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MANAGEMENT OF INFECTIOUS AND NON-INFECTIOUS SOILD WASTE GENERATION IN REWA, MADHYA PRADESH

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ABSTRACT

The management of Bio-medical waste is still in its infancy all over the world. There is a lot of confusion with the problem among generators, operators, decision makers and the general community about the safe management of Bio-medical waste. The reason may be lack of awareness in public and several drawbacks in waste management system. The Rewa city catering a population of nearly 3 lacs, has a Gandhi Memorial Hospital, Sanjay Gandhi Hospital, District Hospital, few health centers, many nursing homes and many pathology centers. These care centers have led to an obvious increase in the Bio-medical waste generated by them. In the present investigation the total amount of infectious and noninfectious waste generated from different healthcare centers within Rewa city was estimated and were classified in various categories under Bio-medical waste (Management and handling) Rules 1998 and amendment rule 2000.

KEY WORDS: Infectious and non-infectious materials, Bio-medical wastes, etc.

INTRODUCTION

The sources of solid waste include residential, commercial, institutional, and industrial activities. Certain types of wastes that cause immediate danger to exposed individuals or environments are classified as hazardous; these are discussed in the article hazardous-waste management. All nonhazardous solid waste from a community that requires collection and transport to a processing or disposal site is called refuse or municipal solid waste (MSW). Refuse include garbage and rubbish. Garbage is mostly decomposable food waste; rubbish is mostly dry material such as glass, paper, cloth, or wood. Garbage is highly putrescible or decomposable, whereas rubbish is not. Trash is rubbish that includes bulky

items such as old refrigerators, couches, or large tree stumps. Trash requires special collection and handling.[1,2]

Construction and demolition waste (or debris) is a significant component of total solid waste quantities (about 20 percent in the United States), although it is not considered to be part of the MSW stream. However, because C&D waste is inert and nonhazardous, it is usually disposed of in municipal sanitary landfills. Another type of solid waste, perhaps the fastest-growing component in many developed countries, is electronic waste, or e-waste, which includes discarded computer equipment, televisions, telephones, and a variety of other electronic devices. In 2006 e-waste made up 5 percent of the total solid waste stream, and the United Nations Environment programme estimated that developed countries would triple their output of e-waste by 2010. Concern over this type of waste is escalating. Lead, mercury, and cadmium are among the materials of concern in electronic devices, and governmental policies may be required to regulate their recycling and disposal.[3,4.5]

Proper solid-waste collection is important for the protection of public health, safety, and environmental quality. It is a labour-intensive activity, accounting for approximately three-quarters of the total cost of solid-waste management. Public employees are often assigned to the task, but sometimes it is more economical for private companies to do the work under contract to the municipality or for private collectors to be paid by individual home owners. A driver and one or two loaders serve each collection vehicle.[6,7]

Wastes generated by the full extent of human activities range from relatively innocuous substances such as food and paper waste to toxic substances such as paint, batteries, asbestos, healthcare waste, sewage sludge derived from wastewater treatment and as an extreme example, high-level (radioactive) waste in the form of spent nuclear fuel rods. Numerous classifications of soli d wastes have been proposed and the following represents a simple classification of waste into broad categories according to its origin and risk to human and environmental health: household waste; municipal waste (MSW); commercial and non-hazardous industrial wastes; hazardous (toxic) industrial wastes; construction and demolition (C&D) waste; health care wastes – waste generated in health care facilities (e.g. hospitals, medical research facilities); human and animal wastes; and incinerator wastes[8,9,10]

The goals of the study related to Solid Waste Management and Recycling Plan are listed below.

(1) Protect the health, safety, and welfare of the total population of City Rewa, M.P. by identifying the proper agencies to implement, administer, and regulate the solid waste and recycling collection and management needs of the County.

(2) Plan for and encourage growth in city in a manner consistent with the Comprehensive Plan and Water and Sewerage Plan, and in a way which will provide effective solid waste management and recycling as one of the public health, safety and welfare services.

(4) Continue to involve and encourage private enterprise, where appropriate, in city-wide solid waste management and recycling programs and services.

(5) To the extent possible and practical, identify and categorize all sources and types of solid waste generated within city.

(6) Provide a functional solid waste management and recycling plan to be updated and amended triennially as necessary.

(7) Plan solid waste facilities and recycling programs, including education, to meet the developing needs of city.

(8) Implement the City's Recycling Plan and waste management policies within the scope of solid waste management as an alternative to land filling and continue to exceed the State mandated goal of recycling 15% of the solid waste stream.

