

SURVEY AND STATE OF THE ART ON BIOMEDICAL WASTE MANAGEMENT IN PUDUCHERRY HOSPITALS

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Abstract: *In a densely populated and developing country like India, the tremendous population growth of over 1.2 billion has aided in the advancement of medical techniques and facilities. But, this has brought a dangerous situation where concern of disposing all the biomedical waste is very important. Biomedical waste includes all types of wastes that are generated from health facilities such as cotton, plaster, disposable syringes, used syrup bottles etc. The biomedical wastes are sometimes mixed with municipal solid waste and disposed. This leads to fatal consequences to environment as well as human. The (MoEF) Ministry of Environment Forests in 2011 showed that close to 13, 000 medical facilities in our country are in violation of the Biomedical Medical Waste Generation and Disposal Rules of 1998. This issue is of grave concern and has gained national wide attention. This critical issue is to be cleared soon and considered as the need of the hour. Bio-Medical Waste (Management and Handling) Rules, 2016 directs the prescribed authorities to execute the rules more efficiently in the way of minimizing the generation of waste with efficient and environmental friendly disposal methods. The present survey was conducted to identify and calculate the sources of the biomedical wastes from the hospitals, labs, clinics. The study shows that the BMW generated per day is high in The Union Territory of Pondicherry. This survey aids in the inventory on status of the society with respect to biomedical waste management and its implication towards protection of the environment and human life.*

Keywords: *Biomedical waste generation, Survey, Treatment, management*

I. INTRODUCTION

The types of wastes categorized as industrial, municipal, sewage, agricultural and hospital waste (biomedical waste) are generated due to the activities of human beings (Ravinder 2017). Biomedical wastes contaminate soil, water and air; hence it should be controlled carefully (Reema Kumari et al., 2013). The materials produced during different activities of treatment of human beings or animals may be noted as biomedical waste (Lee, 1989; Baveja et al., 2000; Gupta and Boojh, 2006). It may include: (1) wastes targeted for safety measures at the time of handling and disposal which includes pathological and infectious wastes, and (needles or sharp materials) (2) toxic wastes such as mercury, and radioactive wastes (Remy 2001, Askarain et al., 2004). The World Health Organization (WHO) 2011 stated that around 10% of the medical wastes are infectious, 5% are non-infectious but hazardous wastes. Biomedical Waste Management Rules (2016) of Government of India have come into force since March 2016. The broad types of waste generated at different health care facilities are similar types of waste and there is constantly a chance of dispersion of the infection owing to improper handling of pathogenic waste. The important issue is that the waste from medical facilities has not drawn serious attention as that of other wastes such as MSW although it has the risk of several health effects. Such residues are capable of transmitting various diseases and create risk to the health care personnel and the community and have an effect on the environment when the wastes are not handled properly (Silva et al., 2005). It is reported that waste generated at different medical facilities is generally low in the lower income countries than that of high-income countries (Muluken Azage and Abera Kumie, 2014).

The World Health Organization (2017) have given the sources of biomedical wastes as follows,

- research centres and laboratories
- hospitals , clinics, dispensaries.
- autopsy centres and mortuary
- testing laboratories and animal research
- different sample collection and blood bank services.
- nursing facilities at old age homes.

The WHO mentioned that, the hazardous waste generated from one hospital per bed per day from the high income is around 0.5 kg whereas it is of 0.2 kg in low-income countries. On the other hand, medical waste is not segregated into hazardous or non-hazardous. Health-care waste includes pathogens that can transmit a disease to hospital patients, staffs and the general public. The other important aspect possibly is development of drug-resistant microorganisms from health facilities into the environment.

The present survey was conducted in The Union Territory of Puducherry with the concern over improper disposal of biomedical waste. First the sources of the biomedical waste from the hospitals, labs, clinics were calculated and the study shows that the BMW generated per day is high and mentions. This survey would be a base in formulating guidelines towards treatment system

Effects of biomedical waste

The World Health Organisation has listed the health effects related by the way of biomedical waste and by-products. They are:

- (i) Injuries due to blades and sharps
- (ii) Noxious exposure to antibiotics and cytotoxic drugs mimicking chemicals.

