



## Original Article

## Health-Care Waste Management in Abadan, Iran in 2018- Current Status and Future Suggestions



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## ABSTRACT

**Background:** In developing countries, due to improper segregation and management of health care waste (HCW), the environmental effects of these infectious components are becoming a major challenge. The purpose of this study was to evaluate quantity and quality of HCW, and current status of waste management in four educational hospitals of Abadan School of Medical Sciences, Iran.

**Methods:** This descriptive study was conducted in four educational hospitals of Abadan School of Medical Sciences to evaluate the amount of production rate, type of hospital waste, and the current status of HCW management. These HCW of hospitals were selected and sampled daily in four seasons in 2018. The waste was manually segregated by the hospital staffs into 8 components (according to WHO manual) and weighted. Proposed questionnaires of WHO for developing countries was used to evaluate HCW management system of studied hospitals.

**Results:** The average of hospital waste produced was 604.75 kg/day including 217 kg/day of infectious and 387.75 kg/day of non-infectious waste, respectively. The per capita of hospital waste generated in all studied hospitals was 4.13 kg/bed-day. The main part of infectious and non-infectious wastes was food waste and plastics which are recyclable. In addition, 70% of the separation sources were performed correctly, which facilitates segregation. All hospitals used autoclave and hydro-clave treatment for disinfection before final disposal. However, the current management status was poor and underdeveloped.

**Conclusion:** According to the waste management hierarchy, waste minimization can be considerable if carried out in an effective, safe and sustainable manner. But in studied hospitals, this strategy was very weakly managed. There was no management program (waste minimization, separation, reuse and recycling) in the hospitals.

**Keywords:** Health-care waste, Infectious waste, Non-Infectious waste, Abadan, Iran

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## Introduction

Nowadays, hospital waste has been considered for public health and the environment because of transmission of hazardous substances (1). It is one of the most important health issues in society, which in Iran constitutes a small percentage of municipal waste of about 1-2% (2). Often 75-90% of hospital waste composition is similar to

household waste (3). Health-care waste includes all the waste generated by health-care institute, research convenience, and laboratories. It includes the waste originating from "minor" or "scattered" sources such as that produced in the course of health care undertaken in the home (dialysis, insulin injections, etc.). Health-care waste contains a wide range of materials that are generated in

hospitals, clinics, health centers, and related places (4). The population is increasing in developing countries, and it will result in generation a high amount of health-care waste (5, 6). In hospitals, waste such as food waste, paper, plastic packaging, etc. which has considered a general waste, might be disposed similar to household waste. Due to their infectious nature, hospital waste could be one of the most dangerous sources of infection transmission in hospitals (7). There are different types of hospital waste such as chemical, pharmaceutical, and radioactive residues, toxic metals in drug & infectious components of the body, and pathogenic microorganisms in the feces, sharp objects, and contaminated materials (8). Identifying waste components helps to properly separate and dispose of waste with the aim of reducing hazardous wastes in hospitals (9). However, if the hospital waste has mismanaged, it posed numerous health risks to people in different wards of the hospital who were in direct or indirect contact (10, 11). Most of hospitals in Iran didn't have a proper disposal system for waste, and also have problems with waste management (12). It is useful to hold training classes for hospital staffs, to reduce poor knowledge of how to face with this kind of waste (13). Many studies have shown that the highest risk of communicable disease transmission such as AIDS, hepatitis B and C, and tuberculosis has been reported in the health-care waste workers (14-16). A study conducted in Pakistan suggest that hospital staffs must be trained on how to transport hospital waste to stay safe from the effects of relating diseases (17). In recent decades, various measures and programs in terms of policy, legislation, technology, and engineering, health and environment have been done nationally and internationally to reduce the risks of hospital waste in some countries (18). In developing countries, including Iran, there are no codified laws regarding hospital waste management (HWM). The results of a study in Lahore, India, showed that all of the hospitals in this city use different standards for collecting and disposing hospital waste (19). A similar study in Lahore found that the HWM system was useful in protecting medical staffs from hepatitis B&C (20). During the collection and segregation stages, Improper collection of hospital waste leads to the transfer of contaminations to hospital staffs in pandemic (21). Therefore, HWM is an important step in designing waste collection systems, selecting special equipment's for decontamination and final disposal. Abadan is one of the largest and populous cities in south-west of Iran in Khuzestan province (22). Also, as we know, there isn't easy to access the information of generation rates and disinfection methods of HCW in Abadan. The purpose of this study was to identify the production rate, types of

hospital waste, management procedures, and the formation of related training courses in the educational hospitals of Abadan School of Medical Sciences, Iran. Finally, procedures were proposed to improve the current situation and we have suggested some solutions for future problems.

