

Medical wastes management in the south of Brazil

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Abstract

In developing countries, solid wastes have not received sufficient attention. In many countries, hazardous and medical wastes are still handled and disposed together with domestic wastes, thus creating a great health risk to municipal workers, the public and the environment. Medical waste management has been evaluated at the Vacacaí river basin in the State of Rio Grande do Sul, Brazil. A total of 91 healthcare facilities, including hospitals (21), health centers (48) and clinical laboratories (22) were surveyed to provide information about the management, segregation, generation, storage and disposal of medical wastes. The results about management aspects indicate that practices in most healthcare facilities do not comply with the principles stated in Brazilian legislation. All facilities demonstrated a priority on segregation of infectious-biological wastes. Average generation rates of total and infectious-biological wastes in the hospitals were estimated to be 3.245 and 0.570 kg/bed-day, respectively.

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1. Introduction

In developing countries, solid wastes have not received sufficient attention. In many countries, hazardous and medical wastes are still handled and disposed together with domestic wastes, thus creating a great health risk to municipal workers, the public and the environment. In Brazil, for instance, it has been estimated by the Sanitary and Environmental Engineering Brazilian Association that 76% of the towns dispose domestic and medical wastes together in municipal dumpsites (ABES, 2000).

In Brazil medical wastes are defined to include all types of wastes produced by healthcare facilities such as general hospitals, medical centers, clinical laboratories, veterinary hospitals, medical research centers and dispensaries. Medical wastes represent a small amount of the total residues generated in a community. However, such residues can potentially transmit diseases and present an additional risk to the staff of the health-

care facilities and to the community when the wastes are not managed properly.

The standard for the management of medical wastes in Brazil is Resolution No. 5 of the National Environmental Council of Brazil (CONAMA, 1993). Resolution No. 5 attributes specific responsibilities to the various sectors involved: generators and sanitary and environmental authorities. The Resolution states that generators are mandated to properly manage medical wastes. This Resolution also establishes definitions, classifications and procedures for collection, storage and disposal of medical wastes. The medical wastes have been classified according to the risks that are presented by them:

Group A: residues that present risk to the public health and the environment due the presence of biological agents (infectious-biological).

Group B: residues that present risk to the public health and the environment due to physical, chemical and physical-chemical characteristics (hazardous waste).

Group C: radioactive wastes.

Group D: all the other residues that are not included in the groups described previously.

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Resolution No. 283 (CONAMA, 2001) states that infectious-biological wastes must be exposed to adequate treatment in order to eliminate their pathogenic characteristics prior to final disposal. All treatment process units and waste disposal sites must apply for environmental license at the specific State Environmental Agency.

The generation rate of medical waste depends upon several factors such as: the type of healthcare facility, status, capacity, level of instrumentation, and location of the facility. According to the estimate performed by Monreal (1993), the average rate of medical wastes produced at Brazilian hospitals is 2.63 kg/bed-day, of which about 15% to 20% are residues classified as Group A (infectious-biological). However a poor waste management system, especially in the segregation stage, can promote the contamination of the whole mass of the residues. Schneider et al. (2002) presented a study on the residues of odontological clinics and estimated a total generation of 0.241 kg/dentist-day, of which around 0.180 kg/dentist-day were residues classified as Group A.

The primary aim of this study was to evaluate the actual situation of medical waste management in the cities located in the Vacacaí river basin in the south of Brazil. An inventory of healthcare facilities was performed, the main aspects of medical wastes management were analyzed, and the amount of residues generated by the facilities was estimated.

2. Study area

The Vacacaí river basin is located at south of Brazil in the State of Rio Grande do Sul. The river's drainage area covers approximately 10,000 km² and includes 11 cities with a total population of 492,567 inhabitants (Fig. 1). According to Brazilian legislation, local governments are only responsible for the collection and disposal of domestic solid wastes. However, all cities in the study area practice poor management of these wastes and no official recycling programs are available. Disposal of the domestic wastes is carried out in municipal



Fig. 1. Location of the study area.

