

## ORIGINAL

# Environmental and health strategies for hospital waste management; a case study

*Estrategias medioambientales y sanitarias para la gestión de residuos hospitalarios; un estudio de casos*

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## Summary

**Background:** Management of hospital and healthcare center wastes is essential to prevent environmental health-related issues and threats. The present survey was performed to assess the environmental and health strategies for hospital waste management; a case study.

**Materials and methods:** This cross-sectional descriptive study was performed to identify the current status of medical waste management in 2 healthcare centers and 2 hospitals in Tehran, Iran. A standard checklist and questionnaire of the Ministry of Health were used, the degree of reliability and validity of which was established. The checklists were completed by highly trained environmental health experts through face-to-face visits, observation and visits under the supervision of environmental health experts of health centers and hospitals. The checklist consisted of two sections, public and private, which did not use general information to evaluate hospital management.

**Results:** A total of 84.16 kg/d wastes were produced in 2 studied healthcare centers. While, a total of 295.13 kg/d wastes were produced in 2 studied hospitals. Among all studied wastes, the amounts of ordinary, infectious and chemical and pharmaceutical wastes were 52.90, 17.50, and 13.76 kg/d, respectively in healthcare units. Among all studied wastes, the amounts of ordinary, infectious and chemical and pharmaceutical wastes were 145.85, 111.11, and 38.17 kg/d, respectively, in hospitals. Studied hospitals had the higher amounts of produced wastes than healthcare units. In about 54% of the studied centers, only one person was assigned to waste collection. None of the studied centers had a temporary storage facility for medical waste.

**Conclusion:** There were essential need to determine proper strategies to manage the hospital wastes to reduce the risk of infections dissemination in the environment and increase the health conditions.

**Keywords:** Health strategies, hospital, healthcare, waste management.

## Resumen

**Antecedentes:** La gestión de los residuos de los hospitales y centros de salud es esencial para prevenir problemas y amenazas relacionadas con la salud ambiental. El presente estudio se realizó para evaluar las estrategias ambientales y sanitarias para la gestión de los residuos hospitalarios; un estudio de caso.

**Materiales y métodos:** Este estudio descriptivo transversal se realizó para identificar el estado actual de la gestión de residuos médicos en 2 centros de salud y 2 hospitales de Teherán, Irán. Se utilizaron una lista de comprobación y un cuestionario estándar del Ministerio de Sanidad, cuyo grado de fiabilidad y validez se estableció. Las listas de comprobación fueron completadas por expertos en salud ambiental altamente capacitados mediante visitas presenciales, observación y visitas bajo la supervisión de expertos en salud ambiental de los centros de salud y hospitales. La lista de comprobación constaba de dos secciones, pública y privada, que no utilizaban información general para evaluar la gestión de los hospitales.

**Resultados:** En 2 centros sanitarios estudiados se produjeron un total de 84,16 kg/d de residuos. Mientras que en 2 hospitales estudiados se produjeron un total de 295,13 kg/d de residuos. Entre todos los residuos estudiados, las cantidades de residuos ordinarios, infecciosos y químicos y farmacéuticos fueron de 52,90, 17,50 y 13,76 kg/d, respectivamente, en las unidades sanitarias. Entre todos los residuos estudiados, las cantidades de residuos ordinarios, infecciosos y químicos y farmacéuticos eran de 145,85, 111,11 y 38,17 kg/d, respectivamente, en los hospitales. Los hospitales estudiados presentaban las mayores cantidades de residuos producidos que las unidades sanitarias. En aproximadamente el 54% de los centros estudiados, sólo había una persona asignada a la recogida de residuos. Ninguno de los centros estudiados disponía de un almacén temporal para los residuos médicos.

**Conclusión:** Es imprescindible determinar estrategias adecuadas para la gestión de los residuos hospitalarios con el fin de reducir el riesgo de diseminación de infecciones en el entorno y aumentar las condiciones de salud.

**Palabras clave:** Estrategias sanitarias, hospital, asistencia sanitaria, gestión de residuos.

## Introduction

Expansion of cities, increase in population, and industrial advances caused severe increase in the waste production<sup>1</sup>. In this regard, transporting and disposing of garbage is an important issue. In these cases, a regular system is essential to monitor the transportation of waste and garbage management. This matter is so important for the human, animal, plant and environmental health<sup>2</sup>. Additionally, the increase in the number of healthcare centers, hospitals and laboratories has led to the mass production of hospital wastes. Thus, proper disposal and management of this kinds of waste can prevent the spread of disease and increase the level of public health<sup>3-5</sup>.

Medical wastes contain different substances and therefore are considered as a special mixed waste. If these materials are not stored properly, they will be difficult to move. Because infectious wastes contain large amounts of infectious disease-causing agents, contact with susceptible individuals can cause infectious diseases<sup>6</sup>. Annually, 5.2 million persons have been death due to the diseases transmitted through hospital wastes<sup>7</sup>. On the other hand, decontamination of infectious and chemical waste in medical centers requires the use of highly advanced and expensive treatment methods, which will not be practical in low-income countries and even in developing countries<sup>8,9</sup>. Therefore, control and preventive measures to reduce the production and minimize hazardous waste in various health centers is one of the basic strategies of the World Health Organization in developing countries<sup>10</sup>.

