
Biomedical Waste Management: An Infrastructural case study of Kolkata based Hospitals

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Abstract

Bio-Medical 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.

However the present study did not have the scope to assess BMW generation from all these sources. The study mainly concentrated on health care units (HCUs) like hospitals, nursing homes, maternity homes, basic level health care centers, immunization centers, diagnostic centers etc. Health camps, blood banks, blood donation camps, laboratories attached to institutions, doctor's chambers, pharmacies and households have been excluded from the purview of this study.

The most important task of the present study has been an assessment of the amount of BMW generated in the above mentioned categories of 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 consists of solids, liquids, sharps, and laboratory waste that are potentially infectious or dangerous. It must be properly managed to protect the general public, specifically healthcare and sanitation workers who are regularly exposed to biomedical waste as an occupational hazard. Waste generated by health care activities includes a broad range of materials, from used needles and syringes to soiled dressings, body parts, diagnostic samples, blood, chemicals, pharmaceuticals, medical devices and radioactive materials. Disposal of this waste is an environmental concern, as many medical wastes are classified as *infectious* or bio-hazardous and could potentially lead to the spread of infectious diseases and other health concerns. World Health Organization (WHO) points out that health care wastes and byproducts cover a diverse range of materials: (a) Infectious wastes -- cultures and stocks of infectious agents, wastes from infected patients, wastes contaminated with blood and its derivatives, discarded diagnostic samples, infected animals from laboratories, and contaminated materials (swabs, bandages) and equipment (disposable medical devices etc.); and (b) Anatomic - recognizable body parts.

From the total of waste generated by health-care activities, almost 80 – 85 % is general waste comparable to domestic waste. The remaining approximate 15 - 20% of waste is considered hazardous materials that may be infectious, toxic or radioactive. When all the waste is mixed together, 100% of the waste turns infectious and hazardous as well as become unmanageable. According to 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."

Background of the Study:

Efforts towards safe and proper management 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 extending to the whole of the Kolkata was taken by the Health and Family Welfare Department of the Government of Kolkata for management of bio-medical waste in the secondary level (District, Sub-Divisional, Kolkata-General and Rural) Government hospitals. With the introduction of the Bio-Medical Waste (BMW) Rules in 1998 West Bengal Pollution Control Board (WBPCB) became the designated authority to approve and monitor the BMW management in the Kolkata. The years that followed witnessed establishment of a number of common bio-medical waste treatment facilities with systems of segregated collection, treatment and disposal of bio-medical waste that covers a major part of the Kolkata.

Today, 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 Kolkata. The exercise is called for not only to identify the strengths and weaknesses of the efforts but also to indicate requirements and possibilities – indispensable elements for future planning.

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 and 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

A) Government Health Care Units

Category of HCUs	Size	HCUs Surveyed
Large Referral Hospitals	Very large	1. Calcutta National MCH, 24 Gorachand Road, Kolkata 700014 2. R.G. Kar MCH, 1 Belgachia Road, Kolkata-700037 3. SSKM Medical College

B) Private HCUs and DUs

Category of HCUs	Size	HCUs Surveyed
Private hospitals (Very Large: 300+ beds; Large: 100+ - 300 beds; Medium: 50+ -100 beds; Small: Upto 50 beds)	2 Hospitals, one very large, and the other of large category	1. Advanced Medical Research Institute (AMRI), P-4 & 5, C.I.T., Sch, Block-A, 15, Panchanantala Road, Kol- 700029 2. Woodlands Hospital, 8/5 Alipore Road, Kol- 700027
Diagnostic Centers	One Diagnostic Center of large category	1. Drs. Tribedi and Roy Diagnostic Laboratory, 93, Park Street, Kol-16
	Two Diagnostic Center of medium category	2. Theism Ultra Sound Center, Dumdum 3. Scientific Clinical Research Laboratory

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

National Medical College Bio-Medical Waste Generated by Category in Kg								
DAY	Occupancy	Human Anatomical Waste	Microbiology & Biotechnology 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	989	32.32	2.85	17.545	2.74	149.85	78.22	283.525
Day 2	911	27.33	3.54	16.22	2.56	135.85	72.88	258.38
Day 3	941	29.5	1.33	18.56	3.125	142.65	82.46	277.625
Day 4	1034	33.08	3.65	18.98	3.98	155.85	79.85	295.39
	3875	122.23	11.37	71.305	12.405	584.2	313.41	1114.92
Average per day	968.75	30.5575	2.8425	17.82625	3.10125	146.05	78.3525	278.73
Average per day per bed		0.032	0.003	0.018	0.003	0.151	0.081	0.288
Average per day per bed by %		10.950	1.019	6.388	1.111	52.334	28.076	99.877
Non-recyclable					Recyclable			
CAT 1	CAT 3	CAT 5	CAT 6	Total	CAT 4	CAT 7	Total	
0.03	0.003	0.003	0.15	0.186	0.018	0.081	0.098	

Non-recyclable	Recyclable	Total
0.186	0.098	0.288

R. G. Kar Medical College								
Bio-Medical Waste Generated by Category in Kg								
DAY	Occupancy	Human Anatomical Waste	Microbiology & Biotechnology 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	1024	29.080	3.820	16.335	1.440	142.322	66.200	259.197
Day 2	1005	33.010	3.200	22.830	2.900	130.865	42.950	235.75
Total	2029	62.090	7.020	39.16	4.34	273.18	109.15	494.95
Average per day	1015	31.045	3.510	19.58	2.17	136.59	54.575	247.47
Average per day per bed		0.031	0.003	0.019	0.002	0.135	0.054	0.244
Average per day per bed by %		12.54	1.42	7.91	0.88	55.15	22.04	100

Non-recyclable				
CAT 1	CAT 3	CAT 5	CAT 6	Total
0.031	0.003	0.002	0.135	0.1

Recyclable		
CAT 4	CAT 7	Total
0.019	0.054	0.073



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Non-recyclable	Recyclable	Total
0.171	0.073	0.244