Table 1
Inventory of healthcare facilities in Vacacaí river basin

City	Population	Hospitals/beds	Health centers	Clinical laboratories	Dentists
Caçapava do Sul	34,643	1/90	1	2	21
Cachoeira do Sul	87,873	2/194	5	2	82
Dilermano de Aguiar	3,200	0/0	–	–	–
Formigueiro	7,598	1/23	3	–	3
Lavras do Sul	8,109	1/32	1	2	7
Restinga Seca	16,400	2/107	–	2	10
Santa Maria	243,611	10/831	28	8	590
São Gabriel	62,249	3/245	9	4	45
São Sepé	24,621	1/57	–	2	19
Vila Nova do Sul	4,263	0/0	1	–	3
<i>Total</i>	492,567	21/1579	48	22	780

dumpsites which has led to serious environmental and social problems in Brazil. There are no official data about medical wastes and in some cases they are mixed with domestic wastes. Currently, two private companies provide services for the collection and disposal of part of medical wastes generated at healthcare facilities.

3. Methodology

Data collection was conducted in all the towns located in the Vacacaí river basin during site visits from September 2001 to March 2002. The methodology consisted in the use of surveys and interviews with the authorities of the healthcare facilities and with personnel involved in the management of the wastes. The information was collected using forms specifically developed for that purpose. Site visits were conducted to support and supplement information gathered in the survey. Site visits were helpful in obtaining information about common practices in the management of the wastes. The forms contain information on the generation of waste and main aspects of segregation, collection, internal and external storage, transport, treatment and final disposal. The researchers also collected data from the private companies responsible for collection and disposal of medical wastes and from health officials. Waste generation rates were obtained on a weight basis, assuming a waste density of 150 kg/m³ as described by Silva et al. (2002). The method of waste management was analyzed by using Resolution No. 283 (CONAMA, 2001) as a reference.

4. Results and discussion

The data in Table 1 summarizes the inventory of healthcare facilities in the Vacacaí river basin. Public hospitals represent 47.6%, while private and philanthropic hospitals represent 28.6% and 23.8%, respectively. All health centers are public and all clinical

laboratories are private. Santa Maria is considered to be an outstanding city concerning health services in the state due to the public medical school, Federal University of Santa Maria, which offers these services through the Santa Maria University Hospital.

4.1. Management aspects

The information in Table 2 shows the percentages of facilities that answered affirmatively to the main aspects of medical waste management. Such results indicate that almost all healthcare facilities do not comply with the principles stated in Resolution No. 283 (CONAMA, 2001). The Resolution states that all healthcare facilities must establish a medical waste commission (MWC) with at least one individual with specific academic training in the area, a medical waste management plan (MWMP) and a training program (TP) for workers that handle the wastes. The worst situation was observed at health centers. Despite the fact that only a small amount of medical wastes is generated in this type of facility, it was observed that such facilities are distributed around all districts of the cities investigated representing a major health risk to the communities if the wastes are not handled properly. These poor management aspects are not only due to the lack of sensitivity from the management of the facilities, meaning there seems to be some lack of awareness concerning health risks towards the community members as well as environmental issues, but also due to economic problems in the country that prevent

Table 2
Medical waste management aspects in healthcare facilities

Facilities	Management aspects		
	MWC	MWMP	TP
Hospitals (%)	28.6	28.6	33.3
Health centers (%)	0.0	4.2	10.4
Clinical laboratories (%)	13.6	9.0	13.6

MWC: medical waste commission; MWMP: medical waste management plan; TP: training program.

the government from adequately supporting a health-care policy.

4.2. Segregation aspects

The data in Table 3 suggest that all facilities demonstrate a priority on segregation of Group A wastes, i.e., sharp wastes (SW) and biohazardous wastes (BHW). Sharp wastes are segregated at the point of generation. Respondents to the survey indicated that they segregated their SW in all hospitals, and in about 98% and 95% of health centers and clinical laboratories, respectively. However, about 20% of health centers indicated that they do not promote the segregation of BHW. All facilities use rigid, puncture-proof containers to dispose of the sharp wastes (needles, syringes, lancets, and similar tools). BHWs are disposed in plastic bags. Nearly all hospitals use white plastic bags as stated in the current legislation. The high level of SW segregation is a significant finding; however, it has been reported that segregated wastes are mixed together by laborers as they collect them for external storage, or that municipal workers mix them together during collection. Consequently, on the one hand, worker's safety in healthcare centers may have been enhanced because of the appropriate handling inside the facility, but on the other hand, in some cases the ultimate cost to the environment and the general public is still the same.

