

Survey of Hospital Solid Waste Management in North of Iran

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Abstract

Background and Objectives: Disposal of hospital waste is a significant environmental concern, particularly in developing regions of the world. Addressing this challenge relies on availability of detailed data on the current status of waste management. Mazandaran Province is located in southern coast of the Caspian Sea and thus its environmental status may directly influence the environment of this Sea. The present study aimed to characterize the situation of hospital solid waste management in this province.

Methods: The solid waste management of 40 hospitals of various types was surveyed. Data were collected by a researcher-made questionnaire and summarized using descriptive statistical methods.

Findings: Mean per capita of infectious, general, sharp, and total wastes, was found to be 0.95, 1.59, 0.06, and 2.61 kg/bed/day, respectively. A total of 36.1% of all waste is hazardous waste (infectious and sharp wastes). The distance between the temporary place of waste and the nearest hospital ward is < 20 m in 15%, 20-50 m in 52.5%, 50-100 m in 12.5%, and >100 m in 20% of the hospitals. This time of waste residence is < 1 day in 42.5%, 1 day in 37.5%, 2 days in 12.5%, and 1 week in 7.5% of hospitals. The type of temporary place of waste was a roofed concrete chamber, a metal container, an outdoor area, and a tightly-closed plastic container, respectively, in 82.5%, 10%, 5%, and <1% of the hospitals. The infectious waste is incinerated in 57.5%, autoclaved/hydro-calved in 35%, and disposed untreated in <1% of hospitals. Infection control training courses are held every month in 27.5%, every three months in 12.5%, every 6 months in 40%, and once a year in 17.5% of the hospitals.

Conclusions: A large volume of the total hospital waste is hazardous waste. Disposal of waste in more than half of the hospitals take one day or more. The environmental and health risk associated with this situation calls for appropriate measures. More than half of the surveyed hospitals treat their waste by incineration which may release considerable amounts of air pollutants. Equipping these hospitals with autoclave and hydro-clave devices is thus significant to protection of the environment.

Keywords: Waste management, Medical waste disposal, Solid waste, Hazardous waste

Background and Objectives

Continuous development of health systems and the growing access of community to medical centers have resulted in escalating production of healthcare-related waste. Hospital waste often contains infectious and/or poisonous materials whose contact with soil, water, and air will contaminate environment.¹ Pollution of environment by hospital waste is a potential source of prevalence of various types of diseases and epidemics. Thus, professional management of hospital waste is crucial to provide, maintain, and promote public health.^{2,3} A basic prerequisite to

design and implement a professional hospital waste management is appropriate differentiation of various types of waste. Given the wide range of solid waste produced by hospitals,^{4,5} there are different views on ideal separation of dangerous hospital waste.^{6,7} Generally, the waste produced by health and medical centers are be divided into 2 groups of general waste and hazardous waste.⁸ Typical hospital hazardous waste includes infectious, pharmaceutical, radioactive, and poisonous-chemical materials which according to a World Health Organization (WHO), hazardous for 15% of total hospital waste.⁹ Depending on the health services provided by a hospital, the amount of hazardous waste, however, may reach up to 90% of total medical waste.¹⁰

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Based on recent statistics from Iran, 450 tons of hospital waste is produced on a daily basis. Also, the average per capita production rate of hospital waste has been estimated to range within 2-9 kg/bed/day, whereas the same rate is limited to 2-6 kg/bed/day in European countries.¹¹ Despite the need for information on medical waste management for relevant policy-making, the data on equipment, skills, and practices related to hospital waste treatment and disposal in Iran is scarce. While through nationwide studies supported by the government is required in this regard, local data obtained from academic studies may contribute to fill this gap. Thus the present study was designed to gain insight into production and management of solid waste in a sample of health care centers from Mazandaran province (Northern Iran).

Methods

This descriptive cross-sectional study was carried out in 40 hospitals of Mazandaran province. Data was collected using a researcher-made questionnaire asking about generation, type, transport, temporary storage, and disposal of waste and provision of training courses for the staff and managers. The validity and reliability of this questionnaire were confirmed by the number of faculty members of Babol University of Medical Sciences. All analyses were carried out by SPSS version 19 software package.

Results

Among 40 surveyed hospitals, 5 (12.5%) are affiliated to the Social Security Organization, 7 (17.5%) are private and 33 (82.5%) are public, 6 (15%) are teaching, 7 hospitals (17.5%), specialized, and 22 (55%) general.

Generation Rate of Solid Wastes

Table 1 shows the rate of waste production, based on the type of waste and hospital.

As seen, 34.2%, 63.9%, and 1.9% of waste in the surveyed hospitals are infectious, general, and sharp waste, respectively. The total percentage of hazardous waste (infectious and sharp waste) is equal to 36.1%.

Table 2 shows the mean per capita production rate of infectious, general, sharp, and total waste. The mean per

capita of hospital waste production for inpatients and outpatients is given in Table 3.

Waste Storage Places

The distance between the temporary place of waste storage and the nearest ward (laboratory, pathology, and infectious disease) was less than 20 m in 6 hospitals (15%), 20-50 m in 21 hospitals (52.5%), 50-100 m in 5 hospitals (12.5%), and more than 100 m in 8 hospitals (20%). The type of temporary place of waste was a roofed concrete chamber, a metal container, an outdoor area, and a tightly-closed plastic container, in 33, 4, 2, and 1 hospital(s), respectively.

Storage Duration

Depending on the amount of waste produced and the distance of temporary disposal site, waste storage time was different among hospitals. The duration of waste storage was found to be less than 1 day in 42.5%, 1 day in 37.5%, 2 days in 12.5%, and 1 week in 7.5% of hospitals.