SSKM Medical College								
Bio-Medical Waste Generated by Category in Kg (Level 3)								
DAY	Occupancy	Human Anatomical Waste	Microbiology & Biotechnology 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	1440	45.060	4.970	27.990	3.200	192.640	86.950	360.810
Day 2	1436	43.300	5.130	27.100	3.760	192.400	82.920	354.610
Total	2876	88.360	10.100	55.090	6.960	385.040	169.870	715.420
Average per day	1438	44.180	5.050	27.545	3.480	192.520	84.935	357.710
Average per day per bed		0.031	0.004	0.019	0.002	0.134	0.059	0.249
Average per day per bed by %		12.34	1.41	7.69	0.97	53.77	23.72	100

Non-recyclable				
CAT 1	CAT	CAT 5	CAT 6	Total

Recyclable		
CAT 4	CAT7	Total



	3							
0.031	0.004	0.002	0.134	0.171		0.019	0.059	0.078

	Non-recyclable	Recyclable	Total
per bed/day	0.171	0.078	0.249
%	69	31	

AMRI								
Bio-Medical Waste Generated by Category in Kg (Bed Capacity-380)								
DAY	Occupancy	Human Anatomical Waste	Microbiology & Biotechnology 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	327	10.850	3.520	9.650	1.320	71.980	69.230	166.550
Day 2	334	12.580	2.950	15.450	2.650	80.480	75.520	189.630
Day 3	330	13.850	4.250	10.950	2.350	73.520	79.800	184.720
Day 4	319	9.350	2.420	9.250	6.350	68.520	74.360	170.250
Total	1310	46.63	13.14	45.30	12.67	294.50	298.91	711.15
Average per day	328	11.66	3.29	11.33	3.17	73.63	74.73	177.79
Average per day per bed		0.036	0.010	0.035	0.010	0.224	0.228	0.542
Average per day per bed by %		6.56	1.85	6.37	1.78	41.41	42.04	100

Non-recyclable				
CAT 1	CAT 3	CAT 5	CAT 6	Total
0.036	0.010	0.010	0.224	0.280

Recyclable		
CAT 4	CAT 7	Total
0.035	0.228	0.263

Woodlands

Bio-Medical Waste Generated by Category in Kg (Bed Capacity-230)								
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	119	3.980	1.750	4.850	1.410	24.990	27.370	64.350
Day 2	124	4.120	2.100	5.420	1.550	25.900	28.360	67.450
Day 3	159	6.420	1.650	6.300	2.350	33.390	30.250	80.360
Day 4	124	4.360	1.250	3.950	1.650	25.240	27.650	64.100
Total	526	18.88	6.75	20.52	6.96	109.52	113.63	276.26
Average per day	132	4.72	1.69	5.13	1.74	27.38	28.41	69.07
Average per day per bed		0.036	0.013	0.039	0.013	0.207	0.215	0.523
Average per day per bed by %		6.84	2.44	7.43	2.52	39.66	41.15	100

Non-recyclable				
CAT 1	CAT 3	CAT 5	CAT 6	Total
0.036	0.013	0.013	0.207	0.269

Recyclable		
CAT 4	CAT 7	Total
0.039	0.215	0.254

Non-recyclable	Recyclable	Total
0.269	0.254	0.523

Drs. Tribedi & Roy Diagnostic Laboratory

Bio-Medical Waste Generated by Category in Kg (Level 3)								
DAY	No. of Samples Collected	Human Anatomical Waste	Microbiology & Biotechnology 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	1200		8.220	5.955		2.290	15.875	32.340
Day 2	1200		7.850	7.630		3.750	18.820	38.050
Total	2400		16.070	13.585		6.040	34.695	70.390
Average per day	1200		8.035	6.793		3.020	17.348	35.195
Average per day per sample			0.007	0.006	0.000	0.003	0.014	0.029
Average per day by %			23.09	19.52	0.00	8.68	49.85	100

Notes

1. Average samples has been considered as 1200 on the basis of information provided by the Laboratory authority
2. Histopathology samples are disposed of once in a month. Average 80 samples per day are analysed as informed by the Lab authority. Considering average 10 gms per samples, Cat 3 has been increased by 0.800 Kg per day.

Non-recyclable				
CAT 1	CAT 3	CAT 5	CAT 6	Total
0.000	0.007	0.000	0.003	0.010

Recyclable		
CAT 4	CAT 7	Total
0.006	0.014	0.020

Non-recyclable	Recyclable	
0.010	0.020	0.030

Theism Ultra Sound Centre

Bio-Medical Waste Generated by Category in Kg (Level 3)								
DAY	No. of Samples Collected	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	900		6.610	4.085		3.705	8.700	23.100
Day 2	900		5.970	4.700		3.450	8.820	22.940
Total	1800		12.580	8.785		7.155	17.520	46.040
Average per day	900		6.290	4.393		3.578	8.760	23.020
Average per day per sample			0.007	0.005		0.004	0.010	0.026
Average per day by %			26.88	18.77		15.29	37.44	100.00

Notes

1. Average samples has been considered as 900 on the basis of information provided by the Laboratory authority
2. Histopathology samples are disposed of once in a month. Average 60 samples per day are analysed as informed by the Lab authority. Considering average 10 gms per samples, Cat 3 has been increased by 0.600 Kg per day.

Non-recyclable				
CAT 1	CAT 3	CAT 5	CAT 6	Total
0.000	0.007	0.000	0.004	0.011

Recyclable		
CAT 4	CAT 7	Total
0.005	0.010	0.015

	Non-recyclable	Recyclable	
	0.011	0.015	0.026
By %	42	58	

Scientific Clinical Research Laboratory Pvt. Ltd.

Bio-Medical Waste Generated by Category in Kg (Level 3)								
DAY	No. of Samples Collected	Human Anatomical Waste	Microbiology & Biotechnology 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	1350		12.190	6.390		7.770	12.790	39.140
Day 2	1350		10.500	6.630		7.950	11.700	36.780
Total	2700		22.690	13.020	0.000	15.720	24.490	75.920
Average per day	1350		11.345	6.510	0.000	7.860	12.245	37.960
Average per day per sample			0.008	0.005	0.000	0.006	0.009	0.028
Average per day by %			30.01	17.22	0.00	20.79	32.39	100

Notes

1. Average samples has been considered as 1350 on the basis of information provided by the Laboratory authority
2. Histopathology samples are disposed of twice in a month. Average 20 samples per day are analysed as informed by the Lab authority. Considering average 10 gms per samples, Cat 3 has been increased by 0.200 Kg per day.

