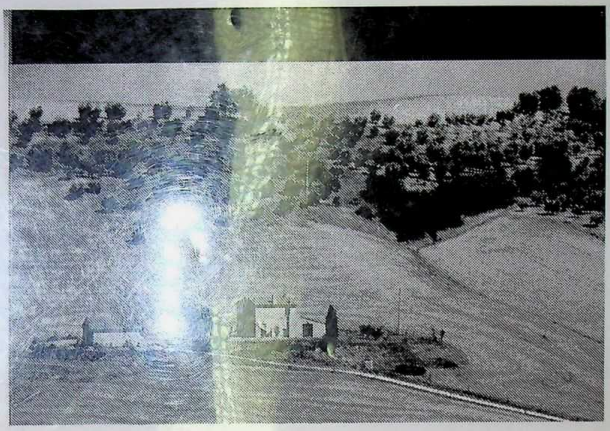

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Forward

Medical waste management is of great importance due to its infectious and hazardous nature that can cause undesirable effects on humans and the environment. The objective of this study was to analyze and evaluate the present status of medical waste management in the light of medical waste control regulations recommended by the WHO in Jenin governorate. A comprehensive field survey was conducted for three hospitals. Field visits and a questionnaire survey method were implemented to collect information regarding different medical waste management aspects, including medical waste generation, segregation and collection, storage, training and education, transportation, disposal, and safety of cleaning personnel. The results indicated that the average hazardous healthcare waste generation rate ranges from 0.54 to 1.82 kg/bed/day with a weighted average of 0.78 kg/bed /day. There was no waste segregation of various types of healthcare wastes in all hospitals.

All hospitals still use some of the unqualified staff for medical waste collection, and all of the hospitals do not have temporary storage areas. Additionally, 67.9% of cleaning personnel at the three hospitals have reported that they received training about healthcare waste handling; however, none of the hospitals have ongoing training and education. It was found that healthcare waste is finally disposed in a centralized sanitary landfill (Zahrat al Finjan) that has been constructed for domestic solid waste disposal and is not specialized for healthcare waste disposal.

The management of Medical waste in Palestine was not given the proper attention. Still there are lacks of legislation and defined policy regarding this issue. The entire Medical waste generated is dumped within general waste. The results also suggested that there is need for sustained cooperation among all key actors (government, hospitals and waste managers) in implementing a safe and reliable medical waste management strategy, not only in legislation and policy formation but also particularly in its monitoring and enforcement. This can be achieved through the cooperation between the Ministry of Health, Environmental Quality Authority, Ministry of Local Government, and Non Governmental Organizations working in related fields. Additional remediation measures are proposed to tackle the problematic areas of medical waste management in Jenin governorate hospitals by proposing some recommendations that will ensure that potential health and environmental risks of medical waste are minimized.

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Abbreviations	
AIDS	Acquired Immune Deficiency Syndrome
Atm.	Atmospheric
EQA	Environmental Quality Authority
gm	Gram
GS	Gaza Strip
HBV	hepatitis B virus
HCF	Health care facility
HIV	Human Immunodeficiency Virus
MAX	Maximum
Min	Minimum
MoH	Ministry of Health
OPD	out-patient-department
PA	Palestinian Authority
RH	relative humidity
SPSS	Statistical Package For Social Science
Tem	Temperature
WB	West Bank
WHO	World Health Organization

Chapter One
Introduction

1.1 Introductory Remarks

Hospitals are health institutions providing patient care services. It is the duty of hospitals and health care establishments to look after the public health. This may directly be through patient care or indirectly by ensuring a clean, healthy environment for their employees and the community. In the process of health care, waste is generated which usually includes sharps, human tissues or body parts and other infectious materials (Patil and Pokhrel, 2004).

Hospital is one of the complex institutions which is frequented by people from every walk of life in the society without any distinction between age, sex, race and religion. This is over and above the normal inhabitants of hospital i.e. patients and staff. All of them produce waste which is increasing in its amount and type due to advances in scientific knowledge and is creating its impact.