## Methods

This cross-sectional descriptive study was conducted in four teaching hospitals affiliated to the Abadan School of Medical Sciences located in southwestern Iran, in 2018 to evaluate hospital waste management. Abadan is one of the most populous metropolises and cities in Khuzestan province with 370,180 citizens. There are two types of hospitals in Iran, private and public (educational) hospital. Four public (educational) hospitals in Abadan have been studied. In the present study, various departments, including the maternity, obstetrics and gynecology, pediatrics, gynecological surgery, general surgery wards, internal, ICU, CCU, emergency and dialysis, thalassemia, physiotherapy, sonography and specialized clinic. The present study was performed firstly to evaluate the waste management of Abadan hospital and secondly to determine the rate of waste generated.

Different types of waste are produced in hospitals, such as infectious and non-infectious waste. The samples were collected and taken to the garbage room by the hospital staff for manual separation. At the end of the daily collection cycle for four seasons, the waste was analyzed and weighed. According to WHO guideline for HCW, Waste and by-products was divided into 8 items of waste categories including: Infectious waste, Pathological waste, Sharps, Pharmaceutical waste, Genotoxic waste, Chemical waste, Radioactive waste, and non-hazardous or general waste (23). In this definition, infectious waste means those solid wastes which may cause human disease and may reasonably be suspected of harboring human pathogenic organisms, or may pose a substantial threat or potential hazard to human health or the environment when improperly treated, stored, transported, disposed or otherwise managed (4).

Data were collected through observation, interviews, hospital visits and checklists. WHO-recommended questionnaires were used to evaluate the health-care waste management system (24). Hospital staff were asked about the separation, collection, disinfection and final disposal of hospital waste. In this regard, a number of questions are focused on the types of dishes and their colors. Hospital waste was calculated in kg / day and per capita production of active beds was reported.

## Results

### *Classification of hospital waste*

The per capita amount of hospital waste for different types of waste produced is presented in table 1.

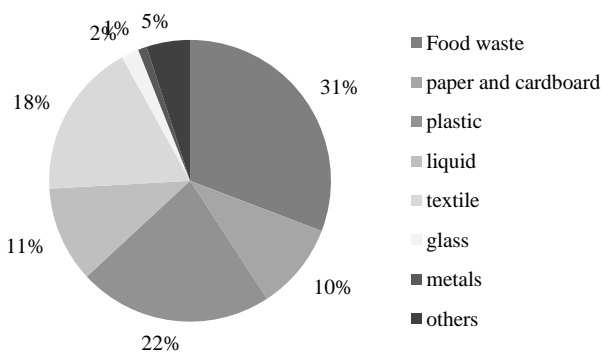
**Table 1.** Characterization of Health-Care Waste and Production Rate in Studied Hospitals

Hospitals	Number of bed	Number of active bed	Health Care Waste (kg/bed-d)		
			Non-infectious (kg/bed-d)	Infectious (kg/bed-d)	Total (kg/bed-d)
1	220	118	2	1	3
2	200	171	4.09	1.754	5.847
3	125	120	2.625	1.67	4.291
4	240	162	1.852	1.54	3.395
Total	785	571	-	-	-
Average	196.25	142.75	2.716	1.520	4.236

**Table 2.** Types of Containers Used to Collect Different Types of Hospital Waste in Studied Hospitals According to the WHO Health-Care Waste Management

Type of waste	Current Color & Containers	Recommended Colors for plastic bags	Hospital performance %
General	Black/red plastic bag	Black	100 %
Medicals & Infectious waste	Red	Yellow	100%
Sharp	Yellow	Red	100%

The average generated hospital waste in all studied hospitals was 604.75 kg/day. The amount of waste produced in hospitals 1 to 4 was 118, 300, 200, and 250 kg/day, respectively. The highest rate of total production waste in hospital No. 2 was 1000 kg/day and the lowest rate of production in Hospital No. 1 was 354 kg/day. The composition of non-infectious and infectious wastes in 4 studied hospitals are presented in Figures 1 and 2, respectively. Food waste has the highest percentage among non-infectious waste.

