

## Study of the Solid Waste Management Production in Selected Hospital of Bam- 2016

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Received: 31 July 2018

Published: 09 August 2018

**Keywords:** *Solid Waste; Waste Management; Educational Hospital*

### Abstract

#### Introduction

In recent years, the production of hospital waste has been increasing rapidly and the management of these wastes has not been addressed. This study aimed to investigate the status of solid waste management in the selected hospital in Bam.

#### Methods

This was a descriptive cross-sectional study. Data gathering was done through observation, interviewing, visiting the hospital, measuring the weight and volume of manufactured waste and completing the questionnaire and included information on the general characteristics of the hospital, a checklist of quantitative and qualitative amounts of waste. All waste produced by the hospital was studied 4times in the year and once a month in the hospital in two shifts in the

morning and afternoon. We used SPSS software, qualitative analyzing conducting for enumeration and quantitative data with descriptive analysis.

### **Results**

The highest amount of waste produced was related to non-infectious waste, which contained 44% of the total waste product, and the smallest amount was related to sharp waste (2%). Total waste per capita in selected Hospital was 5.58 kilograms per hospital bed a day. The highest amount of non-infectious waste produced was related to the kitchen unit.

### **Conclusion**

The improvement of the management of hospital waste should include a national legal framework, and the safety of relevant personnel, as well as plans to estimate the amount of waste produced and to evaluate and determine the effective and appropriate techniques.

## **Introduction**

The hospital is a unit for providing health care services including prevention, treatment, rehabilitation and promoting health education to the community, which also produces wastes in the field of medical and non-medical services [1]. The waste products in these centers consist mainly of homemade homogeneous waste, along with the amount of sharp wastes, human body tissue, blood, clothes, textiles and other infectious substances [2]. United States Environmental Protection Agency (USEPA) has defined hospital waste as hazardous [3]. Hospital wastes are generally divided into infectious and non-infectious (semi-homemade) groups. About 75% to 90% of hospital waste is made up of semi-homemade waste [4]. By increasing the volume and diversity of health-care waste, the risk of transmission of diseases through their displacement and wrong repulsion is increasing [5].

All types of solid waste produced by health centers need to be moved, transported and disposed of in a controlled manner till maintaining public health and preventing environmental pollution. This can only be achieved by the adoption of mandatory enforcement laws and the use of guidelines in all aspects of the transfer, storage, transportation and disposal of these wastes [6]. In many countries, hazardous wastes and medical wastes are still moved and disposed of with homemade wastes that creates a huge health risk for urban workers, the general public, and the environment [3]. Waste management is usually given to ordinary workers who do most of the work without proper instructions and inadequate support [7].

Hospital Waste Management is the coordinator of various stages of production, packaging and storage, collection, transportation, conversion and disposal of waste [8]. Proper management of hospital wastes has a significant role in controlling environmental pollution and the incidence of hospital infections because epidemiological studies have shown that the risk of infection with hepatitis B, C, and HIV is 10%, 1.8% and 0.1%, due to needle steak [9].

In a study on the management of biomedical wastes in Egypt, they found that biomedical waste in hospitals is inadequate and employees, patients and the environment can be negatively affected by this [10]. In Rezaei, *et al.* research, per capita waste production in the units studied was estimated to be 3.406 kg per bed per day. None of the units studied used risk-free technology and delivered their wastes to the municipality without applying health standards for disposal. The hospital waste management process was good inside the hospital but was evaluated poor and average outside the hospital [11]. In the Masoom Beygie study determined that separation and collection of homemade and infectious wastes were performed in 96% of the sectors. The study also focuses on modifying the pattern of purchases, warehousing, distribution and consumption of items, equipment and supplies, and improving service delivery [12].

Unfortunately, despite the fact that in Iran a regulation on the criteria and procedures for the management of medical wastes and related wastes in 2007 by Infrastructure, Industry and Environment Commission and with the suggestion of Environmental Protection Organization and on the basis of Article 11 of the Waste Management Law was approved, however, there are still some deficiencies in the management of hospital wastes [13].

