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EVALUATION OF MEDICAL SOLID WASTES MANAGEMENT IN SOME HOSPITALS IN NAJAF CITY/ IRAQ

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ABSTRACT

This study aims to evaluate the management of medical solidwaste in some hospitals in Najaf city as a case study. For this study, three big local hospitals were selected that are different in specialties. The generation quantities of medical solidwaste were collected for one time in a week over four months (August - November 2010). The most important factors affecting the rate of generation of these wastes in selected hospitals were analyzed statistically to get a mathematical formula to calculate the amount of waste generated per day for each hospital. It is found that the generation rates were ranged from (1.074 - 3.844) Kg/capita/day through the study period. Due to the absence of regular application and workers conscious in management of medical solidwaste, the system management requires a safety environmental program to manage this waste, which minimizes the risks of public health and the environment.

KEYWORDS: Medical solid waste; Management; Incineration; Najaf hospitals

تقييم ادارة النفايات الطبية الصلبة في بعض مستشفيات مدينة النجف / العراق

المدرس فاطمة محسن كزار

قسم الهندسة المدني/ كلية الهندسة/ جامعة الكوفة

الخلاصة

تهدف الدراسة الى تقييم نظام ادارة النفايات الطبية الصلبة في بعض مستشفيات مدينة النجف كدراسة حالة. اختيرت المستشفيات الحكومية الكبرى في المدينة بمختلف اختصاصاتها .حسبت كميات التولد للنفايات الطبية الصلبة مرة واحدة في الاسبوع و لمدة اربعة أشهر (أب – تشرين الثاني 2010). تم التحليل الإحصائي للعوامل المهمة المؤثرة في معدل تولد النفايات لإيجاد صيغة رياضية لحساب كمية النفايات المتولدة في اليوم الواحد لكل مستشفى. اظهرت النتائج ان معدلات تولد النفايات الطبية الصلبة تراوحت بين (1.074 –3.844) كغم / شخص / يوم خلال فترة الدراسة' غياب التطبيق المنظم والوعي للعاملين في ادارة النفايات الطبية الصلبة لذلك فان نظام ادارة النفايات الطبية الصلبة يتطلب برنامج بيئي امين لإدارتها والتقليل من المخاطر على الصحة العامة والبيئة.

1. INTRODUCTION

Solid wastes are all the wastes arising from human and animal activities that are normally solid and discarded as useless or unwanted. The various types of solid wastes that are generated are municipal wastes, industrial wastes, and hazardous wastes. The principal sources of dangerous biological wastes are hospitals and biological research facilities.

Medical solid waste for hospitals is defined as non- liquid waste resulting from the exercise of the hospital for its main role in providing the necessary treatment for patients and taking care of them and making all administrative belongings to facilitate that task. It consists of two main types of waste: general waste which forms ratio between (75-90) % from the generated solid waste and medical waste which forms ratio between (10-25) % from total solid waste and represents the danger portion of them because of its ability in spreading pollution and diseases, so it needs a special approach in management and treatment (Al- Hashimi, 2007).

Bio-medical waste is extremely a hazardous type of waste and if not managed properly can lead to serious health and environment problems. Bio-medical waste is any type of waste generated during the diagnosis treatment or immunization of human beings or animals or in research activities pertaining to the production of drugs in pharmaceutical companies. Animal waste is generated in the veterinary hospitals and also in the slaughter houses (Joshi et al., 2005). Medical waste is defined as the disposal of any human infectious agent or equipment that is capable of transmitting that disease to humans. An example of a human disease agent is Histoplsma capsulatum. Equipment that would be requlated as medical waste includes syringes and scalpel blades. All medical waste must be either treated and disposed of as solid waste or shipped off – site for additional processing to render it non- recognizable.

Hospital waste is different from domestic waste and must be separated, collected and disposed of using scientific technology. If separation is not done properly at source, it can get mixed with municipal solid waste resulting in possible exposure of the entire community to the microorganisms, which are responsible for highly infectious and dreadful diseases like HIV (AIDS), Hepatitis A,B and C, Tuberculosis, and other skin and Respiratory ailments. In many hospitals, unscientific technologies, like incineration of the waste are used for disposal of the hospital waste. This can lead to hazardous levels of emissions of gases like dioxins and furans in the environment which contain cancer causing agents. Residual ash, if not disposed off in secured landfills, can also contaminate the underground water and pollute the soil.

In some countries, medical solid waste must be stored in an area secured as to deny access to unauthorized persons, animals, wind, rain, insects and rodents prior to disposal. If such wastes are placed in a trash receptacle or compactor which is accessible to unauthorized persons, it must be locked to prevent access to the contents by anyone other than authorized persons or refuse collection personnel.