Many countries have enacted laws and proposals to move and dispose of medical waste from hospitals. All types of solid waste produced by health care centers need to be handled, transported and disposed of in a controlled manner to maintain public health and prevent environmental pollution. This can only be achieved by enforcing mandatory enforcement laws and using guidelines in all aspects of the handling, storage, transportation and disposal of this waste<sup>11,12</sup>. In developed countries, the definition of medical waste and the various methods of collecting, transporting, storing and disposing of this waste are provided in the laws and regulations. Also, the best available technologies have been used to develop methods for proper disposal of medical waste with the least risk to human health and the environment<sup>13,14</sup>. However, no comprehensive efforts have been made to understand how waste generated by hospitals is managed. Waste management is usually left to ordinary workers who do most of the work without proper instructions and inadequate support<sup>15-17</sup>. The present survey was carried out to study and review of hospital waste management process was carried out with the aim of explaining the status of production, collection, separation, temporary storage and storage, disposal and

health of personnel working in the collection and disposal of medical waste in health centers and health centers.

## Materials and methods

### Study type

This cross-sectional descriptive study was performed to identify the current status of medical waste management in 2 healthcare centers and 2 hospitals in Tehran, Iran.

### Designing

In this study, a standard checklist and questionnaire of the Ministry of Health were used, the degree of reliability and validity of which was established. The checklists were completed by highly trained environmental health experts through face-to-face visits, observation and visits under the supervision of environmental health experts of health centers and hospitals.

### Check lists

The checklist consisted of two sections, public and private, which did not use general information to evaluate hospital management. However, the dedicated section of the checklist, including 5 separate sections of waste generation rate and percentage of infectious waste, segregation, collection and transportation, storage and temporary storage and final disposal of waste was used to evaluate medical waste management.

### Data analysis

Qualitative data were analyzed in the form of numerical and descriptive statistics, and quantitative data were analyzed after entering the Excel software, calculating the mean and standard deviation of the values and drawing the relevant tables<sup>18,19</sup>.

## Results

According to the study, the type of medical waste of health centers and hospitals are divided into three types, which are: 1) ordinary wastes; 2) infectious wastes; and 3) chemical and pharmaceutical wastes. According to this classification of both healthcare centers and hospitals, the amounts of wastes in each group were presented in tables 1 and 2.

**Table I** shows the amount of waste produced by healthcare centers. A total of 84.16 kg/d wastes were produced in 2 studied healthcare centers. Among all studied wastes, the amounts of ordinary, infectious and chemical and pharmaceutical wastes were 52.90, 17.50, and 13.76 kg/d, respectively. Amounts of produced wastes in healthcare center No 1 were higher than No 2.

**Table II** shows the amount of waste produced by hospitals. A total of 295.13 kg/d wastes were produced

**Table I:** The amount of waste produced by healthcare centers.

Healthcare centers	Supported population	Number of employees	Amount of produced wastes (Kg/d)			
			Ordinary wastes	Infectious wastes	Chemical and pharmaceutical wastes	Total
1	6414	12	30.75	10.52	7.23	48.50
2	4289	8	22.15	6.98	6.53	35.66
Total	10703	20	52.90	17.50	13.76	84.16

**Table II:** The amount of waste produced by hospitals.

Hospitals	Supported population	Number of employees	Amount of produced wastes (Kg/d)			
			Ordinary wastes	Infectious wastes	Chemical and pharmaceutical wastes	Total
1	25123	90	75.22	60.77	20.46	156.45
2	18245	78	70.63	50.34	17.71	138.68
Total	43368	168	145.85	111.11	38.17	295.13

in 2 studied hospitals. Among all studied wastes, the amounts of ordinary, infectious and chemical and pharmaceutical wastes were 145.85, 111.11, and 38.17 kg/d, respectively. Amounts of produced wastes in hospital No 1 were higher than No 2.

There were no strict separation criteria in studied hospitals and healthcare centers. For example, infectious waste of infectious diseases ward s of hospital units is disposed together with the wastes of dental centers. There was no hospital waste management operational plan in any of the health units. Also, the operational plan to reduce the production of hospital waste was not implemented in all studied healthcare units and hospitals. In about 54% of the healthcare centers and hospitals surveyed, only one person was assigned to waste collection. In some cases, the person was responsible for the charge of garbage collection also did other works, such as cleaning. None of the studied centers had a temporary storage facility for medical waste, and basements, warehouses, beds, and courtyards were commonly used for temporary storage. Infectious waste was not stored in any of the centers for a long time. Also, the level of education of a person who were responsible to collect and manage waste were under diploma. The results showed that no training was given to personnel to manage medical waste and collect and dispose of it. None of the disposal wastes were not have significant labels.

