

Quantitative and Qualitative Assessment of Waste Produced in Sari Hospitals

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Abstract

Aims: The Iranian city of Sari with a green nature has great environmental importance, especially in ecotourism. Thus, the proper management of medical wastes is necessary to maintain a sustainable environment. This study is aimed to determine the quantitative and qualitative wastes in the hospitals of Sari. **Materials and Methods:** This was a cross-sectional study using a descriptive-analytical approach to analyze the infectious and noninfectious wastes of four hospitals in Sari. The data collection instrument was a checklist that was completed on visits to hospitals and observation of cases. Data analysis was performed using Excel and R software programs. **Results:** The average quantity of the total waste produced in hospitals was 218, 482, 19.5, and 17 kg/day for infectious, household, sharp-cutter, and pharmaceutical wastes, respectively. The rate of hospital waste production for various types of infectious, household, sharp-cutter, and pharmaceutical wastes equaled 1.15, 2.13, 0.09, and 0.28 kg/bed, respectively. **Conclusion:** Due to the high percentage of infectious wastes, despite considerable efforts to separate wastes, there are still problems in the hospitals that require more attention from the authorities, as well as the incorporation of new methods to render waste safe before it leaves the hospital.

Keywords: Hospital waste, Iran, qualitative and quantitative analysis, waste management

INTRODUCTION.

The increased the amount and diversity of waste and environmental pollutants, and the consequential health hazards are currently among the most important problems of human societies.^[1-3] The range of these wastes is diverse, ranging from ordinary household wastes to the most hazardous chemical and biological contaminants.^[4,5]

Medical waste (hospital waste) refers to a variety of wastes produced in hospitals, clinics, and doctor's offices (both for humans and animals), nursing centers, and laboratories that use microorganisms.^[6,7] According to the World Health Organization (WHO) reports, 80%–85% of the waste produced in health-care centers is the typical waste that is similar to household waste is safe, which does not need special protocols for collection, transportation, or disposal, and is collected and disposed of with other municipal wastes.^[8,9] The remaining

15%–20% of medical waste is considered hazardous and special, and thus may have adverse health-related effects.^[10] Given the potentially hazardous nature of medical wastes, their disposal and safety management is a public and professional challenge. Hazardous and special wastes include infectious, pathological, genotoxic, pharmaceutical, chemical, and radioactive wastes that are toxic, harmful, carcinogenic, and pathogenic.^[11,12] Therefore, the safe handling of medical wastes is a managerial issue that needs the full cooperation of the health-care staff.

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Waste management at health-care centers has two crucial components: first, the management of various types of general and hazardous wastes generated from different sources, which must be carefully separated, collected, transmitted, and disposed of; second, adequate training and supervision of various groups responsible in the waste management system.^[8,13] The important point about health centers' waste is that these wastes should by no means be mixed with urban wastes because of the dispersion of various chemical and biological substances containing dangerous and pathogenic materials that generate specific health and environmental hazards.^[14] According to the WHO statistics, >2 million health workers suffer from skin-related injuries each year due to sharp waste materials in health-care centers. Therefore, the management of medical waste could be improved through national regulation, internal management system, safety training programs, ensuring personnel safety, creating programs for estimating the amount of the waste produced and evaluating disposal methods.^[15]

Special consideration and a large number of cases or cohort studies are required in order to address the problem of medical waste management. In Iran, there are few studies on this topic, which have assessed the medical waste management status. Malekahmadi and Yunesian evaluated the current status of medical waste management in hospitals in Tehran. Their result indicated that medical waste management had an excellent status in 5.6% of the cases, good in 50.7%, moderate in 26.4%, poor in 13.9%, and very poor in 3.5%.^[16] Furthermore, Mohammadian Fazli *et al.* assessed the status of medical waste management in the city of Zanjan, Iran, and showed that the generation of medical waste in the studied hospitals was higher than the amount recommended by the WHO.^[17] Sharp-cutter waste consists of needles, syringes, broken glass, and small surgical scissors.^[18] Since these components can cause injury and let pathogenic agents such as HIV and hepatitis virus enter the human body, it is necessary to separate them from other infectious wastes and collect and dispose of them separately.^[19,20]

A fundamental step to implement a proper waste management program is to identify its quantitative and qualitative amounts in each city.^[21,22] Therefore, given the increasing need of human societies for health and the expansion of various health and medical facilities in the health-care centers, as well as the potential adverse effect of some disposable hazardous medical wastes, there is an urgent need to study in detail the amount of medical waste produced by each hospital, and raise the awareness of the examined wards as to efficient waste management.^[23,24] The setting of the present research was northern Iran with green nature and great environmental significance, especially in ecotourism. We aimed to investigate in detail the quantity and quality of medical wastes generated in four hospitals of Sari in 2018.

MATERIALS AND METHODS

Study area

Figure 1 displays the spatial location of the studied area and hospitals in Sari, Mazandaran Province, Iran.