More stringent security requirements were established because waste of obvious medical origin is perceived as high risk and therefore a cause for concern by some segments of the general public. Medical solid waste should be no more or no less hazardous than any other category of solid waste (Department of Environmental Health DEH, 2005).

Hospitals generate large quantities of waste that falls into diverse categories. Most of this waste is of an infections nature. Other types of waste include toxic chemicals, cytotoxic drugs, flammable and radioactive wastes that can often be considered infectious. For this reason each hospital should develop an infectious waste management plant that provides for a thorough separation and treatment of the waste on site. This can facilitate and lower the costs of ultimate disposal.

In this study, medical solid waste management and treatment in some large hospitals of Najaf city was evaluated.

2. TYPES OF MEDICAL SOLID WASTE

Joshi et al. (2005) categorized the generated waste in the hospitals into the following categorized:

1- General waste: This makes about (80–85) % of the total waste generated in a hospital. This is non- infectious and can be easily managed if it is separated at source properly. General waste includes items like paper, cardboard boxes, plastic packaging, metal boxes, etc. which is non biodegradable. Another category of general waste includes kitchen waste which consists of left over food, vegetable and fruit peels, meat, tea bags or used tea powder, coconut shells, flowers or bouquets brought in by patients' visitors, etc. which is biodegradable.

2- Infectious waste: This accounts for only a small fraction comprising about 10–15% of the total volume of waste generated in a hospital. However, this small fraction is of the biggest concern as it poses direct threat to the health and hygiene of the human beings transmitting viral, bacterial fungal or parasitic diseases. This type of waste includes:

a-Pathological waste: Human anatomical wastes, like organs, body parts, tumors, glands, etc. that are removed during surgery or biopsy or any other medical procedure, imputed parts and also tissues, placentas, aborted fetuses, blood and other body fluid, animal carcasses and tissues from laboratories, cotton swabs soaked in blood / body fluids, hospital gowns, aprons, and other similar materials which have been in contact with the patients bodies.

b- Infectious plastic: Disposable items like syringes, IV set blood bags, catheters, gloves, endotracheal tubes, canulas, dialysis sets, etc.

c- Sharps: These are the most hazardous contents of the hospital waste especially for the healthcare staff handling these. Sharps include broken glass articles or metal articles, such as needles, blades, scalpels, saws, nails, etc.

3-Non-Infectious, but dangerous waste: This type of waste does not contain any infectious, i.e. disease causing component and comprise about (5–10) % of the total volume of waste generated in a hospital. However, it can cause serious health hazards like burns, corrosions, genotoxicity, chromosomal aberrations, toxicity, carcinogenic effects, etc. These include:

a- Chemical waste: chemicals like disinfectants, fumigants, other solid, liquid or gaseous substances, etc. These can be hazardous if these poss corrosive, inflammable or reactive genotoxic properties, or these can be non – hazardous if these do not poss these properties. These include inorganic salts, buffer chemicals, sugars, amino acids, etc.

b- Radioactive waste: solids, liquids, and gases from in vitro analysis of tissues and body fluids, x- rays, chemical dyes, and isotopes of various radioactive elements frequently used in diagnosis, treatment of diseases, etc.

c- Cytotoxic waste: This type of waste is generated from diagnosis and treatment of diseases like cancer. This type of waste can be found in small quantities in human excreta, I.V. solutions and containers from laboratories.

d- Waste with multiple categories: At times, the waste generated in hospitals fall into more than one category like radioactive sharps, plastic I.V. tubes contaminated with cytotoxic drugs, etc.

Figs. 1 and 2 show the percentages and types of medical solidwaste.

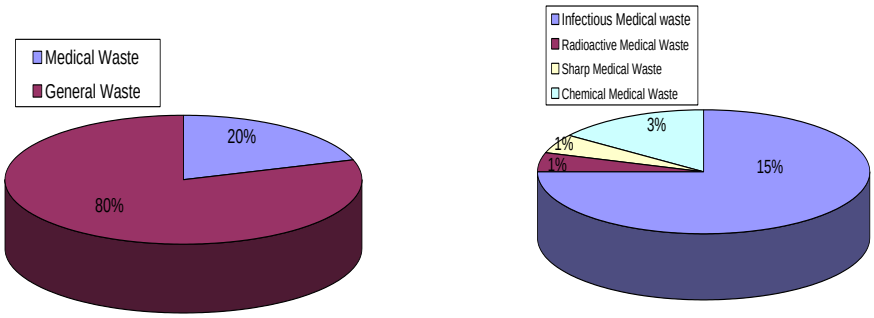
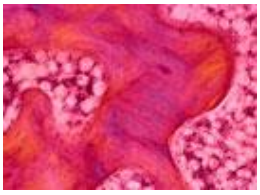


Fig. 1. Percents of medical solid waste (Libyan Club, 2005)

Radioactive waste



Pathological waste

Sharps waste

Pharmaceutical waste

Waste with high heavy metal

Genotoxic waste

Fig. 2. Types of medical solid waste (Libyan Club, 2005)

(Visvanathan, 2006) classified Healthcare waste as shown in Fig. 3.

