CHAPTER IX

STATUS OF THE BIO-MEDICAL WASTE DISPOSAL SCENARIO IN SILIGURI TOWN: AN EMPIRICAL STUDY

The present study relating to Bio-Medical Waste disposal requires an empirical study in the Siliguri Town to corroborate and substantiate the doctrinal findings at the national level. In order to do so a locational and demographic understanding of Siliguri is essential. Hence the following sketch upon Siliguri.

9.1 Geographical location of Siliguri Town

Known as the gateway of the North East India and is situated 392 feet above mean sea level in the foothills of the Himalayas on the banks of the river Mahananda, the Siliguri Sub-division is one of the Sub-divisions of Darjeeling that has a Corporation, the Siliguri Municipal Corporation. Its geographical location is at 26.71°N and 88.43°E. It is a unique city consisted of total forty-seven wards under the Corporation. It has four community development blocks, namely, Matigara, Naxalbari, Phansidewa and Khoribari. It also occupies an extremely important position for Sikkim, Darjeeling, Kurseong and Kalimpong. Sharing the international borders with Bangladesh, Nepal and Bhutan it has a great potential in respect of trade, commerce and many more. It is one of the most rapidly developing metropolises of the State. Situated in Darjeeling district, it is the District's largest city and the third big city in the State after Kolkata and Asansol.

9.2 Population of Siliguri

As per provisional reports of Census India, population of Siliguri in 2011 is 513,264 and it was 472,374 according to the 2001 Census; of which male and female are 263,702 and 249,562 respectively. Although Siliguri city has population of 513,264; its urban/metropolitan population is 705,579 of which 362,523 are males and 343,056 are females[1]. The population accounted for 0.56% of the total State's population which includes the population from the wards falling under the Jalpaiguri District because Siliguri Municipal Corporation consisted of the wards falling under Jalpaiguri District also. The population of the Sub-Division which falls in the

[1] *Available at:* http://www.census2011.co.in/census/city/192-siliguri.html, (Last visited on July 5, *2017).*

Darjeeling district, accounts for 15.93% of the total Darjeeling population and SMC population which falls in the Jalpaiguri district accounts for 5.53% of total population of Jalpaiguri.[2]

Table 1

Existing scenario of Population, Literacy and Sex ratio rate of Siliguri Metropolitan Area[3]

Siliguri Metropolitan	**Total**	**Male**	**Female**
Population	7,05,579	3,62,523	3,43,056
Literates	5,16,056	2,78,867	2,37,189
Children (0-6)	77,475	39,982	37,493
Average Literacy (%)	82.16%	86.46%	77.62%
Sex Ratio	946		
Child Sex Ratio	938		

9.3 Health Care Institutions in Siliguri Town

With the increasing number of populations, the need arises for the health care service sectors to provide health care to the patients as a result of which there has been a tremendous growth of the health care institutions throughout the country. The scenario of the Siliguri city is not different from other parts of the country which can be seen from the following data.

In Siliguri healthcare services are provided by both Government as well as private health care institutions. As per the final report published by the Government of India, Ministry of Urban Development in the year 2015 as part of the City Development Plan

[2] *Ibid*.
[3] *Ibid.*

for Siliguri-2041[4], the city has four major Government hospitals, *viz*., the Siliguri District Hospital (SDH), TB Hospital, NJP Railway Hospital, North Bengal Medical College & Hospital and one veterinary hospital. In addition to this, the city has thirty three (33) nursing homes, and 50-60 pathology[5]. But according to the health care inventory published by the West Bengal Pollution Control Board in the year 2005 there were total ninety nine (99) health care institutions for the entire District of Darjeeling out of which forty four (44) is run by the West Bengal government and fifty five (55) is private consisted of total 4762 beds.

The above data present a clear picture of increasing number of the health care institutions within a gap of ten years. Out of the total fifty five nursing homes in the District of Darjeeling, Siliguri itself has thirty three nursing homes and remaining twenty two are in other Sub-Divisions.

Table 2

Number of the Health Care Institutions in and around Siliguri Town

Nature of Health care institutions	**Total Number of Health care institutions**	**Total Number of beds**
Government	4	1009[6]
Private	33	1318[7]
Public Private Partnership (PPP)	Nil	Nil

[4] Government of India, Ministry of Urban Development, City Development Plan for Siliguri-2041 (Final Report), A Joint Partnership Programme between Ministry of Urban Development, Government of India and the World Bank, (April, 2015) *Available at*: siligurismc.in/userfiles/file/siliguri-CDP-final-report-29April15.pdf (Last visited on July 7, 2017).
[5] *Ibid.*
[6] In NBMC&H-589 *Available at*: https://www.wbhealth.gov.in/other_files/Hospitals.pdf, Siliguri Sub-Divisional Hospital-320 *Available at*: https://www.wbhealth.gov.in/uploaded_files/go/ms_209.pdf, NJP Railway Hospital-100 *Available at*: http://www.indianrailways.gov.in/railwayboard/uploads/directorate/health/health_1.jsp
[7] Based on Bio-Medical Waste Inventory published by the West Bengal Pollution Control Board (2010), also information received from different health care institutions in Siliguri *Available at*: http://web.wbpcb.gov.in/html/downloads/report_BioMedicalWaste.pdf (Last visited on Aug. 2, 2017).

The benefit of the growing number of health care institutions is that the patients from the city Siliguri and the surrounding cities, States and the countries can avail the advanced health care services within their reach and with less expense without going other places. It has other side also. Apart from providing health care services, it is generating bulk quantity of the Bio-Medical Waste which is required to be disposed off in accordance with the Bio-Medical Waste Management Rules, 2016. The problem of treatment and disposal of Bio-Medical Waste is an extremely important issue because improper disposal of the same would have far reaching impact on the health as well as on the environment. The question therefore arises whether the proper disposal of such wastes is made in accordance with the Rules or the disposal of the same is made in gross violation of it. It is important to note that the improper disposal of the Bio-Medical Waste leads to various infectious diseases in particular and the environment pollution in general in the surrounding areas. With a view to understand the existing Bio-Medical Waste disposal scenario prevailing in the various health care institutions in the city, the researcher has undertaken an empirical survey under this chapter to highlight on the current disposal scenario of Bio-Medical Waste in the city.