The hospital waste, in addition to the risk for patients and personnel who handle these wastes poses a threat to public health and environment.

Handling, segregation, mutilation, disinfection, storage, transportation and final disposal are vital steps for safe and scientific management of biomedical waste in any establishment. The key to minimization and effective management of biomedical waste is segregation (separation) and identification of the waste. The most appropriate way of identifying the categories of biomedical waste is by sorting the waste into color coded plastic bags or containers (Rao et al., 2004).

1.2 Definition of medical waste

There are many definitions suggested for medical waste (hospital waste). Medical waste is a significant concern because, in addition to containing conventional toxic pollutants like mercury, chlorinated plastics and solvents, it also includes a number of toxic materials not found in typical waste (Rao et al., 2004). 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 Histoplasma capsulatum (Al-Khatib, 2007; Jahan, 2005).

Medical waste is defined as any solid waste that is generated in the diagnosis, treatment or immunization of human beings or animals, in related research, biological production or testing (Ferraz and Afonso, 2003).

Medical waste is composed of waste that is generated or produced as a result of any of the following actions: diagnosis, production or testing of biological, accumulation of properly contained home-generated sharps waste, and removal of a regulated waste from a trauma scene by a trauma waste management practitioner (Matin, 2006). In addition, medical wastes include those wastes from animals intentionally exposed to pathogens; bulk human blood and blood products (Duan et al., 2008). Regulated medical waste shall mean any of the following waste which is generated in the diagnosis, treatment or immunization of human beings or animals, or in production and testing of biological, provided however, that regulated medical waste shall not include hazardous waste identified or listed pursuant to Section of the Environmental Conservation Law, or

any household waste promulgated under this section (Felicia et al., 2008; Al-Khatib, 2007; Al-Khatib and Khatib, 2006; WHO, 2000).

1.3 Sources of Medical Wastes

It is well known, that hospitals, clinics, nursing homes, laboratories, veterinary clinics and many more establishments have to dispose waste materials that have been generated in the process of medical care and treatment (Abdulla et al., 2008).

With the proliferation of blood born diseases, more attention being focused on the issue of infectious medical waste and its disposal, health care institutions must be aware of the potential risk in handling infectious waste, and adhere to the highest standards of disposal and transport. Education of the staff, patients and community about the management of the infectious waste is crucial in today's health care arena. With increasing awareness in general population regarding hazards of hospital waste, public interest, litigations was filed against erring officials. Some

landmark decisions to streamline hospital waste management have been made in the recent past (Mani, 2006).

1.4 Types of Medical Wastes

1) ***Pathological waste***: consists of organs, tissues, body parts or fluids such as blood. Even if pathological waste may contain healthy body parts, it has to be considered as infectious waste for precautionary reasons (WHO, 2005).
2) ***The non-hazardous waste***: includes wool, kitchen wastes, etc. that do not pose any special handling problem, hazard to health or the environment. Non-hazardous waste is generated in the patients' ward areas, out-patient-department(OPD), kitchens, offices, etc. (Kaseva and Mato, 1999).
3) ***The hazardous waste:*** Portion includes pathological, infectious, sharps and chemical wastes (specific definitions of these are given below). Hazardous wastes are normally produced in labour wards, operation theatres, laboratories, etc. (Kaseva and Mato, 1999).

4) ***Infections wastes:*** *i*s defined as waste that contains pathogens in sufficient construction or quantity that, when exposure to it, can result in diseases, e.g. waste from surgeries with *i*nfectious diseases, contaminated plastic items, etc (Kaseva and Mato, 1999).

5) ***Sharps:*** are defined as any thing that could cause a cut or puncture leading to wound. Items like needles, syringes, scalpels, knives, broken glass, etc. form part of sharp wastes (Felicia, et al. 2008).

6) ***Chemical waste:*** is substances comprise of discarded chemicals—usually from cleaning and disinfecting activities. (Kaseva and Mato, 1999).

7) ***Pressurized containers*:** consist of full or emptied containers or aerosol cans with pressurized liquids, gas or powdered materials (WHO, 2005).