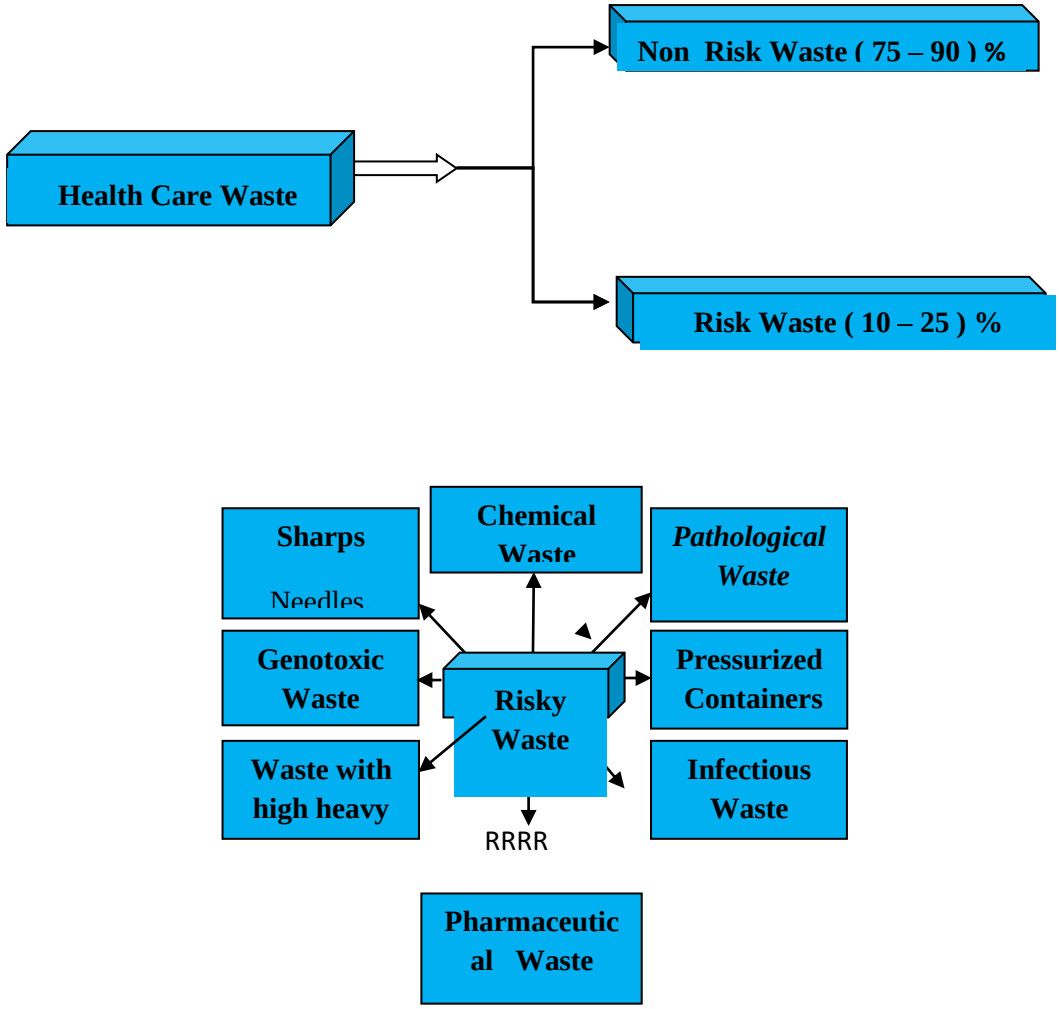


Fig. 3. Health care waste characterization (Visvanathan, 2006)

3. MANGEMENT AND TREATMENT OF MEDICAL SOLIDWASTE

Hospitals form a complex environmental system which are contaminated by many sources of biological, chemical, and physical pollutants. These pollutants directly affect the workers as well as patients in the hospitals, so the concept of environmental management system is necessary to manage and treat hospitals (Mohammad, 2007). Management and treatment of medical solidwaste can be classified as:

3.1. Separation

General waste and infectious as well as hazardous waste generated from various activities of the hospital should be properly separated even if a small amount of infectious waste gets mixed with general waste, it can pollute the total waste collected. Segregation at source means separation the waste materials from each other at the place of its generation. If the waste is separated there itself, then the danger of infection can be greatly decreased. The separated waste must be stored in colored bag or containers in accordance with the colored evidence shown in Table 1.

