	1.487		
	Total	534.46	334	10.529		
<b>Recycling of waste</b>	Between group	54.14	5	10.828	7.13	0.001*
	Within group	499.25	329	1.517		



	Total	533.39	334	12.345		
<b>Medical waste audit</b>	Between group	64.58	5	12.916	8.79	0.001*
	Within group	483.25	329	1.468		
	Total	547.83	334	14.384		
<b>Establishment of green team</b>	Between group	48.36	5	9.672	6.46	0.001*
	Within group	492.24	329	1.496		
	Total	540.6	334	11.168		

Source: Primary data

The above table represents **perception of respondents towards various strategies of biomedical waste management system based on Hospital**. The result shows that there is a significant difference in Perceptions towards various strategies based on gender. Since all the P values are less than 0.05. Hence the null hypothesis is rejected and the researcher concludes that, there is a significant difference in the perception of respondents based on Hospital. These results are significant at five percentage 5% level of significance.

**Table 10**

**Perception of respondents towards various strategies of biomedical waste management system based on amount invested in biomedical waste management- One way ANOVA**

Variables	Label	Sum of Squares	D.O.F	Mean Squares	F	Sig
<b>Segregation of waste</b>	Between group	40.25	3	13.416	9.54	0.001*
	Within group	465.36	331	1.405		
	Total	505.61	334	14.821		
<b>Recycling of waste</b>	Between group	54.12	3	18.04	12.53	0.001*
	Within group	476.25	331	1.4388		
	Total	530.37	334	19.478		
<b>Medical waste audit</b>	Between group	59.48	3	19.826	13.48	0.001*
	Within group	486.54	331	1.469		
	Total	546.02	334	21.295		

<b>Establishment of green team</b>	Between group	62.14	3	20.713	14.24	0.001*
	Within group	481.23	331	1.453		
	Total	543.37	334	22.166		

**Source:** Primary Data

Based on the above table it is observed that the results shows there is a significant difference in **perception of respondents towards various strategies of biomedical waste management system based on amount invested**. Since all the P values are less than 0.05. Hence the null hypothesis is rejected and there is a significant difference in the perception of respondents based on the amount invested. These results are significant at 5% level of significance

**Table 11**

**Perception of respondents towards various strategies of biomedical waste management system based on problems faced in biomedical waste management- Independent sample t test**

<b>Variables</b>	<b>Labels</b>	<b>N</b>	<b>Mean</b>	<b>S.D</b>	<b>t</b>	<b>Sig</b>
<b>Segregation of waste</b>	Yes	269	1.26	0.14	11.25	<b>0.001*</b>
	No	65	1.32	0.09		
<b>Recycling of waste</b>	Yes	269	0.15	0.06	10.69	<b>0.001*</b>
	No	65	1.26	1.01		
<b>Medical waste audit</b>	Yes	269	0.58	0.21	21.25	<b>0.001*</b>
	No	65	1.14	0.08		
<b>Establishment of green team</b>	Yes	269	0.77	0.06	18.36	<b>0.001*</b>
	No	65	1.46	0.24		

**Source:** primary data

The above table identified that **perception of respondents towards various strategies of waste management system based on problem biomedical waste management**. Based on the results it is observed that there is significant difference in perception of respondents Based on problems faced in biomedical waste management Strategies. Since all the P value are less than 0.05. Hence the null hypothesis is rejected and the researcher concludes that, there is a

significant difference in the perception of respondents Based on problems in biomedical waste management strategies. The results are significant at 5% level of significance.

**Table 12**

**Perception of respondents towards various strategies of biomedical waste management system based on tenure of investment in biomedical waste management- One way ANOVA**

Variables	Label	Sum of Squares	D.O.F	Mean Squares	F	Sig
<b>Segregation of waste</b>	Between group	3.65	3	1.216	0.90	0.06
	Within group	446.25	331	1.348		
	Total	449.9	334	2.564		
<b>Recycling of waste</b>	Between group	3.14	3	1.046	0.78	0.12
	Within group	441.26	331	1.333		
	Total	444.4	334	2.379		
<b>Medical waste audit</b>	Between group	2.89	3	0.963	0.72	0.10
	Within group	440.29	331	1.330		
	Total	443.18	334	2.293		
<b>Establishment of green team</b>	Between group	2.36	3	0.786	0.59	0.11
	Within group	439.25	331	1.327		
	Total	441.61	334	2.113		

Source: Primary data

The above table shows the results of one way ANOVA that test the **perception of respondents towards various strategies of biomedical waste management system based on the tenure of investment in biomedical waste management system**. The result shows that there is no significant difference in perception of respondents based on tenure of investment in biomedical waste management. Since all the P values are greater than 0.05. Hence the null hypothesis is accepted. The Researcher concludes that there is no significant difference in perception of respondents based on tenure of investment. These results are significant at 5% level of significance.

