INTERNATIONAL JOURNAL OF RESEARCH IN PHARMACY AND CHEMISTRY

Available online at www.ijrpc.com

Review Article

BIOMEDICAL WASTE MANAGEMENT: AN EMERGENT ISSUE IN EASTERN INDIA

Soma Samaddar* and Nabanita Kundu

Lady Braboume College, P-1/2, Suhrawardy Avenue, Kolkata – 700017,

West Bengal, India.

ABSTRACT

Biomedical waste (BMW)is generated at various places viz., hospitals, nursing homes, maternity homes, basic level health care centres, immunization centres, diagnostic centres, blood banks, health camps, blood donation camps, institution laboratories, doctors' chambers, pharmacies and even households. All these sources come under the purview of Bio-Medical Waste (Management and Handling) Rules 1998. Efforts towards safe and proper management of biomedical waste in Kolkata date back to the 1990s, even prior to the introduction of the Bio-Medical Waste (Management and Handling) Rules, 1998. Dept. of Health & Family Welfare, Govt. of Kolkata took initiative towards this through several projects. With the introduction of the BMW Rules in 1998, WBPCB became the designated authority to approve and monitor BMW management in the Kolkata. After ten years of the introduction of BMW Rules, it is imperative to assess the achievements and the failures, the problems and the prospects of BMW management in the Kolkata. Thus the study was undertaken. The most important task of the present study has been an assessment of the amount of BMW generated in different categories of Health Care Units (HCUs) in Kolkata. The foremost step for the assessment of Bio-Medical Waste generated essentially calls for preparation of an inventory of the HCUs under study by CATEGORY.

Keywords: Bio-Medical waste (BMW), health care units (HCUs), methodology of quantification, constrains, case study, recommendations.

INTRODUCTION

Biomedical waste (BMW) consists of solids, liquids, sharps, and laboratory waste that are potentially infectious or dangerous. Out of the total waste generated by health-care activities almost 80 – 85 % is general waste comparable to domestic waste. The remaining approximately 15 - 20% of waste is considered hazardous material that may be infectious, toxic or radioactive. When all the waste is mixed together, 100% of the health-care waste turns infectious and hazardous as well as become unmanageable. According to World Health Organization (WHO) "poor management of health care waste potentially exposes health care workers, waste handlers, patients and the community at large to infection, toxic effects and injuries, and risks polluting the environment. It is essential that all medical waste materials are segregated at the point of generation, appropriately treated and disposed of safely."

According to a very recent report prepared by Indian Institute of Management (IIM), Lucknow, approximately 4,20,461 kg per day or approximately 155 thousand MT per year bio-medical waste is generated in India. "Presently, 50-55 per cent of bio-medical waste is collected, segregated and treated as per Bio-medical Waste Management Rules. Rest is dumped with municipal solid wastes," the report says. Out of 84,809 hospitals, only 48,183 are either using common bio-medical waste treatment facilities (which are 170 in number) or have engaged other private agencies.

Bio-Medical waste is generated at various places viz., hospitals, nursing homes, maternity homes, basic level health care centres, immunization centres, diagnostic centres, blood banks, health camps,

blood donation camps, institution laboratories, doctors' chambers, pharmacies and even households. All these sources come under the purview of Bio-Medical Waste (Management and Handling) Rules 1998.

Background of the Study

Efforts towards safe and proper treatment of bio-medical waste in Kolkata date back to the 1990s, even prior to the introduction of the Bio-Medical Waste (Management and Handling) Rules, 1998.

The first initiative was taken by the Health Family Welfare Department of the Government of West Bengal for management of bio-medical waste in the secondary level and Government Hospitals under West Bengal State Health System Development Project (WBHSDP). With the introduction of the BMW Rules in 1998 WBPCB became the designated authority to approve and monitor the BMW management in the state. The years that followed witnessed establishment of a number of treatment and disposal facilities with systems of segregated collection, treatment and disposal of bio-medical waste that covers a major part of the state.

During the first phase of this period two common bio-medical waste treatment facilities at Kalyani Jawaharlal Nehru Hospital and Diamond Harbour Sub-divisional Hospital, several stand-alone treatment facilities and a good number of in-campus disposal pits were installed in some government hospitals. Efforts were also made to involve municipalities and municipal corporations to develop disposal facilities to bury a portion of bio-medical waste. Some of the municipalities and Kolkata Municipal Corporation constructed common burial pits to dispose of bio-medical waste.

But the practice of disposal of all categories of bio-medical waste into common or in-campus pits did not corroborate with the BMW Rules, 1998. In course of time all the municipal common pits became defunct. In-campus pits in government hospitals had also been misused and most of these are now filled up.

At later stage several common bio-medical waste treatment and disposal facilities (CBWTF) in compliance with the Rules have come up. These are privately owned facilities. But apart from Kolkata and Howrah, most of the health care units were out of waste management regime till 2007.

Study Objective

1. Quantification of Bio-Medical Waste generated in some of Kolkata Hospitals as case studies.
2. Assessment of Treatment and Disposal Options of Bio-Medical Waste available and in operation in Kolkata.
3. Requirement and availability of Common Bio-medical Waste Treatment Facilities in Kolkata.
4. Assessment of compliance status of BMW management of selected Health Care Units and Treatment Facilities.

Study Period: November 2011 to September 2013

Categorization of the Health Care Units (HCUs)

Methodology

Step 1: The health care units (HCUs) in Kolkata have been firstly categorized as bedded & non-bedded facilities.

It is obvious that there is large difference in BMW generations, by both quantity & quality, between bedded & non-bedded health care facilities.

Step 2: Next, the bedded facilities are further subdivided as in the following:

i) **Government General:** This category includes the general stream of State Government HCUs, i.e. Medical College & Hospitals.

ii) **Other Government:** The Government Hospitals of the general character like those belonging to Steel Authority of India Limited (SAIL), Port Trust of India, Eastern Coalfield Limited, Railways, State Electricity Board, Jail, ESI, are included in this category. It is noted that that the services offered by these HCUs are almost similar to those of the Government HCUs in the general stream mentioned above. It is assumed as well as validated that by the present quantification study that in all these hospitals the generation of BMW per bed per day varies according to their bed strengths. Therefore, the generated BMW per bed per day in each of these hospitals are taken as the BMW generated per bed per day in a Government General hospital belonging to a particular category of comparable bed strength.

iii) **Municipality:** The Municipal bedded health care units are of two kinds, general hospitals & maternity homes. The general municipal hospitals can be definitely taken to generate BMW per bed per day as the HCUs belonging to categories with similar ranges of bed strengths. But in case

of maternity homes, they constitute a different category of hospitals both in terms of services catered and, eventually, the quality & quantity of BMW generated.

iv) **Specialty:** The hospitals of these category, both government & private, exclusively cater to patients with specific diseases those like Infectious Diseases (ID), Tuberculosis (TB), Leprosy, Cancer, Eye disorders and Dental problems. The exclusive and specific character of health care services provided by these hospitals, cause differences in the quality & quantity of BMW generated.

v) **Private:** All the private hospitals & nursing homes belong to this category. In case of private HCUs, BMW generation varies from that in government hospitals because of differences in administrative & health care facilities. But, here also BMW generation per bed per day varies with the range of bed strengths to which they belong. Therefore, bed strength has been taken as an indicator for average quantity of BMW generated aand private hospitals & nursing homes are categorized according to the ranges of bed strengths they belong to.