Table 1. The colored evidence of waste containers (Ministry of Environment, 2010)

Number	Type of Waste	Color Bag or Container
1	Highly infection waste	Yellow plastic bag or plastic container written on it " highly infectious waste" and bio- hazardous waste sign
2	Anatomical waste	Red plastic bag or plastic container written on it " hazardous waste" and bio – hazardous waste sign
3	Infectious waste	Yellow plastic bag or plastic container written on it hazardous waste and bio – hazardous waste sign
4	Acute waste	Yellow plastic bag or plastic container written on it "only cute waste" and bio – hazardous waste sign
5	Chemical materials waste and pharmaceutical	Yellow plastic bag or plastic container shown on it bio – hazardous waste sign
6	Chemotherapy waste	Blue plastic bag or plastic container
7	Radioactive materials waste	Locked bag or container shown on it the international sign of radiation
8	Non–hazardous medical waste	Black plastic bag or plastic container

Colors are used according to the previous table, and the bags are provided with an adhesive writing about the type of waste and its source. Bag should be suspended with special holder or placed in a special plastic or metal container suitable for the color of the bag; the bag must be sealed when it is filled to two thirds.

3.2. Collection and transport the waste inside the hospital

Workers working at the hospitals are collecting public solid waste and medical solid waste by hand and placing them in containers or separate bags with preserving the non – accumulation of filled bags or containers in the place of generated. Medical solid waste is separated from public and transported to the incinerator site then burnt, and the output is taken to landfill site.

3.3. Waste storage

The location of waste storage is in form of isolated and separated warehouse from the rest sections of the hospital and away from the places of food preparation and patients lobbies. The site should be with special specifications where ground is easy to be cleaned, the place provided with a water source, water discharge, and lighting source. Besides, the doors are fitted with locks, insects or birds are not gathered, and its size and area fit with the volume of produced waste. A period of waste storage should not exceed (48) hours in winter season and (24) hours in summer season unless the place is cold.

3.4. Waste Disposal

After putting medical solidwaste in specific bags (coloured evidence), they are sent to the incinerator found inside the hospital, while general wastes are put in black bags and disposed by municipalities. When one of the incinerators is unemployed, the medical wastes are sent to the nearest hospital until the reform of the incinerator.

3.5. Treatment of Medical Waste

Waste treatment is known as the ways able to change the features and properties of hazardous materials to make them non – serious or less serious, then the dealing with them becomes more safely in transportation, collection, storage, and disposal without causing damage to individuals and environment.

The choice of effective methods of treatment the medical waste is dependent on several factors including size, seriousness of treated waste, and type of used incinerator. For example, some bacteria have ability to resist the methods of chemical sterilization, but it can not resist the thermal methods. Heat sterilization is easier than chemical sterilization and less damage to the environment.

There are multiple and different methods to treat medical waste, and each method has advantages and disadvantages like landfill, steam sterilization, chemical disinfection, microwave radiation, encapsulation, and incineration. Some methods are not compatible with the type of treated waste (Al-Thabit, 2010).

For several decades, incinerators were used in disposal of hazardous waste like medical waste, and it is still the most common way in the world. Recently, some international organizations advocated that there should be alternative methods for the burning process.

Incinerators have a great ability in minimizing and reducing the quantity of infectious waste that form a risk to public health and individuals, but at the same time and in case of a defect or not to do soundly there is a great potential in emergence of negative and destructive damages to the environment as a result of treatment.

Incinerators are ways to dry the burnt waste with presence of oxygen at high temperatures to convert organic compounds and combustible materials to inorganic materials and non – combustible materials, as a results the size and weight of the waste are reduced. Incineration process can be conducted in a compensation manner in which much of heat and water vapor is retrieved from burning and use it to produce electricity, thereby the operating cost of the Incinerators is reduced. A simplified sketch of incinerator composition is shown in Fig. 4.

