



Results of a Hospital Waste Survey in Tabriz Hospitals

Mohammad Taheri^{1*} • Amir Hossein Hamidian² • Manoochehr Khazae²
Arash Ketabforoush Badri³ • Saeed Ketabforoush Badri⁴ • Aria Khazae⁵

¹Department of Environment, Faculty of Natural Resources and Marine Sciences, Tarbiat Modares University, Noor, Iran

²Department of Environment, Faculty of Natural Resources, University of Tehran, Karaj, Iran

³Department of Economics, College of Management and Accounting, Islamic Azad University, Qazvin, Iran

⁴Department of Medical, College of Medical, Islamic Azad University, Tabriz, Iran

⁵Department of Environment, Faculty of Natural Resources and Environment, University of Ferdowsi

arashkbadri@gmail.com

Abstract: Hospital wastes because of the presence of hazardous, toxic and pathogenic agents has a particular sensitivity in many countries. Proper management of medical wastes is a very important role in the control of environmental pollution. In this study management of hospital wastes in all hospitals affiliated to Tabriz University of Medical Sciences with the goal of providing comprehensive and appropriate information for planning and improvement of health services in the future were studied. Information obtained through questionnaires, visits, interviews and weighing waste from hospitals during the years 2010-2011. In investigated hospitals were 2283 active beds that per capita waste generation was calculated 3.79 kg per bed per day. According to cluster analysis, hospitals in terms of waste production, were divided into four groups. Comparison of the staffing of hospitals with criterion announced by the research section of medical places of Iran housing company showed that some hospitals are facing with a shortage of services that can be effective in the management of hospital wastes. All hospitals have used the autoclave for disinfecting wastes. The average waste generation rate was calculated 2.75 kg regular and home-quasi, 0.128 kg sharp, 0.875 kg infectious-medical-chemical and 0.043 kg pathological. Finally, management of hospital wastes in studied hospitals was almost acceptable, but at some stage needed more attention.

To cite this article

[Taheri, M., Hamidian, A. H., Khazae, M., Badri, A. K., Badri, S. K., & Khazae, A. (2016). Results of a Hospital Waste Survey in Tabriz Hospitals. *J. Middle East North Afr. sci*, 2(3), 70-77]. (p-ISSN 2412- 9763) - (e-ISSN 2412-8937). <http://www.jomenas.org>. 9

Keywords: Waste management; Environment pollution; Infectious waste; Tabriz.

1. Introduction:

According to the definition given by the environmental protection organization of Islamic republic of Iran about waste management, medical wastes are all infectious residues from hospitals, health centers, clinical laboratories and other similar places (EPA, 1995). Hospitals are one of the medical centers that have been impressively developed because of population growth in recent years. These transformations have caused an increase in the number of clients and variety in service facilities in hospitals which cause an increase in the amount of wastes produced in such places (Shojaei Tehrani, 2004).

The spread of infectious illnesses and other illnesses in developing countries has caused an increase in the amount of dangerous hospital wastes which requires an ordered and decent management for excreting these wastes. The world health organization (WHO) classifies hospital wastes to types of regular

wastes, pathological wastes, radioactive wastes, chemical wastes and infectious wastes and according to the statistics, 75 to 90 percent of these wastes are regular and homemade quasi and the other 10 to 25 percent are known as dangerous and bacterial (Chaerul, Tanaka & Shekdar, 2008). Also according to the researches, more than half of 630 types of chemicals which are mostly used in hospitals are less dangerous and 300 types of them are poisonous and dangerous most of which can be found in hospital wastes (Ebrahimi, Hashemizade & Foadifard, 2008; Takdastan, Jafarzade & Pazoki, 2008). Hospital waste management has different steps, but generally, it has 6 main steps which are: 1- Separating, 2- Packing and labeling, 3- Collecting, 4- Transportation, 5-Waste minimization and 6- Purifying and excretion (Monavari, Omrani & Rezaee, 2008).