A review of studies and studies conducted in Iran despite the fact that there is a waste law and its implementing regulations, due to inadequate supervision, hospital waste management is not done correctly [14]. Correct management of medical waste can reduce the rate of medical waste production by as much as 15% which could reduce the health and environmental problems of these wastes. One of the most important steps to implement a proper waste management program is to know its quantitative and qualitative values in each city [15]. In recent years, the production of hospital waste has been increasing rapidly in Iran, however, as in most developing countries, is the same, the management of these wastes has not been addressed. There is currently no comprehensive information on the status of hospital waste management in the country. It is essential and inevitable to complete this database and update it by monitoring and continuous control [16]. This study aimed to investigate the status of solid waste management in the selected hospital in Bam, determine the amount of waste produced by the infectious and non-infectious disease, Conditions of storage and handling, methods of collection, transportation and disposal of infectious and non-infectious wastes on site and outside the hospital, the conditions of the workers involved in the collection, and finally, suggestions for improving the existing conditions and solving problems were presented.

## Methods

This descriptive cross-sectional study was conducted in selected and active educational therapeutic hospital of Bam University of Medical Sciences during 2015- 2016. It should be noted that the reason for the study was the fact that the hospital was responsible for providing services to patients in the 4 cities of Fahraj, Rigan, Narmashir and Bam.

Data gathering was done through observation, interviewing, visiting the hospital, measuring the weight and volume of manufactured waste and completing the questionnaire and included information on the general characteristics of the hospital, a checklist of quantitative and qualitative amounts of waste (the amount of production of various hospital waste and the status of separation of wastes). The design of the questionnaires was made in such a way that covers all the points related to the six main stages of hospital waste management.

The interviews were conducted with the environmental health officer and the infection control expert at the hospital during the morning hours. During these stages, in addition to determining the status of production, separation, storage, collection, treatment, transportation and disposal of hospital wastes, total weight and per head of manufactured wastes, as well as the weight of all kinds of hospital waste, were separately identified.

All waste produced by the hospital was studied 4 times in the year in April, July, May and December and once a month in the hospital in two shifts in the morning and afternoon we randomly investigated the wastes infectious, non-infectious, chemical and medicinal and sharp and wound in different parts of the hospital. The questionnaire included open and closed questions. It was used in two parts: (a) general specifications; (b) the characteristics of the waste product and its management. The specific section of the questionnaire consisted of 44 questions and 6 fields: production (8 questions), separation (8 items), storage (7 questions), collection (7 questions), hazard (7 items), hospital waste disposal (7 questions) [17]. The total weight, per capita waste produced, as well as the weight of all types of hospital waste through the total waste formulas were obtained to the number of admitted patients.

To collect information and to know about the status of hospital waste management operations in different parts of the hospital, field observation was also on the agenda. In order to determine quantitative and qualitative quantities of waste products, analysis of the types of wastes in the variables studied in this study includes total waste production, per capita production of hospital waste per day, and ultimately considering the number of hospitalized patients and hospital beds, per capita production Types of waste per kilogram were obtained per day per hospital bed.

After choosing a hospital, coordination was needed to get the cooperation and before the start of the work, the necessary explanations for the team members and all necessary safety equipment were prepared. To determine the quantitative and qualitative quantity of waste products, the analysis of the types of wastes was carried out studied 4 times in the year and once a month in the hospital in two shifts in the morning and afternoon with the supervision of the environmental health expert of the hospital and the quantitative amounts of all wastes and infectious, general and sharp and waste wastes using weighing method by weighing scale Accuracy  $\pm 100$  g was determined.

Then, the separation of each sample was done separately. Substances that were differentiated include plastics, paper, textiles, glass, metals, food waste and infectious and general wastes, ultimately the total amount of waste produced, the average per capita waste percentage of waste. The data was collected after obtaining permission from the head of the hospital. In order to observe the ethics of research, the researcher before the interview and completed the questionnaire and checklist explained the purpose of the study and stated that the health expert of the hospital would be free to stop cooperating with the researcher in case of unwillingness. Finally, using SPSS software, qualitative data was analyzed as a whole and quantitative data with descriptive indexes.