Step 3: In a similar manner, the non-bedded facilities, are also further sub-divided

i) **Government:** The non-bedded Government HCUs mainly include Sub-Centers (SC) and out-reach immunization sessions.

ii) **Municipality (Urban):** Municipal non-bedded HCUs are mainly constituted of Municipal Sub-centres (SC) and Extended Special Out Patient Departments (ESOPD)

iii) **Private:** The diagnostic centers of all kinds with pathological laboratories, X-Ray, ECG, EEG, MRI and Scan etc. belong to this category, along with doctor's clinics, eye clinics etc. Pathological laboratories are the main generators of BMW in this category. At the same time the quality & quantity of BMW generated in Pathological Laboratories differ according to the nature and number of tests done.

Thus, the assessment of BMW generated in pathological laboratories necessitates categorization of pathological laboratories according to the nature and number of tests done.

Names of HCUs selected for Assessment
(Assessment and results of of Large Government hospitals, Private hospitals and Pathological Laboratories have been discussed in IJETMAS, Vol 5, issue 3, 2017, p 73-100)
In this discussion we have taken Municipal HCUs and Specialty HCUs only

A) Municipal HCUs

Category of HCUs	HCUs Surveyed
Hospital	Dumdum Municipality Specialized Hospital, Dumdum, 24 Pgs (N)
ESOPDs	Dumdum Municipality

B) Specialty HCUs

Category of HCUs	Size, Type	HCUs Surveyed
3 Categories of Specialty Hospitals	Dental Hospital	Dr. R. Ahmed Dental College,114 A.J.C. Bose Road, Kolkata- 700014
	Cancer Hospital	Chittaranjan National Cancer Institute, 37 S.P. Mukherjee Road Kol-700026
	Eye Hospital	Disha Eye Hospital and Research Centre, Barrackpore Kolkata-120

Treatment and Disposal of Bio-Medical Waste
The assessment of BMW has been done following the Bio-medical Waste (Management & Handling) Rules 1998.

Methodology of Quantification used in our analysis

The study has been conducted through survey, with following steps:

- Identification of the items of bio-medical waste generated in the HCUs and coming into the waste stream,
- Classification of the items by category according to BMW Rules,
- Classification of the items further as recyclable and non-recyclable. Cat 4 (needles, broken glass etc) and Cat 7 (plastic, glass and metal) have been marked as recyclables. Again Categories 1, 2, 3, 5, 6 (Body parts and the soiled materials) have been marked as non-recyclable though some materials like cloth may be recycled),
- Ascertaining bio-medical waste generation per bed per day or per person per day in respective categories of HCUs.

The administrative authorities of the HCUs and the staff were given prior information and necessary instructions before the actual quantification. Particularly hospital sweepers, scavenger service workers, ward sisters and other health workers in each HCU were notified prior to the commencement of the quantification study.

Waste Assessors took charge of the waste sent at the vat sites or disposal sites of the HCUs from each waste generation point of the HCUs. Contents of each of the bags were taken out, thoroughly checked and sorted irrespective of the colour of bags to ensure more accurate categorization of waste in anticipation of possible mixing. Items of each category were manually separated and measured by weighing balance.

None of the HCUs had any facility to separately store or treat liquid waste. So liquid waste was not included in quantification study. Liquid portion of Chemical waste (Cat 10) was generally drained out and solid portion also was not separately collected. As such quantification of the same could not be possible. So Categories 8, 9 and 10 have been excluded from the quantification study. Animal body waste was also not available. So Category 2 has been excluded from quantification.

In every bedded HCU under study data on occupancy were collected for each day during the two-four days' quantification survey (except sub-centres where data for 2 days were collected as those did not function everyday). The total quantity of BMW generated has been divided by occupancy to arrive at BMW generation per bed per day in case of bedded HCUs. In case of municipal ESOPDs attendance of patients/persons at the HCUS was collected and recorded. For these non-bedded HCUs total quantity of BMW generated has been divided by the attendance to arrive at BMW generation per patient/person per day. In case of pathological laboratories number of specimens tested was collected and recorded. The total quantity of BMW generated has been divided by number of specimens to arrive at BMW generation per specimen per day.

Constraints

The survey had to depend on the existing waste management system of the health care units and pathological laboratories. As such, in spite of best possible efforts under the circumstances, variation in the quality of the system operating in different hospitals affected the study in the following ways:

- Collection and hauling of all the waste to the quantification point could not be fully ensured in spite of best possible efforts because of prevailing practice of salvaging, irregular collection and disposal in some units.
- Improper segregation and collection of waste made quantification of BMW very difficult and prone to inaccuracy in many instances.

Case Study

1. Quantification Data

The data on quantification of each health care unit and pathological laboratory under study have been displayed below

Dumdum Municipality Specialized Hospital								
Bio-Medical Waste Generated by Category in Kg (Bed Capacity-110)								
DAY	Occupancy	Human Anatomical Waste	Microbiology & Bio-technology Waste	Waste Sharps	Discarded Medicine & Cytotoxic Drug	Solid Waste (Soiled)	Solid Waste	Total
		CAT 1	CAT 3	CAT 4	CAT 5	CAT 6	CAT 7	
Day 1	50	1.460	0.340	1.120	0.240	5.870	3.960	**12.990**
Day 2	52	1.560	0.260	1.140	0.220	6.500	4.260	**13.940**
Day 3	44	1.320	0.050	0.960	0.230	5.890	3.860	**12.310**
Day 4	54	1.620	0.130	1.230	0.230	6.750	4.250	**14.210**
Total	200	5.96	0.78	4.45	0.92	25.01	16.33	53.45
Average per day	**50**	**1.49**	**0.20**	**1.11**	**0.23**	**6.25**	**4.08**	**13.36**
Average per day per bed		**0.030**	**0.004**	**0.022**	**0.005**	**0.125**	**0.082**	**0.267**
Average per day per bed by %		**11.16**	**1.46**	**8.33**	**1.72**	**46.84**	**30.58**	**100**

Non-recyclable				
CAT 1	CAT 3	CAT 5	CAT 6	Total
0.030	**0.004**	0.005	0.125	0.164

Recyclable		
CAT 4	CAT7	Total
0.022	0.082	0.104

Non-recyclable	Recyclable	Total
0.164	**0.104**	**0.268**

Dumdum Municipality ESOPDS

Bio-Medical Waste Generated by Category in Kg (Bed Capacity-110)