MATERIALS AND METHODS

Table 1: List of studied Health Care Units (Govt. Hospital, District Hospital and Private Nursing Homes) In Rewa City

Sr. No.	Name of HCUs' and Address	Number of Beds
1.	Govt. Sanjay Gandhi Memorial Hospital, Rewa	1141
2.	District Hospital, Bicchiya, Rewa	50
3.	Agarwal Nursing Home, Rewa	30
4.	Chaurasia Nursing Home, Rewa	30
5.	Cahak child care nursing Home, Rewa	12
6.	M.P. Arya Memorial Nursing Home, Rewa	10
7.	Personia Surgical Nursing Home, Rewa	20
8.	Sai Kripa Nursing Home, Rewa	20
9.	M.R. Singhal Nursing Home, Rewa	14
10.	Shankar Nursing Home, Rewa	12
11.	Shanti Hospital and Trama Center Rewa	15
12.	Mithilesh Memorial Hospital, Rewa	12
13.	Neeta Nursign Home, Rewa	6
14.	Puspanjali Nursing Home, Rewa	10
15.	Sagar Nursing Home, Rewa	12
16.	Tirth Memorial Hospital, Rewa	10
17.	Savitri Nursing Home, Rewa	13

18.	Shree Nursing Home, Rewa	8
19.	Anupam Nursing Home, Rewa	5
20.	Child Care Hospital, Rewa	10
21.	Chitiz Hospital, Research Center, Rewa	30
22.	Guru Kripa Nursing Home, Rewa	20
23.	Jeevan Jyoti Nursing Home, Rewa	20
24.	Sanjeevni Nursing Home, Rewa	10

Technology used in Bio-Medical Waste Management in the Health Care Units (HCUs')

The environmental regulations actually mandate the treatment of infectious medical waste on a daily Basis if it is stored at room temperature. A number of treatment methods are available. The final choice of suitable treatment method is made carefully, on the basis of various factors, many of which depend on local conditions including the amount and composition of waste generated, available space, regulatory approval, public acceptance, cost, etc.

Incineration Technology

Incineration designed especially for treatment of health care waste should operate at temperatures between 900 and 1200'C. Pruss, 1999 reported in their second paper in a two part series more detailed data on the physicochemical characteristics of normal Non Infectious Hospital Waste (NHW) and infectious Hospital Waste (IHW). Hospital waste determined experimentally in a large sanitary district that includes four hospitals, public and private, with 164 sanitary departments. 40 analytical laboratories and 2500 rehabilitation beds, near the town of Bari (Southern Italy). In all cases, IHW was shown to be classified as "non-toxic" deserving 950^{o}C rather than 1200^{0}C incineration temperature according to Italian legislation.[11]

Non-Incineration Technology

Non-incineration treatment includes four basic processes: thermal, chemical, irradiative, and biological. The majority of non-incineration technologies employ the thermal and chemical processes. The main purpose of the treatment technology is to decontaminate waste by destroying pathogens. Facilities should make certain that the technology could meet state criteria for disinfection.[12]

Autoclaving

Autoclaving is an efficient wet thermal disinfection process. Atypically, autoclaves are used in hospitals for the sterilization of reusable medical equipment. They allow for the treatment of only limited quantities of waste and are therefore commonly used only for highly

infectious waste, such as microbial cultures or sharps. Research has shown that effective inactivation of all vegetative microorganisms and most bacterial spores in a small amount of waste (about 5-8 kg) require a 60 minute cycle at 121^0C (minimum) and 1 bar (100kPa); this allows for full steam penetration of the waste material. About 99.9999% inactivation of microorganisms is achievable with autoclave sterilization. Blood bank regulations and Bio-Medical Waste rules of India advocate disinfection of contaminated blood units. Incineration is not recommended due to polyviny1 chloride (PVC) content of blood bags. Autoclaving at 15 lbs pressure for 2 hours uniformly inactivated the vegetative forms and, B. stearothermophilus spores. Thus, autoclaving of PVC blood bags is a safer and reliable method compared to chemical disinfection.

Microwave Irradiation

Most microorganisms are destroyed by the action of microwaves of a frequency of about 2450 MHz and a wavelength of 12.24 cm. The microwaves rapidly heat the water contained within the waves and the infectious components are destroyed by heat conduction. In the USA, a routine bacteriological test using Bacillus subtitles is recommended to demonstrate a 99.99% reduction of viable spores. Romani, 2006 assessed a clinical waste decontamination unit that used microwave generated heat for operator safety and efficacy.[13]

RESULTS AND DISCUSSIONS

Various management practices are involved for reducing infectious and non-infectious solid waste. Here is description of some of them:

Government agencies

Proper management of Bio-medical is a concern that has been recognized by both government agencies and non-government organizations. Several hazards and toxic materials containing wastes should be disposed off with proper take and care. Inadequate and insufficient segregation measures, written policies all of these factors contribute to increased risk of exposure of staff, patients and the community of biomedical hazards.

Assessment of operating procedures

Observations were made during the waste handling process and questions were asked to the staff in charge regarding the care taken in handling wastes. The explanation given by staff was that they were handling bio-hazardous materials and that if they were careless it could be injurious to them and to others and also could cause spread of infection or diseases.

Segregation

The waste was segregated separately, according to its characteristics, at the point of generation, mainly from the patient care areas. The hospital used color coded high density polythene bags for identification and segregation of Bio-medical solid waste, non-infectious and domestic type of material was collected in black polythene bags.