## Results

The characteristics of the hospital in Bam (state, educational, and therapeutic) with 200 beds approved and 257 active beds, including 724 personnel, of whom 8.5% (62) were active in post-moth management, had a bed occupancy of 80% and an average number of patients were 783 people each day. In this study, hospital waste was divided into infectious, non-infectious, sharp, chamomile and pharmaceutical groups and their production was measured. The total waste produced by the hospital was 1,4003 kg per year. The highest

amount of waste produced was related to non-infectious waste, which contained 44% of the total waste product, and the smallest amount was related to sharp waste, which contained only 2% of the waste product (Table 1).

**Table 1:** Volume of waste produced by the selected hospital in Bam -2016

Type of waste	Produced waste volume (%)
<b>Non-infectious</b>	44%
<b>Infectious</b>	36%
<b>Sharp</b>	2%
<b>Chemical and medicinal</b>	18%

The results of waste production in selected Bam Hospital, broken down by unit and type of waste, are shown in Table 2 (Table 2).

**Table 2:** Average production of waste in selected Bam Hospital by section and type of waste – 2016

Unit waste	emergency	internal	Male surgery	Female surgery	pregnancy	pediatric	ICU&CCU	neurology	surgery room	laboratory	Radiology	clinic	cookery	administrative
<b>Non-infectious</b>	47	44/6	55/3	52/4	26/4	28/45	26/4	19/6	13/9	26/3	13/9	29/9	60	35
<b>infectious</b>	30/5	35/2	4/6	42/5	24/2	23/15	15/86	18/7	29	31/8	-	27/5	-	-
<b>Chemical and medicinal</b>	16/8	20/5	24/2	21/7	25	17/25	33/9	20	24	58	22	19	11/7	6/6
<b>Sharp</b>	0/67	0/9	1	1/5	0/8	0/85	0/8	0/4	1/7	0/7	-	0/8	-	-

The results of average of wastes in selected Bam Hospital, broken down by unit and type of waste, are shown in Table 3 (Table 3).

**Table 3:** *Average of waste in selected Bam Hospital by month and type of waste – 2016*

<b>month</b>	<b>April</b>	<b>May</b>	<b>June</b>	<b>July</b>	<b>August</b>	<b>September</b>	<b>October</b>	<b>November</b>	<b>December</b>	<b>January</b>	<b>February</b>	<b>March</b>
<b>average of waste</b>												
<b>Non-infectious</b>	417	426	445	431	425	406	432	435	395	409	416	501
<b>infectious</b>	541	574	586	532	526	515	534	536	483	491	480	398
<b>Chemical and medicinal</b>	180	210	215	333	190	150	200	220	180	320	226	175
<b>Sharp</b>	6.8	7.2	7.4	7	6	5	6.2	3.4	5.1	5.8	6.2	5

The presence of large quantities of non-infectious solid waste in infectious waste bags related to emergency, internal, men’s surgery, women’s surgery and laboratory showed that the separation of infectious wastes from non-infectious ones has not been properly addressed. The laboratory unit lacked the proper separation of chemical residues from non-infectious (semi-homemade), but in other units, this kind of separation was done correctly.

All units that studied the safety box individually and correctly. All parts of the study have used standardized bags and waste bins in accordance with the standard. In each unit, infectious and non-infectious waste has been collected separately. Hospital wastes collection personnel did not use uniform clothing and safety equipment. It should be noted that training courses for waste collecting personnel have been held, which period of time was once every six months.

The hospital lacked temporary storage facilities for general wastes, but had temporary storage facilities for infectious wastes, which was not standard. Prior to the final disposal, a safe operation was performed. The without risk method was by burning but the 3flash autoclave was also used with a capacity of 500 liters. Hospital burning machine was active. The non-infectious wastes of the hospital were handed over to the municipal services for sanitary landfill. Infectious wastes have been converted into ashes in the furnace temperature of 800-1200°C, and the ash produced for burial was delivered to municipal services.

