MEDICAL WASTE GENERATION AND MANAGEMENT IN DIFFERENT SIZED FACILITIES

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ABSTRACT

The term “medical waste” refers to the waste generated within health-care facilities, research centres and laboratories related to medical procedures as well as the one originating from minor and scattered sources, including waste produced in the course of health care procedures undertaken at home.

Although the definition of medical waste differ under different regulations and legislations, it is typically classified as major categories of the waste as pathological wastes, human blood and blood products, discarded medical plastics, culture and stocks, waste sharps and other mixed waste.

Most of those residues is potentially hazardous, since it may contain pathogenic agents or toxic substances requiring specific handling procedures.

Adequate medical waste management is thus necessary to avoid environmental pollution as well as to reduce the sanitary risk associated to the transmission of infectious diseases.

In this respect, many European countries have enacted legislation and good practice guidelines to define, classify, and treat medical waste.

The design and costing of a proper system for the management of medical waste is tightly related to its characteristics, both in terms of production and composition.

This work aims at assessing the efficiency of medical waste management system in different-sized hospitals. Annual data dealing with waste qualitative and quantitative characterization were discussed, along with information related to the different forms of reception (day hospital, day surgery or admission), in order to highlight any relation with waste production.

Data analysis addressed the identification of the critical aspects within medical waste management system as well as the proposal of possible solutions to optimize the system, minimizing the relative costs.

Keywords: hazardous solid waste, hospital, infectious waste, sanitary environmental risk, separate collection

1. Introduction

Medical waste is the waste originating from health-care activities, which are carried out in hospitals, clinics, laboratories and veterinary clinics. It is typically classified as major categories of the waste as pathological wastes, human blood and blood products, discarded medical plastics, culture and stocks, waste sharps and other mixed waste (Jang et al., 2011). Liquid waste, such as radioactive solutions, has also to be mentioned.

Although it is quantified as a relatively small amount of the total waste generated in a community (Bokhoree et al., 2014), medical waste can differently affect both environment and public health through several routes (Hossain et al., 2011) due to the presence of a great variety of both pathogenic agents and hazardous substances.

In this respect many European countries have enacted legislation and good practice guidelines to define, classify, and treat medical waste (Insa et al., 2010). However it has been recognized that the design and costing of a proper system for the management of medical waste is tightly related to its characteristics, both in terms of production and composition (Kermenidou et al., 2013).

This work aims at assessing the efficiency of medical waste management system in different sized hospitals. Annual data dealing with waste qualitative and quantitative characterization were discussed, along with information related to the different forms of reception (day hospital, day surgery or admission), in order to highlight any relation with waste production. Data analysis addressed the identification of the critical aspects within medical waste management system as well as the proposal of possible solutions to optimize the system, minimizing the relative costs.

2. Materials and methods

This study gives detailed information about waste management practices in different sized hospital facilities. To this end, data collected at 5 hospitals located in the Province of Salerno, in Southern Italy, were considered. They were characterized by different bed capacities, as given in Table 1.

Table 1: Dimensional class of hospitals considered in this study

Facility	Bed capacity range
H1	< 100
H2	101 - 200
H3	101 - 200
H4	101 - 200
H5	301 - 400

For each hospital the number of hospitalization days, that of admissions for day surgery/day hospital services as well as the average number of beds were considered to discuss the operation of the studied facilities with reference to the different forms of reception (day hospital/day surgery or hospitalization).

Annual data dealing with waste generated between 2008 and 2011 were collected and discussed to identify the application of current medical waste management practices.

3. Results and discussion

3.1. Analysis of recovery data

The hospitals considered in this study provide health-care treatments requiring the patient hospitalization and his/her staying overnight as well as day-care performances, which imply that patients come into hospital for their procedures and go home the same day. Admission and registration procedures are thus different, so that the whole operating conditions of each facilities is referred to different indices, which are the number of hospitalization days and the number of provided performances for ordinary health-care and day care treatments respectively.

Table 2 indicates the average values of both hospitalization days and day-care treatments. Slight variations can be observed over time for each hospital, with the exception of H1 and H3. The relevant standard deviation is related to the drop in the number of health services that these facilities provided in 2011. In all hospitals, approximately 20% of the total number of beds was estimated to be devoted to day-care treatments, which represented the minor health-care activity.

Despite the specific conditions, which obviously reflects the different size of the hospitals, each facility worked close to the saturation level, so that relevant waste productions were expected.

Table 2: Facility operating conditions for both ordinary and daily health care treatments

Facility	Hospitalization days	Day - care performances
H1	11.304 ± 1.472	2.977 ± 111
H2	30.995 ± 421	5.196 ± 648
H3	25.294 ± 7.313	5.656 ± 1.906
H4	25.828 ± 2.039	9.226 ± 3.216
H5	103.057 ± 1.033	38.707 ± 912

3.2. Analysis of waste production

Figure 1 plots the specific waste production in the hospitals under investigation, for the period 2008-2011.