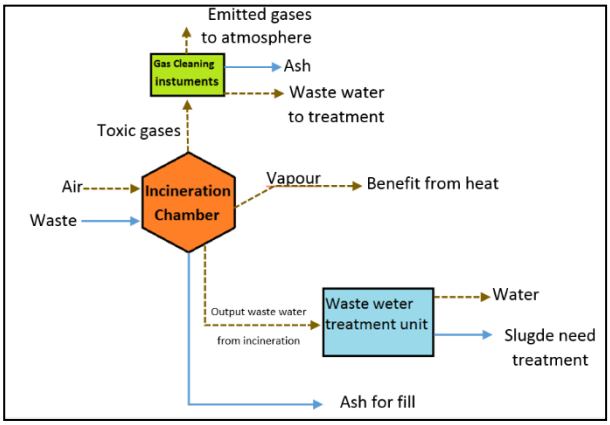


Fig. 4. Simplified sketch of incinerator composition (Al-Thabit, 2010)

Incinerator process is different in quality, size, chosen function, and their effectiveness in eliminating causes or factors disease.

There are several types of incinerators according to their composition (Al- Thabit, 2010, Cited by Al- Kizwini, 2014).

1. Pyrolytic incineration with an efficient gas cleaning:

   Incinerators are known with their high ability of sterilization in particular when dealing with infectious medical waste, temperature (800–900) C^o and have a capacity of (200 kg/day) to (10 tons/day). Disadvantages of these incinerators are the high financial cost of the structure and high technology for operation, and treatment does not eliminate the danger of radioactive medical waste that accumulates with ash.

2. Single chamber with dust reduction: Incinerators with various types and shapes have a high ability of sterilization and reduce size and weight of waste. They are effective in treatment of infectious medical waste including sharp waste and do not need high technology for operation and less expensive. Disadvantage include producing large quantities of vapors which may contain toxic gases, such as dioxin to the atmosphere, non–safe disposal of toxic medicines waste (cytotoxic drugs), and radioactive medical waste. Usually, temperatures of this type ranging from (300–400) C^o and a capacity of (100–200) kg/day, this type is not recommended in countries that suffer from problems of air pollution.

3. Rotary kilns incinerators: Incinerators with rotary thermal cylinder (2–5 times per minute), the cylinder has inclination with a small angle and is provided with waste after it is cut to small particles. This type is effective with infectious medical waste (including sharp infectious waste), pathological, chemical, and pharmaceutical waste (including chemotherapy waste), but it is not effective with radioactive medical waste and waste containing large amounts of heavy metals which result toxic vapors, such as lead, cadmium, and mercury. Temperature in this type ranges from (1200–1600) C^o and capacity ranging from (0.5–3) tons/hour. This type is expensive and is requiring high technology, qualified technicians, and regular maintenance including changing the rotary thermal cylinder.

4. Drum or brick incinerator: A simple type of incinerators and sometimes called the field incinerator, it is an iron or stone barrel open from two sides, and the waste bags are placed on it. It has ability to reduce weight and volume of the waste, and it does not require a qualified person to run, consequently cost less. It can eliminate 99% of the microbes but cannot provide a complete elimination of chemical and pharmaceutical waste, temperature does not reach 200 C^o in most cases. Disadvantage of this incinerators includes production large quantities of black smoke, fly ash, and gas. It is permitted in some developing countries because of low operating cost.

5. Mobile incinerators: Integrated and high–tech incinerators are placed on special vehicles and equipped with bmsfiat work to reduce toxic gases and dust producing from combustion process. The vehicle moves to the sources of medical waste, such as hospitals; this modern method is used in some countries but with avoiding the transfer of medical waste through the streets.

3.6. Basic principles of selection incinerator site

Selection of incinerator site requires detailed study to assess the environmental impact. This study should be verified and approved by the concerned authorities. Overall, the site should be at a distance not less than (5 km) away from residential areas and (1 km) away from any

service or economic activity, as well as sources of surface water and groundwater according to appropriate hydrological study for the site. Next, the site should be in an appropriate direction of wind so that does not reach contaminants to the residential areas and other activities as well as should ensuring an adequate space as isolated warehouses to store the accumulated waste before burning and ensuring the ways to enter and exit mechanisms; the height of the chimney should be design and determine as appropriate to minimize the impact on the nearby communities.

3.7. Hazards result from poor management of medical waste

Medical waste may become a significant cause of morbidity or death around the world, if not managed properly. The main risks that may result from infectious medical waste is the transfer of many diseases such as viral hepatitis B or C in addition to HIV (AIDS) through the wounds caused by contaminated needles with human blood containing such viruses. Also, there are many chemical medical waste are considered hazardous waste because some of them may be toxic, flammable, and other dangerous effects.