**Figure 1.** The Composition of Non-Infectious Wastes in the Four Studied Hospitals

Among the types of infectious waste produced, the percentage of the production rate of textiles and plastics was higher than other type of waste.

#### Source separation methods

In all the studied hospitals, in order to separate infectious and non-infectious substances, no source separation was done from infectious waste, but 70% of non-infectious waste were separated at generation step. Only the sharp

wastes were collected separately from the others in the safety-box. The same colors, including black, red, and yellow for general, medical, infectious and sharp wastes were used, respectively, as shown in table 2. We reported that in most hospitals, infectious waste and other types of waste are usually mixed together in a temporary storage room, and also, for collecting waste plastic bins without holes are used. In all four hospitals, waste was daily collected on a regular schedule.

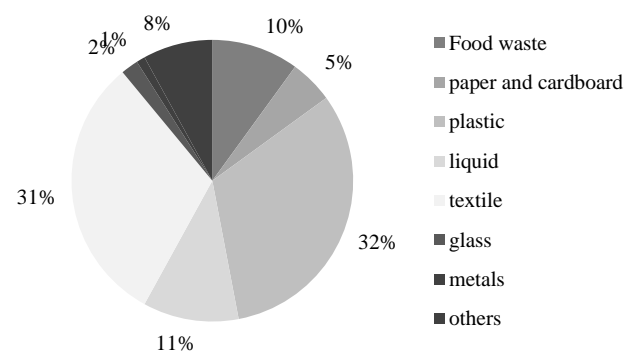
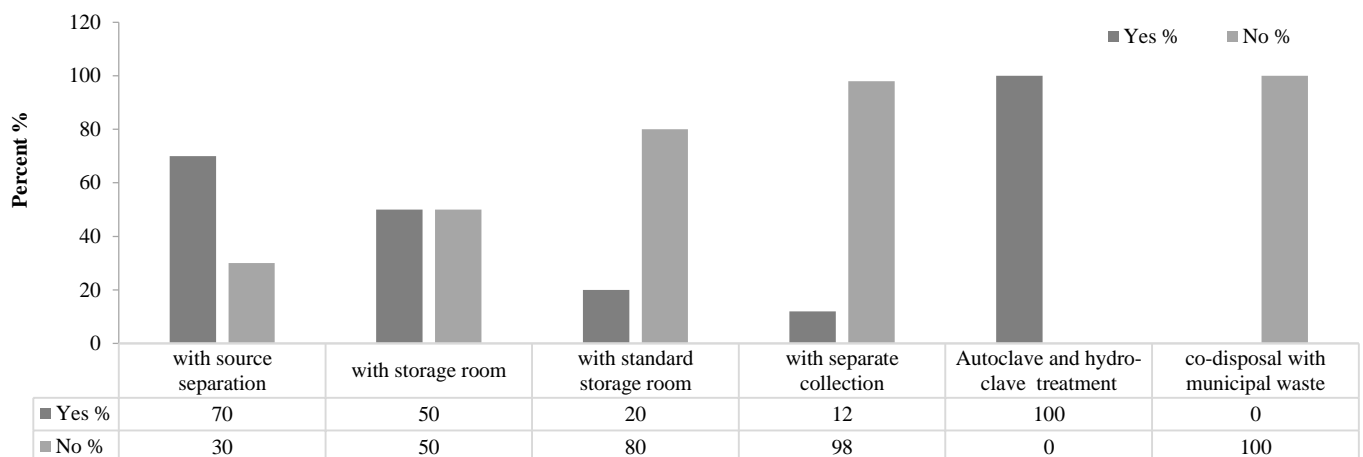
**Figure 2.** The Composition of Infectious Wastes in the Four Studied Hospitals

Figure 3 shows hospital waste management in terms of waste separation, collection, disinfection and final disposal in studied hospitals. No source separation was done from infectious waste, but 70% of non-infectious waste were separated at generation step. All infectious waste in the present study autoclave and hydro-clave treatment were used, and after treatment as general waste were discarded in municipal waste collection and final disposal site.