DAY	Occupancy	Human Anatomical Waste	Microbiology & Bio-technology Waste	Waste Sharps	Discarded Medicine & Cytotoxic Drug	Solid Waste (Soiled)	Solid Waste	Total
		CAT 1	CAT 3	CAT 4	CAT 5	CAT 6	CAT 7	
Day 1	156	0.000	0.000	0.780	0.000	0.490	2.240	**3.510**
Day 2	144	0.000	0.000	0.620	0.000	0.290	2.760	**3.670**
Day 3	120	0.000	0.000	0.560	0.000	0.570	2.230	**3.360**
Day 4	180	0.000	0.000	0.980	0.000	0.670	2.130	**3.780**
Total	600	0.00	0.00	2.94	0.00	2.02	9.36	14.32
Average per day	**150**	**0.00**	**0.00**	**0.74**	**0.00**	**0.51**	**2.34**	**3.58**
Average per day per bed		**0.000**	**0.000**	**0.005**	**0.000**	**0.003**	**0.016**	**0.024**
Average per day per bed by %		**0.00**	**0.00**	**20.42**	**0.00**	**14.03**	**65.00**	**100**

Non-recyclable				
CAT 1	CAT 3	CAT 5	CAT 6	Total
0.000	**0.000**	0.000	0.003	0.003

Recyclable		
CAT 4	CAT7	Total
0.005	0.016	0.021

Non-recyclable	Recyclable	Total
0.003	**0.021**	**0.024**

R. Ahmed Dental College and Hospital								
Bio-Medical Waste Generated by Category in Kg (Bed capacity-100/Day care)								
DAY	**Surgery and other treatments**	**Human Anatomical Waste**	**Microbiology & Bio-technology Waste**	**Waste Sharps**	**Discarded Medicine & Cytotoxic Drug**	**Solid Waste (Soiled)**	**Solid Waste**	**Total**
		CAT 1	**CAT 3**	**CAT 4**	**CAT 5**	**CAT 6**	**CAT 7**	
Day 1	161	0.540	0.520	0.570	0.060	2.350	3.320	**7.360**
Day 2	225	0.720	0.390	0.490	0.070	2.650	3.680	**8.000**
Day 3	219	0.850	0.390	0.860	0.100	1.960	3.910	**8.070**
Day 4	200	0.760	0.240	0.630	0.150	2.610	3.780	**8.170**
Total	**805**	**2.870**	**1.540**	**2.550**	**0.380**	**9.570**	**14.690**	**31.600**
Average per day	**201**	**0.72**	**0.39**	**0.64**	**0.10**	**2.39**	**3.673**	**7.900**
Average per day per patient		**0.004**	**0.002**	**0.003**	0.000	**0.012**	**0.018**	**0.039**
Average per day by %		**9.15**	**4.91**	**8.13**	**1.21**	**30.52**	**46.85**	**100.00**

Non-recyclable				
CAT 1	**CAT 3**	**CAT 5**	**CAT 6**	**Total**
0.004	0.002	0.000	0.012	0.018

Recyclable		
CAT 4	**CAT 7**	**Total**
0.003	0.018	0.021

	Non-recyclable	**Recyclable**	
	0.018	**0.021**	**0.039**
By %	**46**	**54**	

Chittaranjan National Cancer Institute

Bio-Medical Waste Generated by Category in Kg (Bed Capacity-200)

DAY	Occupancy	Human Anatomical Waste	Microbiology & Bio-technology Waste	Waste Sharps	Discarded Medicine & Cytotoxic Drug	Solid Waste (Soiled)	Solid Waste	Total
		CAT 1	CAT 3	CAT 4	CAT 5	CAT 6	CAT 7	
Day 1	164	0.350	0.580	3.850	0.340	22.560	12.900	**40.580**
Day 2	182	0.860	0.860	5.380	0.280	24.850	12.670	**44.900**
Day 3	187	0.670	0.560	4.850	0.260	25.560	11.870	**43.770**
Day 4	189	1.120	0.750	5.380	0.450	25.160	11.360	**44.220**
Total	722	3.00	2.75	19.46	1.33	98.13	48.80	173.47
Average per day	**181**	**0.75**	**0.69**	**4.87**	**0.33**	**24.53**	**12.20**	**43.37**
Average per day per bed		**0.004**	**0.004**	**0.027**	**0.002**	**0.136**	**0.067**	**0.240**
Average per day per bed by %		**1.73**	**1.58**	**11.20**	**0.77**	**56.47**	**28.08**	**100**

Non-recyclable				
CAT 1	CAT 3	CAT 5	CAT 6	Total
0.004	**0.004**	0.002	0.136	0.145

Recyclable		
CAT 4	CAT7	Total
0.027	0.067	0.094

Non-recyclable	Recyclable	Total
0.145	**0.094**	**0.240**

Disha Eye Hospital and Research Centre

Bio-Medical Waste Generated by Category in Kg (Bed capacity-115/Day care)

DAY	Surgery and other treatments	Human Anatomical Waste	Microbiology & Bio-technology Waste	Waste Sharps	Discarded Medicine & Cytotoxic Drug	Solid Waste (Soiled)	Solid Waste	Total
		CAT 1	CAT 3	CAT 4	CAT 5	CAT 6	CAT 7	
Day 1	118		0.160	1.750	0.550	2.800	2.260	7.520
Day 2	118		0.190	1.860	0.450	2.780	2.870	8.150
Day 3	147		0.290	2.205	1.040	3.450	3.850	10.835
Day 4	131		0.240	2.160	0.750	2.970	3.240	9.360
Total	514		0.880	7.975	2.790	12.000	12.220	35.865
Average per day	**129**		**0.22**	**1.99**	**0.70**	**3.00**	**3.055**	**8.966**
Average per day per patient			**0.002**	**0.015**	**0.005**	**0.023**	**0.024**	**0.070**
Average per day by %			**2.44**	**22.08**	**7.72**	**33.22**	**33.83**	**100.00**

Non-recyclable					Recyclable		
CAT 1	**CAT 3**	**CAT 5**	**CAT 6**	**Total**	**CAT 4**	**CAT 7**	**Total**
0.000	0.002	0.005	0.023	0.030	0.015	0.024	0.039

	Non-recyclable	Recyclable	
	0.030	**0.039**	**0.069**
By %	**43**	**57**	

Average bio-medical waste generation profile
Municipal health care units
These are smaller units having bed strength below 50 and moderate service facilities.