Non-recyclable				
CAT 1	CAT 3	CAT 5	CAT 6	Total
0.000	0.008	0.000	0.006	0.014

Recyclable		
CAT 4	CAT 7	Total
0.005	0.009	0.014

	Non-recyclable	Recyclable	
	0.014	0.014	0.028
By %	51	50	

2. Average bio-medical waste generation profile:

Government HCUs

Among the government hospitals it was found that generation of bio-medical waste per bed per day varied in accordance with availability of number of different treatments and laboratory tests. In this way it is evident that the Medical Colleges and Hospitals produce highest amount of waste per bed per day. Average bio-medical waste has been calculated per patient per day. (BMW) are Cat 6 and Cat 7. Again the weight of non-recyclable BMW (Cat 1, 3, 5 and 6) is almost double that of recyclable BMW (Cat 4 and 7). Average weight of used saline bottles ranges from 20% to 30% of Category 7.

1) National Medical College

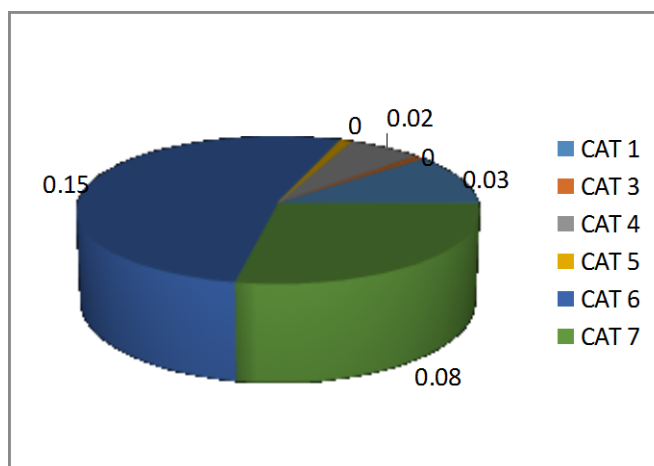


Fig 1: Average bio-medical waste generation profile- National Medical College

2) R.G.Kar Medical College and Hospitals

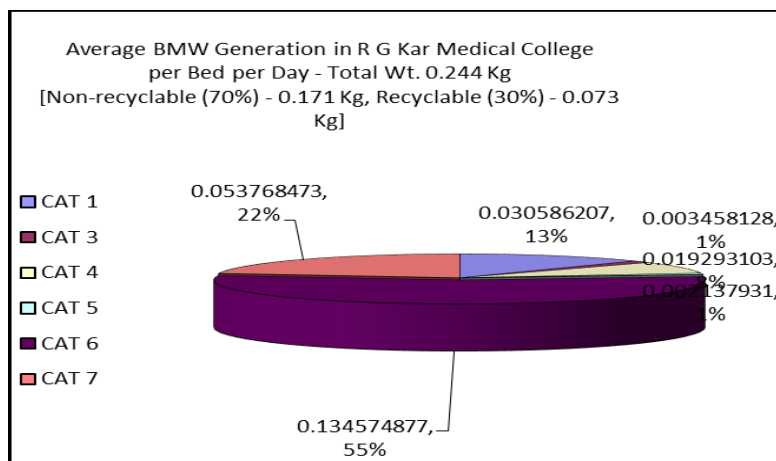


Fig 2: Average bio-medical waste generation profile- R.G.Kar Medical College and Hospitals
3) **SSKM Medical College and Hospital**

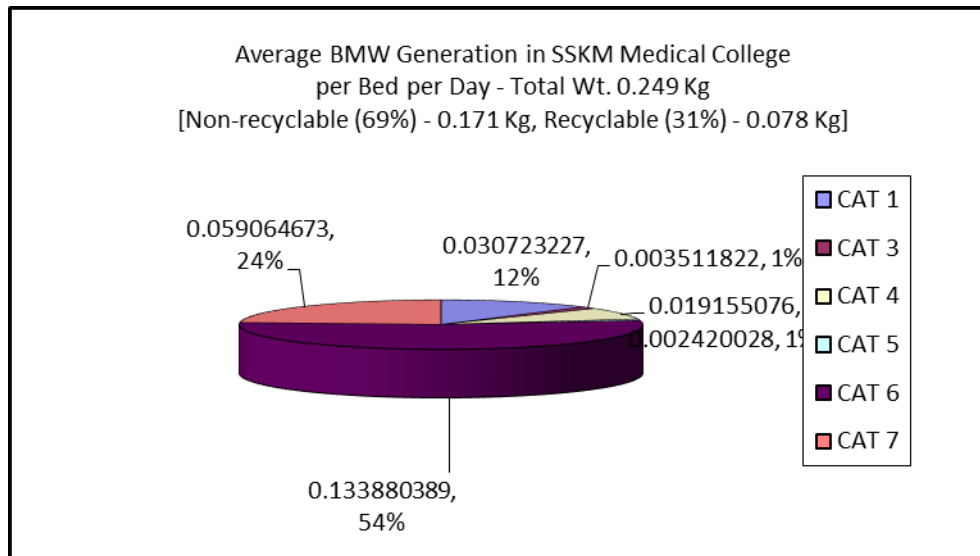


Fig 3: Average bio-medical waste generation profile- SSKM Medical College and Hospitals

Private Hospitals

Private hospitals of different categories by size viz., Very Large, Large, Medium and Small were taken up for study. It is observed that compared to government hospitals of similar bed strength, private hospitals generate considerably more bio-medical waste.

