



# Quantitative and qualitative characteristics of hospital waste in the city of Behshahr-2016

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## Abstract

**Background:** Recently, the rapid increase in quantity and type of waste has resulted to environmental pollution and health hazards which serve as a major challenge to humans. The level of this waste can be so high that dangerous chemicals and biological contaminants can be found in ordinary household waste. Major sources of waste in every city are mostly from care/health centers. Hence, this study aims to investigate the quantitative and qualitative waste taken from hospitals in the city.

**Methods:** In this cross-sectional study, four city hospitals were examined in the city. For this purpose, a questionnaire was designed for quantitative analysis method and weighing scales based on the Ministry of Health questionnaire. Data were analyzed using SPSS software and for statistical analyses, Excel and Graph Pad Prism 5 were used.

**Results:** According to findings, 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.

**Conclusion:** The data should be more focused on waste management and frequent orientation to hospitalized patients. This evaluation indicates the poor management of hospital wastes in view of collection, separation, infectious waste care, temporary storage station and on-time transmission and health disposal.

**Keywords:** Hospital, Medical, Infectious, Solid wastes, Characteristics, Behshahr, Iran

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## Introduction

The rapid increase in quantity and type of waste has led to environmental pollution and health hazards which poses a major challenge to the human society (1-3). The level of this waste can be so high that dangerous chemicals and biological contaminants can be found in ordinary household waste. Major sources of waste in every city are mostly from care/health center (4). Medical waste (from health centers and hospitals), the types of residuals in hospitals, clinics, physicians' offices (for both humans and animals), elderly care centers and laboratories that use microorganisms as they are produced are responsible for. 75% to 90% of waste produced in hospitals (5). Regular waste, similar to household waste and municipal waste ranging from 10% to 25% of medical waste does not require special rules for collection, transportation and disposal according to the regulations of environmental protection agency. Special and hazardous waste consist of infectious waste, pathological, geotaxis, pharmaceutical, chemical and

pharmaceutical which contain toxic substances, harmful, and wastes from cancer patients (6,7).

The remarkable thing about the waste of health care centers is that this waste should not be mixed with municipal waste, because the scattered chemical and biological materials containing dangerous pathogens can lead to health and environmental hazards. Classification and composition of waste in health centers requires special attention for collection and disposal, including a range of different materials ranging from conventional or quasi-domestic waste, infectious, potentially infectious forms of the chemical and pharmaceutical. Various disposable tools and equipment such as sharp instruments contain contaminated blood products and laboratory cultures. According to the World Health Organization (WHO) rules, infectious waste includes waste that contains high levels of pathogens capable of causing diseases in susceptible hosts (6).

Infectious waste is defined in diverse ways and there are



different opinions about it. For instance, in a study carried out in Australia, all residual waste, sharp waste, vials containing droplets and visible blood stains were considered as infectious waste. While in Turkey, the study was on blood-saturated waste that was classified as infectious waste (8). Sharp waste, such as needles, syringes, broken glass and knives are wastes from minor surgeries (9,10). Since these components can cause injury and contain infectious pathogens such as hepatitis and AIDS on the human body, they need to be separated from other infectious waste during collection and disposal (11,12).

An important step in implementing a proper medical waste management is to create awareness on the quantity and quality in each city. In this regard, studies have been carried out in Iran and abroad on how medical waste management can be evaluated in teaching hospitals of Tabriz University of Medical Sciences, Tehran, Sistan and Baluchistan and Bandar Abbas (13-15) and hospitals abroad such as Bahrain, Mongolia, Turkey, Africa, Libya, Nigeria and Korea were noted (16,17).

Behshahr city in northern Iran with green nature has several environmental importance, especially in the field of ecotourism. The systematic management of medical waste in order to maintain a sustainable environment is of utmost importance. The aim of this study was to determine the quality and quantity of infectious waste quantities and management practices within and outside hospitals in Behshahr city.

### Methods

This is a cross-sectional study conducted on four hospitals in the city. The duration of the study extended for about three months and all four hospitals were used as sample to search for waste as designed in the questionnaire. All hospitals in Behshahr city selected as statistical population of this study was four ( $n=4$ ). The questionnaire consists of two parts: the general information of hospital waste and the amount of production, which were tested for various parameters in each section. To determine the amount of waste produced, qualitative and quantitative analysis of waste was conducted three times a week under the supervision of health experts. Small amount of waste and infectious waste, general (domestic) and sharp waste weighing  $\pm 100$  g were determined using a weighing balance. To simultaneously determine the amount of waste, wt% of plastic, paper and cardboard, textiles, glass, metals, food waste and infectious waste, etc in public wastes were analyzed. SPSS software, Excel and GraphPad Prism 5 were used for data analysis.