8) ***Pharmaceutical waste:*** includes expired, unused, spilt and contaminated pharmaceutical products, drugs and vaccines. In this category are also included discarded items used in the handling of pharmaceuticals like bottles, vials, connecting tubing. (WHO, 2005).

9) ***Waste with high contents of heavy metals:*** and derivatives are potentially highly toxic (e.g. cadmium or mercury from thermometers or manometers). They are considered as a sub-group of chemical waste but should be treated specifically (WHO, 2005).

10) ***Highly infectious waste*** : includes microbial cultures and stocks of highly infectious agents from Medical Analysis Laboratories. They also include body fluids of patients with highly infectious diseases (WHO, 2005).

11) ***Genotoxic waste:*** derives from drugs generally used in oncology or radiotherapy units that have a high hazardous mutagenic or cytotoxic effect. Faeces, vomit or urine from patients treated with cytotoxic drugs or chemicals should be considered as genotoxic. In specialized cancer hospitals, their proper treatment or disposal raises serious safety problems (WHO, 2005).

12) ***Radioactive waste***: includes liquids, gas and solids contaminated with radionuclide whose ionizing radiations have genotoxic effects.

1.5 Health and environmental impacts of medical waste

Medical wastes constitute a larger portion of infectious wastes, which are potentially dangerous since they may contain pathogenic agents. Some of the pathogenic organisms can be dangerous, because they may be resistant to treatment and possess high pathogenicity or ability to cause disease (Abdulla et al., 2008).

In the last few decades, human activities and changes associated with lifestyles and consumption patterns have resulted in the generation of huge volumes of different types of wastes. The wastes have threatened the survival of humans and other living things, as well as all natural resources that are necessary to human existence (Oweis, et al., 2005). Improper waste management will cause environmental pollution; unpleasant smell; and growth and multiplication of insects, rodents and worms, and may lead to transmission of diseases like typhoid, cholera, and hepatitis through injuries from sharps contaminated with human blood. The management of the medical waste is an emerging issue that is magnified by lack of training, awareness, and financial resources to

support solutions. The proper collection and disposal of this waste is of great importance as it can directly and indirectly impact the health risks to both public health and the environment (Baraka et al., 2006; Abdulla, et al., 2008).

The waste generated from hospitals is now recognized as a serious problem that may have detrimental effects either on the environment or on human beings through direct or indirect contact. Some of the health impacts originating from exposure to hazardous hospital wastes include mutagenic, tetragenogenic and carcinogenic effects, respiratory damage, central nervous system effects, reproductive system damage and others (Felicia, et al.,2008).

Industrial and medical wastes constitute a larger part on what is known as 'hazardous wastes' (Chul-Jang, et al. 2006). The production of these wastes is and will continue to be an on going phenomenon as long as human civilization persists. the production of these wastes is and will continue to be an on going phenomenon as long as human civilization persists. Worldwide, the management of hazardous wastes has received much attention since the early1980s mainly due to its toxicity and

infectious nature. Although no precise definition of 'hazardous wastes' has received wide acceptance, hazardous substances are considered to be those substances harmful to the health of humans, other organisms and the environment (Kaseva and Mato, 1999).

According to WHO (2009) 80% of medical waste are benign and comparable to domestic waste while the remaining approximate of 20% is considered hazardous, as it may be infectious, toxic and/or radioactive. Infectious wastes together represent the majority of the hazardous waste (up to 15%) from health care activities. Sharp objects, genotoxic waste, heavy metals (1% each), chemicals and pharmaceuticals (3%) constitute the rest of the hazardous waste.

The major components of total plastic wastes were cafeteria plastics, sharps, medical packaging, blood bags, tubing and IV bags. The major sources of plastic wastes generated by the hospitals were facilities, laboratories, operating rooms, and cafeterias (Lee, et al. 2002).