HCU Categories Unit Wt. of BMW generated (gms)

Very large Pvt. Hospital (300+ bed strength) Per Bed per Day	542
Large Pvt. Hospital (100 to 300 bed strength) Per Bed per Day	523
Medium Hospital (50 to 100 Bed Strength) Per Bed per Day	371
Small Hospital (below 50 bed strength) Per Bed per Day	312

Another feature of BMW generated in private hospitals is that the proportion of recyclable waste was found to be more compared to that of government and municipal hospitals. Generation of recyclable waste in private HCUs almost equals that of non-recyclable waste. Average bio-medical waste generation in the HCUs

4) Private Hospitals: AMRI (very large category)

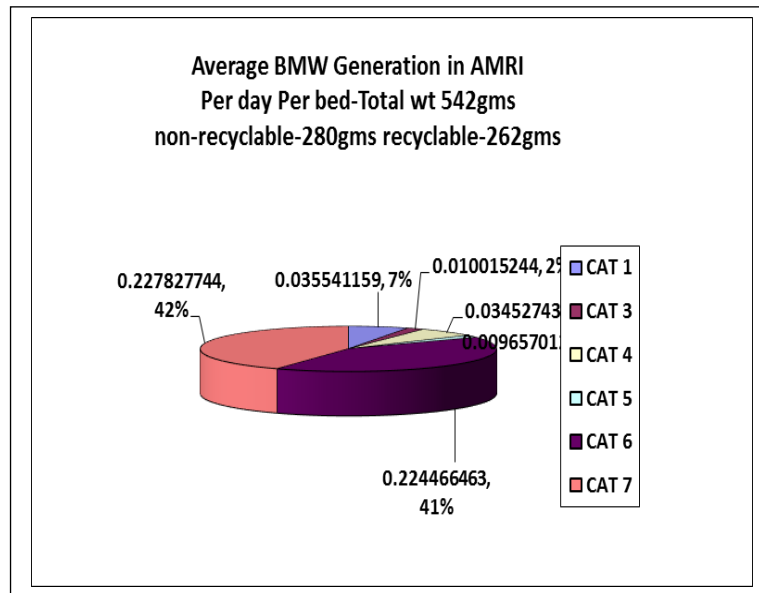


Fig 4: Average bio-medical waste generation profile- AMRI

5) Private Hospitals: Woodlands

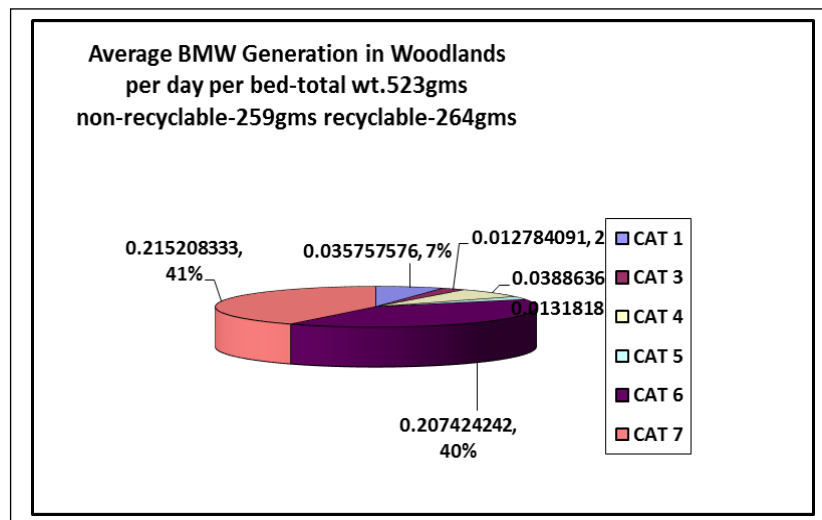


Fig 5: Average bio-medical waste generation profile- Woodlands

Pathological Laboratories

Some of the pathological laboratories (mainly large ones) have histopathology unit. A good amount of human body parts and tissue waste (Cat 1) is generated in these units. Other pathological laboratories, which do not have histopathology, do not produce Cat 1. Thus total production of Cat 1 from pathological laboratories is very small.

6) Large - Drs. Trivedi & Roy Diagnostic Laboratory

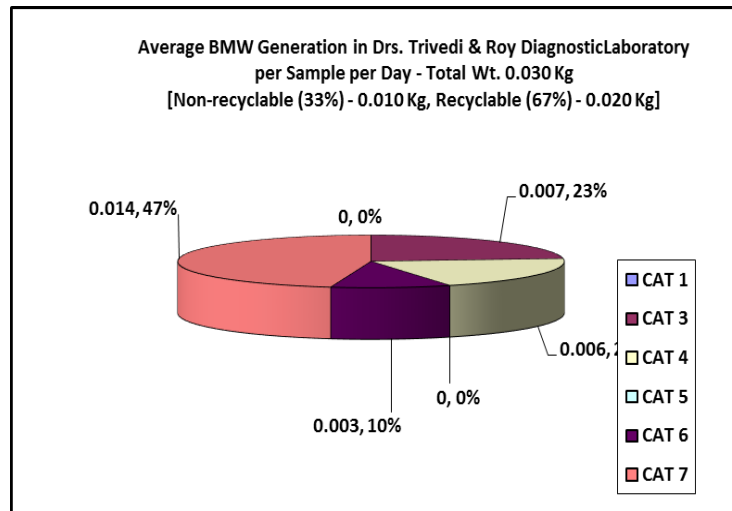


Fig 6: Average bio-medical waste generation profile- Drs. Trivedi & Roy Diagnostic Laboratory

7) Theism Ultra Sound Centre-Dumdum

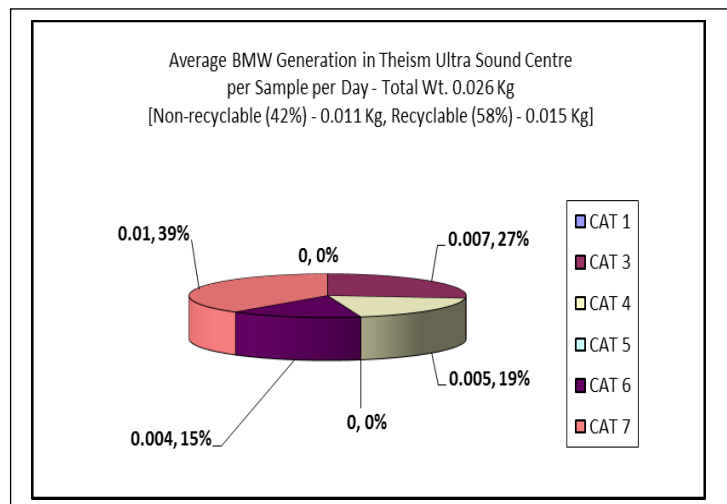


Fig 7: Average bio-medical waste generation profile-Theism Ultra Sound Centre

8) Sceintific Clinical Research Laboratory Pvt Ltd.

