

# Waste Minimization: A Survey in Iranian Public and Private Hospitals

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## Abstract

**Background and Objectives:** Hospitals usually generate large amounts of hazardous waste. If not managed properly, hospital waste can pose threats to public safety and damage the environment. Waste minimization is a waste management approach that focuses on reducing the amount and toxicity of hazardous wastes. This study pursues a two-fold purpose: 1) to gain insight into hospital waste minimization performance in Iran using a sample of public and private hospitals, 2) to compare WM performance between public and private hospitals.

**Methods:** Data were collected using a questionnaire, designed based on WHO measures of hospital waste minimization. Ninety individuals from four public and three private hospitals were enrolled in this study using stratified sampling. Data was summarized using descriptive statistical methods. T-test and ANOVA were used to compare the mean values.

**Findings:** Average waste minimization score of the surveyed hospitals was 2.92 (from 5). No significant difference in overall waste minimization performance was found between public and private hospitals. Waste segregation performance was found to be significantly higher in public hospitals, whereas private hospitals showed higher performance in managing storage of chemicals and pharmaceutical products.

**Conclusions:** According to our results the status of waste minimization is unsatisfactory in Iranian hospitals. Our results also reflect on lack of employee familiarity with the concepts and practices of waste minimization in Iranian hospitals. Insignificant difference in score of waste minimization between public and private hospitals undermines the role of hospital ownership as a determinant of hospital waste minimization performance. Overall, this study emphasizes the the immediacy of devising effective strategies to address the challenge of hospital waste management.

**Keywords:** Waste Minimization, Hospital Waste, Waste Management

## Background and Objectives

Although hospitals and medical centers are dedicated to delivery of healthcare services to the patients, they can also function as media for prevalence of diseases [1]. Any contact between infectious and non-infectious waste can lead to contamination of all the wastes involved [2]. Hospital wastes pose a risk for patients and personnel who handle these wastes. In addition, they underlie a wide variety of health and safety hazards for patients and healthcare workers as well as outsiders [3]. Studies indicate that prevalence of infectious waste increases by 15.1% due

to contact of general and medical wastes with infectious wastes [4]. In addition to health risks, the impact of hospital wastes on the environment, in particular the risk of water, air, and soil contamination is a significant concern [5].

According to literature, 10-25% of medical wastes are classified as hazardous [4, 6, 7]. Despite the fact that the amount of infectious and hazardous waste is relatively small, inappropriate waste management in which infectious wastes are mixed with general wastes, can result in the entire volume becoming potentially infectious [8].

Safe and effective management of medical wastes is not only a legal requirement, but also an important social responsibility. Poor management of hospital wastes leads to a high risk of infection for those in contact with, compromising hospital hygiene, and

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failure in infection control [9].

One of the strategies to alleviate this potential risk is Waste Minimization (WM). WM involves any action toward reducing or recycling the wastes produced, and if possible, reducing or removing their toxicity [10]. WM not only helps protect the environment but it is also a sound economic and business decision. Indeed, WM practices enable organizations to reduce the volume and toxicity of hazardous wastes, costs of purchasing goods, costs of waste disposal and treatment, and environmental liabilities associated with hazardous waste disposal [7, 10, 21].

Each year, healthcare facilities in Iran generate significant amounts of hazardous wastes. In this country, because of rapid population growth and industrialization, disposal of medical wastes has become a major environmental concern [11]. For instance, the increase in number and size of healthcare centers, and the wide use of single-use disposable items have resulted in significant increase in medical wastes [12], which can be a source of various diseases if not managed properly. In Iran, hospital waste treatment has not received adequate attention, and management of medical waste is highly inefficient. WM is thought to be one of the most suitable solutions to address this problem.

In 1999, the World Health Organization [WHO] developed a framework to evaluate WM performance in hospitals. Table 1 presents a brief description of the activities involved in this framework.

This study pursued a two-fold purpose. The first purpose was to assess the clinical WM status in Iran using a sample of public and private health settings. To this end, we used the framework recommended by WHO [7] to evaluate WM performance in hospitals. The second objective of this study was to compare WM performance between public and private hospitals. With respect to the second goal, the study tested the following hypotheses:

- H1: There is a significant difference between public and private hospitals in waste minimization.
- H2: There is a significant difference between public and private hospitals in reducing sources of hazardous wastes.
- H3: There is a significant difference between public and private hospitals in good management and control practices.
- H4: There is a significant difference between public and private hospitals in managing storage of chemicals and pharmaceuticals products.
- H5: There is a significant difference between public and private hospitals in waste segregation.
- H6: There is a significant difference between public and private hospitals in recycling waste products.