1. Dumdum Municipality Hospital

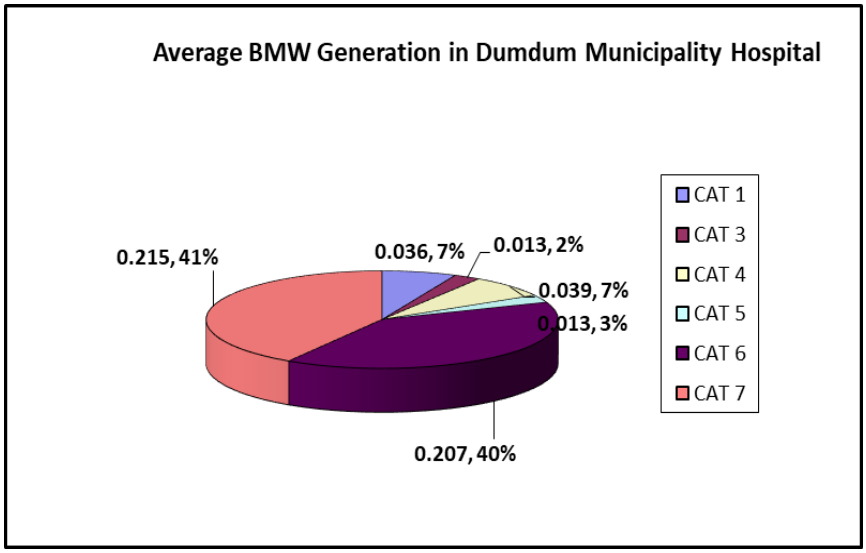


Fig. 1: Average bio-medical waste generation profile- Dumdum Municipality Hospital

Municipal extended Specialized Out-Patient Departments
2. Dumdum Municipality ESOPD
Municipal ESOPDS do not generate any anatomical waste (CAT 1), Laboratory waste (CAT 3) and discarded medicines (CAT 5). Non-recyclable waste (CAT 6) is also very negligible. Major portion of the waste is composed of syringes, needles, glass vials etc.

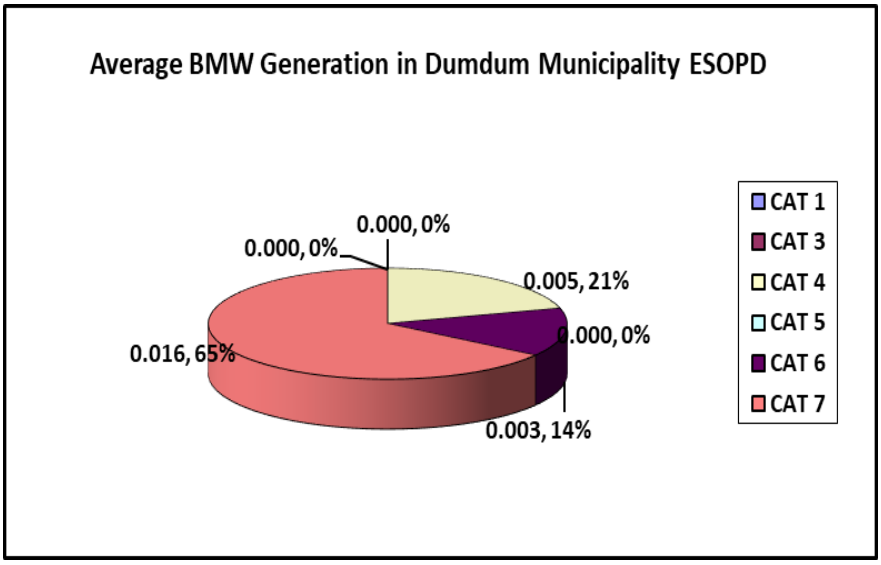


Fig. 2: Average bio-medical waste generation profile- Dumdum Municipality ESOPD

Speciality Hospitals

3) Dr. R. Ahmed Dental College and Hospital

There is no bedded facility. Anatomical waste is composed of extracted teeth. Total amount of waste is much less than general bedded HCUs.

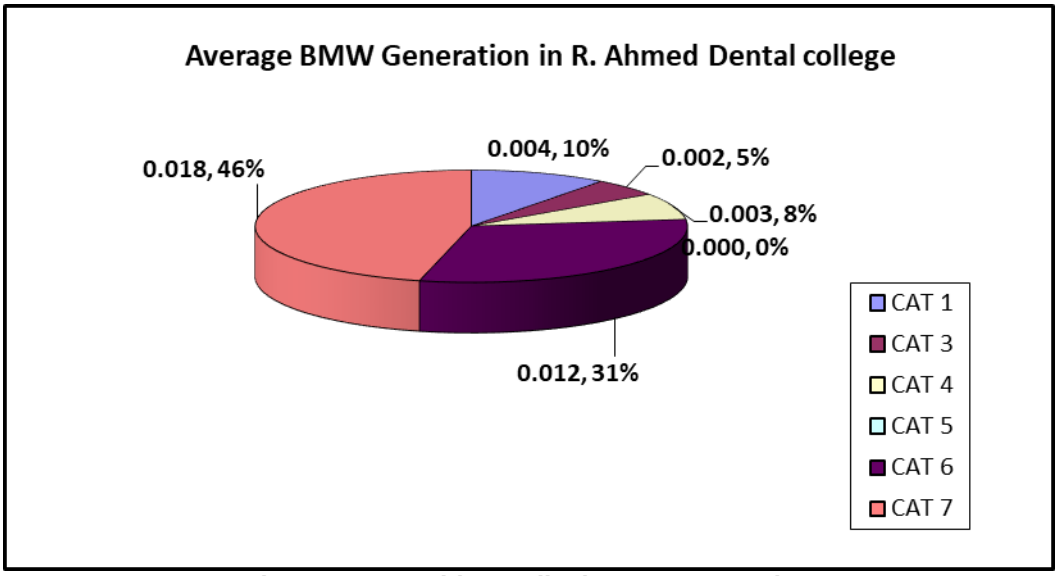


Fig. 3: Average bio-medical waste generation profile- Dr. R. Ahmed Dental College and Hospital

4) Chittaranjan National Cancer Institute

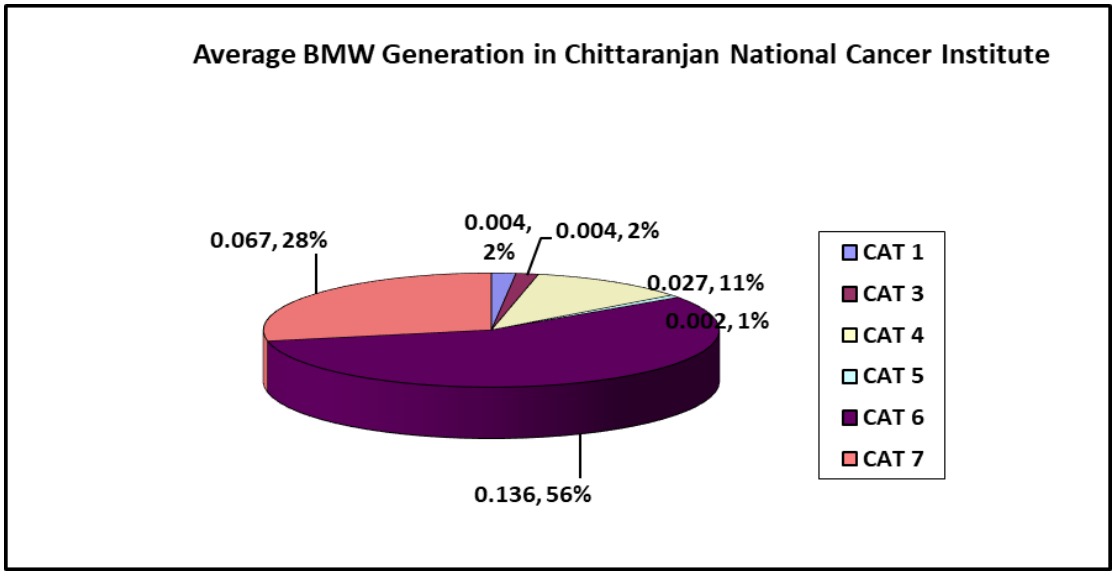


Fig. 4: Average bio-medical waste generation profile- Chittaranjan National Cancer Institute