Infectious and non-infectious waste management

The quantification of Bio-medical waste generation in 3 major categories was also divided into infectious and non-infectious waste. The total Bio-medical waste generation under infectious waste (for category 1+3+4+6+7) was approximately 293.93 kg/day and Bio-medical waste generated under non-infectious (category 5-9) was estimated at 14.33 kg/day (table-1-3).

Table 1- Generation of Bio-Medical Waste (Infectious and non-infectious) in Government Hospitals and Private Nursing Homes of Rewa city (in Kg) during Rainy Season:

Sr. No.	Grouping of HCUs' according to Beds Nos.	Name of HCUs'	No. of HCUs'	Infectious (Cat. 1+3+4+6+7)				Non Infectious (Cat. 5+9)			
				kg/day	% kg/day	kg/month	kg/season	kg/day	% kg/day	kg/month	kg/season
1.	Above 500 Beds	Govt. S.G.M.H. Rewa	1	246.9	68.34%	7407.0	29628.0	12	71.0%	360	1440.0
2.	50-200 Beds	Dist. Hospital Rewa	1	14.75	4.08	442.5	4770.0	0.6	3.55	18.0	72.0
3.	0-50 Beds	Pvt. Nursing Homes	22	99.58	27.57%	2976.51	11905.64	6.82	25.44%	129.0	561.0
Total Bio-Medical Water generation kg/day				361.23				19.42			

Table 2- Generation of Bio-Medical Waste (Infectious and non-infectious) in Government Hospitals and Private Nursing Homes of Rewa city (in Kg) during Summer Season

Sr. No.	Grouping of HCUs' according to Beds Nos.	Name of HCUs'	No. of HCUs'	Infectious (Cat. 1+3+4+6+7)				Non Infectious (Cat. 5+9)			
				kg/day	% kg/day	kg/month	kg/season	kg/day	% kg/day	kg/month	kg/season
1.	Above 500 Beds	Govt. S.G.M.H. Rewa	1	212.0	73.45%	6360.0	25440.0	10.89	74.08%	326.7	1306.8
2.	50-200 Beds	Dist. Hospital Rewa	1	10.2	3.53%	306.0	1224.0	0.32	2.18%	9.6	38.4
3.	0-50 Beds	Pvt. Nursing Homes	22	66.70	23.10%	1933.62	6936.48	3.49	23.74%	104.7	418.8
Total Bio-Medical Water generation kg/day				288.62				14.7			

Table 3- Generation of Bio-Medical Waste (Infectious and non-infectious) in Government Hospitals and Private Nursing Homes of Rewa city (in Kg) during Winter Season:

Sr. No.	Grouping of HCUs' according to Beds Nos.	Name of HCUs'	No. of HCUs'	Infectious (Cat. 1+3+4+6+7)				Non Infectious (Cat. 5+9)			
				kg/day	% kg/day	kg/month	kg/season	kg/day	% kg/day	kg/month	kg/season
1.	Above 500 Beds	Govt. S.G.M.H. Rewa	1	185.0	79.68%	5550.0	22200.0	8.77	76.99%	263.1	1052.4
2.	50-200 Beds	Dist. Hospital Rewa	1	6.68	2.88%	200.4	801.6	0.2	1.75%	6.0	24.0
3.	0-50 Beds	Pvt. Nursing Homes	22	40.49	17.44%	1009.23	3916.78	2.42	21.25%	72.6	290.4
Total Bio-Medical Water generation kg/day				232.17				11.39			

Table 4- Generation of Bio-Medical Waste (Infectious and non-infectious) from pathological Centers (kg/day) for three season

Season	Name of HCUs'	No. of HCUs'	Infectious waste generated (kg/day)	Waste (kg/day)	Waste generated Season (in kg)	Non Infectious Cat. 5+9
Rainy	Pathological Centers	13	9.77	281.1	1124.33	0
Summer		13	8.013	240.3	961.2	0
Winter		13	4.54	136.23	544.92	0
Average			7.44	219.21	876.82	

Table 5- Generation of Bio-Medical Waste (on average kg/day) from pathological Centers of Rewa City

Season	Name of HCUs'	No. of HCUs'	Category wise generation of BMW in kg/day (Approx.)								Avg. BMW kg/day 1+3+4+5+6+7+9)	BMW kg/month	BMW generated in season kg
			1	2	3	4	5	6	7	9			
Rainy	Pathological Centers	13	-	-	-	4.432	-	5.182	-	-	9.77	281.1	1124.33
Summer		13	-	-	-	3.42	-	4.5	-	-	8.013	240.3	961.2
Winter		13	-	-	-	2.027	-	2.514	-	-	4.54	136.23	544.92
Total						9.879	0	12.196	0	0	22.323	657.63	2630.45
Average						3.29	0	4.07	0	0	7.44		

Cat-1 = Human Anatomical Waste Cat-2 = Animal Waste
Cat-3 = Microbiology and Biotechnology Waste
Cat-4 = Waste Sharp Cat-5 = Discarded Medicine and Cytotoxic drugs Cat-6 = Soiled Waste
Cat-7 = Solid Waste Cat-9 = Incineration Ash

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