9.4 The Study Area/Universe

The universe under the study is a finite universe containing four (4) Government health care institutions and thirty three (33) private health care institutions. The population being a finite population and yet of different characterisations, the same is divided under the following category:

a. Government Hospitals and
b. Private health care institutions:
    i. Private Hospitals and
    ii. Nursing Homes.

In the above segregation the researcher had studied all the four Government hospitals. This is important because being a part and parcel of the Government, it is their fundamental duty to abide by the laws and policies laid down by the Government itself. Hence, the researcher has studied the method of waste disposal in the Government hospitals.

Of the second category i.e. private health care institutions, there are the following private hospitals within the precincts of Siliguri in the above identified geographical area. They are:

1. Anandaloke Multi Speciality Hospital;
2. Siliguri Greater Lions Eye Hospital;
3. Sai Hospital and
4. Heritage Hospital.

The researcher studied all the four private health care institutions and has compared the process of Bio-Medical Waste disposal in the Government and private health care institutions in the category of hospitals.

In addition to the above, the researcher has also studied the nursing homes. The residue number being twenty eight (28), the researcher has done random sampling of the twenty eight (28) health care institutions picking every fourth health care institutions. At the beginning, the health care institutions were randomly numbered between one to twenty nine and by picking the fourth institutions, the following health care institutions were selected:

1. Nivedita Nursing Home & Poly Clinic;
2. Dr. Mahpal's Nursing Home Pvt. Ltd.;
3. North Bengal Neuro Center;
4. Mitra's Polyclinic;
5. Siliguri Nursing Home;
6. Arogya Niketan; and
7. Neotia Getwell.

9.5 Methodology adopted for the Collection of Data

Collection of the data is an important aspect for any empirical research. The researcher had collected data from various health care personnel engaged in the whole process of management of the Bio-Medical Waste including its disposal on the basis of which analysis would be made to derive some effectively collected database.

The methodology adopted for collecting data was questionnaire method and interview method. The question was open ended question that is annexed as annexure to the present thesis. The interview was taken verbally and the result was manually written down.

The health care personnel that were interviewed were administrative officers, doctors, nurses, house-keepers, sweepers and laboratory technicians. The administrative officers were interviewed because they are involved in the implementation and the execution of the Bio-Medical Waste disposal policy that is adopted by the health care institutions. The doctors (mostly surgeons) were interviewed because the post-operative waste disposal procedure is followed by them. The nurses are important in the waste disposal chain as post-surgical waste disposal and waste disposal at other stages are handled by them. The house-keepers are general supervisors to ensure ground level execution of proceedings. The sweepers do the actual disposal and laboratory technicians were interview to understand the Bio-Medical Waste emanating from the path lab. In addition to the above, the researcher has observed the segregation of the waste and its respective disposal.

Questionnaire survey was conducted in order to build a requisite database on various aspects of waste management, its treatment and disposal methods, awareness among the target groups, recycling of waste, etc. which in turn became a storehouse of information. A total of thirty (30) questions were set in the questionnaire part with a view to obtain detail information about the Bio-Medical Waste disposal practices followed in various health care institutions in Siliguri. The questionnaire was divided into three parts:

1. The first part consisted of ten questions relating to the knowledge of Bio-Medical Waste Management Rules, type/category of waste, its nature and the various processes for its management as per the Rules ;
2. In the second part, it contained twelve questions involving level of awareness such as segregation as per colour coding, autoclaving, disposal of used needles etc.;
3. The last part consisted of total eight questions that focus on the method of disposal of the Bio-Medical Waste. The various disposal methods such as sterilisation, shredding, autoclaving etc. had included among others in this part of question.

Data was obtained from the documents available in the various health care institutions. Selected health care institutions were visited frequently with a view to check available documents on Bio-Medical Waste management and disposal. It includes maintenance of Bio-Medical Waste Register, receipt submitted by the

Greenzen Bio Pvt. Ltd., a private concern, engaged in the final disposal, to each health care institution based on per day collection of different types of Bio-Medical Waste alongwith its quantity. The purpose of the verification of the on-record data with a view to cross check it with the data collected during survey in order find out the difference between the two. This would help in highlighting on the correct existing scenario on the Bio-Medical Waste management and disposal.

Apart from the visits in various hospitals, nursing homes etc., the researcher had also visited to the Fulbari site, within the District of Jalpaiguri where disposal of particular category of Bio-Medical Waste is being made through incineration, autoclaving, shredding etc. by the said Greenzen Bio Pvt. Ltd. Such visit was made with a view to provide an insight to the current disposal and treatment practices followed in Siliguri and to reach to a findings as to whether the disposal is made in accordance with the existing Bio-Medical Waste Rules, 2016 or not. This is most efficient way of gathering information and a way of filling the gap between paper work and practical work.

9.6 Limitations

The following are the limitations/obstructions that put hindrances while conducting the survey in the arena of Bio-Medical Waste disposal within the Siliguri town:

1. **Difficulty in obtaining permission**- It was not easy to obtain permission from the authority of the health care institutions. Apart from visiting the health care institutions, permission was sought through e-mail and the outcome was that it was either denied or permission was granted restricting the time. Sometimes the survey in some health care institution was restricted only to a particular unit or department. The researcher has been researching for five years but not able to get permissions from the authorities. It took lot of persuasion on the part of the researcher to obtain permissions.
2. **Non-co-operative attitude**-In some health care institutions the authority was reluctant in providing the actual information on the exact quantity of the Bio-medical Waste generates and was sent to disposed off. Despite due

permission, the person in charge of maintenance of the Register had denied to produce such documents.

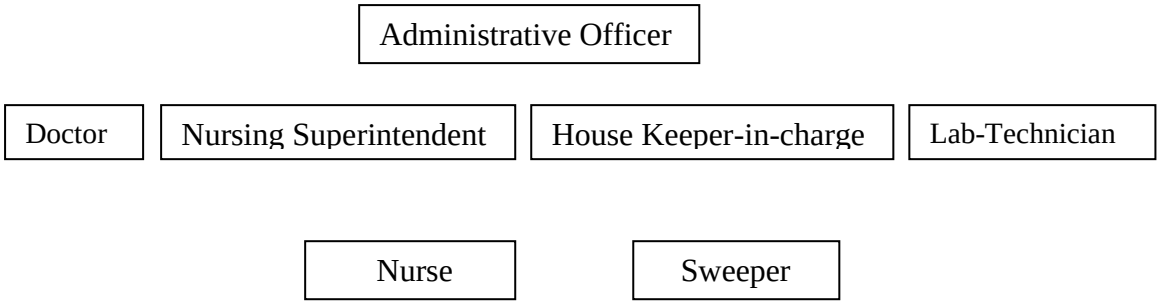
3. **Illiteracy**-Another problem was faced while interviewing the sweepers as they were unable to respond to the written set of questionnaire due to their illiteracy.