**Figure 3.** Hospital Waste Separation, Collection, Disinfection and Final Disposal in the Studied Hospitals

## Discussion

The result of hospital waste production rate in this study showed an average of 4.23 kg / bed-day for the studies hospitals in Abadan. This estimate is similar to previous study in Tehran, Alborz, Rasht, and Kashan and was much higher than some other parts in Iran. In Iran, for example, Mazloomi et al reported a per capita production of 0.2 kg / bed-day (25). However, the per capita of hospital waste produced in Ardabil with a range of 2.74-5.70 kg / bed-day was higher than the present study. Shakiba and Mohagheghian report the total hospital waste was 4.46 kg/bed/day for Rasht hospitals that is higher than our study (26). A similar study conducted in the Kerman province of Iran showed that the amount of waste generated in teaching and non-teaching hospitals was 3.48 and 4.033, respectively that is lower than our results (27).

This study found that 70% of the studied hospitals followed separation from the source correctly, but Pazuki and Jafari reported this of about 100% of hospital waste had source separation. However, sometimes due to inadequate accuracy during transportation general waste mixed with infectious waste (28). In a study conducted in Pakistan on how to separate waste from the source was to divide the produced waste into two parts, infectious and biodegradable, due to the use of especially bins with different colors for each type of waste. Therefore, in source separation of hospital waste in basic Health Units, red bins for hospital waste and yellow and green bins were used for infectious and biodegradable, respectively (29). In a similar study in Pakistan, five colors were used for collection containers, such as black for medicinal waste and red and yellow for different types of infectious waste, and blue or white for sharp and solid waste. Food waste, garden waste, and waste paper were dumped in green containers (30). In previous studies, hospital staffs training in improving waste management was emphasized (31, 32). The data obtained from the questionnaire showed that they didn't have a specific method for managing hospital waste which is consistent with studies that have been done in the past (33). Occasionally, some of the general waste (such as; food waste, plastics, paper, and cardboard) was mixed with infectious waste, which must be neutralized like an infectious waste. Previous studies have reported that in developing countries, hospital waste had different terms of production rate and disposal of waste. Generally, one of the most important reasons of mismanagement and multiple problems in these countries is lack of a comprehensive definition for hospital waste (34, 35).

## References

1. Naeem S, Waseem S, Mustafa G. Assessment of Hospital Waste Management Practices in Public and Private Healthcare establishments of Rahim Yar Khan. *J Sheikh Zayed Med Coll*. 2020; 11(01):26-29. doi: 10.47883/jszmc.v11i01.81.
2. Dehghani MH, Dashti Ahrami H, Nabizadeh R, Heidarinejad Z, Zarei A. Medical waste generation and management in medical clinics in South of Iran. *MethodsX*. 2019; 6:727-733. doi: 10.1016/j.mex.2019.03.029.
3. Sartaj M, Arabgol R. Quantitative assessment and statistical analysis of medical waste generation in developing countries: a case study in Isfahan (Iran). *IJST Trans Civ Eng*. 2014; 38(C2):409-420.
4. Koolivand A, Gholami-Borujeni F, Nourmoradi H. Investigation on the characteristics and management of dental waste in Urmia, Iran. *J Mater Cycles Waste Manag*. 2015; 17:553-559. doi: 10.1007/s10163-014-0278-2.
5. Zazouli MA, Alavinia SM, Bay A. Medical waste generation in gorgan hospitals, 2014. *J Mazandaran Univ Med Sci*. 2016; 25(132):304-308.
6. World Health Organization. Health-care waste. Geneva, Switzerland: World Health Organization; 2021.
7. Majlesi M, Alavi NA, Mohammadi AA, Valipor S. Data on composition and production rate of dental solid waste and associated management practices in Qaem Shahr, Iran 2016. *Data Brief*. 2018; 19:1291-126. doi: 10.1016/j.dib.2018.05.114.
8. Mousavi S, Sh A, Almasi A, Shokohizadeh M, Amini M, Sobhani Z. A Survey on Knowledge, Attitude and Practice of