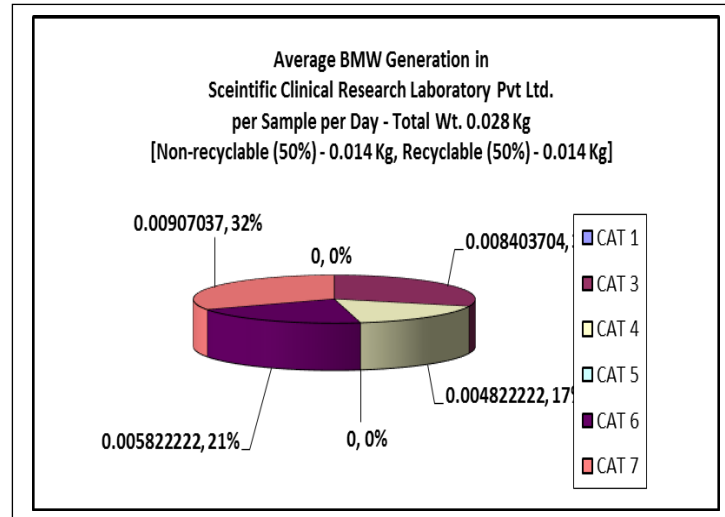


Fig 8: Average bio-medical waste generation profile- Scientific Clinical Research Laboratory Pvt Ltd.

3. Quantification Summary

Table-I-Government Hospitals (Large)

Average BMW Generation Bedded facility per bed per day							
Government	CAT 1	CAT 3	CAT 4	CAT 5	CAT 6	CAT 7	Total BMW
National Medical College	0.03	0.00	0.02	0.00	0.15	0.08	0.29
R.G.Kar	0.03	0.00	0.02	0.00	0.13	0.05	0.24
SSKM	0.03	0.00	0.02	0.00	0.13	0.06	0.25
Total(category wise)	0.09	0.01	0.06	0.01	0.42	0.19	0.78

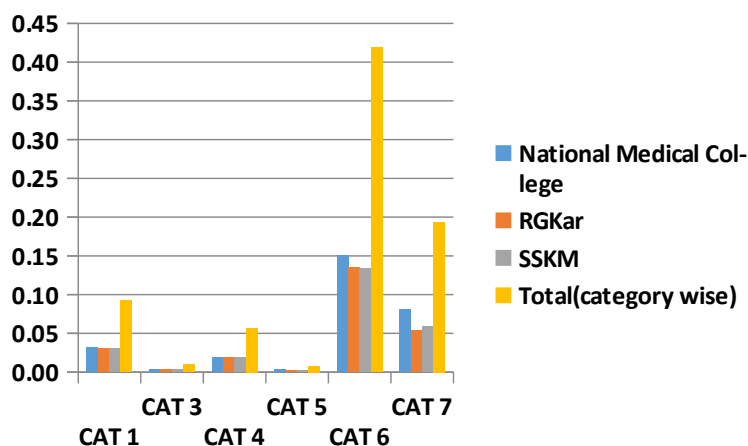


Fig 9: Average category wise BMW generation (wt in kg) in government hospitals with bedded facility

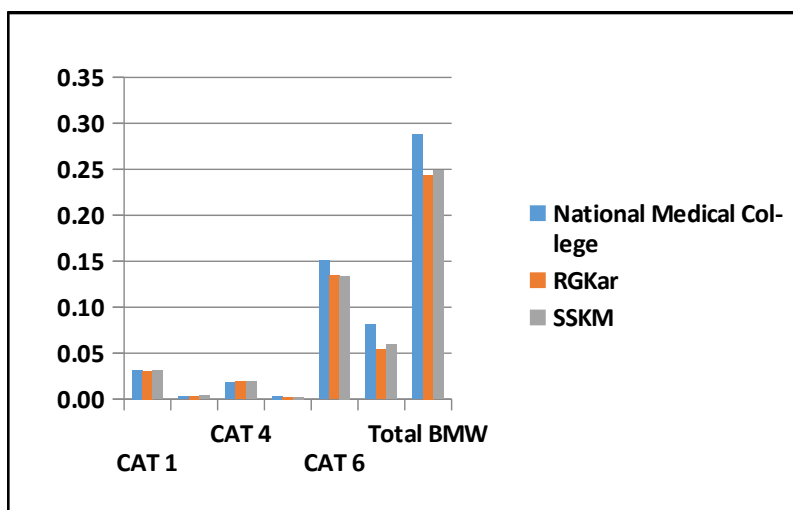


Fig 10: Comparison of total BMW generation (wt in kg) in government hospitals with bedded facility

Table-II-Private Hospitals with Bedded Facility (Large)

Average BMW Generation Bedded facility per bed per day(Private Hospitals)							
Private Hospitals	CAT 1	CAT 3	CAT 4	CAT 5	CAT 6	CAT 7	Total BMW
AMRI	0.036	0.010	0.035	0.010	0.224	0.228	0.542