5) Disha Eye Hospital

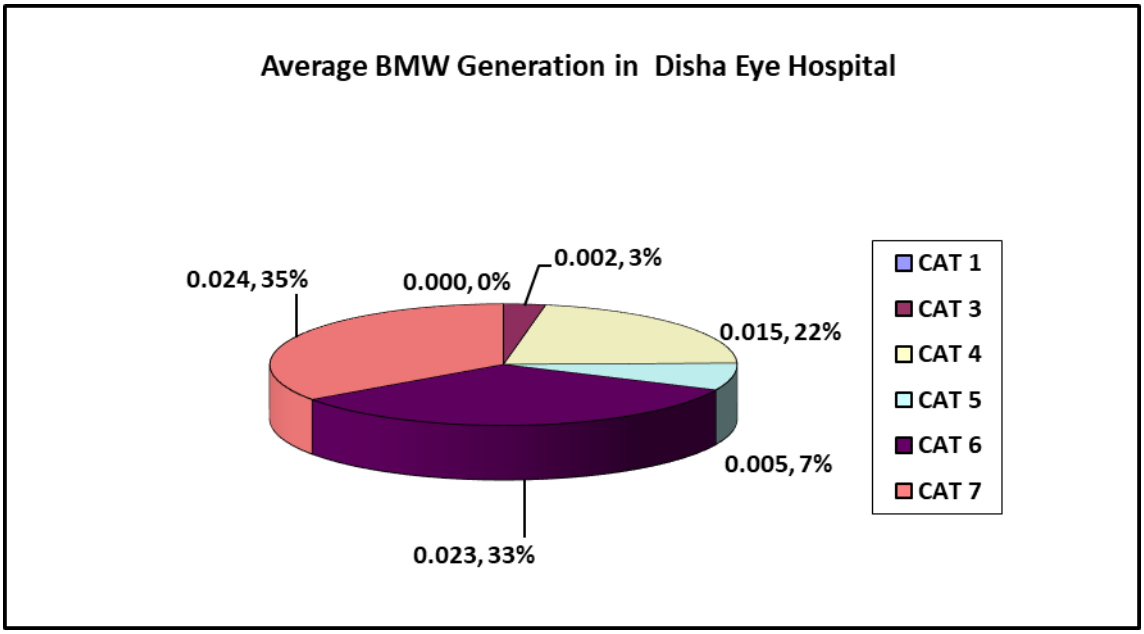


Fig. 5: Average bio-medical waste generation profile- Disha Eye Hospital

Quantification Summary
(Summary of Large Government hospitals, Private hospitals and Pathological Laboratories have been discussed in IJETMAS, Vol 5, issue 3, 2017, p 73-100)

Table I: Other Government Hospitals

Average BMW Generation Bedded facility per bed per day							
Other Government	CAT 1	CAT 3	CAT 4	CAT 5	CAT 6	CAT 7	Total BMW
Dumdum Municipality Hospital	0.030	0.004	0.022	0.005	0.125	0.082	0.267
Dumdum MunicipalityESOPDS	0.000	0.000	0.005	0.000	0.003	0.016	0.024
Total(category wise)	0.030	0.004	0.027	0.005	0.128	0.097	0.291

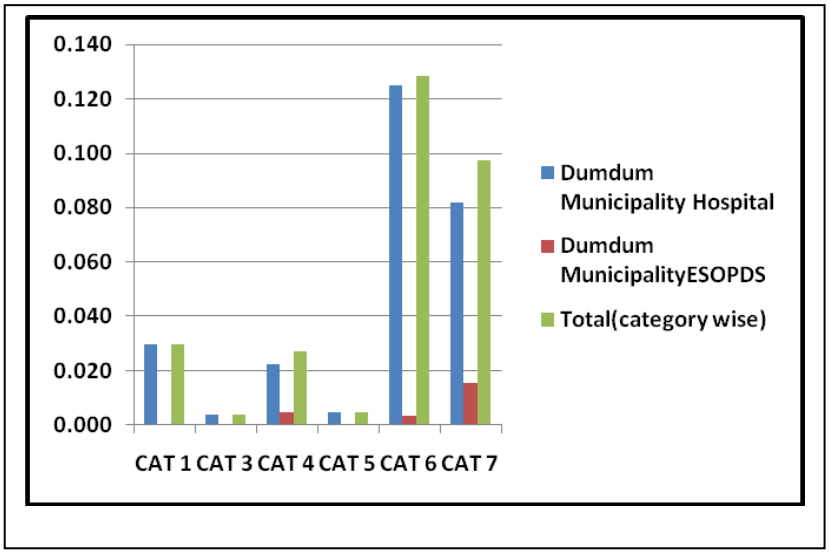


Fig. 6: Comparison of Average category wise BMW generation (wt in kg) in other government hospitals with bedded facility

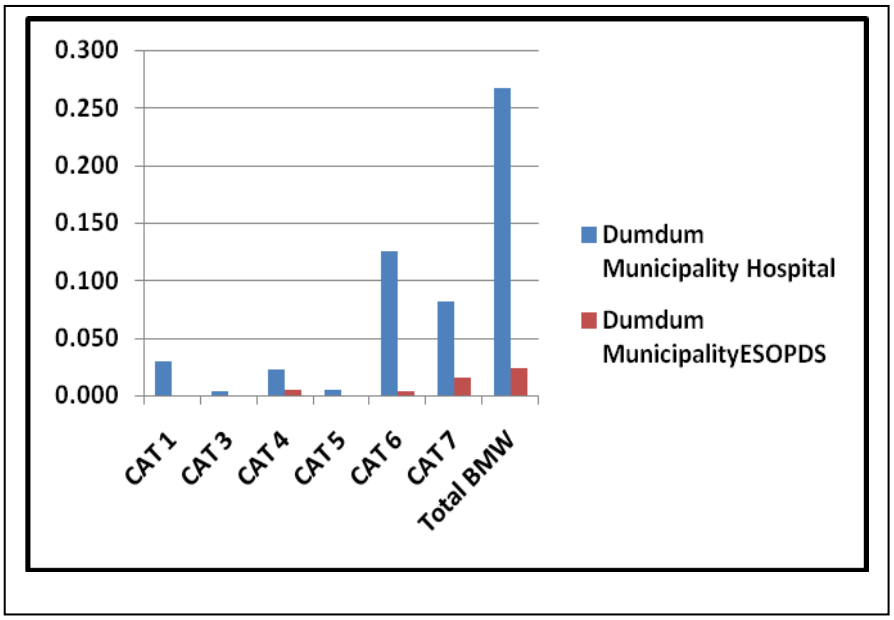


Fig. 7: Comparison of total BMW generation (wt in kg) in other government hospitals with bedded facility

