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Major article

Evaluation of an education and training intervention to reduce health care waste in a tertiary hospital in Spain

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Key Words:

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Background: In recent decades there has been a significant increase in waste generation. Training interventions in advanced health care waste management can improve the segregation of regulated medical waste and reduce volume and costs.

Methods: We carried out a quasi-experimental intervention study with before and after training session analysis to compare waste segregation. Descriptive analysis of the segregated health care waste and an evaluation of the quality of segregation were done. A comparison of monthly average waste to assess the effectiveness of the educational intervention was performed.

Results: After the intervention, there was a significant reduction in the monthly average health care waste volume of 6.2%. Statistically significant differences in the infectious waste and genotoxic/pharmaceutical waste weight segregated before and after the intervention ($P < .05$) were found. Because of the health care waste weight reduction and the improvement of waste classification, a savings cost of €125,205 was achieved.

Conclusions: The health care waste management training improves biomedical waste segregation at the hospital, reducing the health care waste volume and costs as an added value.

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In recent decades there has been a significant increase in waste generation. Concern to develop a more sustainable model of production and consumption has made environmental stewardship a matter of general interest. This interest has focused the efforts of international and national organizations to invest a significant proportion of their resources in environmental protection and specific legislation.^{1–7} Following the Organisation for Economic Co-Operation and Development definition, the environmentally sound management of waste is “a scheme for ensuring that wastes and used and scrap materials are managed in a manner that will save natural resources, and protect human health and the environment against adverse effects that may result from such wastes and materials.”³

Medical waste is not an exception to the increasing trend of waste minimization in today’s society.⁸ In particular, regulated medical

waste (RMW), specific to this activity, and inappropriate management of waste potentially contaminated with biologic substances, genotoxins, or chemicals can be a risk to hospital staff and public health. Furthermore, within the general large volume of waste produced, RMW is of special impact variability and processing complexity.^{9–11}

There are different treatment and disposal options from health care waste segregation. Although a large percentage of hospital waste is classified as general waste, which has a similar nature to that of municipal solid waste and, therefore, could be disposed in controlled landfills, the rest of the waste streams have to be managed in the proper manner in order to minimize risk to public health. In our area, infectious waste is discharged into autoclaves to disinfect it and then compacted for disposal in controlled landfills. Genotoxic, pharmaceutical, and chemical waste are eliminated by chemical disinfection or combustion (medium and high technology). The direct combustion (incineration) generates particulate matter and chemical compounds that can potentially affect human health and safety and have a negative impact on the environment. At the present time, the major fraction of health care waste collected

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in our hospital is disposed of directly in landfills (general waste) or disinfected by autoclaves (infectious waste). Only a few of them, such as genotoxins and chemicals, are incinerated. There is a concerted effort to discontinue the reliance on incineration for the treatment of RMW in developing countries.¹²

The production and separation of waste in hospitals is regulated by international, national, and regional legislation, which states that waste holders are required to manage them properly, both in their segregation and elimination.^{5–7} In fact, according to the Basel Convention, waste is defined as “substances or objects that are removed or intended to be removed or should be eliminated by the provisions of national laws.” The European Convention establishes rules designed to control international movements of waste disposal hazardous to human health and the environment.¹³ Furthermore, in order to eliminate the relationship between economic growth and waste production, the European Union has adopted a legal framework to control the entire waste cycle, from production to disposal, promoting recovery and recycling.¹⁴

To minimize the risk to public health, we found that waste segregation and infectious waste treatment prior to disposal have to be conducted properly by hospital management. Waste management practices are the result of both organizational and individual factors. Behavior of each individual staff member will determine its success. There is a need for training and capacity building programs of all employees involved in medical waste management. Continuous ongoing educational programs to sensitize health care professionals for correct segregation and minimization of health care waste are important to improve outcomes and reduce costs. This could be achieved through greater incorporation of sustainability concepts within organizational policies, enhanced communication, added training and development programs, and increased promotion of the multiple benefits of sustainable practices.¹⁵

The purpose of this study is to assess the impact on the segregation of RMW at the Alcorcón University Hospital Foundation (AUHF) after a training intervention in advanced waste management. The educational intervention tries to avoid inadequate and inappropriate knowledge of handling waste that may have serious health consequences and significant impact on the environment. It also aims to promote the transition from classical to advanced waste management, which is more efficient and environmentally friendly.