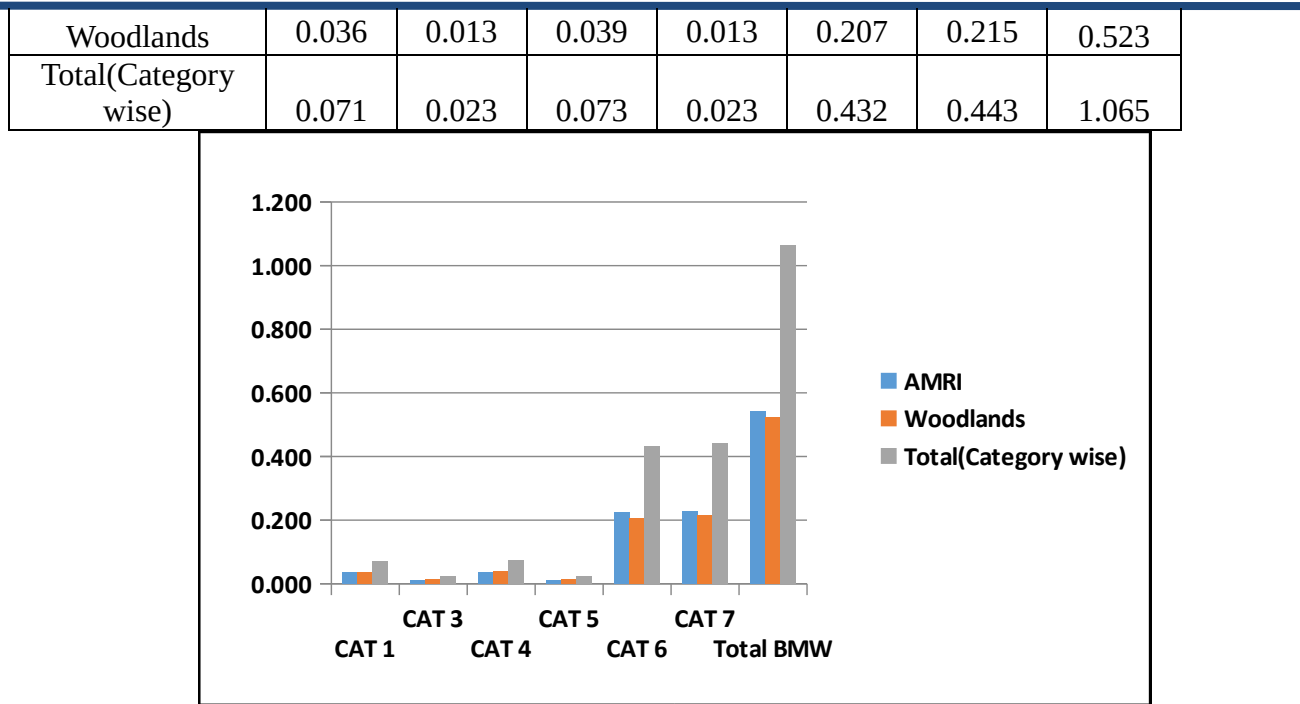


Fig 11: Comparison of Average category wise BMW generation (wt in kg) in Private government hospitals with bedded facility

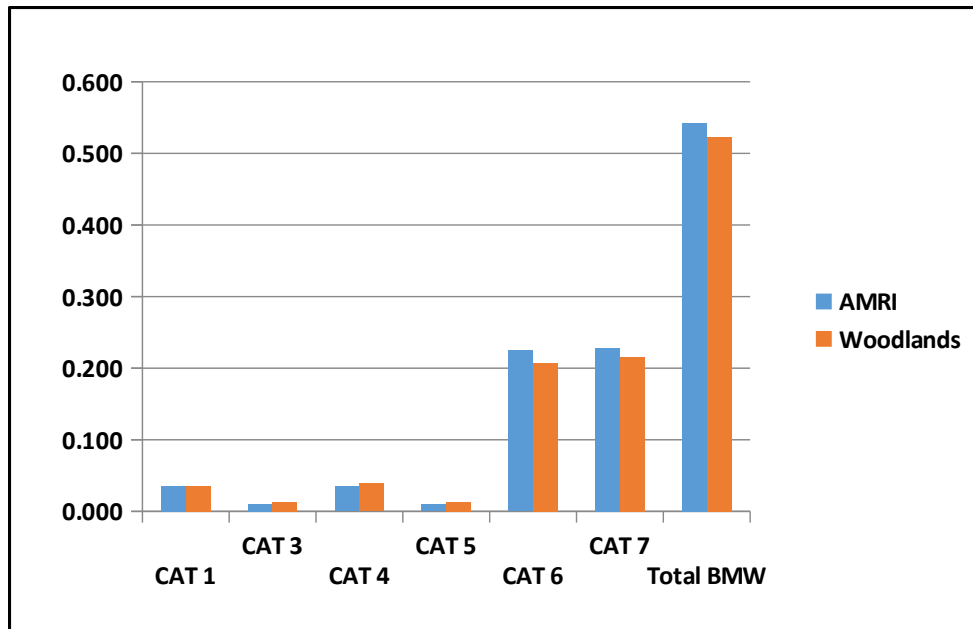


Fig 12: Comparison of Average BMW generation (wt in kg) in Private hospitals with bedded facility

Table-III- Pathological Laboratories

Average BMW Generation Pathological Laboratories							
	CAT 1	CAT 3	CAT 4	CAT 5	CAT 6	CAT 7	Total BMW
Roy and Trivedi	0.000	0.007	0.006	0.000	0.003	0.014	0.030
Theism	0.000	0.007	0.005	0.000	0.004	0.010	0.026
Scientific Clinical Laboratories	0.000	0.008	0.005	0.000	0.006	0.009	0.028
Total(Category wise)	0.000	0.022	0.016	0.000	0.013	0.033	0.084