Exposure to medical waste can result in disease or injury. According to WHO (1999), all individuals specifically the health care staff (e.g., doctors, nurses, laboratory technicians, and waste handlers), exposed to

medical waste, are potentially at risk. waste care workers handling waste containing blood-soaked objects from patients in different units in the hospitals must be protected from the transmission of hepatitis B (WHO,1985). Hospital staff were reported to frequently have an infection rate of hepatitis B three to six times higher than normal risks, (Qusus,1988).

There is strong epidemiological evidence, that the main concern of infectious hospitals waste is the transmission of AIDS\HIV viruses and, more often, of hepatitis B virus (HBV) through the injures caused by syringe needles contaminated by human blood, (WHO, 1999).

Disposal of hospital and other medical waste requires special attention since this can create major health hazards. This waste generated from the hospitals, health care centers, medical laboratories, and research centers such as discarded syringe needles, bandages, swabs, plasters, and other types of infectious waste are often disposed with the regular non-infectious waste. Skin and blood infections and eye and respiratory infections disease could spread due to the exposure to medical waste.

Different diseases that results from the bites of animals feeding on the waste. Intestinal infections that are transmitted by flies feeding on the waste. Infecting wounds resulting from contact with sharp objects (Al-Khatib, 2003).

1.6 Medical waste regulations and management in Palestine

Medical waste Management in Palestine has paid little attention to the proper handling and disposal of Medical wastes .

By the end of 1994, Palestinian authority has concentrated at the issue of Medical waste Management because the donor countries have given Palestinian authority many incinerator to be used in treating Medical waste in the West-Bank and Gaza Strip . But the lack of experiences and maintenance in the Palestine territories made the operation of this equipment insufficient and un acceptable because of the emissions of smoke and smells which affect health and the environment of the area (Al-Khatib, 2003).

In the West Bank, many hospitals are using autoclaving to treat positive bacterial cultures, blood samples, syringes or any waste produced from testing or treatment of patients who are infected by AIDS. In other hospitals, waste from isolation rooms, if available, is dealt with as general waste. Most of the waste (about 65%) is disposed of in open dumping site, 15% is disposed of by open burning, and less than 10% is incinerated. Incinerators are only available in Nablus and Jericho cities and were part of a Spanish donation to the Ministry of Local Government. The incinerator in Jericho was out of order while the one in Nablus was working with very low efficiency in such a way that waste items can still be recognized after being incinerated. The incinerator has a very low chimney and research which was carried out by Chemical Engineering Department at Al-Najah University showed that this incinerator is polluting the atmosphere and should not be used (Environment Quality Authority (EQA), 2005).

1.7 Justification of the Study

Jenin hospitals were selected to conduct the study because no studies has been conducted about medical waste management in Jenin governorate. This area is a semi-neglected in terms of research and studies. The results of this study could be a factor to rectify the situation of medical waste management, especially after the presentation of its results to the stakeholders of the officials.

1.8 The objectives of the study were:

1- To quantify the amount of medical waste generated by three hospitals in Jenin .

2- To identify the current medical waste handling practices within each hospital including (personnel).

3- To identify storage, collection, transportation, and disposal practices

4- To assess the occupation health and health care workers

5- Investigate possible health risks, especially hepatitis B, that may affect on medical waste care workers at these hospitals.

Chapter Two

Methodology

2.1 Study Area

Jenin is located in the northern part of the West Bank, at the edge of Marj Ben-Amer Plain which is considered some of the most productive land in Palestine. Jenin Governorate is considered the center of the transportation roads coming from Nablus, Al-Afula, and Bisan and a transportation point for the roads going to Haifa, Nazareth, Nebulas and Jerusalem.. The area of Jenin Governorate is 583 Square Kilometers and with Tubas governorate it becomes 985 Square Kilometers. The population of the Governorate is around 285,832 persons (Jenin JSC, 2004). Location of Jenin governorate within the West Bank is shown in Figure 1.

Climate of Jenin governorate:

The climate of Jenin governorate is governed by its position on the eastern Mediteraneanean. Winter is moderate and rainy, summer is hot and dry. Monthly distribution of meteorological conditions in Jenin governorate during the year 2007 is shown in Table 1.