### Results

Based on the findings of this study (Table 1), the highest amount of total hospital waste, infectious waste, sharp waste, pharmaceutical chemical wastes was related to Imam Khomeini hospital and the values were obtained as 442, 200, 12 and 10 kg/d respectively (Figure 1). Also, the maximum amount of general waste (220 kg/d) was related to the same hospital. The highest general waste produced

by the Mehr hospital was obtained as 3.01 kg per bed-day (Figure 2). The results of this study demonstrated that the total hospital waste was 833 kg/d (304 tons per year). A percentage of 62% general waste, 33% infectious, 1% chemical and pharmaceutical and 4% sharp waste were obtained (Figure 3).

Based on the weight of waste, infectious, general, chemical and sharp wastes were determined as  $2.35 \pm 0.25$ ,  $0.39 \pm 0.075$ ,  $1.25 \pm 0.66$ ,  $0.05 \pm 0.028$  and  $0.021 \pm 0.015$  kg/d/bed respectively (Table 1). Highest weight of food waste was related to public hospitals (Figure 4).

In hospitals, medical wastes are kept in various temporary places to prevent where they are later disposed from the hospital. Elimination of general and infectious wastes occurs in all hospitals and they are collected by municipalities. Reservation time for wastes in hospitals is 72 hours in wet season and 48 hours in dry season. General wastes were collected by the municipality every night. In hospitals, some staff were trained in relation to methods of transportation and disposal of medical wastes. In this regard, managers at every single service, nurses were trained. Lectures on health education and training were often face to face.

The highest infectious, chemical and pharmaceutical wastes as kilogram per bed-day related to the Imam hospital are shown in Figures 5 and 6. The highest sharp wastes based on kilogram per bed-day related to the Omidy hos-

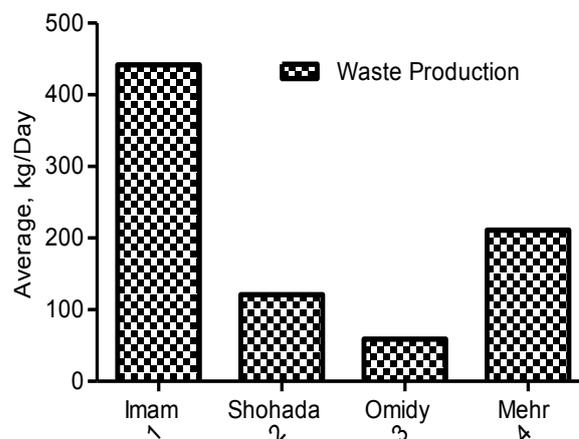


Figure 1. Waste production solid wastes in different hospitals of Behshahr city

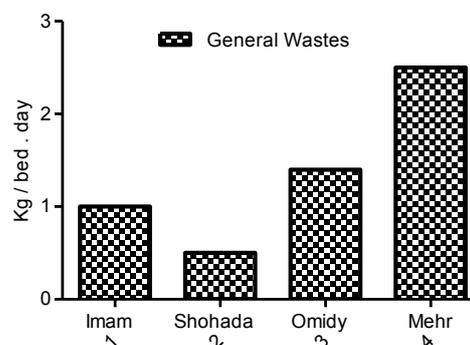


Figure 2. Average of hospital waste production per bed

Table 1. Statistical results of Behshahr hospitals data in view of wastes production and kg/bed.day