Waste Disposal Method

Table 4 shows the method used for disposal of infectious waste. As seen 57.5% of hospitals incinerate the hazardous waste, 35% perform disinfection using autoclave and hydro-clave. Hospitals which lack incinerator and disinfection devices transfer their infectious waste to another hospital or incinerate it in an outdoor place.

Infection control training courses are held every month in 11 hospitals, every 3 months in 5 hospitals, every 6 months in 16 hospitals, and once a year in 7 hospitals. Only one of the surveyed hospitals offers no training on infection control to its staff and managers.

Table 2. The Mean Per Capita of Infectious, General, Sharp, and Total Wastes Per Bed

Type of Waste	Per Capita Production (kg/bed/d)
Infectious waste	0.95
General waste	1.6
Sharp waste	0.05
Total waste produced	2.6

Table 1. The Rate of Waste Production, Based on the Type of Waste and Hospital

Type of Hospital	Type of Waste			
	General Waste (kg/d)	Infectious Waste (kg/d)	Sharp Waste (kg/d)	Total Waste Produced (kg/d)
Social Security	546	350.5	23	930
Private	593	463	66.6	1122
Public	5981.5	3571.5	135.4	9869
Total	7120.5	4385	225	11921

Table 3. Mean Per Capita of Hospital Waste Per Inpatient and Outpatient

The Mean Per Capita Waste Production (kg/d)	Infectious Waste		General Waste		Sharp Waste		Total Wastes	
	%	No.	%	No.	%	No.	%	No.
Per inpatient	3	71.4	5.9	74	0.15	75	9.10	74
Per outpatient	1.2	28.6	2.1	26	0.05	25	3.30	26
Total	4.2	100	8	100	0.20	100	12.40	100

Table 4. Hazardous Waste Disposal Methods

Methods of Waste Disposal	No. of Hospitals	%
Incinerator	23	57.5
Autoclave and hydro-clave	14	35
Lack of equipment disposal	3	7.5

Discussion

The aim of the present study was to survey the rate, types, and disposal of hospital waste in a sample of health facilities of Mazandaran province. More than one-third of waste in the surveyed hospitals was found to be infectious and the total percentage of hazardous waste (infectious and sharp wastes) reached to 36.1%, falling close to the lower bound of the amount of hazardous waste in Iran reportedly varies in the range of 30 to 53%.¹²⁻¹⁴ Thus the relative volume of hazardous waste in our surveyed hospitals falls close to the lower bound of this range. Nonetheless, this amount goes beyond the range of 10%-25% reported from some developed countries.¹² The average relative volume of hazardous waste in our hospitals is higher than that reported from South Africa (8.94%)¹⁵ and Libya (28%)¹⁶ and lower than that reported from Egypt (38.9%).¹⁷ The difference may be justified by factors such as the hospital specialty and type of services, number of active beds, hospital management, hospital location, and cultural and economic status of the community.¹⁸⁻²⁰

The mean per capita of infectious and sharp waste in the present study was 1 kg/day/bed. Previous studies have reported the average per capita of hazardous waste to vary between 0.67 to 4 kg/day/bed.^{12-14,21,22} Again this variable approaches to its lower bound in the surveyed hospitals. Nonetheless, lower amount of per capita hospital hazardous waste production has been reported from Brazil (0.57 kg/day/bed)²³ and Taiwan (0.19-0.88 kg/day/bed).²⁴

In 85% of hospitals surveyed, the distance between the temporary place of waste and the nearest hospital ward was more than 20 m. In addition a majority of hospitals (52.5%) store their waste temporarily 20-50 m away from hospital wards. Reports from a number of hospitals surveyed in Iran show the corresponding distance varies between 10 to 30 m,^{25,26} which is consistent with our observation. The place of temporary waste storage is directly

associated with the environmental and health risk.¹⁴ Thus, in order to prevent infection and disease transmission the waste should be disposed at the utmost distance from hospital wards especially infectious diseases and surgery operation wards.

While more than 40% of the inspected hospitals took less than 1 day to remove the waste from temporary storage site, this duration was 1 day in more than one-third, and 2 days or higher in one-fifth of the hospitals. A comparable proportion of teaching hospitals in Tehran also remove their waste in less than 24 hours.²⁵ However, the proportion was found to be higher among private hospitals in the same study.²⁵ Duration of temporary waste storage in the temporary disposal place is a significant waste management issue which may be improved by appropriate training of the staff.¹⁴

While the more than half of the surveyed hospital incinerated their waste, only around one-third of them used autoclave and hydro-clave for waste disinfect, and the rest lacked equipment for professional waste disposal. Similarly, Habibzadeh et al²⁶ reported 50% of hospitals situated in 3 Western Iranian cities (Bookan, Mahabad, Saqqez, and Myandoab) to use incinerator for infectious waste handling. Our result together with those from previous reports indicates that incinerator is the most popular method for waste disposal/treatment in Iran. Given the environmental pollution risks associated with this method, application of more advanced and environmental friendly approaches such as autoclave and hydro-clave should be encouraged. Also modern hospital waste management requires separation of waste based on their types to choose the most appropriate pre-disposal treatment method. Facilitating the access to the disinfection equipment was shown to be effective in promotion of this method.^{14,26} Evidence also shows the positive impact of training on improvement hospital waste management.²⁷

Conclusions

A large volume of the total hospital waste is hazardous waste. Disposal of waste in more than half of the hospitals takes one day or more. The environmental and health risk associated with this situation calls for appropriate measures. More than half of the surveyed hospitals treat their

waste by incineration which may release considerable amounts of air pollutants. Equipping these hospitals with autoclave and hydro-clave devices is thus significant to protection of the environment.

Competing Interests

The authors declare no competing interests.

Authors' Contributions

The authors contributed equally to this work.

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