Average BMW Generation Specialty Hospitals							
	CAT 1	**CAT 3**	**CAT 4**	**CAT 5**	**CAT 6**	**CAT 7**	**Total BMW**
R. Ahmed Dental Hospital	0.004	0.002	0.003	0.000	0.012	0.018	**0.039**
Chittaranjan Cancer Institute	0.004	0.004	0.027	0.002	0.136	0.067	**0.240**
Disha Eye Hospital	0.000	0.002	0.015	0.005	0.023	0.024	**0.069**
Total (category wise)	**0.008**	**0.008**	**0.045**	**0.007**	**0.171**	**0.109**	**0.348**

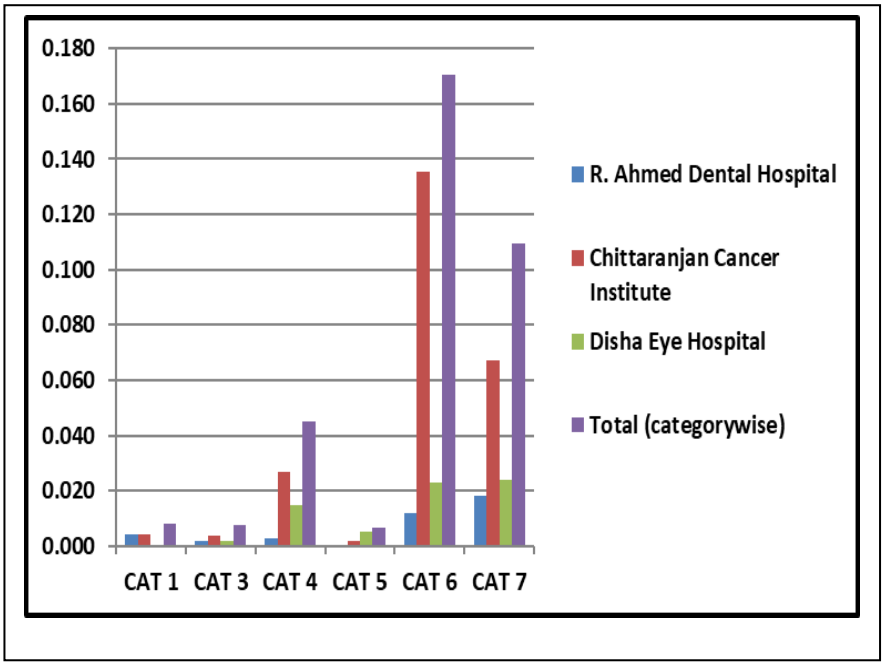


Fig. 8: Comparison of Average category wise BMW generation (wt in kg) in Specialty Hospitals

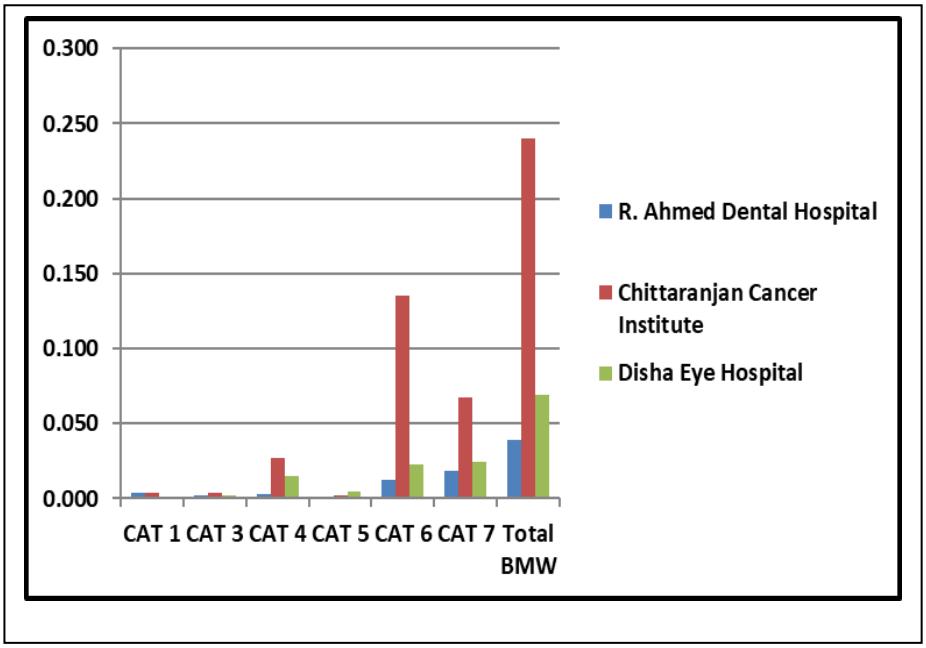
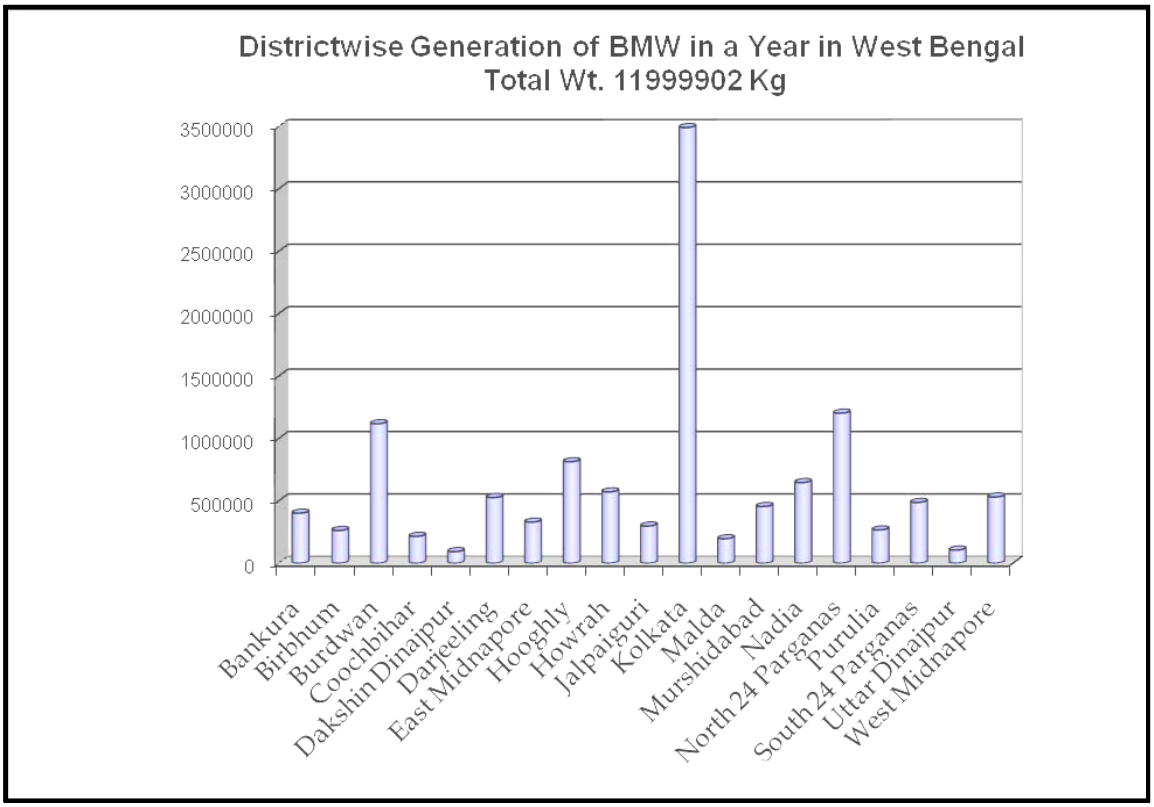


Fig. 9: Comparison of Average BMW generation (wt in kg) in Speciality Hospitals

According to data provided by WBPCB the district wise generation of BMW:
Kolkata produces at highest amount.