Several studies have been done about hospital waste management in the world, for instance studies done in Poland (Altin, Altin, Eleveli & Cerit, 2003),

Turkey (Alagoz & Kocasoy, 2007; Alagoz & Kocasoy, 2008), India (Kumar, DK & Kumar, 2004), Portugal (Alvim Ferraz, Barcelos Cardoso & Ribeiro Pontes, 2000), Switzerland (Prüss, Giroult & Rushbrook, 1999), Bahrain (Mohamed, Ebrahim & Al-Thukair, 2009), Mongolia (Shinee, Gombojav, Nishimura & Hamajima, 2008), Africa (Nemathaga, Maringa & Chimuka, 2008), South Korea (Jang, Lee, Yoon & Kim, 2006) and Nigeria (Coker et al., 2009). Also different studies have been done in our country in the following cities; Mashhad (Ariyae & Hamidian, 2012), Sanandaj (Firouzmanesh, Qavami, Shahmoradi & Rahimi, 2008), Yasouj (Raygan Shirazi & Mary Ariad, 2008), Sabzevar (Yaqubifar & Khamirchi, 2007), Karaj (Khazae, Hamidian, Taheri, Babakan, Mashoof, Rabizadeh & Khazae, 2015), Arak (Dehghani, Fazelinia, Omrani, Nabizadeh & Azam, 2011), Tehran (Monavari, Omrani & Rezaee, 2008), Khorram-abad (Mirhosseini, Dahestani Athar & Vaseqi, 2008), Babol (Amouei, Tahmasbizadeh, Asgharnia, Fallah & Mohammadi, 2012), Kermanshah (Karami-Matin, 2001), Semnan (Noorisepehr, 2008), Rasht (Taghavi, 2005), Shiraz (Askarian, Vakili & Kabir, 2004) and Gorgan (Shahryari, Nooshin & Borghei, 2011), that this studies have been focused on average production rate and quantitative and qualitative features of produced hospital wastes.

According to the studies, hospital wastes management in developed countries like Portugal, Sweden, and South Korea have a more perfect and more coherent process comparing to undeveloped countries like most of the African countries. For example; in most of the undeveloped countries, infectious and non-infectious wastes are not separated from each other (Alvim Ferraz, Barcelos Cardoso & Ribeiro Pontes, 2000; Prüss, Giroult & Rushbrook, 1999; Shinee, Gombojav, Nishimura & Hamajima, 2008; Nemathaga, Maringa & Chimuka, 2008; Jang, Lee, Yoon & Kim, 2006; Coker et al., 2009).

In this study, the situation of hospital waste management of hospitals under the supervision of Tabriz Medical Science University has been studied. Tabriz is one of the major cities of Iran that has faced many environmental problems because of population increase. Therefore, some actions like giving practical suggestions and solutions have been done based on the results of the researches to improve the waste management process in the studied hospitals.

2. Materials and Methods:

2.1. Introducing the studied region and the status of the Reviewed hospitals

Tabriz is the biggest city in North West of Iran with an area about 45/481 square kilometers and a population about 1/525/000 and is one of the biggest

cities of Iran, which is the provincial capital of East Azerbaijan. According to the statistics, Tabriz has 22 hospitals, over 35 clinics and infirmaries, 51 radiology centers and over 90 medical laboratories and some of these clinics, infirmaries, laboratories and radiology's are working independently and some are working together with hospitals while some are working together with hospitals, but out of the hospitals.

2.2. Research method:

In this study, 10 hospitals under the supervision of Tabriz medical science university have been studied in a one-year period (2010-2011). After getting the required permissions from Tabriz medical science university, authorization for this action was achieved. All the data have been gathered by completing questionnaires and blank tables, interviewing and visiting and the type of study was descriptive-sectional. All the aspects related to the 6 steps of hospital waste management were considered in the questions of the questionnaire.

The questionnaire was made based on the instructions are given by The World Health Organization (WHO) to study hospital waste management in developing countries (Alagoz & Kocasoy, 2007) and was frequently reviewed and corrected by University of Tehran professors. The questionnaire was designed packed and had 2 parts; general and professional. The professional part of the questionnaire contained 44 questions and it helped us gather some information about different steps of hospital waste management.

Interviewing the environment health undertaking and experts of infection control of hospitals was done from 9 to 10 A.M and inspecting the place of temporarily keeping residues at the hospitals was done from 10 to 11 A.M. During these steps, in addition to determining the status of production, separation, storing, collection, purification, transportation and getting rid of the hospital wastes, total weight of the wastes and the average production rate and the weight of different kinds of wastes were determined separately.