9.7 The Respondents

A total of one hundred and forty two (142) health care personnel have been interviewed from fifteen (15) hospitals, four each from Government and private hospitals and seven nursing homes located in Siliguri engaged in different occupations as mentioned above. They are the main study population to whom a set of questions was given or interviewed for the purpose of collection of the data. Based on their respective occupation they can be place in the following hierarchy:

Table 3

Hierarchical structure of health care personnel engaged in the disposal of Bio-Medical Waste



The hierarchical position of different personnel in the health care institutions is worth mentioning. The selection was made taking into account the involvement of each personnel in the process of disposal of the Bio-Medical Waste. They can be divided into two groups, those who are directly involved and the rests are connected indirectly. The first group consisted of nurses, sweepers etc. and the other group includes personnel like administrative officer, house keeper, lab-technician, doctor etc. It is the duty of the house keeper, administrative officers etc. to ensure the proper disposal of the Bio-Medical Waste as per the Medical Waste Management Rules, 2016.

The number of respondents from different Government and private hospitals and Nursing homes who were questioned and interviewed has been referred in the table below:

Table 4

Status of the total number of health care personnel questioned and interviewed

Total number of respon-dent	**Category of respondent**	**Govt. Hospital (Total-4)**	**Private Hospital (Total-4)**	**Nursing Home (Total-7)**	**Total in each categor-y**	**% of responde nt in each category**
142	Admin. Officer	2	4	6	**12**	12 (8%)
	Doctor	7	2	7	**16**	16 (11%)
	House-keeper	0	4	5	**09**	09 (6%)
	Lab-Technician	1	2	5	**08**	08 (6%)
	Nurse	23	14	28	**65**	65 (46%)
	Sweeper	14	6	12	**32**	32 (23%)
Grand Total					**142**	142 (100%)

In the present research survey out of the total thirty seven (37) Government and private hospitals and nursing homes located in Siliguri all the four (4) Government hospitals, four (4) private hospitals and seven (7) nursing homes have been studied by the researcher being the study population covering fifteen (15) health care institutions.

Among the total respondents, the above table shows that nurses constitute the highest percentage (46%) whereas house-keepers and lab-technicians constitute the lowest (6%) percentage. A good percentage (23%) of the sweepers has also been questioned because they are mainly involved in the disposal of the Bio-Medical Waste.

9.8 Assessment of the Bio-Medical Waste disposal scenario in Siliguri Town in the light of knowledge, awareness, attitude and practices followed by the respondents

The study was aimed at to assess the present disposal scenario of the Bio-Medical Waste prevailing in the various health care institutions in the city Siliguri. To achieve the goal, the researcher had prepared some thirty (30) open ended questions touching different aspects (referred in the annexure of the thesis) relating to the Bio-Medical Waste management and its disposal. All the questions were brought under three specific heads (as mentioned above) which form the data for the study by analysing of which the researcher would be in a position to highlight about the practical scenario of the Bio-Medical Waste disposal prevailing in Siliguri town.

9.8.1 Knowledge relating to the existing Rules, nature and type of Bio-Medical Waste, segregation, storage, colour bag, treatment and disposal

Detail and appropriate knowledge about the various aspects for the management of the Bio-Medical Waste in accordance with the existing Bio-Medical Waste Management Rules, 2016, is the first and foremost criteria for its proper disposal. In the absence of in-depth knowledge about the Rules consisting of the various segments for the proper management, from segregation to final disposal-a chain in the management of Bio-Medical Waste, would ultimately affect the final disposal. Therefore, considering the importance of management chain, the researcher had studied various aspects falling within the chain to know the existence of knowledge among the health care personnel engaged in the Government and private hospitals and nursing homes and the same have been referred below in the table:

9.8.1.1 Existing scenario of the Bio-Medical Waste management and disposal in the Government Hospitals

Table 5.1

Knowledge among the health care personnel regarding the management of Bio-Medical Waste

Knowledge Parameter	Administrat-ive Officer (%)	Doctor (%)	Nurse (%)	House Keeper-incharg-e (%)	Sweeper (%)	Lab-Technician (%)
Knowledge about Bio-Medical Waste Rules (Old & New)	02 (100%) (old)/ 02 (100%) (new)	07 (100%) (old)/ 07 (100%) (new)	23 (78%) (old)/ 23 (26%) (new)	00 (00%) (old)/ 00 (00%) (new)	14 (14%) (old)/ 14 (0 %) (new)	01 (100%) (old)/ 01 (100%) (new)
Knowledge about the nature of BMW	02 (100%)	07 (100%)	23 (87%)	00 (00%)	14 (31%)	01 (100%)
Knowledge about the types/categ-ories of BMW	02 (100%)	07 (100%)	23 (74%)	00 (00%)	14 (57%)	01 (100%)
Knowledge about the segregatio-n	02 (100%)	07 (100%)	23 (87%)	00 (00%)	14 (43%)	01 (100%)
Knowledge about the storage	02 (100%)	07 (100%)	23 (69%)	00 (00%)	14 (64%)	01 (100%)
Knowledge about the colour bag	02 (100%)	07 (100%)	23 (72%)	00 (00%)	14 (36%)	01 (100%)
Knowledge about the treatment	02 (100%)	07 (100%)	23 (71%)	00 (00%)	14 (29%)	01 (100%)

9.8.1.2 Situational analysis in the Government hospitals

Based on the above table the knowledge about the various management processes along with the knowledge of the existing Bio-Medical Waste Rules can be summarised as follows:

1. On the question about the existence of the Bio-Medical Waste (Handling & Management) Rules, 1998 (old) the table shows that among others the administrative officers, doctors and laboratory technician have 100% knowledge. On the other hand, on the same question, the knowledge among the sweeper is very poor constituting only 14% and that of the nurses is quite satisfactory being 78% of the total nurses.
2. Regarding the knowledge about the nature, segregation, storage, colour coding and treatment of the Bio-Medical Waste, the table shows 100% result among the administrative officers, doctors and laboratory technician. Among the nurses it is more than 70% on an average. On the other hand, the sweeper has poor knowledge on different procedures for the management of the Bio-Medical Waste. 57% of them know about the types categories of the waste which is 64% for the storage. For others, it is below 40%.
3. Regarding different type/category of Bio-Medical Waste, 74% of the nurses have knowledge whereas on the question of storage it is 69%. 72% of the nurse knows about the colour bag and about segregation 87% of the nurse has knowledge.