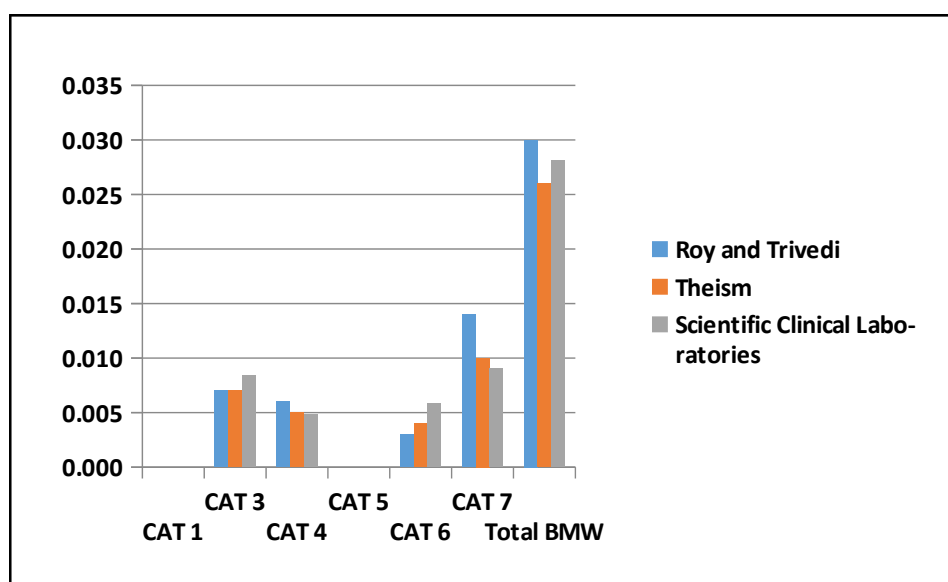


Fig 13: Comparison of Average BMW generation (wt in kg) in Path Labs

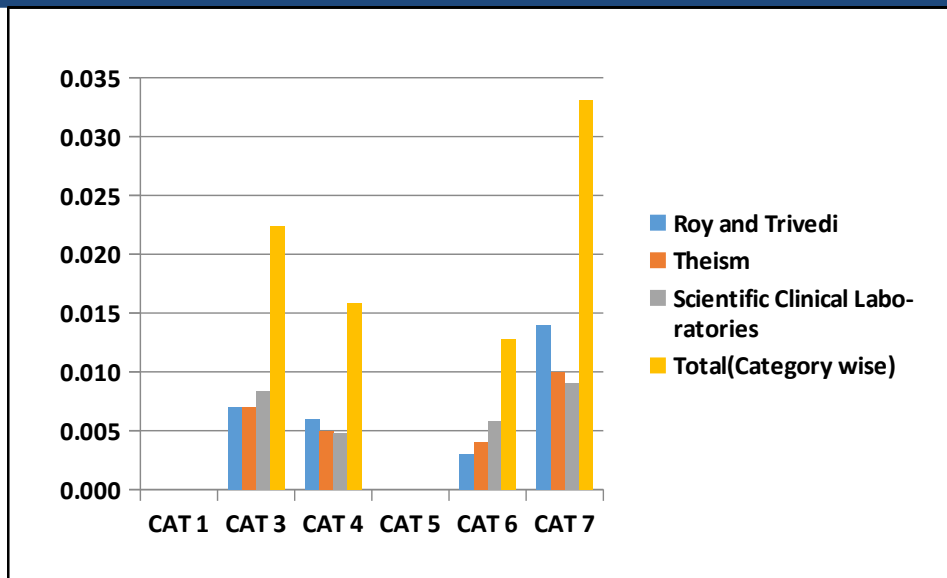
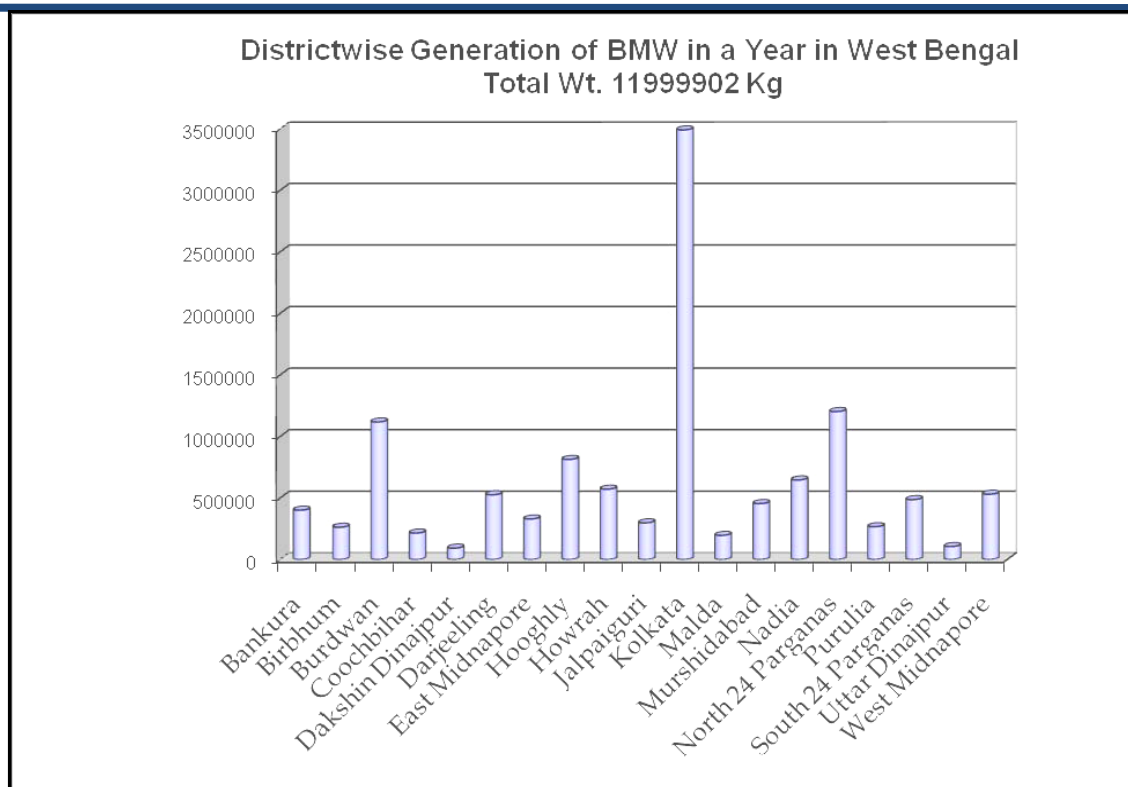


Fig 14: Comparison of Average category wise BMW generation (wt in kg) in Path Labs

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	2520 7	13135	12072	63462	32505	3095 7
2011	89499	46045	43454	2548 9	13262	12227	64010	32783	3122 7
2012	90320	46445	43874	2576 9	13388	12381	64551	33057	31494
2013	91122	46836	44287	2604 5	13511	12534	65077	33325	31752
2014	91920	47223	44697	2632 0	13634	12686	65600	33589	32011
2015	92725	47613	45112	2659 8	13757	12841	66127	33856	32271
2016	93550	48012	45538	2688 3	13883	13000	66667	34129	32538