- (iii) Chemical burns due to ill effects of disinfection and sterilization;
- (iv) Air pollution takes place as a consequence of the release of mercury, dioxin, and particulate matter during incineration; and other activities.
- (v) Radiation burns.
- (vi) The most dangerous effects of biomedical wastes are mainly because of the poor management. Bacterial contamination is the most immediate health risk and water is the main source for this contamination. Disposal of expired drugs, used syringes causing Hepatitis B, C and HIV etc., are to be taken care of with uttermost importance (Manasi 2017).

An extensive variety of pollutants are produced during waste incineration systems which are harmful to human health. Dioxin is an extremely toxic compound which may disrupt reproductive systems, cause cancer and neurological damage, thyroid systems respiratory systems etc. MSW (Municipal Solid Waste) contains all the chemicals, hospital wastes, organic and an inorganic material causes many problems. The contamination of soil with dumped waste is route to the ground water pollution. The water contamination level gets increased near dumping sites (Akhtar Malik Muhammad et al., 2014).

II. MANAGEMENT AND TREATMENT

Segregation of wastes

The harmful effects of waste need to be identified and segregated according to their hazards. This separation makes the disposal process quite simple and easy (Rashmi Kundapur, 2014).

Collection of wastes

The BMW should be collected from the point where it is generated and ensured that waste is collected regularly and never allowed to accumulate in the place itself. According to WHO the waste should be collected safely with air tight bags, the transportation equipment should be simple and easy for loading and unloading. The corners or edges should not be sharp so that tearing of bags can be avoided. The container should be demarcated clearly. WHO recommends that while transporting waste over a longer distance, the waste should be carried in closed rigid well labeled containers as mentioned in Table 1 as per the Biomedical Waste Management Rules of 2016.

Table 1 Types of coloured bags allotted for types of waste (Source: Biomedical Waste Management and Handling Rules, 2016)

COLOURED BAGS	TYPE OF WASTES
Yellow bag	Human tissues, body parts, organs, blood/body fluids, and other contaminated materials.
Red Bag	Items disposed after use: tubes, bags, syringes etc.
White bag (Translucent)	Waste sharps: needles, blades etc.
Black bag	Broken unwanted, non-usable glasses etc.

III. TREATMENT

The most challenging task is the treatment of the waste in such a way that there is a decrease or eradication of serious threat.

MEDICAL WASTE TREATMENT ON-SITE

Autoclaving

Thermal treatment is mainly used for sharps and other infectious wastes. Autoclave use high temperature and the pressure deeply penetrate through all materials and kills microorganisms and thus it sterilizes the contents.

Chemical Treatment

Chemical disinfectant is useful for deactivating the microorganism in liquid waste. Depending upon the waste, chemicals like hypochlorite, chlorine, sodium hydroxide, and calcium oxide is used with uttermost care as these chemicals makes some byproducts which are harmful. Sometimes solidifying agents are used to turn the liquid into solid form and then directed for disposal.

OFF-SITE MEDICAL WASTE TREATMENT

1. Incineration

Pathological and pharmaceutical wastes are disposed mainly by incineration process. About 99% of microorganisms get killed and it leaves behind very minimal waste. Incineration is the process of controlled combustion of the waste converting them into inert material and gas. Incomplete/improper combustion may release toxic substances.

2. Land Disposal

This is the popular and most followed method over other practices. Land disposal is recommended for shredded, treated and decontaminated wastes. Specialized sites are planned for this disposal to reduce the risk of soil and water pollution. It is comparatively an easy and low-cost disposal method. But this disposal cause several environmental problems when not disposed in order.

3. Plasma Pyrolysis

It is a new technique for safe disposal of medical waste, which converts organic wastes into commercially useful byproducts of commercial value. Medical waste with plasma made in contact with plasma – arc which pyrolysed the waste into CO, H₂ and hydrocarbons. These gases are burned and generate high temperature (Praveen Mathur et al., 2012).