	Average hospital wastes, kg/bed. day				Average hospital wastes, kg/day						
	Chemical and pharmaceutical	Sharp wastes	Infectious wastes	General Wastes	Waste Production	Chemical and pharmaceutical	Sharp wastes	Infectious wastes	General Wastes	Waste Production	Beds
Number of Hospitals	4	4	4	4	4	4	4	4	4	4	4
Minimum	0/0040	0/0400	0/0900	0/5000	1/900	1/000	3/000	10/00	45/00	59/00	31/00
25% Percentile	0/0050	0/0425	0/1425	0/6250	1/925	1/000	4/000	12/50	51/25	74/50	35/25
Median	0/0190	0/0500	0/3000	1/200	2/250	1/000	8/500	31/50	125/0	166/0	59/00
75% Percentile	0/0375	0/08000	0/7500	2/225	2/883	7/750	11/50	160/8	210/0	384/3	182/5
Maximum	0/0400	0/0900	0/9000	2/500	3/010	10/00	12/00	200/0	220/0	442/0	220/0
Mean	0/0205	0/0575	0/3975	1/350	2/353	3/250	8/000	68/25	128/8	208/3	92/25
Std. Deviation	0/01731	0/02217	0/3493	0/8505	0/5109	4/500	3/916	88/91	84/50	167/9	86/65
Std. Error	0/008655	0/01109	0/1747	0/4252	0/2555	2/250	1/958	44/46	42/25	83/93	43/33
Lower 95% CI of mean	-0/007046	0/02222	-0/1584	-0/003327	1/540	-3/911	1/769	-73/23	-5/703	-58/86	-45/63
Upper 95% CI of mean	0/04805	0/09278	0/9534	2/703	3/165	10/41	14/23	209/7	263/2	475/4	230/1
Actual mean	0/0205	0/0575	0/3975	1/350	2/353	3/250	8/000	68/25	128/8	208/3	92/25
P value (two tailed)	0/0986	0/0139	0/1073	0/0503	0/0027	0/2444	0/0265	0/2223	0/0555	0/0892	0/1231
Significant (α=0.05)	No	Yes	No	No	Yes	No	Yes	No	No	No	No
Coefficient of variation	84/44%	38/56%	87/88%	63/00%	21/72%	138/46%	48/95%	130/28%	65/63%	80/61%	93/93%
Geometric mean	0/01400	0/05477	0/2922	1/150	2/312	1/778	7/085	36/21	105/7	160/6	69/19
Lower 95% CI of geo. mean	0/002471	0/03152	0/06544	0/3948	1/650	0/2848	2/663	4/684	31/68	41/35	18/18
Upper 95% CI of geo. mean	0/07932	0/09519	1/305	3/351	3/242	11/10	18/85	280/0	352/5	624/0	263/3
Sum	0/0820	0/2300	1/590	5/400	9/410	13/00	32/00	273/0	515/0	833/0	369/0

pital are shown in Figure 7. As indicated in Figures 1, 8, 9, 10, 11 and 12, the Imam hospital in view of the number of beds and all types of wastes was rank first among these hospitals.

**Discussion**

Based on the findings of hospital wastes produced, different values were obtained not only in hospitals but also in other cities of Iran and other countries. This difference is primarily due to factors such as waste management, provision of hospital services, the number of active beds, cultural and economic status of the community etc.

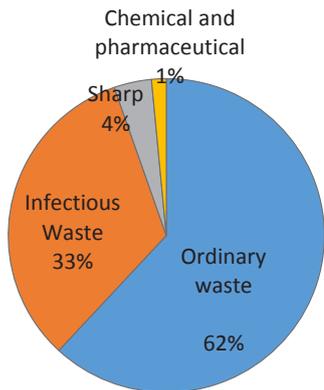


Figure 3. Percent of hospital waste.

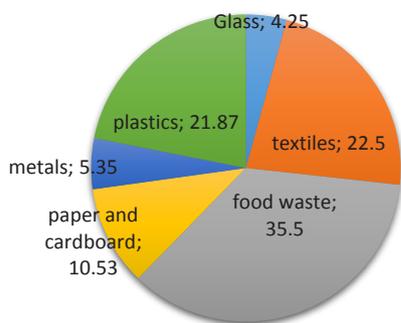


Figure 4. Physical composition of normal and infectious wastes.

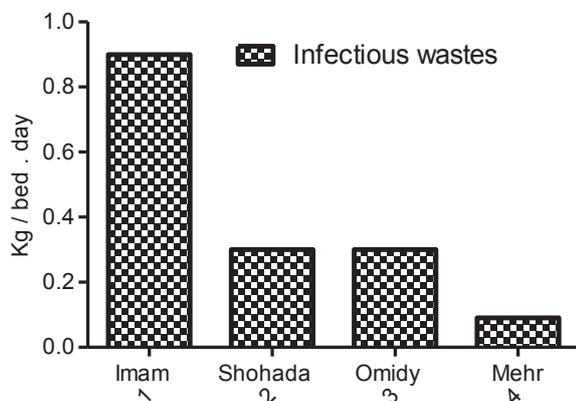


Figure 5. Average of hospital Infectious waste per bed.