Growth Rate:(http://www.wbhealth.gov.in/statics%20_html/2007_2008/1/1_21.html

Department of Health & Family Welfare, Govt. of West Bengal have estimated increase in number of population in the state from 2008 to 2016 for developing strategy to expand health care facilities:

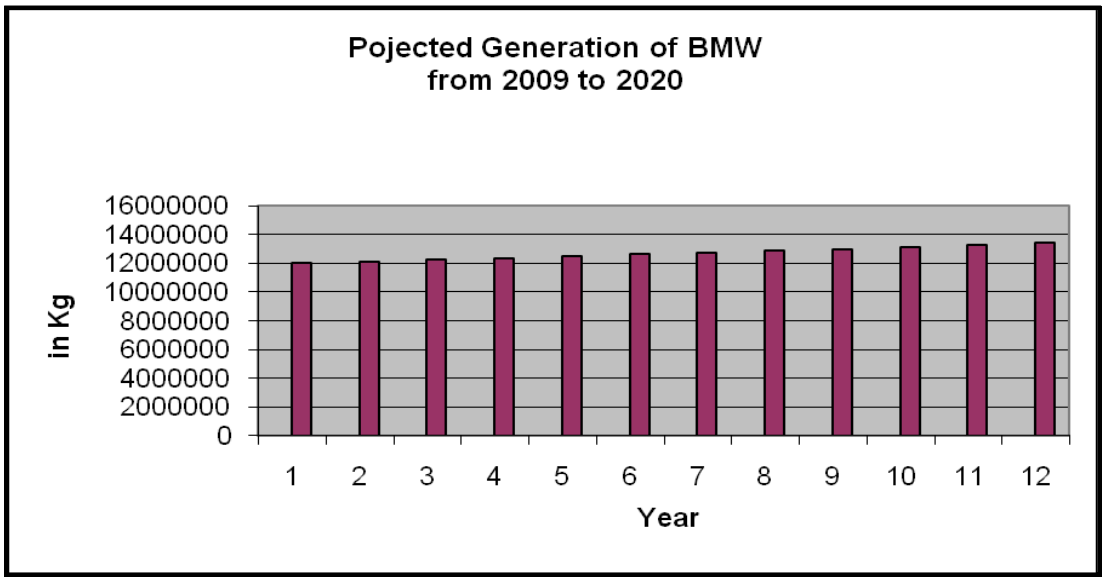
Projected Population of West Bengal 2008-2016 In '000									
Year	Total			Urban			Rural		
	Persons	Male	Females	Persons	Male	Females	Persons	Male	Females
2008	86995	44820	42174	24642	12879	11763	62353	31941	30412
2009	87839	45234	42605	24926	13008	11918	62913	32226	30687
2010	88669	45640	43029	25207	13135	12072	63462	32505	30957
2011	89499	46045	43454	25489	13262	12227	64010	32783	31227
2012	90320	46445	43874	25769	13388	12381	64551	33057	31494
2013	91122	46836	44287	26045	13511	12534	65077	33325	31752
2014	91920	47223	44697	26320	13634	12686	65600	33589	32011
2015	92725	47613	45112	26598	13757	12841	66127	33856	32271
2016	93550	48012	45538	26883	13883	13000	66667	34129	32538

In the above estimate it is seen that annual increase in population has been estimated as 0.87% to 0.94% per year. Though there is a huge shortfall in number of existing basic health care facilities with respect to population, a very conservative estimate is made regarding increase of BMW generation i.e. 1% increase per year up to 2020.

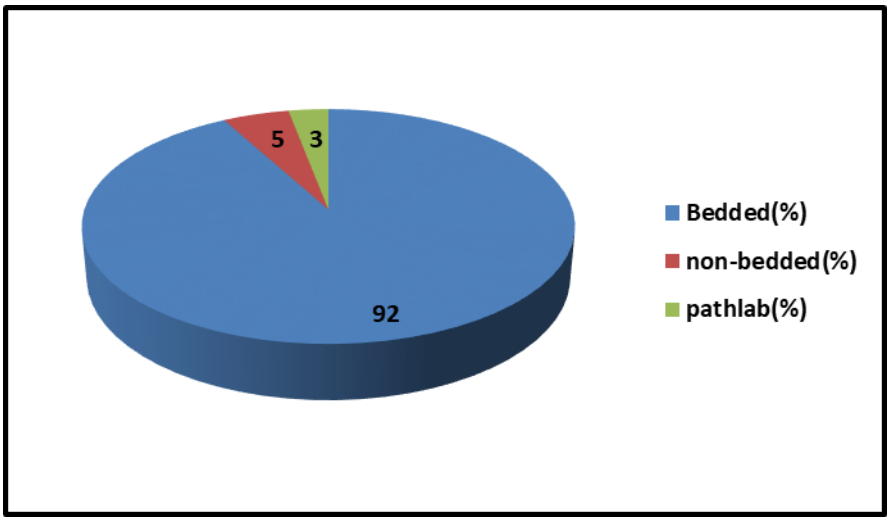
Hence the estimated increase may be seen in the following table and chart

Project Increase in BMW Generation	
YEAR	Wt in Kg
2009	11999902
2010	12119901
2011	12241100
2012	12363511
2013	12487147
2014	12612018
2015	12738138
2016	12865520
2017	12994175
2018	13124117
2019	13255358
2020	13387911

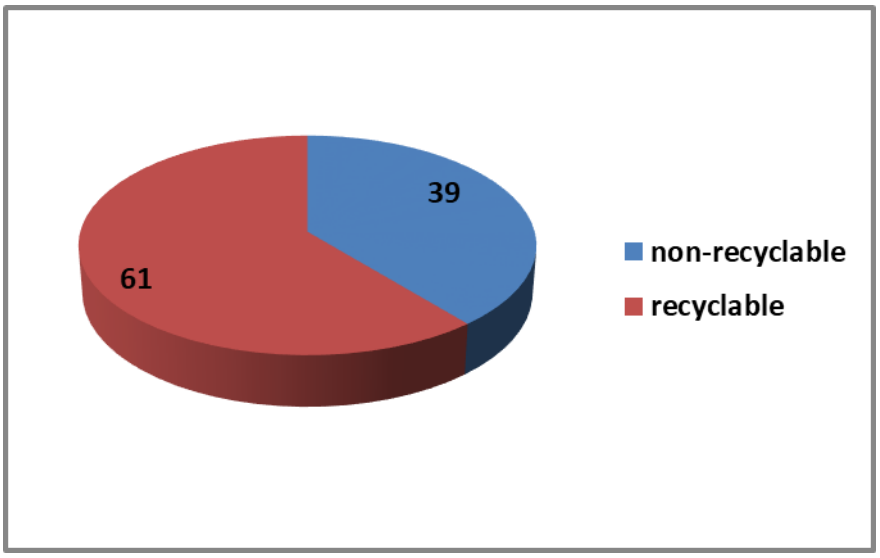
Thus projected annual BMW generation in 2020 may be estimated as 13500 MT.