**Table 13**

**Perception of respondents towards various strategies of biomedical waste management system based on support received from government for biomedical waste management-**

**One way ANOVA**

<b>Variables</b>	<b>Label</b>	<b>Sum of Squares</b>	<b>D.O.F</b>	<b>Mean Squares</b>	<b>F</b>	<b>Sig</b>
<b>Segregation of waste</b>	Between group	64.25	3	21.416	14.48	0.001*
	Within group	489.56	331	1.479		
	Total	553.81	334	22.895		
<b>Recycling of waste</b>	Between group	74.25	3	24.75	16.50	0.001*
	Within group	496.25	331	1.499		
	Total	570.5	334	26.249		
<b>Medical waste audit</b>	Between group	73.25	3	24.416	16.68	0.001*
	Within group	484.36	331	1.463		
	Total	557.61	334	25.879		
<b>Establishment of green team</b>	Between group	89.36	3	29.786	20.72	0.001*
	Within group	475.63	331	1.436		
	Total	564.99	334	31.223		

Source: Primary data

Based on the above table the researcher identified that there is significant difference in **perception of respondents towards various strategies of biomedical waste management system based on support received from government for biomedical waste management**. Since all the P values are less than 0.01. Hence then null hypothesis is rejected and the researcher concludes that there is a significant difference in the perception of respondents based on Support received from government for biomedical waste management. These results are significant at 5% level of significance.

**Table 14**

**Perception of respondents towards various strategies of biomedical waste management system based on perceived effectiveness of biomedical waste management-Independent sample t test**

Variables	Labels	N	Mean	S.D	t	Sig
Segregation of waste	Yes	189	1.14	0.12	1.26	0.08
	No	145	2.39	0.14		
Recycling of waste	Yes	189	1.25	0.06	10.56	<b>0.001*</b>
	No	145	1.36	0.24		
Medical waste audit	Yes	189	1.19	0.11	24.25	<b>0.001*</b>
	No	145	1.28	0.13		
Establishment of green team	Yes	189	0.74	0.25	23.63	<b>0.001*</b>
	No	145	0.16	0.18		

Source: Primary data

This table shows that **perception of respondents towards various strategies based on perceived effectiveness of biomedical waste management**. The result shows that, there is no significant difference in the perception only towards segregation of waste. Since the P value is greater than 0.05. There is significant difference towards their perception about recycling of waste medical waste audit establishment of Green team. Since all the P values are less than 0.01. Hence the null Hypothesis accepted only for segregation of waste and rejected for all other variables. These results are significant that 5% level of significance.

## MEAN SCORE AND RANKING

**Table 15**

**Depicting the level of waste management system in hospitals as a part of environment protection strategies**

SI No.	Statements	Mean score	Ranking
1	The hospital adopts separate bin system for collecting waste	3.98	5
2	The hospital clearly describes the safety procedures in handling wastes	4.09	3
3	The hospital management educates staffs on the importance of waste management	4.15	2
4	The hospital does not dump the waste in open areas	3.66	6

5	The rooms are cleaned and waste materials are removed twice every day	4.36	1
6	The patients are made aware of waste management policies of the hospital	4.01	4
<b>Average mean score=</b>		<b>4.041</b>	

**Source:** Primary data

The above table depicts **the level of waste management system in hospitals as a part of environment protection strategies**. The researcher has used means score and ranking to identify the Level of waste management system in hospitals as a part of environment protection strategies. The first rank is scored by “The rooms are cleaned and waste materials are removed twice every day”. [Mean score = 4.36]. The second Rank is scored by “The hospital management educates stops on the importance of waste management” [Mean score = 4.15]. The statement “The hospital clearly describes the safety procedures in handling waste” has scored third rank [Mean score = 4.09]. The statement “The patients are made aware of waste management policies of the hospital” has ranked fourth. [Mean score = 4.01]. The fifth rank scored by “The hospital adopts separate bins system for collecting waste” [Mean score = 3.98] and The sixth rank scored by “The hospital does not dump the waste in open areas” [Mean score = 3.66].