Survey of biomedical waste generation in Puducherry

The wastes were collected from hospitals, clinics of Puducherry and calculated based on the wastes generated per bed in a day. For each and every bed the appropriate ratio of wastes that the hospitals disposes was calculated (Rajakannan et al., 2013). The average daily generation of biomedical waste in Pondicherry was surveyed and collected as per Rajakannan et al., (2013) and Jagadesh et al., (2013). The survey was carried out from the maximum biomedical waste generated. It was around 2613 kg/day from JIPMER followed by 734 kg/day from Rajiv Gandhi Women and Children Hospital, Puducherry and 609 kg/day from Government General Hospital, Puducherry. These are the three major biomedical waste generating hospitals as compared to any other hospitals, Clinics, Nursing Homes and Dispensaries in Puducherry. The Tables 2, 3, and 4 describes elaborately the biomedical waste generation in kilo grams per day with respect to the number of beds available and outpatients per day with respect to all the medical facilities available at Puducherry.

Table 2 Biomedical Waste generated in Puducherry

S. No	Hospital name	No of beds available	Daily Average bed occupancy rate (%)	No of beds occupied	Avg. BMW (Kg/ bed/ day)	Daily out-patient/day	BMW (Kg/ head/day)	Total BMW generated (Kg/day)
1	Arupadaiveedu Medical College and Hospital	600	58	350	1.2	260	0.04	430.4
2	Mahathma Gandhi Medical College and Research Institute	600	70	398	1.4	321	0.03	566.83
3	Sri Lakshmi Narayana Institute of Medical Sciences	600	52	224	1.5	189	0.03	341.67
4	Rajiv Gandhi Women and Children Hospital	480	100	450	1.6	360	0.04	734.4
5	Sri Vengateshwara Medical College And Research Centre	500	60	300	1.2	250	0.02	365
6	PIMS	450	90	360	1.1	150	0.04	402
7	Sri Manakula Vinayagar Medical College and Hospital	600	65	350	1	241	0.03	357.23
8	Government General Hospital Puducherry	550	100	500	1.2	450	0.02	609
9	Aravind Eye Hospital	120	62	74.4	0.7	51	0.04	54.12
10	JIPMER	1750	120	1600	1.5	7100	0.03	2613
11	Indira Gandhi Government Hospital	400	100	370	1.4	1800	0.02	554
								7027.65

Table 3 Biomedical Waste generated from primary hospitals

S.No	Hospital name	No of beds	Daily Average bed occupancy rate(%)	No of beds occupied	Avg. BMW (Kg/ bed/ day)	Daily out-patient/day	BMW (Kg/ head/day)	Total BMW generated (Kg/day)
1	St.Josephs hospital (Cluny)	80	72	57.6	1	50	0.03	59.1
2	Clinic Nallam	50	56	28	0.6	41	0.02	17.62