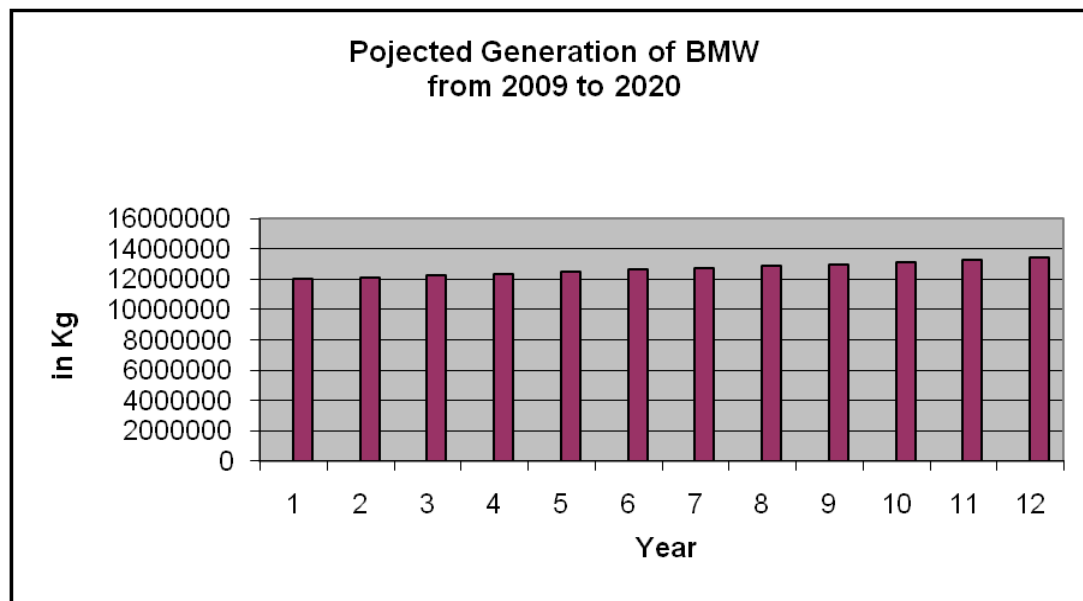
In the above estimate it is seen that annual increase in population has been estimated as 0.87% to 0.94% per year. Though there is a huge shortfall in number of existing basic health care facilities with respect to population, a very conservative estimate is made regarding increase of BMW generation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

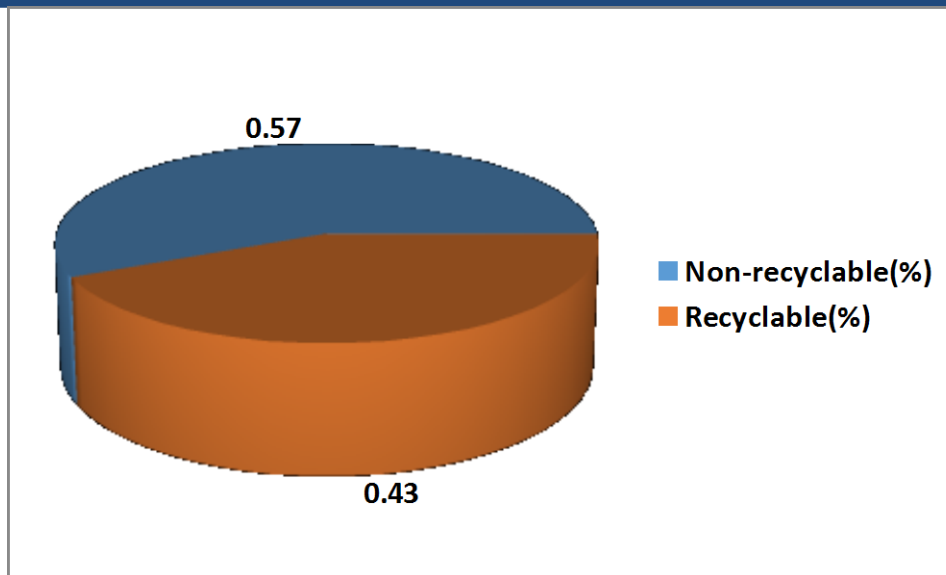
2014	12612018
2015	12738138
2016	12865520
2017	12994175
2018	13124117
2019	13255358
2020	13387911

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

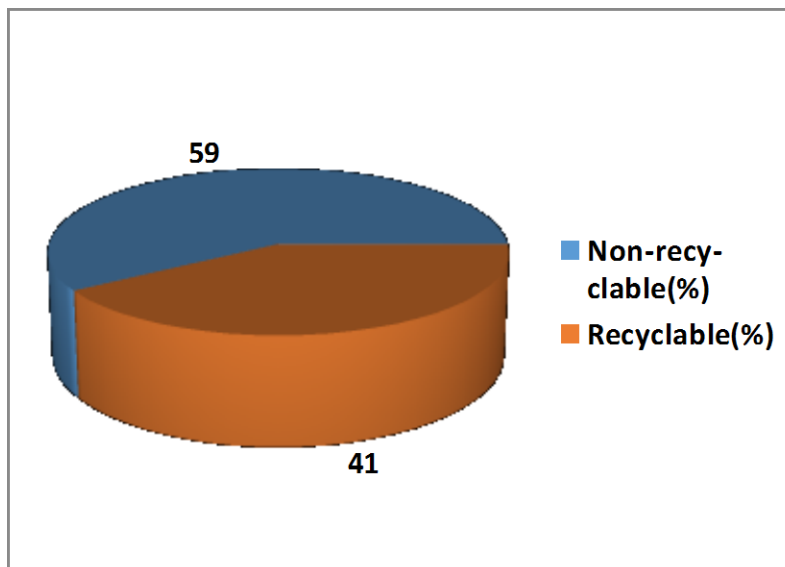


Proportion of Recyclable and Non-Recyclable BMW:

Generally plastic, glass and metal in BMW are recyclable items while others are considered as non-recyclable (though cloth, linen etc. may be recycled). For calculation of proportion of recyclable and non-recyclable items only categories 4 and 7 have been included in recyclable and categories 1,2,3,4,5 and 6 have been considered as non-recyclable.



Considering the total waste from different categories of HCUs, it may be noted that 43% of BMW is found recyclable whereas 57% is found non-recyclable. However in case of bedded HCUs proportion of soiled waste is more. In bedded HCUs proportion of recyclable waste is only 41% of total BMW generated. Again it has been estimated that 30% of recyclable waste in bedded HCUs is composed of IV fluid bottles.



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 HHCU 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.

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