4. THE STUDY AREA

Najaf city is located uphill above a sandy soil. The city is sited at the edge of the western hill of Iraq/south west of Baghdad (capital of Iraq) at a distance of (180 km). It is situated between (44^{o} 19 $^{/}$) longitude and (31^{o} 59 $^{/}$) latitude, and ground elevations in the area rises about (55m) above sea level. The city area covers (183 km^2) within the basic scheme for the year 2012 through 2035 (Al- Taghlubi, 2013).

Najaf is one of very important cities in different perspectives religious, social, and economic because it contains sacred shrines and science centers, therefore it is necessary to focus on environment of this city which it is a destination by a large number of Muslims, throughout the year. This city contains three large government hospitals that provide services to population in various medical specialties, see Fig. 5**.** Table 2 provides Information about these hospitals.

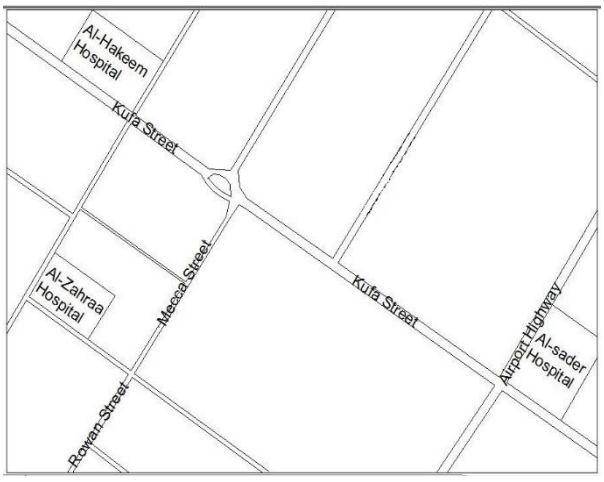


Fig. 5. Locations of selected hospitals in Najaf city

Table 2. Information of studied hospitals

Hospital	Date of establishment	Area of hospital (m^2)	Number of working staff	Capacity (patient)
Al- Sader	1982	54,000	1,283	505
Al- Hakeem	1966	40,000	810	268
Al- Zahraa	1984	40,950	721	319

5. EXPERIMENTAL WORK

The most important data were collected from selected hospitals per day over four months (August–November 2010); these data were: number of patients, number of operations, and quantity of medical solid waste. These data are summarized in Tables 3-5.

6. STATISTICAL ANALYSIS

The collected data were analyzed statistically using a program (**SPSS version 17 software**) to find a relationship between amount of waste as a function of number of patients and number of operations per day.

General equation was accessed to estimate the amount of medical waste to get the highest value of correlation Table 6. For medical wastes of hospitals. Non Linear Regression was used as follows:

$$\text{Log } y = a + b * \text{Log } (x_1) + c * x_2 \quad (1)$$

$a = 0.1$ $b = 0.1$ $c = 0.1$

Where:

y = Amount of medical solid waste per day. x_1 = Number of patients per day.

x_2 = Number of operations per day.

Table 3. Quantity of medical solidwaste in Al- Sader hospital

No.	Date	Medical solid waste (kg/day)	No. of patients /day	Rate of Waste kg/ patient/day	No. of operations/day
1	1-8	375.00	71.00	5.280	41.000
2	8-8	410.00	69.00	5.940	42.000
3	15-8	375.00	54.00	6.940	35.000
4	22-8	395.00	65.00	6.080	30.000
5	29-8	245.00	71.00	3.450	36.000
6	5-9	365.00	64.00	5.700	42.000
7	12-9	315.00	14.00	22.50	14.000
8	19-9	225.00	86.00	2.620	38.000
9	26-9	395.00	151.0	2.620	40.000
10	3-10	379.00	130.0	2.920	32.000
11	10-10	389.00	153.0	2.540	30.000
12	17-10	369.00	76.00	4.860	22.000
13	24-10	242.00	194.0	1.250	38.000
14	31-10	345.00	89.00	3.880	30.000
15	7-11	336.00	75.00	4.480	28.000
16	14-11	425.00	73.00	5.820	34.000
17	21-11	345.00	113.0	3.050	24.000
18	28-11	344.00	84.00	4.095	31.000
Ave.	N/A	348.56	90.67	3.844	32.611