All the wastes produced in studied hospitals were weighed 4 times with SECA scale; once a month in each hospital in both morning and afternoon shifts during January and February 2010 and March and April 2011 (Ariyae & Hamidian, 2012). Overall, about 180 samples from the studied hospitals were weighed. Samples were weighed by trained people with safety tools and ultimately the information was processed in Excell-2010 and SPSS-19 and for sorting the studied hospitals by waste production rate, clustered analysis was done on the results (Zaree Chahouki, 2010).

Table 1: The total production and per capita production of hospital wastes.

Hospital	Total produced wastes (kg/d)	Regular and home-quasi (kg/d)	Sharp (kg/d)	Infectious, medical & chemical (kg/d)	Pathological and cut body organs (kg/d)	Per capita of waste generation (kg/b/d)	Per capita of home-quasi wastes (kg/b/d)	Per capita of sharp wastes (kg/b/d)	Per capita of infectious, medical & chemical wastes (kg/b/d)	Per capita of Pathological wastes (kg/b/d)
Imam-Reza	3220	2150	67/8	968/5	33/7	5/36	3/58	0/113	1/61	0/056
Sina	416	325	21/1	66/3	3/6	1/89	1/47	0/095	0/301	0/016
Shohada	758	540	17/7	190/4	9/9	3/03	2/16	0/07	0/761	0/039
Madani	650	464	27/5	154/4	4/1	4/3	3/07	0/182	1/01	0/027
Taleghani	830	673	19/2	128	9/8	8/3	6/73	0/192	1/28	0/098
Nikou-Kari	186	124	14/5	44/6	2/9	2/77	1/85	0/216	0/665	0/043
Koudakan	628	453	17/7	63/9	3/4	3/32	2/87	0/093	0/338	0/017
Alavi	325	198	10/6	112/2	4/2	4/85	2/95	0/158	1/67	0/062
Razi	1343	877	32/5	433/5	-	2/31	1/51	0/056	0/747	-
Al-Zahra	423	312	18/3	87	5/7	2/62	1/93	0/113	0/54	0/035
Total / Average	8779	6206	246/9	2248/8	77/3	3/79	2/75	0/128	0/875	0/043

3. Results:

The total number of beds in use in all 10 hospitals was 2383 which produce 8779 kilograms of waste in a day. The occupancy rate for the beds of the studied hospitals was 87.53%. The types of wastes produced in the studied hospitals were sorted into 4 categories; regular and home quasi, sharp, infectious-medical-chemical and pathological. In this research, the amount of waste generated per capita was examined to separate the different components in kg per day per patient in each hospital (Table 1). The results showed that the wastes produced in the studied hospitals contained 71% regular and home-quasi, 25% infectious-medical-chemical, 3% sharp and 1% pathological (Figure 1). Also, the average per capita waste production in 10 studied hospitals in Tabriz was 3.79 kilograms per day for each in-use bed which was sorted like this; 2.75 kg regular and home-quasi, 0.128 kg sharp, 0.875 kg infectious-medical-chemical and 0.043 kg pathological.

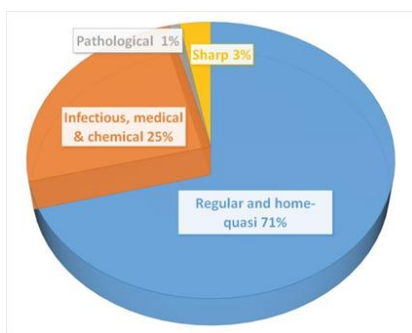


Figure 1. Percentage of different kinds of wastes produced in the studied hospitals.

For sorting the studied hospitals by waste production, cluster analysis was done on the results. According to the results of cluster analysis, hospitals under supervision of Tabriz medical university were

sorted into 4 groups by waste production. Hospitals "Sina, Al-zahra, Alavi, Nikou-kari" were placed in one group, hospitals "Shohada, Madani, Taleghani, Koudakan" in one other group and hospitals "Razi" and "Imam-Reza" were separately placed in one group each (Figure 2).

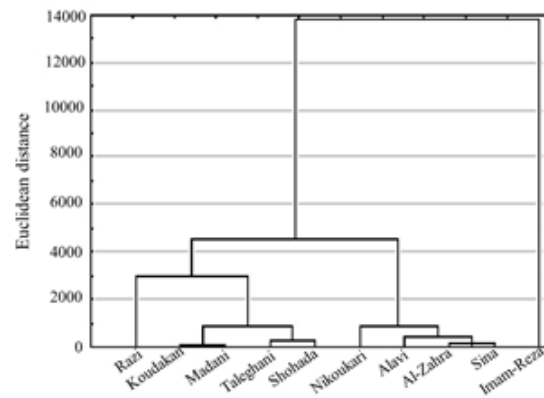


Figure 2. Results of the cluster analysis for studied hospitals based on waste production by "Ward" method.