## Methods

### Settings and Sample

In this study, the WM status was investigated in a sample of hospitals in Isfahan province, situated in central Iran. The study adopted a cross-sectional approach. Study settings included seven hospitals (four public and three private hospitals) selected using stratified sampling from 11 public and eight private hospitals. Sample size was determined by a panel of experts. Ninety individuals were enrolled in this study, of which 51 were from public and 39 were from private hospitals. The participants included nurses as well as directors of different hospital departments, including purchasing, storage, and pharmacy departments.

### Measurement Tool

To measure WM performance a self-designed questionnaire was developed. Items included in the questionnaire were grouped according to the framework proposed by WHO [7]. The questionnaire included 39 items on a five-point Likert-type scale. An independent panel of experts confirmed content validity of the questionnaire, and a Cronbach's alpha of 89% ensured its internal consistency reliability.

### Data Analysis

The data were summarized using descriptive statistical methods. T-test was used to compare the mean values. All statistical analyses was performed using IBM SPSS Version 17 Software.

## Results

Table 2 presents the hospitals' mean scores in WM practices. The mean WM score of hospitals was 2.92. While the highest score (3.37) was obtained by a public hospital (D), the lowest score was gained by a private hospital (G). The highest score of public hospitals (88.5) was related to CP, whereas the lowest corresponding score (36.12) was given to RP. In addition, the highest score of the private hospitals (92.09) was in CP, whereas the lowest corresponding score (31.08) was received by WS.

No significant difference in overall WM score was found between public and private hospitals. However, comparing the scores in WM measures between public and private hospitals revealed a significantly higher WS score in public hospitals compared with private facilities. In addition, a significantly higher CP score was observed in private hospitals as compared with public health settings. No other significant score difference was observed between the two hospital

**Table 1** Definition of Waste Minimization Measures

Variables	Abbreviation	Operational definition
Source Reduction	SR	Measures such as purchasing restrictions to ensure the selection of methods or supplies that are less wasteful or generate less hazardous waste.
Good Management and Control Practices	MC	Apply to commitment and support of managerial team, set rules and regulations to reduce waste.
Management in Storage of Chemical and Pharmaceutical Products	CP	Apply particularly to the purchasing, keeping, storing and using of chemicals and pharmaceuticals.
Waste Segregation	WS	Careful segregation (separation) of waste materials into different categories helps to minimize the quantities of hazardous waste.
Recyclable Products	RP	Use of materials that may be recycled, either on-site or off-site.

types. Therefore, according to our results, hypotheses H3 and H5 are supported, whereas the inverse is true for H1, H2, H4, and H6.

## Discussion

The average WM score of the studied hospitals was not satisfactory, calling for urgent attention. In addition, our study did not indicate a significant difference in WM performance between public and private hospitals. However, public hospitals showed higher performance in WS as compared with private hospitals. This observation contrasts with the results of a previous study in Iran where private hospitals showed a higher performance in WS [13].

Our results also identified a higher MC performance in private hospitals as compared with public health settings. This observation does not agree with a similar study in Jordan where public hospitals showed a higher WM performance [14].

Both public and private health settings showed a good record in CP and MC. Chemicals and pharmaceutical products are critical materials whose standard storage includes a series of specific procedures. Careful management of storage can lead to reduced accumulation of outdated chemicals and pharmaceuticals. Small amounts of chemical and pharmaceutical wastes can be disposed of easily and relatively at low cost, whereas disposal of large amounts of waste requires specialized and costly treatments. Healthcare organizations can

take step towards waste minimization by ordering their materials only from suppliers that undertake rapid delivery of small orders, return of unopened stock, and off-site management of hazardous wastes [7].

Both public and private hospitals showed a poor score in WS. This weakness is common in several other hospitals in developing countries [15, 16]. In a study in Turkey, the disposal method was found to be unsanitary, posing an environmental hazard [15]. In Aligarh, India, hospital wastes is reportedly dumped in shallow pits or in open areas in the outskirts of the city, without following any standard methods [16].

Waste minimization does not include waste treatment, unless treatment is a part of the recycling process [10]. Using recyclable products was found quite unsatisfactory in both public and private hospitals.