Table 4. Quantity of medical solidwaste in Al -Hakeem hospital

No.	Date	Medical solid waste (kg/day)	No. of patients /day	Rate of Waste kg/ patient/day	No. of operations/day
1	1-8	75.00	56.0000	1.340	30.00
2	8-8	83.00	47.0000	1.770	19.00
3	15-8	62.00	74.0000	0.838	25.00
4	22-8	86.00	29.0000	2.970	18.00
5	29-8	52.00	50.0000	1.040	21.00
6	5-9	35.00	54.0000	0.650	19.00
7	12-9	33.00	18.0000	1.830	10.00
8	19-9	97.00	68.0000	1.430	18.00
9	26-9	83.00	82.0000	1.010	28.00
10	3-10	48.00	62.0000	0.770	17.00
11	10-10	55.00	45.0000	1.220	22.00
12	17-10	60.00	62.0000	0.970	18.00
13	24-10	60.00	73.0000	0.820	23.00
14	7-11	53.00	55.0000	0.960	18.00
15	14-11	88.00	52.0000	1.690	16.00
16	21-11	98.00	54.0000	1.810	7.000
Ave.	N/A	66.75	55.0625	1.212	19.31

Table 5. Quantity of medical solidwaste in Al- Zahraa hospital

No.	Date	Medical solid waste (kg/day)	No. of patients /day	Rate of Waste kg/patient/day	No. of operations /day
1	1-8	223.0	160.000	1.390	36.00
2	8-8	194.0	148.000	1.310	35.00
3	15-8	184.0	147.000	1.250	36.00
4	22-8	115.0	128.000	0.898	32.00
5	29-8	230. 0	131.000	1.760	31.00
6	5-9	125.0	123.000	1.020	26.00
7	12-9	130.0	66.0000	1.970	14.00
8	19-9	120.0	144.000	0.830	31.00
9	26-9	139.0	155.000	0.890	30.00
10	3-10	136.0	173.000	0.790	35.00
11	10-10	140.0	200.000	0.70	29.00
12	17-10	192.0	179.000	1.070	24.00
13	24-10	208.0	222.000	0.940	32.00
14	31-10	164.0	195.000	0.840	40.00
15	7-11	178.0	175.000	1.020	37.00
16	14-11	212.0	197.000	1.080	38.00
17	21-11	201.0	148.000	1.360	37.00
18	28-11	192.0	178.000	1.080	27.00
Ave.	N/A	171.3	159.389	1.074	31.67

Table 6. Parameter estimates

Parameter	Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
a	1.673	0.270	1.131	2.214
b	-0.077	0.170	-0.419	0.266
c	0.024	0.005	0.014	0.034

It is found that the R- square of the proposed equation is about (0.795) as shown in Table 7. Which means that the equation is accurate, and dependent variable is explained by independent variables.

R^2 is a measure used in statistical model analysis to assess how well a model explains and predicts future outcomes. It is indicative of the level of explained variability. Fig. 6. Illustrates normal P- P plot of predicted values.

Table 7. Value of correlation coefficient for the study

ANOVA[a]

Source	Sum of Squares	df	Mean Squares
Regression	254.165	3	84.722
Residual	3.12500	49	0.0640
Uncorrected Total	257.291	52	N/A
Corrected Total	5.16500	51	N/A

Dependent variable: logy

a. R squared = 1- (Residual Sum of Squares) / (Corrected Sum of Squares) =0 .795

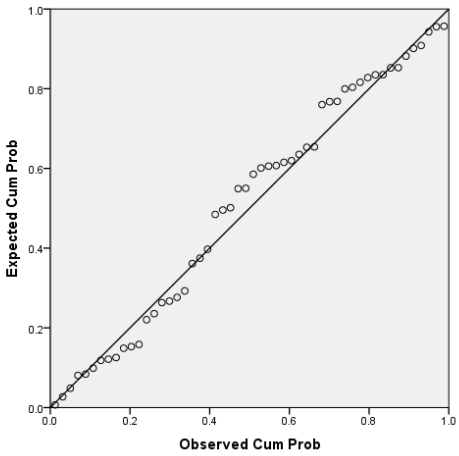


Fig. 6. Normal p-p plot of predicted values

6. RESULTS AND DISCUSSION

The results proved that the rate of waste generation during the study period in Al-Sadr hospital was (348.56 kg/day); the max. value of waste was (425 kg/day) and the min. value was (225 kg/day). For Al-Hakeem hospital, the rate of waste was (66.75 kg/day); the max. value of waste was (98 kg/day) and the min. value was (33 kg/day). In Al-Zahraa hospital, the rate of waste was (171.3 kg/day), the max. value was (230 kg/day) and the min. value was (115 kg/day). The generation rates of medical waste were ranged between (1.074–3.844) Kg/bed/day as shown in Tables 3- 5.