The results of Taghipour et al showed that the average weight of the total waste produced in hospitals in Tabriz, dangerous infectious and domestic wastes based on the results of the corresponding list and observation were 3.48, 1.039, 2.439 kg/bed-day respectively. Also, the contribution of each infectious waste, sharp and normal was 29.44%, 0.45%, 70.11%, respectively (13). The results from

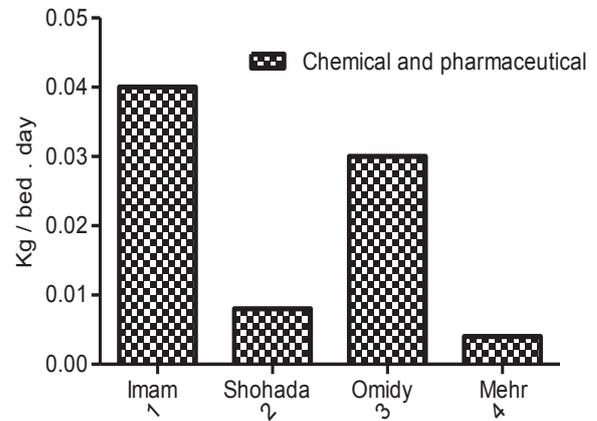


Figure 6. Average of hospital Chemical and pharmaceutical waste per bed.

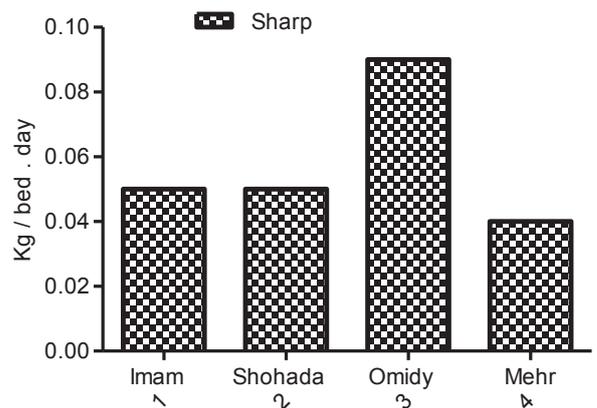


Figure 7. Average of hospital Sharp waste per bed.

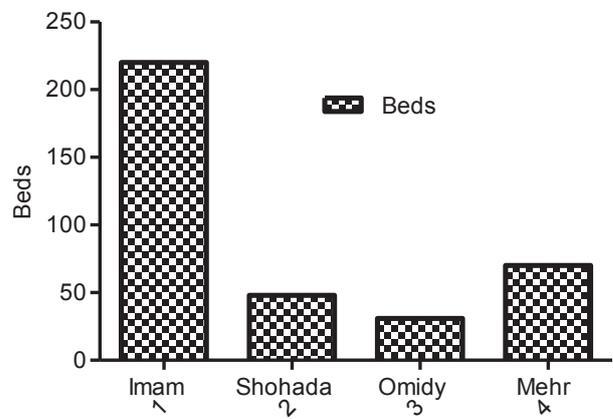
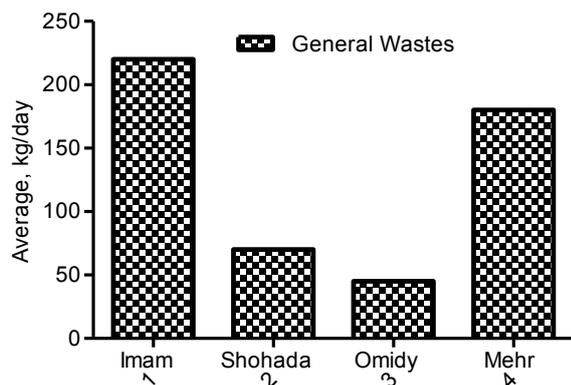
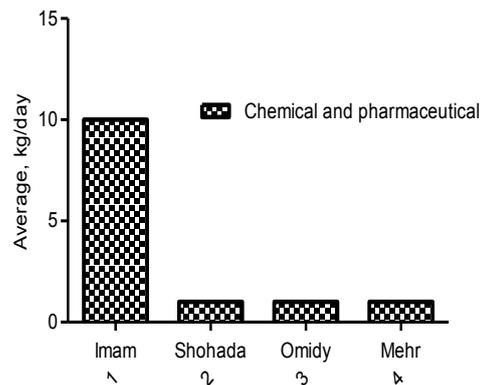