Sari is located in the north of Iran with a mild and humid climate in the summer and relatively cold and dry weather in the winter. This city has great environmental importance, especially in ecotourism. The annual average temperature and annual average rainfall equal 15°C and 789.2 mm, respectively. Sari is located between 53°5' N latitude 36°4' E longitude, and its average height is ~132 m above the sea level. The total population of the region is 309,820 (2016), and the majority of inhabitants are farmers.

Data collection

This descriptive cross-sectional investigation was conducted in 2018 to examine four hospitals in Sari. In the first step, the participation of each ward and unit of the studied hospitals in the generation of medical wastes was investigated. To this end, the wastes collected in bags from all units of the four hospitals were weighed daily for a month under the supervision of health experts. A small amount of waste and infectious, household, sharp-cutter, and pharmaceutical wastes weighing ± 100 g was determined using a weighing balance. One month is the shortest period to investigate the daily generation of waste, as reported by the WHO.^[10] During this period, the modality of labeling of the bags and filling of the bags to — of capacity, method of transferring the waste from each unit to the final chamber, and the use of personal protective equipment were also examined.^[25-27] The raw data obtained from waste weighing, the analysis of their components, and the effect of educational intervention were analyzed in Excel and R software programs.^[26,28]

Prevention of unintended infection in samplers

Before analyzing and separating the wastes, the researchers were first examined for hepatitis B virus antibody titers and in the absence of immunity, were vaccinated three times to prevent unintended infection. Furthermore, to take more precise safety measures in all the stages of separation, the workers were equipped with personal protective equipment, including work gloves, protective glasses, and activated carbon masks (FFP2 class).



Figure 1: Geographic location of the studied area

RESULTS

Table 1 presents the average status of waste production in each hospital in kg/day. Hospital A had 162 active beds with an average of 575 kg/day of waste and the least amount of waste produced among the hospitals. Moreover, Hospital C, with 279 active beds, had the highest rate of waste production (1106 kg/day).

Figure 2 illustrates the average daily production of waste types in hospitals A, B, C, and D; the average infectious, household, sharp-cutter, and pharmaceutical wastes equaled 28%, 61%, 2%, and 9%, respectively.

Based on the findings, Figure 3 demonstrates the average daily production of waste types in different hospitals in comparison with one another; sharp-cutter wastes had the minimum rate, and household wastes had the maximum rate.

Figure 4 shows the average daily production of waste types in the studied hospitals; household waste had the highest amount (482.5 kg/day), while sharp-cutter waste had the lowest amount (19.5 kg/day).

Figure 5 presents the daily production (kg) of infectious waste per bed in the studied hospitals (kg/day). Evidently, one hospital produced 0–1 kg, one hospital 1–1.5 kg, and one hospital 1.5–2 kg of infectious waste per day. The chart shows that no hospital produced >2 kg of infectious waste per bed daily.

DISCUSSION

A major challenge for waste management, especially in developing countries, is the disposal of medical waste. Research on the details of waste generation in medical and health-care centers can help improve medical waste management. Different studies have been conducted in various hospitals in Iran, but further studies are required to address this problem in detail to implement efficient medical waste management.

Herein, the amount of medical waste generated in four hospitals in Sari, Iran, was evaluated in detail. The amount of waste in educational hospitals for each occupied bed was 2.75 kg/day. Compared with other studies conducted in hospitals, the total amount of medical waste generated in the hospitals examined in this study differed, which may be due to the larger number of active units with more beds, highlighting the necessity of taking measures for improving waste management in these hospitals. Based on our findings, the amount of waste generated in the hospitals also differed from hospital to hospital, and this may complicate waste management in the future.^[29]

Our results are consistent with the WHO report based on which the daily waste production rate is 4.1–4.8 kg/bed/day in academic hospitals, 2.4–1.2 kg/bed/day in general hospitals, and 0.5–1.8 kg/bed/day in regional hospitals.^[29,30]

In the study by Yousefi and Rostami (2017), the hospital waste of Behshahr, Iran, contained 62% ordinary, 33% infectious, 4% sharp, 1% pharmaceutical, and chemical waste.^[31]

In the study by Bahrami (2008), the combined sanitary-health waste of Kerman, Iran, contained household, infectious, sharps, pharmaceutical, and chemical wastes (18.4%, 16.3%, 1.9%, and 4.1%) respectively.^[32]