9.8.1.3 Existing scenario of the Bio-Medical Waste management and disposal in the Private Hospitals

Table 5.2

Knowledge among the health care personnel regarding the management of Bio-Medical Waste

Knowledge Parameter	Administrat-ive Officer (%)	Doctor (%)	Nurse (%)	House Keeper-incharg-e (%)	Sweeper (%)	Lab-Technician (%)
Knowledge about Bio-Medical Waste	04 (100%) (old)/ 04 (100%)	02 (100%) (old)/ 02	14 (93%) (old)/ 14	04 (100%) (old)/ 04	06 (33%) (old)/ 06	02 (100%) (old)/ 02

Rules (Old & New)	(new)	(100%) (new)	(36%) (new)	(100%) (new)	(00 %) (new)	(50%) (new)
Knowledge about the nature of BMW	04 (100%)	02 (100%)	14 (79%)	04 (100%)	06 (66%)	02 (100%)
Knowledge about the types/categ-ories of BMW	04 (100%)	02 (100%)	14 (86%)	04 (100%)	06 (50%)	02 (100%)
Knowledge about the segregatio-n	04 (100%)	02 (100%)	14 (86%)	04 (100%)	06 (33%)	02 (100%)
Knowledge about the storage	04 (100%)	02 (100%)	14 (93%)	04 (100%)	06 (83%)	02 (100%)
Knowledge about the colour bag	04 (100%)	02 (100%)	14 (79%)	04 (100%)	06 (50%)	02 (100%)
Knowledge about the treatment	04 (100%)	02 (100%)	14 (93%)	04 (100%)	06 (29%)	02 (100%)

9.8.1.4 Situational analysis in the Private Hospitals

It is also important to study the existence of knowledge among the health care personnel engaged in the private hospitals as per the Bio-Medical Waste Rules. From the above table the researcher has extracted the following conclusion:

1. The knowledge about the existence of the old Rules, 1998 among the administrative officers, doctors, house-keepers and laboratory technicians is 100 %. The same is adequate among the nurses which is 93% but only 33% sweepers know about the Rules. Regarding the new Bio-Medical Waste Rules the knowledge of the nurses is not satisfactory whereas the sweepers do not have any knowledge about the new Rules.

2. 100% of the health care personnel engaged in the field of administration, house-keeping, as laboratory technician and in the profession of doctor have

the knowledge regarding the nature, category, segregation etc. of the Bio-Medical Waste. Regarding the same the nurses have adequate knowledge.

3. The sweepers, who are mainly engaged in the disposal part, do not bear satisfactory knowledge regarding the segregation and treatment as the table shows that it is 33% and 29% respectively. Half the sweepers have knowledge about the colour bags/bins which is required for the proper segregation.

4. Regarding knowledge about the storage, 83% of the sweepers responded which is 93% among the nurses.

9.8.1.5 Existing scenario of the Bio-Medical Waste management and disposal in the Nursing Homes

Table 5.3

Knowledge among the health care personnel regarding the management of Bio-Medical Waste

Knowledge Parameter	**Administrat-ive Officer (%)**	**Doctor (%)**	**Nurse (%)**	**House Keeper-incharg-e (%)**	**Sweeper (%)**	**Lab-Technician (%)**
Knowledge about Bio-Medical Waste Rules (Old & New)	06 (100%) (old)/ 06 (100%) (new)	07 (100%) (old)/ 07 (100%) (new)	28 (93%) (old)/ 28 (36%) (new)	05 (100%) (old)/ 05 (80%) (new)	12 (33%) (old)/ 12 (00%) (new)	05 (100%) (old)/ 05 (80%) (new)
Knowledge about the nature of BMW	06 (100%)	07 (100%)	28 (96%)	05 (100%)	12 (67%)	05 (100%)
Knowledge about the types/categ-ories of BMW	06 (100%)	07 (100%)	28 (89%)	05 (100%)	12 (50%)	05 (100%)
Knowledge about the segregatio-n	06 (100%)	07 (100%)	28 (89%)	05 (100%)	12 (67%)	05 (80%)

Knowledge about the storage	06 (100%)	07 (100%)	28 (86%)	05 (100%)	12 (92%)	05 (100%)
Knowledge about the colour bag	06 (100%)	07 (100%)	28 (82%)	05 (100%)	12 (58%)	05 (100%)
Knowledge about the treatment	06 (100%)	07 (100%)	28 (96%)	05 (100%)	12 (75%)	05 (100%)

9.8.1.6 Situational analysis in the Nursing Homes

The scenario about the knowledge on various aspects of the Bio-Medical Waste in the nursing homes in Siliguri can be understood by highlighting on the following points:

1. The present scenario in the various nursing homes in Siliguri town under the study regarding the knowledge on Bio-Medical Waste Rules (old), the nature, type and other processes among the administrative officers, doctors, house-keepers etc. is 100%. The nurses and sweepers have also adequate knowledge regarding the same.

2. The knowledge about the new Rules is not adequate among the nurses and the sweepers. Only 36% of the nurses have the knowledge about the new Rules but none of the sweepers have knowledge about it.

3. 50% of the sweepers know about the different types of the Bio-Medical Waste. Whereas 58% of them know about the colour bag where primary disposal of the Bio-Medical Waste is to be made.

4. Only 67% of the sweepers have the knowledge about the segregation of the waste which constitutes 89% among the nurses. The sweepers have adequate knowledge of storage of the Bio-Medical Waste.

9.9 A comparative study

A comparative analysis of the above data from three categories of health care institutions i.e. Government hospitals, private hospitals and nursing homes is necessary to present a clear picture about the situation prevailing in these health care institutions and accordingly it would be possible for the researcher to highlight on the

important issues to improve the situation. The data shows that in all the health care institutions whether Government or private the management authorities including the doctors have a detail knowledge regarding the existence of the Bio-Medical Waste Rules, both old and new. The picture is different among the other personnel such as nurses and sweepers. It is unfortunate that in all the three health care institutions the knowledge about the new Rules among the nurses is not satisfactory. It is also important that nurses should have adequate knowledge in the management and disposal of the waste which according to the data is satisfactory but the percentage of satisfaction is variable in different health care institutions. It is clear from the above data that the sweepers, in the whole study populations do not have adequate knowledge except the knowledge about the nature of the Bio-Medical Waste and its storage. The situation is far better in nursing homes and private hospitals compare to the Government hospitals.