For confirming the chart above, assessment analysis was used. The results of assessment analysis showed that the first two functions have justified the %100 of variances. Also, according to this analysis, all the places have been grouped correctly (Table 1).

Table 2: Check of trueness of grouping studied hospitals in cluster analysis by assessment analysis.

Group	Anticipation				Total
	1	2	3	4	
Actual (%)	1	2	3	4	
1	100	0	0	0	100
2	0	100	0	0	100
3	0	0	100	0	100
4	0	0	0	100	100

Fortunately, in all of the hospitals, the workers and the staff of residue collecting were adequately trained. Also, in 72.7% of the studied hospitals, the staff had special uniforms. Comparing the studied hospitals in terms of the number of beds in use and the staff of collecting residues to the total amount of produced waste and per capita waste generation of each hospital was done (Figure and Table 3). The results show that "Imam-Reza, Madani, Taleqani and Alavi" hospitals have a higher waste production rate than the average per in-use bed. Also "Imam-Reza, Taleqani and Madani" hospitals have a much higher waste production rate regarded to their in-use beds.

On the other hand, manpower is an important factor for collecting residues from different parts and sections of the hospitals. The service section is responsible for collecting residues from other sections. According to the standards announced by the research section of medical places of Iran housing company, the number of workers of service section per number of beds is:

Table 4: The standards of the research section of medical places of Iran housing company about the number of service section of the hospitals per number of in-use beds.

Number of beds	Less than 100	100-200	200-300	300-400	400-500
Number of service staff	12	21	33	45	58

So we can say that Al-Zahra, Razi, Koudakan, Imam-Reza and somehow Alavi hospitals have a lack of manpower in their service section which affects their waste management quality. There is a temporary residue storing site in all 10 studied hospitals and in 90% of them different kinds of residues are kept separately, but only in 60% of hospitals, yellow buckets are kept separately from black buckets in the temporary storing site. Temporary residue storing site in some of the studied hospitals were metallic chambers, concrete storages and special modules and 70% of the hospitals used special room modules.

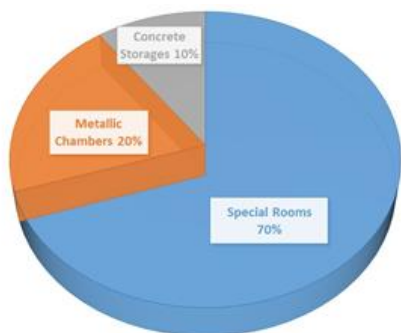
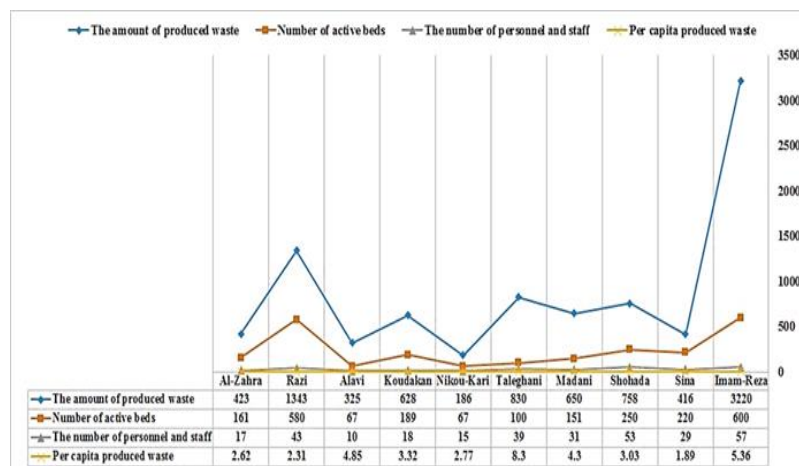


Figure 4. Types of residue temporary storing sites in the studied hospitals.

Figure and Table 3: Comparing the in-use beds and the number of staff of residue collecting to the amount of wastes produced in each hospital in kilograms per day.