3	Pondicherry Medical Mission	50	62	31	0.5	30	0.03	16.4
4	A.G.Padmavathi Hospital	40	60	24	0.6	31	0.04	15.64
5	L.K. Nursing Home	30	60	18	0.4	30	0.02	7.8
6	Sri Sai Kruba Hospital	24	62	14.88	0.6	20	0.03	9.528
7	St.Marys eye care	5	50	2.5	0.4	3	0.02	1.06
8	Sri Aurobindo Ashram	24	70	16.8	0.7	16	0.04	12.4
9	Kamala Nursing Home	8	65	5.2	0.4	2	0.02	2.12
10	East coast (Fortis)	20	60	12	0.4	10	0.04	5.2
11	East Coast Specialty Centre	26	76	19.76	0.7	12	0.03	14.192
12	New Medical Centre	25	80	20	0.6	13	0.04	12.52
13	Vasan Eye Care	10	82	8.2	1.1	4	0.03	9.14
14	Lucas TVS ltd	1	80	0.8	0.3	1	0.02	0.26
15	BVL Hospital pvt.ltd	20	66	13.2	0.7	11	0.03	9.57
16	Vasudevan ENT clinic	1	65	0.65	1.1	0	0.02	0.715
17	Tresor nursing home	1	60	0.6	0.7	0	0.02	0.42
18	Madhava hospital	12	78	9.36	0.9	4	0.03	8.544
19	Sedhu Nursing Home	10	70	7	0.8	4	0.03	5.72
20	Maternity Hospital	10	70	7	1.2	2	0.03	8.46
21	Jothi Eye Care Centre	10	72	7.2	1	4	0.04	7.36
22	Sri Mahalakshmi Nursing Home	12	75	9	1.1	4	0.04	10.06
23	Rani Hospital	10	71	7.1	0.9	3	0.02	6.45
24	Sri Krishna Nursing Home	12	74	8.88	0.4	6	0.03	3.732
25	New Ashoka Nursing Home	10	70	7	0.9	4	0.03	6.42
26	Dakshin Women Care	8	67	5.36	1	3	0.03	5.45
28	Jahadish Eye Care	1	74	0.74	1	1	0.02	0.76
29	SS Remedy	8	70	5.6	0.5	1	0.03	2.83
30	Pondicherry Specialties Centre	1	69	0.69	0.4	0	0.02	0.276
31	Sri Arunachalam Hospital	10	52	5.2	0.7	2	0.03	3.7
32	Vasan Dental Care Hospital	1	50	0.6	1.2	0	0.03	0.72
33	Shuruthie Clinic	4	50	2	0.5	2	0.03	1.06
34	Mohan Clinic	6	70	4.2	0.5	2	0.02	2.14
35	Sristi Assited Advanced Fertility Centre	6	60	3.6	0.3	2	0.03	1.14
36	Sridevi Nursing Home	6	68	4.08	0.5	1	0.02	2.06
37	CERTH India	18	80	14.4	0.7	8	0.03	10.32
38	Gothis	1	60	0.6	0.4	0	0.02	0.24
39	ESV Clinic	15	74	11.1	0.4	3	0.03	4.53
40	MVR Medical Centre	16	64	10.24	0.6	6	0.03	6.324
41	Senthil Women And Child Hospital	20	80	16	1.1	8	0.04	17.92
42	Ariankuppam	4	100	4	0.8	108	0.03	6.44
43	Gorimedu	3	98	3	1.1	97	0.03	6.21

44	Kalapet	3	92	2.86	0.8	96	0.04	6.128
45	Kosapalayam	3	101	3.03	0.8	128	0.03	6.264
46	Lawspet	4	104	4.16	0.8	140	0.02	6.128
47	Mettupalayam	3	97	2.91	1.1	105	0.03	6.351
48	Mudaliarpet	3	90	2.7	0.8	102	0.03	5.22
49	Muthialpet	2	92	1.84	0.8	98	0.04	5.392
50	Odiansalai	3	86	2.58	0.6	87	0.03	4.158
51	Reddiarpalayam	4	93	3.72	0.9	103	0.03	6.438
52	Murungapakkam	3	96	2.88	0.8	122	0.03	5.964
53	Villianur	5	103	5.15	0.8	120	0.03	7.72
54	Ariyur	3	100	3	0.9	91	0.04	6.34
55	Abishegapakkam	3	100	3	0.9	110	0.03	6
56	Bahour	5	101	5.05	1	108	0.03	8.29
57	Karaymputhur	5	104	5.2	0.6	120	0.03	6.72
58	Katterikuppam	4	99	3.96	0.7	103	0.03	5.862
59	Kirumampakkam	4	92	3.68	1.1	119	0.02	6.428
60	Koodapakkam	2	96	1.92	0.8	95	0.03	4.386
61	Maducarai	4	97	3.88	0.8	120	0.04	7.904
62	Nettapakkam	10	100	10	0.8	110	0.03	11.3
63	Sedarapet	90	98	88.2	1.1	92	0.03	99.78
64	Sorapet	2	90	1.8	0.8	81	0.03	3.87
65	Sooramangalam	2	94	1.88	0.7	109	0.04	5.676
66	Thavalakuppam	4	85	3.4	1	108	0.03	6.64
67	Thirubuvanai	3	93	2.79	0.9	102	0.03	5.571
68	Thirukanur	2	92	1.84	0.7	110	0.03	4.588
69	Karikalam Pakkam	30	100	30	1.2	200	0.03	42
70	Mannadipet	20	98	19.6	0.8	110	0.03	18.98
71	Pondicherry University Health Centre	4	60	2.4	0.6	80	0.02	3.04
								588.973