Proportion of BMW generated from different sources: bedded, non-bedded HCUs and path labs.



It is important to note that 8% of total BMW is generated in rural government and urban municipal non-bedded HCUs. These facilities are still not connected with any treatment facility. Individually each of these HCUs generate little amount of BMW but by their sheer number, as a whole; they produce a huge amount of BMW.



It is interesting to note that in case of non-bedded facilities bulk of the BMW (around 61 %) is recyclable.
This indicates that a major portion of BMW from non-bedded HCUs may go to recycling market without being treated if these are not brought under coverage of treatment facilities. Treatment facilities also would welcome the nature of this BMW as there is a common complaint of all the facility operators that they receive disproportionately larger amount of non-recyclable BMW items. So their revenue earning through sale of treated recyclable items get reduced.

RECOMMENDATIONS

The Summary Recommendations appended with the Executive Summary indicated possible solutions to the problems in brief and general terms. A list of detailed recommendations is furnished here to provide a better understanding of the same so that appropriate actions may be taken.

Common Bio-medical Waste Treatment Facilities (CBWTFs)

1. Since due to improper collection mixing of waste is very common phenomena, a good amount of recyclable materials including PVC are coming to CBWTFs mixed with incinerable waste. Plastic waste, especially PVC should not be burnt. As such feasibility of introducing secondary segregation at CBWTFs with environmental and occupational precautions should be probed.
2. Incineration ash generated in CBWTFs should be regularly and properly disposed at hazardous disposal site and records of the same maintained.
3. Tests should be conducted to find presence if dioxin in organic matters and live stocks in the vicinity of the CBWTFs.

In-House Management

1. As per BMW Rules heads of the institutions are responsible for bio-medical waste management in respective HCUs. But they are also in-charge of all other activities of the HCUs. To enable proper management there should be one officer in-charge responsible for in-house BMW management. Particularly in larger HHCUs having above 100 beds this should be introduced immediately.
2. Dept. of H&FW, municipal corporations and municipalities need to be pursued to institute regular collection mechanism of BMW from non-bedded HCUs under their jurisdiction and arrange their proper treatment and disposal.
3. A regular mechanism and reporting mechanism should be introduced for every HCU, particularly those having above 100 bed strengths, for periodic review of status of BMW management in respective HCUs. In view of constraints of personnel and expertise, services of NGOs and/or experts should be utilized in this.
4. Both on-the-job and off-the-job training should be imparted at regular intervals to develop awareness and motivation of the health workers at all levels.
5. Regular reporting system with respect to generation, storage and transfer should be maintained to check pilferage, salvaging etc.
6. IEC materials should be displayed at all BMW generation points.
7. Regular supply of good quality working and protective equipments should be ensured.

Mercury Waste

1. Identify all equipments, devices and substances containing or using mercury.
2. Explore and take concrete steps towards eliminating all mercury- containing products and mercury compounds in hospitals and clinical practices especially thermometers, sphygmomanometers – replacing them with non-mercury cost effective products.
3. Pending phasing out of mercury containing equipments and compounds, develop a proper protocol for safe handling and management of existing mercury devices and possible mercury spills and ensure that mercury does not find its way into the waste stream or environment.
4. Train doctors, nurses and other hospital staff to appreciate the reasons and rationale of the protocol and to abide by it.
5. Encourage mercury use reduction and proper waste management procedures in the dental sector, through voluntary and/ or regulatory measures. Measures could include implementation of proper waste management procedures and installing amalgam separates at dental clinics to reduce most of the emissions from wastewater.
6. Ensure that controlled mercury disposal and/ or storage facilities are available and maintained for all hospitals and health care facilities.

CONCLUSION

In short it can be concluded that though the infrastructure for treatment of BMW in the state is almost adequate and highest authorities including monitoring body have started to wake up to the issue, overall status of in-house management of BMW in the HCUs especially which are owned by government, are not at all up to the mark.

REFERENCES

1. Samaddar, S. and Kundu, N., IJETMAS, Vol 5, issue 3, 73-100 (2017).
2. Mandal S. K. and Dutta J., Integrated Bio-Medical Waste Management Plan for Patna City, Institute of Town Planners, India Journal 6-2: 01-25 (2009).

3. Singh V. P., Biswas G., and Sharma, J. J., Biomedical Waste Management-An Emerging Concern in Indian Hospitals, Indian Journal of Forensic Medicine & Toxicology, Vol. 1, No. 1. (2007-12).
4. Hem Chandra, Hospital Waste-an Environmental Hazard and Its Management, (1999).
5. Govt. of India, Ministry of Environment and Forests Gazette Notification No. 460, dated July 27, New Delhi: 1998: 10-20
6. Glenn, Mc. R & Garwal, R. Clinical Waste in Developing Countries, An Analysis with a Case Study of India, and a Critique of the Basle TWG Guidelines (1999).
7. CEET: Biomedical Waste Management-Burgeoning issue (2008)
8. Gravers PD. Management of Hospital Wastes-An Overview. Proceedings of National Workshop on Management of Hospital Waste, (1998)
9. Thornton J., Tally MC, Orris P., Wentreg J. Hospitals and Plastics Dioxin Prevention and Medical Waste Incineration; Public Health Reports. 1996;1: 299-313.
10. Surjit S. Katoch Biomedical Waste Classification and Prevailing Management Strategies, Proceedings of the International Conference on Sustainable Solid Waste Management, p. p. 169-175 (2007).
11. The Bio Medical Waste (Management and Handling) Rules, (1998).
12. Dr. Saurabh Sikka, Biomedical Waste in Indian Context.
13. Sharma S and Chauhan, S. V. S., Assessment of Bio-medical Waste Management in Three Apex Government Hospitals of Agra, Journal of Environmental Biology, 29(2), p. p. 159-162 (2008).
14. Bekir Onursal, Health Care Waste Management in India, The Indian Bank (2003).
15. http://www.initial .co.uk/medical-services/regulations/index.html
16. Net Regs – Current legislation lists.
17. “National Research Council Recommendations Concerning Chemical Hygiene in Laboratories”. United States Department of Labor. Retrieved 15 May 2013.
18. “Guidance on Closed Containers”. Environmental Protection Agency. Retrieved 15 May 2013.