Despite legal requirements, hazardous wastes (Group B) have not received the proper amount of attention in all facilities. The data in Table 3 show that segregation of these materials is practiced in about 57% of hospitals, 42% of health centers and 14% of clinical laboratories. Since hazardous wastes have a great potential to cause or significantly contribute to mortality or serious illness, or pose a substantial hazard to human health and the environment, they should be properly managed and disposed. As a result of the lack of waste segregation practices in most hospitals, many of these hazardous materials are mixed into general solid waste (Group D) for disposal in municipal bins or are mixed with other infectious wastes. In both cases they represent a serious hazard to workers and the public in general. The lack of alternatives in the region for the proper disposal of these wastes leads to stockpiling them inside the premises, creating then another potential threat.

Recyclable wastes (RCW) are segregated in about 70% of hospitals, 40% of health centers, and 50% of laboratories. Despite the percentages reported, no facility currently is operating a program to recycle general wastes, i.e., office paper, cardboard, plastics, metal cans and selected glass. Most of the RCW are collected together with the general wastes and disposed of in dumpsites.

4.3. Medical wastes generation

Waste generation was related as the most difficult aspect to evaluate in all of the healthcare facilities surveyed. Not all of them were able to estimate the amount of waste generated. Values presented by respondents were given on a wide range basis, i.e., kg/day, kg/week, liter/day or liter/week. Hospitals and clinical laboratories were able to estimate their wastes on a kg/day basis. However, health centers reported the amount of wastes generated by them on a liter/day or liter/week basis. This estimate was based on the number of plastic bags used to store the wastes that were filled within a specific period of time (day or week). All of the data were evaluated on a weight basis (kg/month) for comparison purposes, assuming a bulk density of 150 kg/m³.

The data in Table 4 show the amount of total waste and Group A waste (sharp and biohazardous wastes) generated in the hospitals surveyed. Using only non-zero values given by hospitals, the average total waste and Group A waste generation rates were found to be 3.245 and 0.570 kg/bed-day, respectively. The data in Table 4 also show the estimated waste generation using these rates. The data show that about 17% of all medical wastes produced are in Group A. These rates are comparable to those obtained by Monreal (1993). A wide difference in waste generation reported by small hospitals may be noticed. It demonstrates the poor waste management aspects discussed in Section 4.1, where only 30% of hospitals are operating a MWC and have prepared a MWMP and a TP.

Taking into consideration that the total number of beds in the study area is 1579, and that the total medical waste and Group A waste generation rates are as indicated, the estimated total amount of waste generated by hospitals is 153,742 kg/bed-month and the amount of Group A waste is 26,674 kg/bed-month. The data in Table 5 summarize the average quantity of medical wastes produced by all facilities. Accordingly, about 84% of the total waste originated from hospitals. The average percentage of Group A wastes in all the medical wastes was about of 22% by weight, although wastes generated from health centers, clinical laboratories and

Table 3
Segregation practices of medical waste in healthcare facilities

Facilities	Waste groups			
	G-A (SW)	G-A (BHW)	G-B (HW)	G-D (RCW)
Hospitals (%)	100	100	57.1	71.4
Health centers (%)	97.9	79.2	41.7	41.7
Clinical laboratories (%)	95.5	95.5	13.6	50.0

G-A: Group A waste; G-B: Group B waste; SW: sharp wastes; BHW: biohazardous wastes; RCW: recyclable wastes.

Table 4
Medical waste generation in the surveyed hospitals

Hospitals	Beds (#)	Reported (kg/month)		Estimated (kg/month)	
		Group A	Total	Group A	Total
1	5	276.3	726.3	87.6	486.8
2	8	1.1	136.1	140.2	778.9
3	9	690.0	1980.0	157.7	876.3
4	14	2934.0	4959.0	245.4	1363.1
5	15	12.3	141.3	262.9	1460.5
6	16	12.0	552.0	280.4	1557.9
7	17	567.0	1017.0	297.9	1655.2
8	23	300.0	1800.0	403.1	2239.4
9	32	225.0	360.0	560.8	3115.7
10	42	–	–	736.1	4089.4
11	46	105.0	7305.0	806.2	4478.9
12	52	151.8	303.6	911.4	5063.1
13	55	16.7	2716.7	963.9	5355.2
14	57	660.0	750.0	999.0	5549.9
15	66	900.0	7500.0	1156.7	6426.2
16	71	1035.0	5310.0	1244.3	6913.0
17	90	–	–	1577.3	8763.0
18	178	2400.0	4800.0	3119.6	17331.3
19	220	3420.0	8820.0	3855.7	21420.7
20	252	4772.7	76412.7	4416.6	24536.4
21	311	6300.0	15300.0	5450.6	30281.0
<i>Total</i>	1579	24778.9	140889.7	26673.6	153742.0