**Table 16**

**Depicting the level of management of hazardous waste in hospitals as a part of environment protection strategies**

SI No.	Statements	Mean score	Ranking
1	Hazardous waste are appropriately classified by hospital management	4.16	3
2	The detailed list of different hazardous waste handling is provided in every room	4.24	2
3	Patients are not exposed to near the hazardous waste management areas	3.78	5
4	Proper warning against hazardous items are provided by the management	4.09	4
5	Hazardous waste of the hospital are handled at site away from human habitat	3.54	7
6	The hazardous waste is handled with due care by the hospital authorities	4.36	1

7	The hospital has sufficient provision for managing hazardous waste	3.67	6
<b>Average mean score=</b>		<b>3.977</b>	

Source: Primary data

The above table shows that **the level of management of hazardous waste in hospitals as a part of environment protection strategies**. The researcher has used means score and ranking to identify the Level of waste management system in hospitals as a part of environment protection strategies. The statement “The hazardous waste is handled with due care by the hospital authorities ” has scored first rank [Mean score = 4.36].The second Rank is scored by “The detailed list of different hazardous waste handling is provided in every room ” [Mean score = 4.24].The statement “Hazardous waste are appropriately classified by hospital management ” has scored third rank [Mean score = 4.16].The statement “Proper warning against hazardous items are provided by the management ” has ranked fourth.[Mean score = 4.09].The fifth rank scored by “Patients are not exposed to near the hazardous waste management areas ” [Mean score = 3.78].The sixth rank scored by “The hospital has sufficient provision for managing hazardous waste ” [Mean score = 3.67] and least rank scored by “Hazardous waste of the hospital are handled at site away from human habitat” [Mean score = 3.54].

**Table 17**

**Depicting the level of energy conservation in hospitals as a part of environment protection strategies**

SI No.	Statements	Mean score	Ranking
1	The hospital is committed in energy conservation for sustainability	4.12	2
2	The hospital uses smart power strips that reduces power consumption during activity	3.98	4
3	The hospital uses energy efficient equipment and machinery for various purposes	3.64	7
4	The hospital provide pamphlets in every room regarding energy conservation	4.36	1
5	The hospital has replace light bulbs with CFLS and LEDs wherever possible	3.78	6
6	The hospital has efficient window system that can reduce heat	4.03	3

7	Window shades shutter and screen are used to insulate the room from external temperature	3.89	5
<b>Average mean score=</b>		<b>3.971</b>	

Source: Primary data

The above table shows **the level of energy conservation in hospitals as a part of environment protection strategies**. The researcher has used means score and ranking to identify the Level of waste management system in hospitals as a part of environment protection strategies. The statement “The hospital provide pamphlets in every room regarding energy conservation” has scored first rank [Mean score = 4.36].The second Rank is scored by “The hospital is committed in energy conservation for sustainability” [Mean score = 4.12].The statement “The hospital has efficient window system that can reduce heat ” has scored third rank [Mean score = 4.03].The statement “The hospital uses smart power strips that reduces power consumption during activity ” has ranked fourth.[Mean score = 3.98].The fifth rank scored by “Window shades shutter and screen are used to insulate the room from external temperature” [Mean score = 3.89]. The sixth rank scored by “The hospital has efficient window system that can reduce heat” [Mean score = 3.78] and least rank scored by “The hospital uses energy efficient equipment and machinery for various purposes” [Mean score = 3.64].