MATERIAL AND METHODS

We carried out a quasi-experimental intervention study with before and after analysis to compare waste segregation at the AUHF. The AUHF is a tertiary care hospital in Spain with 382 beds, including acute medical surgical (general and orthopedic) and intensive care units.

The training was conducted over 9 months (March–November 2010). There was a previous evaluation of health care waste management performance in every hospital department that included a waste bin analysis. A medical doctor and nurse of the preventive medicine department of the hospital observed the appropriateness of segregation of waste streams at clinical and technical departments. A report of inadequate waste management practices was done. The health care staff dealing with waste disposal were asked to come to the training sessions. There was a schedule of sessions for any area of the hospital. The staff were exposed once to the training session. After the training, a report of improvements was sent to each department with the recommendations needed to adequately segregate waste in a sustainable regulated manner.

The educational intervention included 24 training sessions of half an hour each in different areas (eg, laboratories, hospitalization ward, dialysis, pathology, intensive care unit, day hospital,

Table 1

Comparison of health care waste segregation pre- and postintervention

Type of waste	Preintervention weight (kg)	Postintervention weight (kg)	P
General	80,658.33 ± 6,718.37	80,646.37 ± 7,006.56	.995
Infectious	11,631.08 ± 1,507.01	5,945.64 ± 587.39	.000
Genotoxic and pharmaceutical	609.50 ± 53.51	422.53 ± 40.37	.000
Chemical	666.10 ± 365.07	744.53 ± 236.19	.440
Total	93,629.78 ± 7,656.76	87,823.58 ± 7,505.92	.021

NOTE. Values are monthly averages ± SD or as otherwise indicated.

pharmacy, microbiology, radiology, emergency, outpatient clinic, operating rooms). Also, a course on advanced health care waste management (10 hours) was done. In total, 455 people were involved, mainly nurses, laboratory technicians, radiology technicians, and sanitary staff. The training was performed by a medical doctor and nurse of the preventive medicine department of the hospital. The aim of the training was to assess the correct segregation of different waste streams, pointing out misclassifications where observed in waste bin analyses. We used a poster with basic information of any waste and disposal bins, which was available on the information boards in all working areas.

The waste streams are collected daily and weighed at the hospital's final waste storage area by the waste company personnel. This is standard operating procedure in relation to waste management at the hospital. The data are collected by the financial department, and there is a monthly report of the waste segregation activity.

We evaluated the data of segregated waste: infectious, chemical, genotoxic/pharmaceutical and general solid wastes. The pre-intervention period was considered from March 2009–February 2010, and the postintervention time of evaluation was from December 2010–November 2011.

Descriptive analysis of the segregated waste before and after the intervention was done. Quantitative variables were described with mean (kg/month) and standard deviation (SD). A comparison of means to assess the effectiveness of the educational intervention was performed with a paired Student *t* test.

We analyzed the economic impact of the intervention, calculating the average monthly savings in the segregation of health care waste and taking into account prices from our contract with the company that manages the waste removal from the hospital.

Data analysis has been done with Microsoft Excel 2000 (Microsoft Corporation, Redmond, WA) and SPSS v 17.0 (IBM Corporation, Endicott, NY).

RESULTS

After this intervention, a significant decrease in waste production was observed (Table 1), finding statistically significant differences in the volume of waste segregated before and after the intervention ($P < .05$) (Fig 1).

Table 2 presents information of the different types of waste generated before and after the educational intervention at the different areas of the hospital. Improving the classification method, we achieved that some infectious waste shifted to chemical in the laboratory and pathology departments (eg, some laboratory samples with blood and chemical reagent and surgical samples in formaldehyde). In the dialysis department, most of the dialysis filters shifted from biologic/infectious to general waste (only AIDS and hepatitis B or C waste were segregated as infectious). Careful exclusion of noninfectious from infectious waste streams in hospitalization wards (eg, urine collection bags, colostomy bags) were drained to be segregated as general waste.

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