Table 4 Biomedical Waste from clinical laboratories

S.No	Hospital Name	No of beds	Daily outpatient/day	BMW (Kg/head/day)	Total BMW generated (Kg/day)
1	Ideal Analytical And Research Institute	0	8	0.03	0.24
2	Metropolis Health Care	0	30	0.03	0.9
3	Senthil Diagnostics	0	20	0.03	0.6
4	Vcrc	0	15	0.02	0.3
5	Yohesh Clinical Lab	0	20	0.04	0.8
6	Aruna Clinical Lab	0	31	0.03	0.93
7	Medall Lab	0	25	0.04	1
8	East Coast Diagnostic	0	40	0.03	1.2
9	Roshini DiagnosticCentre	0	35	0.03	1.05
10	Aruna Collection Centre	0	44	0.04	1.76
11	Nirmal Lab	0	34	0.03	1.02
12	I.K.Lab	0	28	0.02	0.56
13	P.Balaji Clinical Lab	0	24	0.03	0.72
14	Devaraj Clinical Lab	0	36	0.03	1.08

15	Dr.Kumar S.K. Clinical Lab	0	45	0.04	1.8
16	Curie Lab	0	30	0.03	0.9
17	Surya Lab	0	32	0.04	1.28
18	Swamy Clinical Lab	0	24	0.03	0.72
19	Sugam Clinical Lab	0	33	0.02	0.66
20	Vimal Clinical Lab	0	33	0.03	0.99
21	Selvam Clinical Lab	0	42	0.03	1.26
22	J.S.Diagnostic Centre	0	55	0.02	1.1
23	Dr.Sivakumarharii Diabetic Clinic	0	35	0.03	1.05
24	Lalitha Clinical Lab	0	30	0.03	0.9
25	PondicherryBiotech (P) Ltd	0	45	0.03	1.35
26	Abusali Medical Lab	0	42	0.04	1.68
27	Thyrocare	0	20	0.03	0.6
28	Pondicherry Private Hospitals Association Blood Bank	0	70	0.03	2.1
29	Thillai Clinical Lab	0	23	0.04	0.92
30	Pondy Surgical Centre*	0	33	0.03	0.99
31	Tej Clinical Lab	0	25	0.04	1
32	Jaya Clinical Lab	0	21	0.02	0.42
33	Grace Diagnostic Centre	0	50	0.03	1.5
34	Shalom Diagnostic Centre	0	47	0.03	1.41
35	Lawspet Lab	0	36	0.02	0.72
36	Shankari Clinical Lab	0	60	0.04	2.4
37	Amirtha Diagnostic Centre	0	38	0.03	1.14
TOTAL					39.05

IV. CONCLUSION

With the cooperation of Government agencies and the Non-Government organizations, an appropriate management of biomedical waste is a task that needs to be realized. A number of toxic and hazardous materials are ought to be disposed off under controlled condition by means of proper transportation. Improper waste management cause severe problem to the society (Ravishekar et al., 2016). An establishment of concerned biomedical waste management with effective communication plan is crucial in case of awareness if trained staff are not employed. The awareness campaign to ignorant populace should be prioritized at present scenario. At present, incineration is the main disposal method which is commonly being practiced. But with the growth of the wastes quantity there is need for alternate disposal facilities. Finally this study investigated the current waste management practices and proved the problem arising with inappropriate techniques. Hence suitable techniques need to be implemented immediately. New and innovative methods which are affordable, feasible; simple to operate should be explored with serious concern towards better management. The waste management practice should be performed according to the WHO guidelines i.e. strict segregation of waste, deployment of well trained employees, proper storage and proper disposal of the waste.

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