Temperature:

In the summer, the temperature is moderate as a result of the influence of the Mediterranean winds that reach Jenin governorate due to the absence

of the highlands between Jenin governorate and Mediterranean sea. The average maximum temperature from June to August is 33.6 °C, the average minimum is 19.3 °C (ARIJ, 1996).

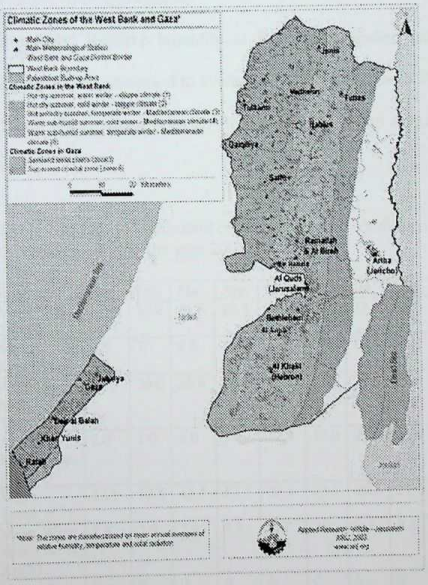

Figure 1. Location of Jenin governorate within the West Bank

Wind: wind direction above Jenin governorate is between southwest and northwest, more northerly during the summer, with daily speed about 9.2km\h (Bait Qad station).

Humidity: Relative humidity at Bait Qad weather station is 67.2% during winter, increased to average of 84% and drops to 39% on average during (Khamaseen period). In summer, the mean annual humidity is 63.7%.

Table 1. Monthly distribution of meteorological conditions in Jenin Governorate during the year 2007*

Element	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Mean Max Temp.	17.4	18.2	21.6	28.3	31.0	32.9	33.6	34.2	32.2	30.6	25.0	18.8
Mean Min.Temp.	6.8	7.1	8.6	11.2	14.0	17.3	19.6	21.1	19.8	16.1	11.8	8.7
Absolute Max. Temp.(C°)	25.0	26.0	26.8	38.6	40.4	37.6	37.0	35.8	37.0	39.0	29.0	25.4
Absolute Min. Temp. (C°)	2.0	1.0	5.0	3.4	12.8	17.0	21.4	21.0	17.8	11.0	11.0	6.0
Mean Temp. (C°)	12.1	12.6	15.1	19.7	22.5	25.1	26.6	27.6	26.5	23.3	18.4	13.7
Mean Wind Speed (Km/h)	7.5	7.9	7.9	7.9	9.0	9.4	9.7	8.6	7.2	5.4	6.1	7.5
Mean Atm. Pressure (mbar)	0	0	0	0	0	0	0	0	0	0	0	0

Mean Sunshine Duration (h/ day	5.4	5.6	6.8	7.8	9.7	11.3	11.1	10.0	9.1	8.1	6.8	5.4
Mean RH %	80	84	76	67	60	63	63	65	64	55	66	74
Total Rainfall (mm)	20.8	23.2	18.8	3.2	0	0	0	0	0	0	36.7	17.5
Total Evaporation (mm)	0	0	0	0	0	0	0	0	0	0	0	0

(Palestinian Central Bureau of Statistics, 2007).

(Max = maximum, Min=minimum, Tem. = temperature, Atm. = atmospheric, RH= relative humidity,

Precipitation: The mean annual rain-fall in Jenin governorate is 528mm. The rainy season in Jenin governorate starts in the middle of October to the end of April (ARIJ 1996).

2.2 Field work and data collection

This study was carried out in both governmental and private hospitals in Jenin governorate during 2008-2009 and was dependant on different methods for data collection. Table 2 shows some of the characteristics of Jenin city hospitals. Data were collected through field observations, interviews, and questionnaire survey during April-May 2009.

A questionnaire has been developed for collecting data about cleaning personnel working in Jenin hospitals. The questionnaire aimed at gathering information about the generation, segregation, collection, internal and external storage, transportation, treatment and disposal of medical waste, and also focusing on general cleaning in Jenin hospitals. The number of Jenin hospitals is three, one of them is governmental and the other two are private. Data has been collected from 30 worker distributed between governmental and private hospitals through site visits.