**Table 2** Mean and Standard Deviation of Scores of Hospitals in Waste Minimization

Hospitals	Mean	SD
A	2.95	0.67
B	2.91	0.73
C	2.93	0.57
D	3.37	0.22
E	2.86	0.65
F	3.15	0.51
G	2.6	0.41
Total	2.92	0.6

**Table 3 Comparison of Scores of Public and Private Hospitals in Waste Minimization Measures**

Waste Minimization Measures	Public Hospitals		Private Hospitals		Significance of Difference
	Mean	SD	Mean	SD	
SR	2.88	0.76	2.57	0.89	0.07
MC	3.18	0.85	3.52	0.62	0.03
CP	4.40	0.66	4.60	0.68	0.2
WS	2.64	1.35	1.56	1.50	0.001
RP	1.80	1.00	1.86	0.81	0.6

In general, both public and private hospitals showed a similar and low WM performance, which undermines the role of hospital ownership as a determinant in WM practice.

Commitment to efficient waste minimization is also important from the economic standpoint. Altin *et al.* concluded that separate collection of hospital wastes (medical, kitchen, and etc.) would decrease investment and operational costs of the incineration plants [17]. In a hospital case study, it was documented that waste reduction practice alone, could prevent occupation of 238 cubic yards, and would save generation of over 10,700 pounds of waste. In addition to the savings from avoided disposal costs, this practice resulted in an annual 11,030 USD cost savings for the hospital [18].

All health services employees can play a role in the WM process, and should therefore be trained in the management of hazardous materials. This is particularly important for the employees of departments generating large quantities of hazardous wastes [7]. According to Gamble *et al.*, employee involvement is the most important factor in the successful implementation of recycling initiatives [19]. Other studies support the notion that by virtue of a proper and regular training, management of healthcare-related wastes can be improved, and segregation of the wastes can be performed more effectively [20]. Environmental Protection Agency emphasized the advantages of source reduction over all other waste management practices [21]. The best way to manage waste is to simply not generate it in the first place, thereby eliminating the need for its collection, treatment, and disposal [21].

Developed countries have contributed enormously to the field of waste management, being far ahead of developing countries. A survey of over 700 member facilities of Practice Green Health [2008] revealed that 90% of the members had implemented strategies to improve energy efficiency, 48% had implemented

an environmental preferable purchasing program, and 31% had implemented a waste reduction program [22]. Poor clinical waste management in developing countries, in general, can be attributed to the overall managerial problems, which would affect all sectors, including the health sector. National income is another important factor that impedes efficient management of clinical wastes [23].

Considering the above-mentioned findings, it seems that there is a lack of familiarity with WM concepts and practices in Iranian hospitals. Given the importance of this issue from both health and economic standpoints, there is an urgent need for developing and implementing relevant strategies. Relevant to our results, such a strategy should pursue the following objectives: 1) Effective training for personnel in WM practice; 2) Increasing public awareness about waste hazards and the importance of using safe waste management methods; 3) Improving the awareness of the hospital managers about significance of WM; 4) Developing guidelines to help hospital staff in effective reduction of hospital wastes; 5) Devising standard procedures for selecting, handling, storing, using, and disposing of hazardous materials, and 6) Effective collection of data regarding the amount and hazards of waste materials.

## Conclusions

This study pursued a two-fold purpose: First, to survey the status of WM in a sample of Iranian hospitals; and second, to compare WM performance between public and private hospitals. Performance of the surveyed hospitals was found to be unsatisfactory. In addition, no significant difference in WM performance was found between public and private hospitals, undermining hospital ownership as a determinant of WM performance.

Our results also reflects on a considerable lack of familiarity with the concepts and practices of WM in

Iranian hospitals. The survey, therefore, indicate the urgent need for relevant strategies to support and promote WM practice in health settings. Such a strategy should involve training of hospital employees, development of relevant guidelines, improving awareness of the hospital managers about significance of WM, devising standard procedures for selecting, handling, storing, using, and disposing of hazardous materials, and effective collection of data regarding the amount and hazards of waste materials.

### Abbreviations

(WM): Waste Minimization; (SR): Source Reduction; (MC): Good management and control practices; (CP): Management in stores of chemicals and pharmaceuticals products; (WS): Waste segregation; (RP): Recyclable Products

### Competing Interests

The authors declare no competing interests.

### Authors' Contributions

MJ designed the study and contributed to data analysis and interpretation of results. SM was involved in data analysis and preparation and editing of the manuscript. MY contributed to data analysis and interpretation of the results. FS, MA and ZT cooperated in data collection, developing study instrument, and interpretation of the results.

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