In all hospitals under the supervision of Tabriz medical science university, infectious, sharp and chemical residues, are separated from the regular ones and the yellow bags are used for infectious, chemical residues and the black bags are used for collecting regular residues and for collecting sharp residues safety box (special resistant boxes) are used. In 60% of the hospitals washing and disinfecting the buckets and residue transportation facilities are done every day. None of the studied hospitals use incinerators to avoid air pollution and environmental problems and all the hospitals had disinfecting devices (autoclave) which their performance in all 10 hospitals was acceptable and after disinfecting, all the residues are shattered(to have less volume) and collected by municipal vehicles with other regular residues and gotten rid of.

In 80% of the hospitals, different types of residues mixed after disinfection and directly taken to the final excretion place. In 10% of hospitals, dangerous residues (infectious, chemical and sharp ones) are separately taken to the final excretion site and in the rest 10%, residues are separately first taken to city transfer station, and then taken to the final excretion site. Transporting the residues in all hospitals is done by the municipality. Collecting the residues from sections at all hospitals is done at the end of each business shift and is done once every 8 hours in a day.

According to the observations and interviews done with the experts of the hospitals, it was observed that in more than 50% of these hospitals there was no recycling being done on the residues inside the hospitals and in rest of the hospitals recycling is mostly done on dried bread and paper. This causes the



dried breads or other foods mix with bacterial and chemical residues in most cases and that causes the illnesses to thrive outside the hospitals.

4. Discussion and Conclusion

This research shows that the amount of wastes produced for each in-use bed in the hospitals of Tabriz Medical Science University is 3.79 kilograms per day and 1.046 kilograms of that is infectious which is 29% of total produced wastes. This is even higher than the 10-25% limitation given by world health organization for the amount of production rate of infectious wastes for the hospitals of developing countries. According to the other researches done in Iran, per capita waste generation in hospitals of Tehran (Monavari, Omrani & Rezaee, 2008), Karaj (Khazaei Mashhad (Ariyae & Hamidian, 2012), Araak (Dehghani, Fazelinia, Omrani, Nabizadeh & Azam, 2011), Karaj (Fazili, Salehi, Abdoli, Jafari & Sheykh Pour, 2010), Gorgan (Shahryari, Nooshin & Borghei, 2011), Shahre-kord (Rakhshan, Dadkhah & Sadeghian, 2010) and the hospitals of Sistan-balouchestan province (Bazrafshan & Kord Mostafapoor, 2007) in order were reported 3.406, 2.95, 4.6, 3.12, 2.53, 1.8 and 2.76 kilograms per day which in order contained 39, 31.58, 38.97, 46.67, 47.42, 27.77, 51.6 percent infectious residues.

On the other hand, according to the statistics of health and medical education ministry, the average amount of hospital residues in Iran has been estimated 2.71 kilograms for each bed. Studies done between years 1994-2008 about qualitative and quantitative management of hospital waste production in Africa (Nemathaga, Maringa & Chimuka, 2008), Libya (Sawalem, Selic & Herbell, 2009), United States of America (MWC, 1994), Turkey (Alagoz & Kocasoy, 2007; Alagoz & Kocasoy, 2008), India (Kumar, DK & Kumar, 2004), Portugal (Alvim Ferraz, Barcelos Cardoso & Ribeiro Pontes, 2000), Peru (Diaz, Eggerth, Enkhtsetseg & Savage, 2008), Italy (Lee, Ellenbecker & Moure-Ersaso, 2004), Greece (Tsakona, Anagnostopoulou & Gidakos, 2007), Korea (Jang, Lee, Yoon & Kim, 2006) and Jordan (Oweis, Al-Widyan & Al-Limoon, 2005) showed that the amount of waste production in these countries for each bed in order was 0.6, 1.3, 5-7, 1.92, 0.5-2, 3.8, 0.76, 2.6, 3-5, 1.9, 0.14-0.49, 0.77-2.21.

On the other hand, in the research that Taghipour and Mosaferi did in 2007 about hospital waste management in Tabriz, the amount of the residues produced for each bed was estimated 3.48 kilograms every day (Taghipour & Mosaferi, 2009). The comparison between 3 similar studied hospitals and the statistics that Taghipour and Mosaferi announced about these 3 hospitals in 2007 shows that in 4 recent years, the amount of waste production has

reached 1367 from 1206 kilograms per day which show a 13.31% increase in the amount of waste production.