Table 5
Medical waste generation in healthcare facilities

Facilities	Total (kg/month)	Group A (kg/month)	Group A (%)
Hospitals	153,742	26,674	17.6
Health centers	18,758	8402	44.8
Clinical laboratories	6380	2449	38.4
Dentists	3760	2808	74.7
<i>Total</i>	182,640	40,333	22.1

dental offices contain large percentages of Group A wastes.

4.4. Internal and external storage areas

Cleaners and nursing assistants are responsible for collection, internal storage and transport to external storage of the medical wastes. These workers usually do not wear sufficient protective gear during waste handling, increasing the potential risk of accidents. In the hospitals the wastes are collected once or twice a day and in the healthcare centers and laboratories the frequency of collection ranges between two to five times a week. Internal storage areas are available in about 75% of hospitals and 50% of health centers and clinical laboratories. About 85% of hospitals and 40% of clinical laboratories and health centers have external storage areas. However, in some facilities these areas present an inadequate infrastructure and are used for others activities in addition to waste storage. For example,

observations during site visits showed that in some facilities the internal waste storage area also is used to store cleaning materials.

4.5. Treatment and final disposal

Two private companies are engaged on collection, treatment and final disposal of Group A and Group B wastes. Group A wastes are collected daily in almost all hospitals and two times or three times a week at other facilities.

An incineration facility is operated by a private company that collects about 10% of Group A wastes generated in the study area. This company operates a two-chamber incinerator with a capacity of 500 kg/day of waste. Apparently, the incinerator has many operational problems that lead to partial burning of waste and thus constitute health risks and air pollution. The greatest amount of medical waste is collected by another private company and buried in small cells (medical waste landfill) without preliminary treatment. A public municipal collection service is responsible for the collection of Group D wastes (domestic wastes). Group D wastes are disposed in dumpsites. Waste in Group B is collected monthly by a private company and transported for disposal at a hazardous wastes landfill located in the city of Estancia Velha (around 300 km from the study area). This is the only licensed site for hazardous waste located in an industrial metropolitan area in the State of Rio Grande do Sul.

Recently, legal aspects of treatment and final disposal of medical wastes has been the core of great debates in several sectors of the community in the study area based on a federal act by the Ministry of Interior (MINTER, 1979) that required compulsory incineration of medical wastes. This requirement was revoked by CONAMA No. 5 (CONAMA, 1993). However, there was not the respective updating in the local policy. Another important restriction at the local level is that regarding the prohibition of waste disposal generated in other cities. The city of Santa Maria, having the largest waste generation and a great regional importance, formulated a new policy in December 2001 to make possible a better waste management at the regional level, imposing however, compulsory medical waste treatment before any final disposition.

In the face of a new regional reality, in October 2002 a private company located in Santa Maria obtained an environmental license to operate a medical waste disinfection unit (autoclave) combined with final waste disposal at a sanitary landfill in the city of Butiá (around 200 km from Santa Maria). So, the medical waste landfill operated by the same private company is now only used to dispose of animal carcasses. According to Resolution No. 09 (COSEMA, 2000), new and existing medical waste incinerators must comply with the regulation that sets strict limits on their air emissions. Faced with increasing public opposition to incinerating and with increasing cost to adequately manage air emissions, all small incineration units will cease operation.

5. Conclusions

Nearly all the healthcare facilities studied promote segregation of Group A wastes, especially sharp wastes. However, not much attention is given to the other types of wastes, which are usually managed without a perspective for recycling and are collected through the municipal collection system. The involvement of society is making possible the establishment of a medical waste management policy, especially for the final stages in the flow of the wastes. The medical waste management

situation in the region, while far from ideal, is better than in other parts of Brazil. To ensure improvement and continuity in the management practices, healthcare institutions should develop clear plans and policies for the proper management and disposal of wastes. They need to be integrated into routine employee training, continuing education, and management evaluation processes for systems and personnel. It is important to point out that all cities in the study area promote the final disposal of the domestic wastes in open dumpsites, representing serious sanitary, environmental and social problems.

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