## Discussion

The results showed that total waste per capita in selected Hospital was 5.58 kilograms per hospital bed a day. In the study of Naeemi *et al.* [18], Ali Taleshi *et al.* [19], the total waste per capita was 2.64, 2.7 kg per hospital bed a day. However, in study of Dehghani [15], total waste per capita production was 4.6 kg per day per active bed. Compared with the production rate in Germany, 3.56, Belgium 1.81, Holland 1.71, Taiwan 3.5, England 3.2, and Tehran 2.71, Isfahan 3, Urmia, 0.95, and Sanandaj 1 .92 kg per hospital bed per day is a high figure [20]. The management of hospital wastes, especially infectious and hazardous wastes, is an inseparable part of the hospital's health, and is one of the most important issues in the hospital's control of infections, and the lack of attention to it, is irreparable damage to the hospital staff and, in fact, the hospital itself. For this reason, effective and continuous control measures are needed for hospital waste management, especially for reducing production [21]. The reason for the difference between the present study and other studies may depend on various factors such as the management of waste, the type of services provided by the hospital, the number of active beds, the cultural and economic status of the community, and so on.

The results showed that the highest amount of non-infectious waste produced was related to the kitchen unit. The study of Taghipour *et al.* In Tabriz hospitals showed that food waste (46.87%) accounts for the highest percentage of general waste types [22]. Bazr Afshan and Kurd Mustafa Poor in a study found that food waste constitutes a high percentage of public disasters [17]. It is possible that the proper management of the staff can reduce the amount of these wastes, for example, instead of providing food in high volume and in poor quality, a food menu that is of interest to the patient, suitable and better quality, as approved by a hospital nutrition expert is a good strategy to reduce the waste of food consumed by patients.

In the present study, the rate of infectious waste per year in selected Hospital was 2.4 kg per hospital bed per day. The results of Diaz *et al.* show that the percentage of infectious wastes in all health care centers in developing countries is about 63% and between 0.01 and 0.65 kg per bed per day [7]. Attention should be given to the proper disposal of infectious waste and its risks and how to collect and dispose of them [23]. The infectious wastes produced by hospitals are among the hazardous wastes, which, based on the type of activity and compliance with health standards, comprise at least 3% and a maximum of 90% of the total medical waste. The existence of various chemical, radioactive, infectious, pharmaceutical and biological compounds in hospital wastes on the one hand and the risk of the spread of dangerous diseases such as hepatitis and AIDS among hospital staff on the other requires serious management measures in this regard. Failure to collect, maintain, transport and repatriate them can create special problems in the country, which will reflect a serious threat to health and the environment (pollution of water, soil, air) [22]. The higher amounts of infectious wastes in the present study can be due to how the separation of infectious wastes from non-infectious wastes was done. Also, the weaknesses in personnel training issues, in particular the service forces,

and lack of proper supervision of their performance, and lack of motivation and, in some cases, neglect of health care personnel through the disposal of non-infectious wastes in special infectious waste bags, are among the causes of an increase in the percentage of infectious wastes.

In the selected hospital, most of the waste was produced in men's surgical wards, gynecology, and domestic surgery. In a study by Ali Taleshi [19] the most common types of wastes were related to emergency and internal wards and women's surgery. With regard to both studies, it can be seen that both the internal and surgical units of women in both researches have high levels of wastes. Similarity in both researches can be due to the lack of awareness of the personnel of the correct separation and also the frequent referral in these units.

In Bam selected Hospital, there were infectious wastes in non-infectious bags as well as non-infectious wastes in infective bags when weighing. Considering the high diversity and volume of hospital wastes, especially waste materials, and also the high costs of management of infectious wastes, accurate and continuous monitoring of their management to maintain, maintain and increase the health of patients, staff and other community members is essential. All parts of the study use standard bags and safety box separately and correctly. In Monirie *et al.* study [24], the similarity of both studies is the lack of use of educational brochures and low level personnel knowledge about waste separation.