The results of Taghipour and Mosaferi show that the average amount of medical waste, dangerous and infectious residues and general home-quasi waste production rate in Tabriz has been in order 3.48, 1.039, 2.439 kilograms per day for each bed. Also, general and home-quasi, infectious and dangerous and sharp wastes in order are 70.11, 29.44, 0.45 percent of total wastes produced. As the results of this study show, the percentage of different kinds of residues produced in Tabriz hospitals other than the small difference is true according to Taghipour and Mosaferi's research. Of course, there has been an 8.9% increase in the amount of waste production per capita in the past 4 years. Assigning over 29% of the produced residues to infectious wastes, shows weak and incorrect separation of infectious and home-quasi wastes which requires more attention. If we compare the total amount of produced wastes of 3 studied hospitals to the same hospitals in the year 2007, there has been a 0.033% annual growth in waste production.

Suppose this increase is constant and knowing that the produced wastes in these 3 hospitals including 15/57% of total production waste in Tabriz, we can estimate that in 2020 the amount of waste produced by the studied hospitals will be 11760 kilograms per day. According to the estimated weight about 99.58 kilograms per m³ by Taghipour and Mosaferi for hospital wastes of Tabriz, it is expected that this amount of produced waste, will take 118.09 m³ and this is while the international estimation for disinfecting 1 m² of soil 5-50 thousand dollars is needed. So, the importance of separating and minimizing the production of hospital wastes and applying a dynamic system for correct separation of infectious residues from home-quasi residues will cause an impressive decrease in the costs. During the researches that Rezayi has done on Mashhad hospitals, has said that if there be an accurate supervision and control on separation at the first place, a lot of dry residues will be recyclable every day and the income from selling these residues will save money. So that the cost of organizing the produced wastes in hospitals comparing to the situation before the separation will show a 19.51% decrease (Rezaee, Mansormoghadam & Amanishahri, 2008).

Comparing the amount of per capita hospital waste production in Iran and the world shows that the amount of wastes produced in our country is in the middle of the world average limitation for waste production. Unfortunately the average amount of waste production for each bed in-use in Tabriz,

compared to other cities of Iran, has a high amount which needs general planning and aggressive following up by the undertaking about this. The results of this study are warnings for the undertakings so that with their help and cooperation and spending not so much costs, try to solve this problem as soon as possible.

Of course, the consequences of such a process which has mostly been furtive and there have been no statistics for it in our country until now. Especially with the money being spent on medication and peripheral services of hospitals, we can observe that doing such a basic and healthy thing, despite health and conscionable duty, is totally affordable. As we said, the other part of this research is about determining types of residues and their percentage and with earning information and providing general statistics about this, we can use it for designing and planning the decent management for the collecting system and the healthy excretion of infectious residues. According to this, we can estimate the total policy of required facilities, manpower, and other related costs so that based on a motivated and conscious management there can be an aggressive supervision of this process. Also for studying and refining the current condition, it is required that the management method of the wastes be done in each one of different steps and alongside a more general study in all the hospitals of the city and the proper implementation of the residues separation plan and supervision on the right excretion of them be considered.

Corresponding Author:

Arash Ketabforoush Badri,
Department of Economics, College of Management
and Accounting, Islamic Azad University, Qazvin,
Iran.