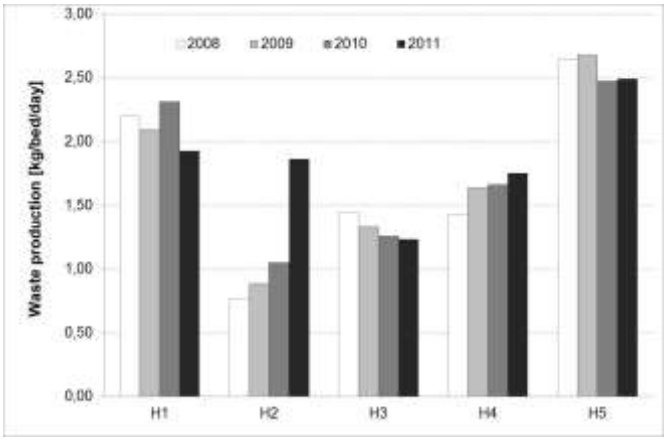

Figure 1: Hospital specific waste production (2008-2011).

Production data correspond to average generation rates varying in the range 1,1-2,6 kg/bed/d, which is comparable with the values reported in other studies (Lee et al., 2004; Jang, 2011), but is double the results of Komilis et al. (2012) for Greek hospitals. Similarly, Elimelech et al. (2011) estimated for Israeli facilities a daily generation rate one order of magnitude lower than the one found in this study. The different generation rates in different countries depend on several factors, including types of healthcare service, the amount of disposable or reusable medical devices, the existence of enforced regulations and the consequent medical waste management policies.

The specific waste production was found to enhance for increasing bed capacity, with the exception of H1. Even though it is the smallest facility in terms of number of beds, the specific waste production was found to be comparable with the one of H5, which is the biggest among the hospitals under investigation. This evidence can be reasonably related to the high number of beds that in H1 were devoted to both surgery and general medicine wards, recognized as the ones providing the greatest waste production (Voudrias et al., 2012).

Most of the produced waste (81-91% of the total production) was classified as infectious; liquid waste containing hazardous substances was found to be another relevant portion of medical waste, representing 9-23% of the total waste produced in each facility. Among hazardous waste, cytotoxic and cytostatic pharmaceuticals (Kermenidou et al., 2013) were produced only in H5, where accounted between 0,05 and 1,12% of the total waste production. Non-hazardous waste, including the residues of both healthcare activities (i.e. bandage, plaster cast, …) and the ones assimilated to municipal waste (i.e. paper and paperboard packaging), were discontinuously recorded over the investigated period of time: only in 2009, data dealing with the production of this kind of waste were recorded in each facility. The composition of medical waste observed in this study was rather different than the one found by other authors. Mohee (2005) claimed that 90% of hospital wastes were similar to domestic ones and only 10% was

classified as infectious: these data were consistent with previous studies performed in healthcare facilities located in France (15-20% infectious waste) and USA (15% infectious waste).

This evidence, along with the irregular data of non-hazardous waste, suggests an improper segregation of waste, which is a common issue of healthcare facilities (Oroei et al., 2014), related to either inadequate separate collection systems or incorrect waste registration procedures as well as to poor awareness. Such aspects represent a relevant issue for waste management after collection: due to the high differences in costs associated with disposal of hazardous waste, segregation of non-hazardous waste from hazardous waste is an important economic factor in healthcare facilities (Akarian et al., 2010). Further reduction of operating costs can be reached by implementing a healthcare waste reduction programme, which can result in disposal savings in the range 40 - 70% (Tudor, 2005).

4. Conclusions

The analysis of waste generated in different sized hospitals highlighted that medical waste production trend is related to both bed capacity and the health-care activities performed. Although specific waste production enhances for increasing number of available beds, the presence of wards characterized by relevant waste generation rates in small hospitals can intensify specific waste production so that it tends to be comparable to that of bigger health-care facilities.

Despite the hospital bed capacity, most waste was found to be classified as hazardous, with a prevailing presence (between 72-91%) of infectious materials. Conversely, non-hazardous materials were discontinuously recorded: only data for 2009 were obtained from the hospitals under investigation and, in that period, this kind of waste accounted up to 22% of the total waste produced. Such values are not consistent with the ones expected on the basis of scientific literature analysis, which pointed out that medical waste mainly consists of non-hazardous materials (up to 80% of the total waste production), assimilated to municipal waste.

This evidence suggests the need for more correct waste identification procedures, in order to efficiently implement the strategy enforced by Italian Regulation, which is based on both waste segregation and treatment and disposal forms aiming to reduce the environmental risk posed by hazardous medical waste.

To this end, training activities seem necessary to make medical personnel aware about the importance of waste classification according to its hazardous characteristics. This would promote the proper segregation of medical waste and, reasonably, the reduction of the hazardous aliquot. A further decrease in hazardous medical waste production can be enabled by providing a preliminary on site sterilization of infectious waste. Such treatment would reduce pathogen concentration and allow the treatment and/or disposal of infectious materials as non-hazardous industrial waste.

This would promote the proper segregation of hazardous waste from the non-hazardous one, thus reducing the disposal costs, which are usually higher for the former. The implementation of such system at ward level could be particularly useful: it would allow the quantitative and qualitative characterization of the waste produced from single health-care treatments and the consequent optimization of waste management system by focused reduction strategies.

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