Similar to other studies, in this study the amount of non-infectious general waste was higher than infectious waste (5, 26, 28). General waste in hospitals is mainly contaminated with infectious substances which must be scientifically treated to be safe for final disposal. As much as possible, it is also suggested that source separation is useful to reduce the production rate. Iran doesn't have codified rules in the HWM system. To better managing hospital waste should be use specific methods for segregation and classification. Executive organs of HWM and health professionals can make an effective contribution to establishing rules and standards to protect the environment and the health of hospital staffs. Decontamination of infectious and sharp waste by hospitals should be done at the production site to minimize the risks of transportation and related costs. Personal protective equipment should be provided for the staffs of different wards of the hospital and "Prevention of transmission of infections" training classes should be held periodically to acquaint the staffs with the most common and important way of infections. The main goal of the Program of Infection Control is to reduce the risk of acquiring infections and thus protect patients, hospital staffs, students, and visitors.

## Conclusion

According to the waste management hierarchy, waste minimization can be considerable if carried out in an effective, safe and sustainable manner. But in studied hospitals, this strategy was very weakly managed. There was no management program (waste minimization, separation, reuse and recycling) in the hospitals.

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## Ethical consideration

This study was extracted from a research approved by the Ethics Committee of Abadan School of Medical Sciences, Abadan, Iran with Ethical code: IR.ABADANUMS.REC.1395.128.

## Conflicts of interests

Authors declared no conflict of interest.