9.10 Awareness regarding training, storage timings, segregation as per colour coding, autoclaving, disposal of used needle etc.

It is clear from the above discussions that for understanding the disposal aspect of the Bio-Medical Waste knowledge play an important role because without adequate knowledge every step in the process of disposal would be futile. Apart from the knowledge, the awareness among the health care personnel is also an important factor which if ignored might affect the whole disposal scenario. The awareness among these personnel would obviously help in the proper disposal of the Bio-Medical Waste. For example, if the health care personnel have training it would raise their awareness in the proper handling of it which in turn would help in the disposing off the waste as per the Rules. Likewise, awareness in segregation as per the Rules would reduce the chances of improper disposal. If there is improper segregation, the disposal of some category of Bio-Medical Waste would not be made in accordance with the Bio-Medical Waste Rules. Similarly, awareness regarding autoclaving, sterilising, disinfectant etc. which are the pre-disposal method should exist otherwise the proper disposal method would not be possible. Therefore, taking into consideration the aspect of awareness as an important step towards the disposal of Bio-Medical Waste, the researcher had studied the in various Government hospitals,

private hospitals and nursing homes in Siliguri Town. The table referred below highlights on this aspect:

9.10.1 The scenario in the Government Hospitals

Table 6.1

Percentage of level of awareness among the health care personnel regarding the management prior to disposal of Bio-Medical Waste

Awareness Parameter	Administr-tive Officer	Doctor	Nurse	Housekeeper-in-Charge	Sweeper	Lab.Tech-nician
Awareness on maxim-um storage time	02 (100%)	07 (86%)	23 (57%)	00 (00%)	14 (29%)	01 (100%)
Awareness about category wise segregation	02 (100%)	07 (100%)	23 (48%)	00 (00%)	14 (21%)	01 (100%)
Awareness about use of Disinfect Chemical	02 (100%)	07 (100%)	23 (74%)	00 (00%)	14 (36%)	01 (100%)
Awareness regarding training	02 (100%)	07 (100%)	23 (39%)	00 (00%)	14 (14%)	01 (100%)
Awareness about autoclaving	02 (100%)	07 (100%)	23 (74%)	00 (00%)	14 (29%)	01 (100%)

9.10.1.1 Situational analysis in the Government Hospitals

From the above data the following conclusion can be drawn on the question based on awareness relating to the disposal of the Bio-Medical Waste.

1. The health care personnel who are in the superior position in the hierarchy such as administrative officer, doctor, laboratory technician etc. are 100% aware on matters relating to the disinfectants, category wise segregation, autoclaving etc. But the same is not satisfactory among the sweepers ranging from 14% to 29%. On the other hand, the position of the nurses on the questions of awareness is adequate except the awareness regarding training.

Only 39% of the nurse is aware about the training which is an important aspect for the proper disposal of the Bio-Medical Waste.

2. On the question relating to awareness about category wise segregation the response among the sweeper is very poor. Only 21% of the sweepers are aware which indicates that in the Government hospitals the disposal of the Bio-Medical Waste is not proper. Similarly, the awareness regarding training and autoclaving is also poor which is 14% and 29% respectively.
3. The position of the nurses on the same question although not similar to that of the sweeper but at the same time it is not adequate. Regarding training only 39% of the nurse is aware and 48% among them are aware about the category wise segregation. Regarding autoclaving, 74% among them are aware which is satisfactory.

9.10.2 The scenario in the Private Hospitals

Table 6.2

Percentage of level of awareness among the health care personnel regarding the management and disposal of Bio-Medical Waste

Awareness Parameter	Administr-tive Officer	Doctor	Nurse	Housekeeper-in-Charge	Sweeper	LabTech-nician
Awareness on maxim-um storage time	04 (100%)	02 (100%)	14 (65%)	04 (100%)	06 (33%)	02 (100%)
Awareness about category wise segregation	04 (100%)	02 (100%)	14 (71%)	04 (75%)	06 (17%)	02 (100%)
Awareness about use of Disinfect Chemical	04 (100%)	02 (100%)	14 (71%)	04 (100%)	06 (33%)	02 (100%)
Awareness regarding training	04 (100%)	02 (100%)	14 (71%)	04 (100%)	06 (50%)	02 (100%)
Awareness about autoclaving	04 (100%)	02 (50%)	14 (79%)	04 (100%)	06 (50%)	02 (100%)

9.10.2.1 Situational analysis in the Private Hospitals

The present scenario in the private hospital has been given below:

1. 100% of the administrative officer, doctor and laboratory technician are aware of the Bio-Medical Waste disposal related questions as referred in the above table.
2. The awareness among the nurses is adequate on the questions relating to training, autoclaving, chemical disinfectant etc. ranging from 65% to 79% whereas the same varies among the sweepers. For example, only 17% of them are aware about the category wise segregation.
3. The nurses are aware on the question of autoclaving which is 79%. In private hospital 71% of the nurses is aware about the disinfectant and training which is satisfactory.

9.10.3 The scenario in the Nursing Homes

Table 6.3

Percentage of level of awareness among the health care personnel regarding the management and disposal of Bio-Medical Waste

Awareness Parameter	Administr-tive Officer	Doctor	Nurse	Housekeeper-in-Charge	Sweeper	Lab. Technici-an
Awareness on maxim-um storage time	06 (100%)	07 (100%)	28 (79%)	05 (100%)	12 (42%)	05 (100%)
Awareness about category wise segregation	06 (100%)	07 (100%)	28 (64%)	05 (00%)	12 (25%)	05 (100%)
Awareness about use of Disinfect Chemical	06 (100%)	07 (100%)	28 (75%)	05 (100%)	12 (35%)	05 (100%)
Awareness regarding training	06 (100%)	07 (100%)	28 (79%)	05 (100%)	12 (50%)	05 (100%)

Awareness about autoclaving	06 (100%)	07 (50%)	28 (75%)	05 (100%)	12 (50%)	05 (00%)

9.10.3.1 Situational analysis in the Nursing Homes

1. It can be said from the above table that the awareness among the administrative officer, doctors and housekeepers is 100% whereas it is adequate among nurses but poor among the sweepers.
2. Although awareness regarding segregation as per colour code is adequate among most of the health care provider but the sweepers have poor knowledge regarding the same which is only 25%. On the same question 64% nurses is aware which is also not satisfactory.
3. Regarding awareness about the autoclave, among the various health care providers, the nurses and sweepers are 75% and 50% aware.
4. The use of disinfected chemical solution for some Bio-Medical waste is adequate among the health care personnel except the sweepers which constitute only 35%.