Al-Sader hospital was produced the highest rate of waste during the months of study compared with the other hospitals because of its large size and variety specialties, so it requires attention from an environmental perspective, as shown in Fig 7.

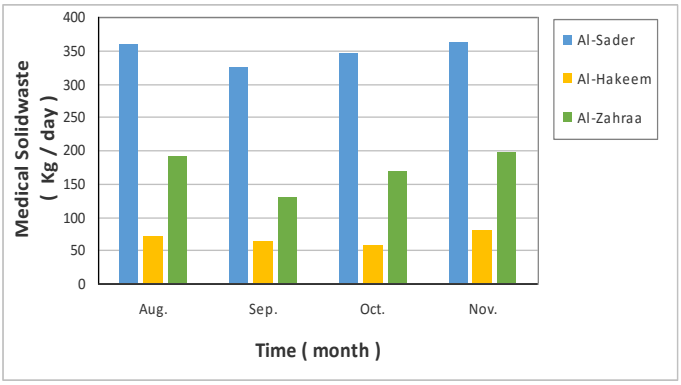


Fig. 7. Rates of medical solidwaste generation of hospitals during study Period in (kg/day).

The method that was used for treatment in the selected hospitals was incineration method. After the separation of medical solids waste from public waste, the waste was incinerated in the incinerator with a temperature of (1000–1300) C^o for hazardous waste and a temperature (800-1000) C^o for non- hazardous waste. After incineration, the waste is treated either with a water way as in gas incinerator or with cooling by air as in kerosene incinerator.

Medical waste needs high temperatures to get rid of the harm; the required temperature varies depending on the type of the waste. Infectious waste of inherent human organs needs temperature of (800-900) C^o, while some of pharmaceutical medical waste needs temperatures at least (1200) C^o.

Al-Sader hospital contains two incinerators, the capacity of first is (250 kg) and the capacity of the second is (50 kg). Al- Hakeem hospital contains two incinerators where their capacity are (100 kg) and (50 kg), while Al – Zahraa hospital contains one incinerator with two rooms, the capacity of one room was (15 kg).

When comparing the incinerators' capacity found in all selected hospitals with the amount of medical solid waste produced by the hospital per day, it was noted that there was a deficit in the possibility of burning all the waste in Al-Sader and Al-zahraa hospitals. While the incinerators' capacity in Al-Hakeem hospital was enough to burn all medical waste generated per day.

The danger of the incineration cannot be underestimated; the incinerator even it is new will not solve the problem because even the very modern incinerator emits toxic substances. It is worth mentioning that there are no specialized institutions known to have appropriate means of hospitals waste disposal. The majority of hazardous hospitals waste including machinery, sharp, infectious waste and expired medicines treat with improper ways. Studied hospitals run very old polluting where incinerators do not abided by environmental standards and so far have not developed a clear plan to sort their waste healthy and environmentally.

Studied hospitals are located near residential areas, so the gases that are emitted during the burning process affect these areas because of the evaporation of toxic gases like mercury emissions, arsenic, lead, cadmium, and dioxin that cause many diseases when spread in large quantities.

More incinerators disadvantages, especially those with low temperature (less than 800 C^o) is the emission of toxic fumes and the most important and most serious is dioxin which produces when burning waste contains chlorine compounds. Dioxin is a group of compounds have harmful effects on health and some of which may be fatal even with low concentrations.

Ash resulting from burning was disposed by landfill in the soil, and this leads to contaminate the soil and groundwater

Finally, the method of treatment medical solid waste in studied hospitals by incineration is an incorrect method at the time that developed countries tend to reduce the number of incinerators and adopt other ways of dealing with waste substitute incineration and landfill.

The establishment and operation of these incinerators are considered backward in environmental management and made the sky full with hazardous gas wastes.

7. CONCLUSIONS

1-Al- Sader hospital is a more productive hospital for medical waste in comparison with other studied hospitals.

2-There was a deficit in the possibility of burning all the waste in Al- Sader and Al Zahraa hospitals, while the incinerators' capacity in Al-Hakeem hospital was enough to burn all the medical waste generated per day.

3-The generation rates of medical waste were ranged between (1.074-3.844) Kg/ bed/ day.

4-The most important factors that affect the rate of generation medical waste in studied hospitals were the number of patients and the number of surgical operations during the day.

5-Burning is a major source of different toxic pollutants which pollutes the air, the most serious is dioxin which is scientifically proven to cause cancer.

6-The burning of contaminated and hazardous waste is a primitive and highly dangerous method and scientific studies confirm and document the risks of burning waste, which indicates that the hospitals ignored the importance of applying advanced methods in dealing with medical waste.

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