The questionnaire consisting of five parts for focusing and gathering information mainly at several issues as generation of medical waste, collection, internal and external storage, transportation, treatment and disposal of medical waste, safety of the workers and also focusing on general cleaning in Jenin hospitals. The key persons, the cleaners and sanitary workers were personally interviewed during April-May 2009 in order to gather additional information about the current practices in the medical waste management in Jenin hospitals.

Table 2. Characteristics of Jenin city hospitals (2009).

Characteristics of hospital	Hospital		
	Dr Khalil	Al-Razi	Al- Amal
Number of beds	129	38	14
Number of employees	295	125	39
Departments			
Surgery	A*	A	A
Pediatrics	A	NA**	NA
Male	A	A	NA
Female	A	A	NA
Emergency	A	A	NA
Neonates	A	NA	NA
Intensive care unit	A	A	NA
Kidney dialysis	A	NA	NA
Maternity	A	A	A
Orthopedic	A	NA	NA
Support departments and units			
Pharmacy; Laundry; Physiotherapy; X- ray unit; Laboratory; Maintenance; Kitchen	A	A	A

*available ** not available

Analysis of data was performed by the use of Statistical Package for Social Science (SPSS).Descriptive statistics such as means and % were computed.

2.3 Solid medical waste generation and characterization

Experimental and field work in which separation and segregation of medical waste generated in the targeted studied private and governmental hospitals were conducted. The samples taken from the three hospitals were tested for determination of waste components in accordance to the classification shown in Table 3. The method used for the separation of medical waste was by sorting using a special table metal as shown in figure 2. The main objective of experimental work was to measure and characterize the medical waste generated in Jenin hospitals. In order to obtain exact quantities of medical and general waste, two different size waste collection baskets have been distributed in each department of hospitals.

Table 3. Type and classification of medical waste

Waste category	Components
Tissue and pathological waste	Tissues of humans or animal pathological waste. including tissues, organs, blood, pus, body parts and fluids that are removing during infectious agents from test or examination, culture dishes, Discarded blood fluids and containers
Absorbent cotton Items	Cotton, pads, bandages, disposal diapers, or bedding) saturated or stained with human or animal blood, pus, discharge or secretion
Discarded medical plastic	Disposal syringe, IV bag, blood bag or waste taken from blood dialysis, or other plastic components
Waste sharps	Discarded sharps, hypodermic needles, syringes surgical blades and blood lancets
Waste mixed with infectious waste	Wastes that are not classified into the above categories but mixed or in contact with them

(Chul-Jang et al., 2006)

In each basket bags with different colors were used : the yellow bags specified for medical waste and the black bag for general waste, the empty weight of each basket has been recorded before collection. Also,

special boxes for sharp waste were distributed in each department of hospitals as shown in figure 3. Special sheets for recording weight of medical waste were prepared. In these sheets, the general and medical waste was divided into six and five subdivisions respectively (according to the classification of general and medical waste which includes sharp waste).

Data was collected day after day from three hospitals with total of 15 days.

Special arrangement with the workers in the target hospitals have been made at the beginning of each 5 days of weighing so as not to dispose any solid waste without being weighed.