9.11 A comparative study

The above data from all the three categories of the health care institutions shows that the superior authorities have total awareness about various important issues relating to the management and disposal of the Bio-Medical Waste. This is significant from the point of view that without being aware in the proper disposal by these authorities, the effective implementation of the disposal procedure in accordance with the existing Rules would not be possible. It is also expected that they will take all steps to make it successful. However, if we look to the data of the nurses and sweepers, it is clear that although the superior authorities are aware but the same is not effectively applied and this is the reason that there is lack of awareness among the nurses and sweepers especially among the sweepers. It is important to note that without being aware by the sweepers, the whole disposal of the Bio-Medical Waste would jeopardise. A comparative study of the above data also present the scenario that in the private hospitals and nursing homes the existing situation is better than what is

prevailing in the Government hospitals. Therefore, there is an urgent need to improve the situation so that the present scenario in the Government hospitals could be changed. Moreover, there is also a need to improve the situation in the private hospitals and nursing homes so that it would be possible to make successful disposal of the Bio-Medical Waste.

9.12 Disposal of Bio-Medical Waste in the Government and private hospitals and in the nursing homes

The very purpose of the Bio-Medical Waste Management Rules, 2016 is to curve the menace of pollution arising from the Bio-Medical Waste. The inclusion of different provisions is with a view to root out the problem in its entirety with finally disposing of it as per the Rules. The health care institutions are duty bound to follow the Rules for the proper and effective management and disposal of the waste. Out of all the processes, it is the disposal part which is considered as the most crucial because improper disposal of the waste would not only increase the pollution in the environment, it would also give rise to various other problems including some dreadful diseases. Therefore, all the health care institutions must incorporate in its policy, the steps required to be followed for the proper disposal of the Bio-Medical Waste. With a view to know the existing scenario of disposal in Government, private hospitals and in the nursing homes in Siliguri town, the researcher had given set of questions to the health care personnel to highlight on this issue. The following tables would help in understanding the disposal scenario in the health care institutions in Siliguri town.

9.12.1 Knowledge about the disposal scenario in the Government Hospitals

Table 7.1

Knowledge among the health care personnel relating to the method of disposal (pre and post) of Bio-Medical Waste

Knowledge on disposal of BMW	Admini-strative Officer (%)	Doctor (%)	Nurse (%)	House keepe-r-in-Charge (%)	Sweeper (%)	Lab.Tec-hnician (%)
Sterilisation	02 (100%)	07 (100%)	23 (91%)	00 (00%)	14 (29%)	01 (100%)
Shredding	02 (100%)	07 (100%)	23 (43%)	00 (00%)	14 (14%)	01 (100%)

Autoclaving	02 (100%)	07 (100%)	23 (83%)	00 (00%)	14 (43%)	01 (100%)
Microwaving	02 (100%)	07 (50%)	23 (35%)	00 (00%)	14 (14%)	01 (00%)
Common Bio-Medical Waste Treatment/In-cineration	02 (100%)	07 (100%)	23 (91%)	00 (00%)	14 (86%)	01 (100%)
Deep Burial	02 (100%)	07 (71%)	23 (09%)	00 (00%)	14 (21%)	01 (00%)
Effluent treatment plant	02 (100%)	07 (43%)	23 (00%)	00 (00%)	14 (00%)	01 (00%)

9.12.1.1 Situational analysis in the Government Hospitals

The following are the result of knowledge about the Bio-Medical Waste disposal scenario in the health care institutions in Siliguri:

1. In the Government hospitals, the administrative officers, who hold superior position in the hierarchy have 100% knowledge about the various disposal and its methods. But the doctors do not have 100% knowledge in microwaving, deep burial and effluent treatment system. The laboratory technician also falls in this category but regarding microwaving, deep burial and effluent treatment it is nil.
2. From the above data it is clear that a good percentage (91%) of nurses has knowledge in sterilisation. The same is very poor among the sweepers which are only 29%. Regarding shredding and microwaving the result is dissatisfactory to both categories of the health care personnel.
3. Almost all categories of the health care personnel have the knowledge about the common bio-medical waste treatment facilities.
4. Regarding deep burial and effluent treatment the knowledge among the health care personnel is very poor except the administrative officers. The doctors have poor knowledge (43%) regarding the same. Only 21% of the sweepers have knowledge about the deep burial and it is 00% in connection with the effluent treatment plant.

9.12.2 Knowledge about the disposal scenario in the Private Hospitals

Table 7.2

Knowledge among the health care personnel relating to the method of disposal (pre and post) of Bio-Medical Waste

Knowledge on disposal of BMW	Admini-strative Officer (%)	Doctor (%)	Nurse (%)	Housekeepe-r-in-Charge (%)	Sweeper (%)	Lab.Tec-hnician (%)
Sterilisation	04 (100%)	02 (100%)	14 (86%)	04 (100%)	06 (50%)	02 (100%)
Shredding	04 (100%)	02 (100%)	14 (36%)	04 (100%)	06 (17%)	02 (100%)
Autoclaving	04 (100%)	02 (100%)	14 (86%)	04 (100%)	06 (67%)	02 (100%)
Microwaving	04 (100%)	02 (100%)	14 (36%)	04 (100%)	06 (33%)	02 (50%)
Common Bio-Medical Waste Treatment/In-cineration	04 (100%)	02 (100%)	14 (93%)	04 (100%)	06 (83%)	02 (100%)
Deep Burial	04 (100%)	02 (50%)	14 (14%)	04 (50%)	06 (07%)	02 (100%)
Effluent treatment plant	04 (100%)	02 (50%)	14 (00%)	04 (100%)	06 (00%)	02 (00%)

9.12.2.1 Situational analysis in the Private Hospitals

In order to understand the situation prevailing in the private hospitals in Siliguri town about the knowledge on the disposal aspect, the below referred information would help**:**

1. In the private hospitals in Siliguri the methods of disposal of the Bio-Medical Waste among the administrative authorities, doctors regarding sterilisation, autoclaving, microwaving, shredding and the common bio-medical waste treatment or incineration is well known except deep burial and effluent treatment which is 50% among the doctors.
2. The position among the nurses is more or less satisfactory regarding sterilisation, autoclaving and incineration. But they hold poor knowledge in microwaving, shredding and deep burial. On the other hand, their knowledge in the effluent treatment is nil.