## Discussion

Despite all advances occurred in medical sciences, several infectious diseases become health-threatening in the last century<sup>20-25</sup>. Studies showed that proper management of wastes in hospitals and healthcare centers can diminish the risk of diverse outbreaks of infectious diseases<sup>26,27</sup>. Our findings showed that the low management levels were accompanied for disposal of medical wastes in healthcare units and hospitals studied in the present survey. Regarding the personal hygiene of garbage collectors, it was found that most of them

do not have proper work clothes and also did not have regular recruitment and periodic examinations, so it is necessary for the center managers to wear appropriate clothes, gloves and shoes. Prepared for them and introduced to the medical diagnostic laboratory for necessary examinations. The statistics obtained show that the volume of hazardous waste production in the centers and bases is relatively small, shows that with proper planning, waste can be properly separated and separated so that it can be disposed of better.

Given that the bins used in the centers are unlabeled or do not use standard colored containers and bags, it practically means that the separation has not been done properly. Therefore, it is necessary to teach the staff how to label and use different nylons and containers with different colors to identify and separate the types of waste and reduce their risks. There is no special place for washing trash in the centers and if necessary, washing is done in the sanitary facilities.

Comparison of the results of this study with similar studies conducted on hospital waste management in other regions, showed that the amount of hospital waste is somewhat different, which can be due to the type of services provided in each city, cultural and economic situation. and how to manage the hospital.

Bazrafshan et al<sup>28</sup> stated that the he average of total quantity of waste produced in all hospitals was 6096.41 kg/day. Medical waste generation rate for total waste, infectious waste, general waste and sharp waste are  $2.76 \pm 0.10$ ,  $1.36 \pm 0.66$ ,  $1.37 \pm 0.66$  and  $0.042 \pm 0.028$  kg/bed-day, respectively, which is comprised of 51.6% (3142.05 kg/day) of infectious waste, 47.2% (2880.25 kg/day) general waste and 1.2% (74.11 kg/day) sharps waste. Soltanian et al<sup>29</sup> reported that total produced waste in any 24 hours duration equal to 61 kg, including 37.8, 22.5 and 0.7 kg of domestic wastes, infectious solid wastes and sharp objects, respectively. The average per annual was 1.9 kg in 24 hours each hospital bed of the study area. Amouei et al<sup>30</sup> reported that the generation

rate of the solid wastes were: total dental wastes: 291.2 kg including general solid wastes: 251.3 kg (86.3%), infectious wastes and sharps: 38 kg (13%) and hazardous chemical waste: 2 kg (0.7%). The total amount of wastes in a year was 69888 kg. The solid wastes are daily produced according to each active dental unit as total, domestic-type, infectious and the hazardous chemical wastes were 3.07 kg, 2.65 kg, 0.4 kg and 0.02 kg, respectively. Gitipour et al<sup>31</sup> mentioned that total active beds in 165 surveyed hospitals were 26444 beds, which produced 91.22 ton/d of medical wastes, and per bed production of wastes was 3.44 kg/d. Of all wastes in hospitals, 38.35% were infected wastes (1.31 kg/day/bed), 57.85% were non- infected wastes (1.99 kg/day/bed) and 3.75% were pharmaceutical and chemical wastes (0.13 kg/day/bed). The treatment efficiency of 81.29 % of hospitals was accepted (TST and Spore test results were negative). Yousefi et al<sup>32</sup> reported that the total amount of hospital waste comprising infectious waste, sharp and pharmaceutical chemicals were related to Imam Khomeini hospital with values of 44 220 012 and 10 kg per day respectively, with 220 kg per day of general waste related to same hospital. Hence, the total weight of waste produced per capita, for infectious waste, general waste, chemical waste, and sharp-machinery were  $2.35\pm 0.25$ ,  $0.39\pm 0.075$ ,  $1.25\pm 0.66$ ,  $0.05\pm 0.028$ , and  $0.021\pm 0.015$  kg per day per bed respectively. The study of Nemathaga et al<sup>33</sup> in South Africa showed that among the total waste, ordinary waste had an average of 60.74%, medical waste was 30.32% while sharp

waste was 8.94%. The average rate of medical waste production was obtained as 0.6 g/patient/d. In other study, the amount of infectious waste, general, sharp and pharmaceutical chemicals were 82.7%, 61.32%, 3.84% and 1.5% of all waste produced, respectively<sup>34</sup>.

Study problems regarding hospital waste and lack of proper implementation of laws and principles, and the rules for proper implementation and management of hospital waste need to be revised. This can reduce the quantity and quality of waste in the country to a minimum. Environmental health education is needed for nurses on hospital waste management followed by strict monitoring for compliance<sup>35</sup>.

## Conclusions

The results indicate that waste management in health centers has serious problems. Therefore, it is necessary to fundamentally review the waste management method, provide regular programs and equip the centers with infectious waste disposal equipment before the final landfill. Also, setting up safety centers or sites to provide services for all existing health care units (public, private) can be one of the necessary solutions to solve this problem.

## Conflict of interests

The authors have no conflict of interest.

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