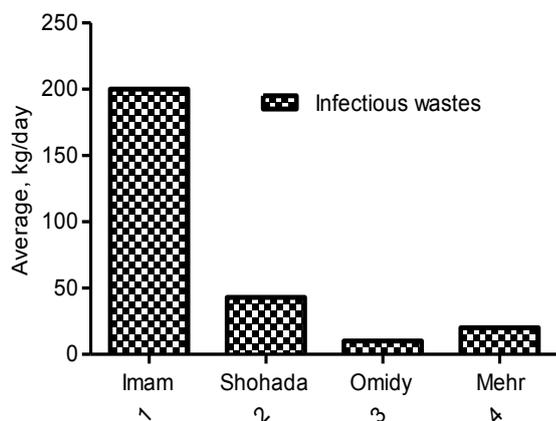
Figure 8. Number of beds in different hospitals of Behshar city



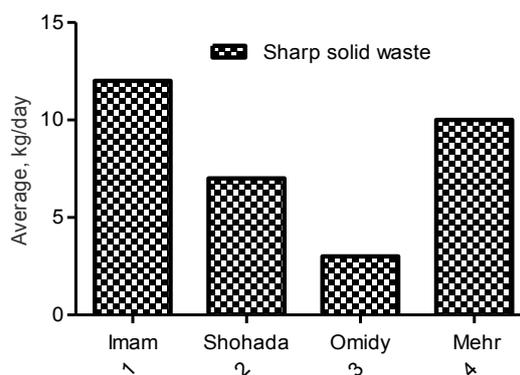
**Figure 9.** General solid wastes in different hospitals of Behshar city.



**Figure 11.** Chemical and Pharmaceutical solid wastes in hospitals of Behshar city.



**Figure 10.** Infectious wastes solid wastes in different hospitals of Behshar city.



**Figure 12.** Sharp solid wastes in different hospitals of Behshar city.

the study of Dehghani et al at Tehran hospital waste per capita per bed were between 4.4-4.6 kg/d (18).

The study of Nemathaga et al 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 (19). 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 (20).

The results of Habibzadeh et al on waste management from hospitals in Buchan, Mahabad and turpentine showed that 61% of hospital wastes are public waste, 23% are infectious waste while 16% are sharp waste (21).

A study of Binavapor in Bandar Abbas showed that the production of overnight domestic waste, potentially infectious, toxic chemical and pharmaceutical, and sharp wastes were 23526.92, 16177.08, 3817.42, 3168.49 kg/y respectively. The highest share in the production of waste, like household waste was obtained as 50.39% and potentially infectious waste was obtained as 34.65% (22).

In a study of Bahrami in 2008, combined sanitary-health waste of Kerman city were 59.3% of overnight domestic waste, 18.4% infectious, 16.3% sharp waste, 1.9% pharmaceutical and chemical and 4.1% pathological wastes

respectively (23).

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 (24). The main focus should be primarily on minimizing waste production, especially hospital waste (25). The study of waste in government hospitals is lower than those of in private hospitals. Hence, inter-sectoral cooperation, especially the Ministry of Health, Treatment and Medical Education, Department of Environment and municipalities is of great importance in solving the problems mentioned. On the other hand, one of the most important health and environmental problems is to reduce management costs of hospital waste and proper implementation of waste segregation program and supervising the proper disposal and sanitation is also necessary.

### Conclusion

The results of this study showed that the total hospital waste was 833 kg/d, 61.82% of general waste, 32.7% infectious waste, 1.5% chemical and pharmaceutical waste

and 32% as sharp waste. This evaluation indicated the poor management of hospital wastes in view of collection, separation, infectious waste care, temporary storage station and on-time transmission and health disposal. A proper program for solid waste management requires having a good arrangement of waste bins with different colors and an appropriate site selection in the hospital for different types of wastes. Moreover, hospital solid wastes transmission system by private contractors and special landfill sites with future health care should be checked by the authorities.

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### Ethical issues

There were no ethical issues for writing of this article.

### Competing interests

We affirm that this article is the original work of the authors and have no conflict of interest to declare.

### Authors' contributions

All authors were involved in all stages of the article. On behalf of the co-authors, the corresponding author bears full responsibility for this submission.

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