**Table 18**

**Depicting the level of green environment in hospitals as a part of environment protection strategies**

SI No.	Statements	Mean score	Ranking
1	The hospital manages the environmental pressure efficiently	4.36	2
2	The hospital addresses the environmental issues and takes concrete actions to tackle the issues	4.28	4
3	The hospital has truly sustainable policies as its identity	4.51	1
4	The hospital use innovative product and practices to reduce environmental Issues	4.32	3
5	The hospital maintain a separate department for	4.17	5



	hospital waste management		
	<b>Average mean score=</b>	<b>4.328</b>	

**Source:** Primary data

The above table depicts **the level of green environment in hospitals as a part of environment protection strategies**. The researcher has used means score and ranking to identify the Level of waste management system in hospitals as a part of environment protection strategies. The statement “The hospital has truly sustainable policies as its identity ” has scored first rank [Mean score = 4.51].The second Rank is scored by “The hospital manages the environmental pressure efficiently ” [Mean score = 4.36].The statement “The hospital use innovative product and practices to reduce environmental Issues ” has scored third rank [Mean score = 4.32].The statement “The hospital addresses the environmental issues and takes concrete actions to tackle the issues” has ranked fourth.[Mean score = 4.28].The fifth rank scored by “The hospital maintain a separate department for hospital waste management ” [Mean score = 4.17].

**Table 19**

**Depicting the level of recyclability in hospitals as a part of environment protection strategies**

SI No.	Statements	Mean score	Ranking
1	Whenever possible reusable products are used instead of single-use products	4.33	2
2	Patients are provided awareness about recycling of possible materials	4.71	1
3	The pharmacy and dispensaries use Eco-friendly packages	4.10	3
	<b>Average mean score=</b>	<b>4.38</b>	

**Source:** Primary data

The above table shows **the level of recyclability in hospitals as a part of environment protection strategies**. The statement “Patients are provided awareness about recycling of possible materials” has scored first rank [Mean score = 4.71].The second Rank is scored by “Whenever possible reusable products are used instead of single-use products” [Mean score = 4.33].The statement “The pharmacy and dispensaries use Eco-friendly packages” has scored

third rank [Mean score = 4.10]. The researcher has used means score and ranking to identify the Level of waste management system in hospitals as a part of environment protection strategies.

**Table 20**  
**Depicting the level of green building initiatives in hospitals as a part of environment protection strategies**

SI No.	Statements	Mean score	Ranking
1	Our hospital adopts environmentally responsible design for the buildings	4.28	2
2	The layout of the hospital is resource efficient	4.21	3
3	The hospital has improved indoor environment quality	3.98	5
4	Hospital does not have potential liability resulting from indoor air quality problems	4.36	1
5	Green aspects is visible in every aspect of Hospital architecture and construction	4.04	4
6	The hospital interiors are done with green materials that reduces allergy and other illness	3.84	6
7	The hospital is built on appropriate site only based on existing regulation	3.67	7
	<b>Average mean score=</b>	<b>4.054</b>	

**Source:** Primary data

The above table shows **the level of green building in hospitals as a part of environment protection strategies**. The researcher has used means score and ranking to identify the Level of waste management system in hospitals as a part of environment protection strategies. The statement “Hospital does not have potential liability resulting from indoor air quality problems ” has scored first rank [Mean score = 4.36].The second Rank is scored by “Our hospital adopts environmentally responsible design for the buildings ” [Mean score = 4.28].The statement “The layout of the hospital is resource efficient ” has scored third rank [Mean score = 4.21].The statement “Green aspects is visible in every aspect of Hospital architecture and construction ” has ranked fourth.[Mean score = 4.04].The fifth rank scored by “The hospital has improved indoor environment quality ” [Mean score = 3.98]. The sixth rank scored by “The hospital interiors are done with green materials that reduces allergy and other illness” [Mean

score = 3.84] and least rank scored by “The hospital is built on appropriate site only based on existing regulation” [Mean score = 3.67].

## CONCLUSION

To conclude, the present study has revealed that the practice of biomedical waste management of the two municipal corporations is adequate and still requires to be to desired full extent. Every doctor, nursing staff and laboratory technicians must know all aspects of bio medical waste that will affect their attitude and practice. Particularly the laboratory technicians must be forced to undergo training and motivation to do away with the Bio Medical Wastes generated from their labs. There is a need to improve the awareness levels as well as practice of biomedical waste management appropriately for which necessary training and follow up are required. Awareness generation drives should be there. There should be Continuing Medical Education on this practical aspect irrespective of their subject of the doctor serving in any category of healthcare institution. Proper training and practices should be given to the doctors, para medical staffs, nurses, technicians, sweepers regarding the proper waste management on behalf of the municipal authorities, Pollution Control Boards and the Health Department of the Government. On the event of any Amendment of Handling Rules, Regulations, it is to be circulated and particularly stressed in training programmes.

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