3. Among the sweepers, the knowledge of incineration is quite adequate. Only 50% of them know about the sterilisation. 67% among the sweepers know about the autoclaving. Regarding shredding, microwaving and deep burial they have poor knowledge which is 50%. They do not have any information about effluent treatment.

9.12.3 Knowledge about the disposal scenario in the Nursing Homes

Table 7.3

Knowledge among the health care personnel relating to the method of disposal (pre and post) of Bio-Medical Waste

Knowledge on disposal of BMW	Admini-strative Officer (%)	Doctor (%)	Nurse (%)	Housekeepe-r-in-Charge (%)	Sweeper (%)	Lab.Tec-hnician (%)
Sterilisation	06 (100%)	07 (100%)	28 (86%)	05 (100%)	12 (50%)	05 (100%)
Shredding	06 (100%)	07 (43%)	28 (32%)	05 (100%)	12 (17%)	05 (50%)
Autoclaving	06 (100%)	07 (100%)	28 (86%)	05 (100%)	12 (42%)	05 (80%)
Microwaving	06 (100%)	07 (50%)	28 (32%)	05 (80%)	12 (25%)	05 (50%)
Common Bio-Medical Waste Treatment/In-cineration	06 (100%)	07 (100%)	28 (93%)	05 (100%)	12 (75%)	05 (80%)
Deep Burial	06 (100%)	07 (50%)	28 (07%)	05 (40%)	12 (17%)	05 (60%)
Effluent treat-ment plant	06 (100%)	07 (50%)	28 (00%)	05 (100%)	12 (00%)	05 (20%)

9.12.3.1 Situational analysis in the Nursing Homes

The situational analysis of the above data can be understood under the following manner:

1. All the administrative officers under the study have 100% knowledge about the various methods of disposal of the Bio-Medical Waste. The scenario is not the same among the doctors and laboratory technician. It varies from one method to another. For example, the doctors have 100% knowledge about

some disposal method such as sterilisation, autoclaving and incineration but regarding shredding, deep burial and effluent they have lack of knowledge.

2. Only 40% of the house-keeper-in-charge knows about the deep burial. Regarding other disposal methods the percentage varies between 80% and 100%.
3. The position of nurses in the nursing homes in Siliguri is that they have good knowledge about sterilisation, autoclaving and incineration. On the other hand, the other methods of disposal such as microwaving, deep burial etc., the knowledge is very low.
4. The position of sweepers is no better. Except common bio-medical waste treatment or incineration, their knowledge in other methods of disposal is not satisfactory. The knowledge about sterilisation and autoclaving is better compare to the knowledge regarding other disposal methods which is 50% and 42% respectively.

9.13 A comparative study

From the above situational analysis it is found that in all the three categories of health care institutions in Siliguri most of the health care personnel falling in the category of the top most hierarchy as mentioned above, have quite a satisfactory knowledge on the various methods of the disposal of the Bio-Medical Waste. In all the category wise institutions these personnel possess sufficient knowledge for the proper disposal of the waste. In the contrast, the scenario is not the same with regard to the other category of the health care personnel, hierarchically who are in the lowest rank such as nurses and sweepers. It is interesting to note that the personnel who are actually involved in the disposal aspect suffer from lack of knowledge which would lead to the improper disposal of the same. The situation prevailing in the Government hospitals is much worse compare to the private hospitals and nursing homes. For example, the sweepers have less knowledge about the disposal methods against the sweepers engaged in other category of institutions. Therefore, it can be concluded that the Bio-Medical Waste disposal scenario is different in the Government and private health care institutions. In the private health care institution, the existing scenario is much better compare to the Government hospitals.

9.14 Quantity of Bio-Medical Waste generation and its disposal: Relationship

As it has already pointed out that the Bio-Medical Waste disposal is done by a single agency in Siliguri, namely Greenzen Bio Pvt. Ltd., the researcher was required to verify the capacity of the said agency and after visiting its factory located in Fulbari, within the District of Jalpaiguri it was found that the said agency has the incineration capacity of 15000 kg per day of particular categories of the Bio-Medical Wastes. This is important in the sense that if there is disparity between the quantity of waste generated and the incineration capacity, the whole disposal procedure would fail. The table below presents the existing per day Bio-Medical Waste generation in various health care institutions in Siliguri.

Table 8

Quantity of Bio-Medical Waste generated every day in the Health care institutions in Siliguri town

Category of the Health Care Institutions	Number of Beds in the Health care institutions	Average Per Day Generation of particular category of BMW (from yellow and blue bag)
Government Hospitals	1009	123 kg
Private Hospitals	0274	033 kg
Nursing Homes	1044	126 kg
Total	2327	282 kg

The above data shows that the health care institutions (37) in Siliguri town government as well as private, consisting of two thousand three hundred and twenty seven (2327) beds, generates a total of two hundred and eighty two (282) kg Bio-Medical Waste every day. This indicates that the incineration which is installed in Fulbari has sufficient capacity to incinerate. However, the incineration that has been installed by the agency is for the entire North Bengal region.