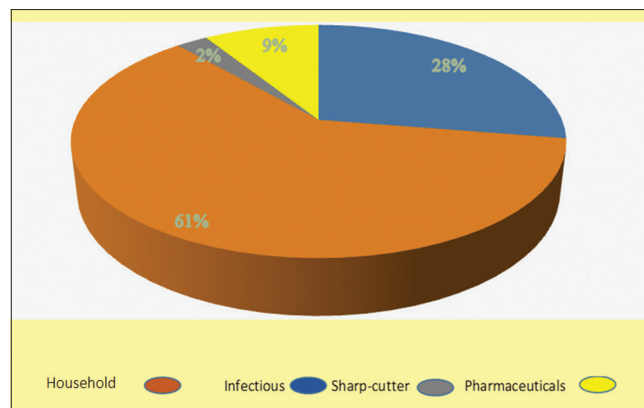


Figure 2: Average daily production of waste types in the studied hospitals (%)

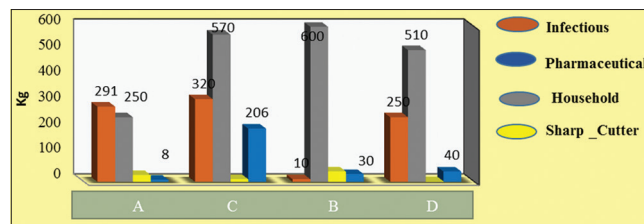


Figure 3: Comparison of the types of waste produced in the four studied hospitals

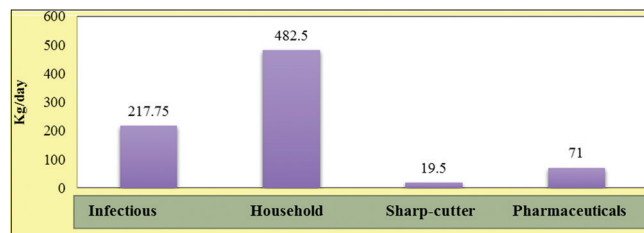


Figure 4: Average daily production of waste types in the studied hospitals

Table 1: The daily production of waste types in hospitals (kg)

Hospital	Number of beds	Infectious waste	Household waste	Sharp and cutter waste	Pharmaceutical waste	Total (kg)
A	162	291	250	26	8	575
B	250	10	600	40	30	680
C	279	320	570	10	206	1106
D	200	250	510	2	40	802

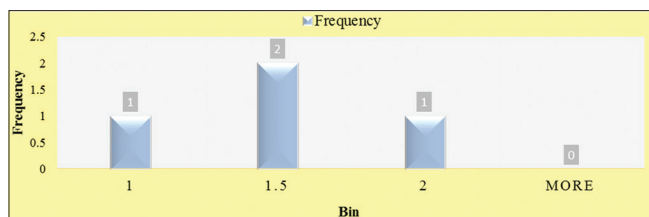


Figure 5: Frequency of infectious waste production (kg/bed/day)

In a 2009 study assessing medical waste management in 10 hospitals in Tabriz, Iran, the results showed 70.11% general waste, 29.44% hazardous–infectious waste, and 0.45% sharp waste.^[21]

The results of another study in the United States revealed that hospital waste comprises 86% household-like wastes and 14% hazardous medical waste, of which ~ 80% is infectious waste, 8% sharp objects, 5% chemical waste, 3% pathological waste, and 4% pharmacological waste and cytostatic waste.^[33]

The results of Habibzadeh *et al.* on waste management from hospitals in Buchan, Mahabad and turpentine showed that 61% of hospital wastes are general waste, 23% are infectious waste, and 16% are sharp waste.^[34]

In a 2015 study assessing medical waste management in 44 public hospitals and 15 specialized hospitals in 13 provinces of Iran, The results showed that a per capita rate of hospital wastes in Iran is 3.16 and 3.7 kg per bed per day in public hospitals and specialized hospitals, respectively. The solid waste from the public hospitals consists of 56% general waste, 42% medical waste, 2% sharp waste and in specialized hospitals 63% general waste, 36% medical waste, 1% sharp waste.^[35]

Experts and nurses should receive the necessary training. Waste separation, inter-departmental cooperation between the Ministry of Health and municipalities, as well as strong monitoring of relevant programs and disposal will assist the promotion of hospital waste management.

CONCLUSION

The results indicated that the total hospital waste is 3163 kg/day, containing household, infectious, sharp, pharmaceutical, chemical wastes (61.01%, 27.53%, 2.46%, and 8.97%, respectively). This evaluation demonstrated the poor management of hospital wastes in terms of collection, separation, temporary storage stations, and disposal.

A basic action to mitigate health and environmental problems and reduce the costs of hospital waste management is the proper implementation of a waste separation program and monitoring proper and sanitary waste disposal. Holding training courses on the proper management of hospital waste can be an effective and practical solution. In addition, equipping hospitals and health centers with modern sterilization systems for hospital waste can be an important step toward mitigating the hazard potential of these wastes. The present study highlights the necessity of continuous training on and monitoring of the collection and separation of the waste produced in the wards

and units of medical centers, which can help reduce the proportion of infectious wastes and thereby decrease the cost of handling hazardous wastes.

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Conflicts of interest

There are no conflicts of interest.

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