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- Personnel Regarding Hospital Waste Management in Imam Hossein Educational Hospital of Kermanshah [in Persian]. *J Health*. 2020; 11(2):213-222. doi: 10.29252/j.health.11.2.213.
9. Cesaro A, Belgiorno V, editors. Medical waste generation and management in different sized facilities. Presented at: Proceedings of the 14th International Conference on Environmental Science and Technology, Rhode, Greece; September 3-5, 2015.
  10. Adu RO, Gyasi SF, Essumang DK, Otobil KB. Medical Waste-Sorting and Management Practices in Five Hospitals in Ghana. *J Environ Public Health*. 2020; 2020(4):1-14. doi: 10.1155/2020/2934296.
  11. Aghapour P, Nabizadeh R, Nouri J, Monavari M, Yaghmaeian K. Analysis of hospital waste using a healthcare waste management index. *Toxicol Environ Chem*. 2013; 95(4):579-589. doi: 10.1080/02772248.2013.802792.
  12. Farzadkia M, Moradi A, Mohammadi MS, Jorfi S. Hospital waste management status in Iran: a case study in the teaching hospitals of Iran University of Medical Sciences. *Waste Manag Res*. 2009; 27(4):384-389. doi: 10.1177/0734242X09335703.
  13. Khan K, Shaheen S, Iqbal H, RajaGM, Arif R, Khalil M, et al. Assessment of waste management practices in hospitals of Islamabad and Abbottabad-Pakistan. *Pure Appl Biol*. 2020; 9(1):282-289. doi: 10.19045/bspab.2020.90033.
  14. Bazrafshan E, Kord Mostafapour F. Survey of quantity and quality of hospital wastes in Sistan and Balouchestan Province, 2008-2009 [in Persian]. *Tabib-E-Shargh*. 2010; 12(1):26-32.
  15. Davoodi R, Eslami Hasan Abadi S, Sabouri G, Salehi M, Ghooshkhaneh H, Rahmani S, et al. Medical Waste Management in the second largest City of Iran (Mashhad) with Three-Million Inhabitants. *J Patient Saf Qual Improve*. 2014; 2(4):160-164. doi: 10.22038/psj.2014.3401.
  16. Farzadkia M, Ansari A, Emamjomeh MM. Review of hospital waste management in one of the highly specialized hospitals of Tehran [in Persian]. *J Qazvin Univ Med Sci*. 2013; 16(4):106-109.
  17. Hameed K, Riaz O, u Minallah MN, Munawar H. Types of hospital waste and waste generation rate in different hospitals of Faisalabad City, Pakistan. *J Basic Appl*. 2017; 13:386-391. doi: 10.6000/1927-5129.2017.13.63.
  18. Taghipour H, ASL Hashemi A, Mohammadpoorasl A. Training and monitoring of hospitals staffs concerning proper medical waste management [in Persian]. *Med J Tabriz Univ Med Sci*. 2012; 34(4):47-52.
  19. Farooq MT, Omar N, Shahid F, Khizar S, Khan A, Manzoor I. Assessment of hospital waste management protocols in tertiary care hospitals of Lahore. *Biomedica*. 2017; 33(2):136-142.
  20. Toheed R, AYUB TB, Mumtaz S. Hospital Waste Management in Teaching Hospitals of Lahore System Assessment Using New Tool. *Pak J Med Health Sci*. 2016; 10(2):377-379.
  21. Sharma HB, Vanapalli KR, Cheela VS, Ranjan VP, Jaglan AK, Dubey B, et al. Challenges, opportunities, and innovations for effective solid waste management during and post COVID-19 pandemic. *Resour Conserv Recycl*. 2020; 162:105052. doi: 10.1016/j.resconrec.2020.105052.
  22. Mortaheb R. Building the petro-polis: oil capitalism, imperialism, and the making of Abadan, 1908-1933 [dissertation]. New Jersey, NJ: School of Architecture, Institute of Technology; 2020.
  23. da Silva IA, Sant'Ana LP. Management of healthcare waste. *Unisanta BioScience*. 2020; 9(2):124-129.
  24. Pruss A, Cirouit E, Rushbrook P. Safe Management of Wastes From Health-Care Activities. Geneva, Switzerland: World Health Organization; 1999.
  25. Mazloomi S, Zarei A, Alasvand S, Farhadi A, Nourmoradi H, Bonyadi Z. Analysis of quality and quantity of health-care wastes in clinical laboratories: a case study of Ilam city. *Environ Monit Assess*. 2019; 191(4):207. doi: 10.1007/s10661-019-7345-z.
  26. Shakiba M, Mohagheghian A. Hospital waste generation and management status in Rasht, north of Iran. *Caspian J Health Res*. 2018; 3(1):20-23. doi: 10.29252/cjhr.3.1.20.
  27. Parandeh M, Khanjani N. The quantity and quality of hospital waste in kerman province and an overview of hospital waste quantities in Iran. *World Applied Sciences Journal*. 2012; 17(4):473-479.
  28. Pazuki S, Jafari HR. Hospital waste management in hospitals of Tehran University of Medical Sciences and Health Service [in Persian]. *J Environ Sci Technol*. 2018. doi: 10.22034/jest.2018.2711.1215.
  29. Sadia A, Farid MU, Ghafoor A, Nasir Awan A, Maqsood U, Farid MZ, et al. Effective management of hospital and medical waste in rural areas of pakistan: a case study. *Waste-to-Energy Technologies* 2020. doi: 10.47278/journal.abr/2020.018.
  30. Ali S, Mahmood U, Malik AU, Aziz F, Naghman RB, Ahmed I. Current hospital waste management practices in Pakistan: Case study and curative measures. *Public Health Prevent Med*. 2015; 1(3):125-129.
  31. Hyde P, Reeve P. *Essentials of environmental management*: Routledge; 2018.
  32. Tudor TL, Noonan CL, Jenkin LET. Healthcare waste management: a case study from the National Health Service in Cornwall, United Kingdom. *Waste manag*. 2005; 25(6):606-615. doi: 10.1016/j.wasman.2004.10.004.
  33. Shapiro JS, Genes N, Kuperman G, Chason K, Exchange TNYCI, Richardson LD, et al. Health information exchange, biosurveillance efforts, and emergency department crowding during the spring 2009 H1N1 outbreak in New York City. *Ann Emerg Med*. 2010; 55(3):274-279.
  34. Ali M, Wang W, Chaudhry N, Geng Y. Hospital waste management in developing countries: A mini review. *Waste Manag Res*. 2017; 35(6):581-592. doi: 10.1177/0734242X17691344.
  35. Bdour A, Altrabsheh B, Hadadin N, Al-Shareif M. Assessment of medical wastes management practice: a case study of the northern part of Jordan. *Waste Manag*. 2007; 27(6):746-759?.