In the hospital, all waste is collected by the municipality and transferred out for disposal. The waste incinerator is active for burning infectious hospital waste. In a study by Mohseni *et al.*, It was found that 60% of government hospitals were equipped with waste incinerators [25]. Health education and the changing of culture and attitudes as an important issue for groups involved in hospital activities should be done at different stages and according to their needs.

In the hospital, the staff used various lecture methods, workshops, brochures, videos and slides and face-to-face methods to train them. Hospital staff were trained in some way in relation to the transportation and disposal of medical waste. Studies in the United States have shown that all employees who are in contact with the hospital wastes and those who are involved in providing health services have the highest percentage of injuries during work. The annual rate of injury varies from 180 to 200 per 1,000 workers in the health sector (waste collectors) [26]. The results of the study by Tsakona *et al.* Show that in their hospitals, 80% of workers involved in garbage collection have been trained adequately [27]. In the study, all workers responsible for the management of hospital wastes used appropriate personal protective equipment, while the results of the study by La Grega and his colleagues in Istanbul, Turkey, showed that only 77% of workers use the appropriate personal protective equipment [28]. Inappropriate and non-systematic use of primary sources, regardless of the hazards and their application threats to human health and the environment, is the cause of generating more quantities of waste types, and given the economic value and health importance of a variety of wastes, in particular hospital wastes, particular attention is paid to The amount and mode of production of these wastes is of particular importance. The study and the problems of hospital wastes suggest that the rules and regulations concerning the management of hospital wastes are not properly implemented and the need for a review of how they are implemented correctly and without defects in order to meet the challenges of the abundance of the quantity and the quality of these wastes in the country will be minimized.

In the hospital, the temporary place of infectious wastes was sub-standard. The results of studies conducted in China and Brazil show that 93.3% and 85% of hospitals are equipped with temporary storage sites [29]. The results of the Askari study show that 80% of the hospitals in Fars province are equipped with temporary storage facilities [30]. The ingredients of hospital wastes have a direct impact on the collection and recycling of waste materials, and with the increase of health information, recovery can be achieved from the source.

Hospital wastes and their management not only affect the health of hospitalized patients and patients referring to hospitals, but also play an important role in creating a positive and desirable picture of the hospital in the minds of clients (patients and their companions) and motivating and willing to do so. To go back to the same hospital, they will play services if they need it again. Some of the causes of poor management of hospital wastes in Iran can be due to lack of laws, regulations and guidelines on various aspects of waste management, including collection and disposal in the country, failure to allocate sufficient funds to provincial level and Hospital, lack of adequate control and supervision on how to collect and dispose of wastes, lack of adequate equipment for proper management of wastes at hospitals level, lack of information on the type and amount of waste produced and the methods used for treatment and disposal in hospitals and etc.) [1].

## Conclusion

The study suggests that the rules and regulations regarding the management of hospital wastes are not properly implemented and the need to review the correct implementation of them, in order to address the challenges of the quality and quantity of these wastes in the country. In this regard, the expansion of inter-departmental cooperation, especially the Ministry of Health and Medical Education of the EPA and municipalities, is of great importance in addressing the problems mentioned.

The improvement of the management of hospital waste should include a national legal framework, precise internal management systems and training programs, and the safety of relevant personnel, as well as plans to estimate the amount of waste produced and to evaluate and determine the effective and appropriate techniques. They will be repulsed in any country.

The most necessary measures to reduce the health and environmental problems, as well as the costs of hospital waste management, are the proper implementation of the Waste Sequestration Program and the monitoring of their proper disposal and sanitation. In this regard, the organization of proper hospital waste management courses can be Effective solution. Also, equipping the hospital with a modern sterilization system for hospital wastes can be an important step towards reducing the potential hazard of these wastes.

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