E-mail: arashkbadri@gmail.com

References

1. Alagöz, B. A. Z., & Kocasoy, G. (2007). Treatment and disposal alternatives for health-care waste in developing countries—a case study in Istanbul, Turkey. *Waste management & research*, 25(1), 83-89.
2. Alagöz, A. Z., & Kocasoy, G. (2008). Determination of the best appropriate management methods for the health-care wastes in Istanbul. *Waste Management*, 28(7), 1227-1235.
- 3- Altin, S., Altin, A., Elevli, B., & Cerit, O. (2003). Determination of hospital waste composition and disposal methods: a case study. *Polish Journal of Environmental Studies*, 12(2), 251-255.
- 4- AMOUEI, A., TAHMASBIZADEH, M., ASGHARNIA, H., FALLAH, H., & MOHAMMADI, A. (2012). QUANTITY AND QUALITY OF SOLID WASTES IN THE HOSPITALS OF BABOL UNIVERSITY OF MEDICAL SCIENCES, NORTH OF IRAN. *Journal of Applied Sciences in Environmental Sanitation*, 7(3). (In Persian).
- 5- ARIYAEI, M., & HAMIDIAN, A. (2012). *Management of Hospital Wastes in Mashhad*. 65(1), 1-12. (In Persian)
- 6- Askarian, M., Vakili, M., & Kabir, G. (2004). Results of a hospital waste survey in private hospitals in Fars province, Iran. *Waste management*, 24(4), 347-352.
- 7- Bazrafshan, E., & KORD, M. F. (2009). *Quantifying the Rate of Hazardous Wastes Production in Sistan and Baluchestan Province in 2007*.
- 8- Chaerul, M., Tanaka, M., & Shekdar, A. V. (2008). A system dynamics approach for hospital waste management. *Waste Management*, 28(2), 442-449.
- 9- Coker, A., Sangodoyin, A., Sridhar, M., Booth, C., Olomolaiye, P., & Hammond, F. (2009). Medical waste management in Ibadan, Nigeria: Obstacles and prospects. *Waste management*, 29(2), 804-811.
- 10- Dehghani, M. H., Fazelinia, F., Omrani, G. A., Nabizadeh, R., & Azam, K. (2011). Investigation of Management Status on Medical Wastes in Public Hospitals of Arak City. *Iranian Journal of Health and Environment*, 4(1), 93-104.
- 11- Diaz, L. F., Eggerth, L. L., Enkhtsetseg, S., & Savage, G. M. (2008). Characteristics of healthcare wastes. *Waste management*, 28(7), 1219-1226.
- 12- Ebrahimi, A., Hashemizade, B., & Foadifard, R. (2008). Proposal On Process And Disposal Management Of Hospital Wastes. *The 4th National Conference On Waste Management*. Mashhad Recycling Organization. Mashhad, I.R.Iran. (In Persian).
- 13-Environment protection agency, *waste management act*. (1995). Environment protection agency press.
- 14- Fazili, A., Salehi, A., Abdoli, M.A., Jafari, H.R., & Sheykh Pour, M. (2010). Review of hospital wastes management in Karaj. *International Journal of Environmental Studies*. 36(53), 99-106. (In Persian).
- 15- Ferraz, M. A., Cardoso, J. B., & Pontes, S. R. (2000). The concentration of atmospheric pollutants in the gaseous emissions of medical waste incinerators. *Journal of the Air & Waste Management Association*, 50(1), 131-136.