9.15 Assessment of practices on Bio-Medical Waste disposal in the health care institutions in the Siliguri Town

To understand the practices followed for the disposal of the Bio-Medical Waste the researcher had made several visits to the health care institutions with a view to present a correct scenario. Most of the visits were made during 10 AM to 2 PM in the first half because it is during this period the Bio-Medical Waste is collected from the bin and is primarily disposed in the storage area and from there the same is collected by the Greenzen Bio Pvt. In addition, sometimes surprise visit was also made during the second shift of working hours i.e. in the evening. The practices prevailing in the Government and private hospitals and the nursing homes in Siliguri town can be summarised as under:

9.15.1 Government Hospitals

In the North Bengal Medical College and Hospital and in Siliguri Sub-divisional Hospital it was seen that all kinds of wastes are collected in the bins but not in accordance with the Bio-Medical Waste Management Rules, 2016. Further, instead of keeping the same in the designated store, the same is thrown indiscriminately in the open field including the nearby road within the hospital compound. It was observed that only black, blue and yellow coloured plastic bags are used for all categories of Bio-medical Waste. Apart from this, aluminium/steal puncture proof containers covered with lid are used for needles, syringes etc. No red coloured plastic bags were found in any of such hospitals. It is to be noted here that red colour plastic bag has been introduced in the new Bio-Medical Waste Management Rules, 2016. This shows the lack of awareness among the Government health care personnel regarding the existing Rules. It was also seen that instead of proper segregation of the waste in designated colour bin, different category of wastes are mix improperly and the same is stored in the colour bin not meant for. General waste like food, paper etc. is thrown in the yellow bags instead of the black bin. Regarding the used needles, it was seen that the same was disposed off without recapping and this resulted in the needle stick injury to the sweepers which may be fatal if proper precautions are not taken. Further, the autoclave machines which are used for sterilisation are not functioning properly or it is non-functioning. The containers which is required to be filled three-fourth, are

full with the waste and sometimes it is overflowing and the waste, especially liquid waste has made the situation worse as it spill all over the floors creating air and eye pollution and there is every possibility of spreading deadly diseases from such waste containing infectious waste. During rainy season the situation get worst as the liquid waste after mixing up with the rain water spread all over thereby increases the chance of infectious diseases.

9.15.2 Private Hospitals and Nursing Homes

In the private health care institutions also the scenario about the use of different colour bags for different category of the Bio-Medical Waste is similar compare to the Government hospitals except in Neotia Getwell and Medica North Bengal Clinic. It was found that some private nursing homes such as Heritage Hospital, Sai Hospital, Siliguri Greater Lion Hospital, Siliguri Nursing Home, and Dr. Mohpal's Nursing Home do not have any storage area and the colour bins have been kept in the open area. Although in the private hospitals and nursing homes the practice of using colour bins are prevailing similar to that in the Government hospitals, however, the bins are covered with lid and it is only half filled. However, the management and disposal of the Bio-Medical Waste in such health care institutions are made with care and caution in a hygienic way using gloves, masks etc.. The floors are generally kept clean and is regularly mopped using disinfected. On interviewing it was found that the hospital administration usually provided with training intermittently.

It has been the practice in the private hospitals and nursing homes to use needle cutter, syringe destroyer to avoid needle prick injury. Further, it was found that the used sharps after it has been disinfected with hypochlorite (1%) solution are disposed off. This reduces the risk factor of needle stick injury and sharps related injury among the personnel who are especially involved in the disposal of the Bio-Medical Waste.

9.16 Final disposal of the Bio-Medical Waste by the Greenzen Bio Pvt. Ltd. at Fulbari, Jalpaiguri

Regarding the disposal of the Bio-Medical Waste, all the health care institutions in the Siliguri town are tied up with a private agency namely, Greezen Bio Pvt. Ltd. for the removal and disposal of the same. This agency is involved in various activities right from the primary collection till the permanent disposal of the Bio-Medical Waste. This is the only company for the entire North Bengal region which is involved in the whole aspect of disposal. The company has three waste vans for the Siliguri, Matigara and Khoribari for collecting the waste from all the health care institutions in this area. After collecting it the same is either incinerated or autoclaved. There is one incinerator, one non-functioning autoclave and one shredder set up in the factory. It was seen that different persons were engaged in the segregation of different types of Bio-Medical Waste. Most of them persons were without masks and proper foot wear. After segregation the same is stored in different bins with a view either to sent the same for shredding or autoclaving. Items like saline bottles, catheters etc. are sent for recycling. The glass waste is shredded and the dust is stored in plastic sacks to be used for manufacturing the glass items. On visiting the site the researcher found that the whole factory compound is fully air polluted as the bad and filthy odour is coming from the deposited waste collected for several days but yet not incinerated.

Further, there is one blower machine installed in the factory which is used to disinfect the incinerated ash to reduce air pollution in the surrounding areas. The researcher had found that although the incineration machine was in operation but the blower was not functioning. On asking the same was put in operation and it was found that instead of black fumes, it was removing clear fumes from the chimney. Due to such careless attitude on the part of the person involved it is creating pollution in the nearby areas. This careless attitude of the Greenzen resulted in the institution of a suit against the Greenzen in the Jalpaiguri Court seeking relief to close down the same on the ground of air pollution. An instance of such careless attitude on the part of the Greenzen can also be found in collecting the Bio-Medical Waste. Instead of daily collection they collect it irregularly, sometimes after two to three days which increases the risk of spreading infection in the health care institutions located in the Siliguri town.

Apart from the collection and incineration, the company also supplies all types of colour bags, red, blue and yellow to the entire health care institutions in North Bengal. The colour bag is stamped with bar code and is distributed among the different health care institutions. The aim of providing with the bar code is to identify the health care institution who are involve in mixing the general waste with the particular type of Bio-Medical Waste and to take necessary steps to avoid the same. While interviewing the person who is the in-charge of the factory disclosed that many a time it was found that the health care personnel employed in the Government hospitals has such type of tendency. On asking what steps they usually takes in order to prevent it, he said that the same is incinerated. Regarding the use of colour bags as per the Rules, he replied that usually they supply all types of colour bag except the red colour bag which is being supplied on demand. According to him, only two nursing homes i.e. Neotia Getwell and Medica North Bengal Clinic uses red colour bag.

9.17 An Overview

From the above discussion it can be concluded that a wide difference exists between the perception and practices for the management of the Bio-Medical Waste both in the Government and private health care institutions. Although, the practices followed in the private health care institution is better compare to the Government health care institution, still much has to be done to improve the condition for the proper management and disposal of the Bio-Medical Waste. There is an urgent need to improve the condition prevailing in the Government health care institution in order to maintain a balance for the wholesome development on the aspect of the management of the Bio-Medical Waste. Improvement of the condition in the private health care institutions only without improving the waste management situation in the Government hospitals would be futile as nothing can be achieved and the whole Bio-Medical Waste disposal scenario would remain unchanged. To overcome it the necessity is to find out the appropriate steps by strict application of which the situation would be changed. What different steps could be adopted which would help in improving the existing scenario relating to the Bio-Medical Waste has been discussed in the concluding chapter.