- 16- Firouzmanesh, M., Qavami, A., Shahmoradi, B., & Rahimi, Y. (2008). Study of Quality And Quantity Of Hospital Waste Management In Sanandaj Medical And Health Centers In 2005. *The 4th National Conference on Waste Management. Mashhad Recycling Organization.* Mashhad, I.R.Iran. (In Persian).
- 17- Jang, Y. C., Lee, C., Yoon, O. S., & Kim, H. (2006). Medical waste management in Korea. *Journal of environmental management*, 80(2), 107-115.
- 18- Karami-Matin, B. (2001). *The study of hospital waste management in Kermanshah teaching hospitals* [dissertation]. Tehran University of Medical Sciences. (In Persian).
- 19- Khazaei, M., Hamidian, A. H., Taheri, M. Babakan, T., Mashuf, A., Rabizadeh, S., & Khazaei, A. (2015). Assessment of medical waste management in Karaj hospitals, Iran. *International Research Journal of Applied and Basic Sciences*, 9(10), 1750-57.
- 20- Kumar, R., Patel, D. K., & Kumar, R. (2004). A survey of trace metals determination in hospital waste incinerator in Lucknow City, India. *Online Journal of Health and Allied Sciences*, 3(2).
- 21- Lee, B. K., Ellenbecker, M. J., & Moure-Ersaso, R. (2004). Alternatives for treatment and disposal cost reduction of regulated medical wastes. *Waste management*, 24(2), 143-151.
- 22- Medical Waste Committee (MWC). (1994). Medical waste disposal. *Journal of the Air & Waste Management Association*. 44, 1176-1179.
- 23- Mirhosseini, H., Dahestani Athar, S., & Vaseqi, F. (2008). Investigation of Solid Waste Management in Khoramabad Hospitals in 2008. *The 4th National Conference on Waste Management. Mashhad Recycling Organization.* Mashhad, I.R.Iran. (In Persian).
- 24- Mohamed, L. F., Ebrahim, S. A., & Al-Thukair, A. A. (2009). Hazardous healthcare waste management in the Kingdom of Bahrain. *Waste management*, 29(8), 2404-2409.
- 25- Monavari, S.M., Omrani, G.H., & Rezaee, F. (2008). Quality and quantity of wastes in private hospitals of Tehran. *International Journal of Environmental Science and Technology*, 10(4), 232-45. (In Persian).
- 26- Nemathaga, F., Maringa, S., & Chimuka, L. (2008). Hospital solid waste management practices in Limpopo Province, South Africa: A case study of two hospitals. *Waste management*, 28(7), 1236-1245.
- 27- Noorisepehr, M. (2008). *The Necessity of Hospital Waste Management and the Role of Local People Contribution.* The 4th National Conference on Waste Management. Mashhad Recycling Organization. Mashhad, I.R.Iran. (In Persian).
- 28- Oweis, R., Al-Widyan, M., & Al-Limoon, O. (2005). Medical waste management in Jordan: A study at the King Hussein Medical Center. *Waste Management*. 25(6), 622-625.
- 29- Prüss, A., Giroult, E., & Rushbrook, P. (1999). *Safe management of wastes from health-care activities.* World Health Organization.
- 30- Rakhshan, N., Dadkhah, F., & Sadeghian, P. (2010). Investigation of hospital wastes management in Shahr Kord hospitals. *Med Soc Sec J.* 9(52-53), 127-30. (In Persian).
- 31- Raygan Shirazi, A., & Mary Ariad, H. (2008). An Investigation on the Status of Hospital Waste Management in Yasuj City in 2006. *The 4th National Conference on Waste Management.* Mashhad Recycling Organization. Mashhad, I.R.Iran. (In Persian).
- 32- Rezaee, E., Mansormoghadam, Z., & Amanishahri, A. (2008). The Location of Waste Separation in Hospital Waste Management. *The 4th National Conference on Waste Management.* Mashhad Recycling Organization. Mashhad, I.R.Iran. (In Persian).
- 33- Sawalem, M., Selic, E., & Herbell, J.D. (2009). Hospital waste management in Libya: A case study. *Waste Manage.* 29(4), 1370-1375.
- 34- Shahryari, A., Nooshin, S., & Borghei, P. S. (2011). Medical Waste Management in Gorgan Hospitals. *Journal of Health*, 2(1), 49-55.
- 35- Shinee, E., Gombojav, E., Nishimura, A., Hamajima, N., & Ito, K. (2008). Healthcare waste management in the capital city of Mongolia. *Waste management*, 28(2), 435-441.
- 36- Shojaei Tehrani, H. (2004). *Textbook of Preventive and Social Medicine.* Volume Tehran: Samat Publication. (In Persian).
- 37- Taghavi, K. (2005). Investigation and Physical Analysis of Medicine and Infectious Wastes of Rasht university hospitals and proposals to control the adverse effects on the environment. *The 8th National Conference on Environmental Health. Tehran University of Medical Sciences and Iranian Association of Environmental Health.* Tehran, I.R.Iran. (In Persian).
- 38- Taghipour, H., & Mosaferi, M. (2009). Characterization of medical waste from hospitals in Tabriz, Iran. *The science of the total environment*, 407(5), 1527-1535.
- 39- Takdastan, A., Jafarzade, N., & Pazoki, M. (2008). *Study of Quality and Quantity of Hospital Wastes and Introducing Methods for Safety, Minimization, Treatment and Disposal Management of Hospital Wastes in Iran.* The 4th National Conference on Waste Management.

- Mashhad Recycling Organization. Mashhad, I.R.Iran. (In Persian).
- 40- Tsakona, M., Anagnostopoulou, E., & Gidakos, E. (2007). Hospital waste management and toxicity evaluation: a case study. *Waste Management*. 27(7), 912-920.
- 41- Yaqubifar, M.A., & Khamirchi, R.A. (2007). Investigation of the status of collection and disposal of hospital wastes in hospitals and medical centers of Sabzevar. *Asrar Journal of Sabzevar Medical Sciences*. 14(2), 128-34. (In Persian).
- 42- Zaree Chahouki. M.A. (2010). *Data Analysis in Natural Resources Research Using SPSS Software*. Jahad Daneshgahi Tehran Publication. (In Persian)

Received January 27, 2016; revised February 17, 2016; accepted February 20, 2016; published online March 1, 2016.