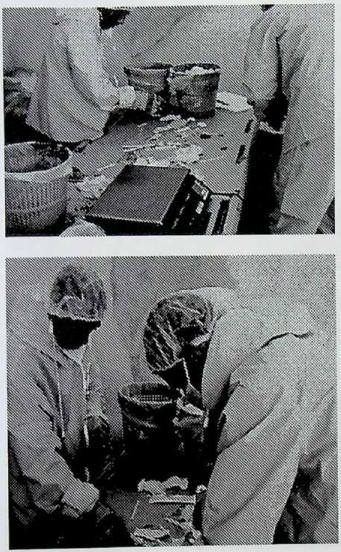

Figure 2. Workers during separation of medical waste

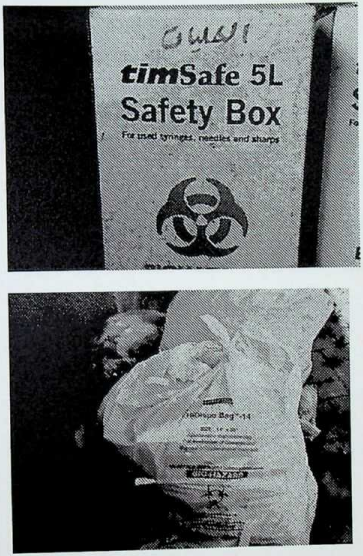

Figure 3. Materials used in the experimental study

The method followed in the measurement of medical waste samples was as follows:

1) Determination of the weight of empty baskets and boxes

- Baskets empty weight (235 gr.)
- Sharp boxes empty weight (280 gr.)

2.) Determination of gross weight of each sample waste using the weighing balance (digital balance) from (1 gr.-5 kg).

3.) Picking the waste on the screen table for sorting operation so as to remove the selected materials and empty them in plastic baskets for each type:

- Tissue and pathological waste
- Absorbent cotton
- Discarded medical plastics
- Waste sharps
- Waste mixed with infectious waste

1. Determination of the weight of each type.
2. Determination of the percentage of each type in the sample.
3. Repeating this procedure in each shift.

4. The procedure was followed by the measurement of sample of waste on different sampling days and different waste sources during the whole study period and the waste generation rates were computed.

Other facilities were used in segregations and sorting the wastes, gloves, facemasks and special clothes for personal protection. Labels with biohazard's wastes sign were used for each box and bag.

2.4 Blood sample collection

Blood samples were obtained from all cleaning personnel working at the three hospitals and tested for hepatitis B. The blood samples were taken using disposable sterile syringes. The blood was left to clot at room temperature, and then centrifuged at 3000 rpm for five minutes. Serum was aspirated and four aliquots of each sample were transferred into screw capped tubes and stored at –30 °C.

Chapter Three
Results and Discussion

3.1 Some selected features for sanitation workers

Table 4 shows the social characteristics of the cleaning workers shows in figures and ratios, that most cleaners 11(40.7%) have the preparatory educational level . The number of workers who have got the general secondary certificate was 10 (37 %). This is an indication of the lack of employment opportunities because of the closure on the Palestinian Authority areas, thus depriving large numbers of people to work in other areas. On the other hand, this is an indication that number of school years that cleaning workers have finished is considered acceptable . This will be helpful in training them and in educating them how to deal with medical waste. This is of course, if a good program has been adopted for this purpose.

As for the social situation of the work of cleaning, it is found – through this study- that 16 (57.1%) of the employees are married . This indicates that married people prefer this profession because of the need to spend on their families.

For workers ages, most (70%) are between the ages of (20-39) years and this age is the period of carrying the burden of responsibility for men

where the need for urgent action in order to provide a decent livelihood for their families. As most of ages are considered in the youth category, this will make it easy to train them on how to deal with medical waste. It is known that as the worker get older and exceeds the youth age, it will be more difficult to train him.

For the working period at hospital, it is noted that 14 (50%) have been working in hospital for a period 1-3 years. The number of workers who had been in work for less than one year is only 4 (14.3%). This is a positive indicator that the worker may last in this job for longer period. This may be due to the lack of job opportunities because of the economical conditions and the Israeli closures. On the other hand investment in the training of these workers will be useful as it is expected they will stay in their job for reasonable period. Also it will be very helpful to keep the trained workers by giving them good work atmosphere and conditions. The danger that the worker may be subjected to when dealing with medical waste will decrease as the experience of the worker increases.

Table 4. Socioeconomic characteristics of hospitals' cleaning personnel surveyed (numbers and valid percentages), in three hospitals for Jenin Governorate in 2009 .

Independent Group	Number of respondents (percentage in parentheses)					Total
Level of Education	Elementary	Preparatory	Secondary			27 (100%)
	6 (22.2)	11 (40.7)	10 (37.0)			
Marital Status	Married	Single	Divorced			28(100%)
	16 (57.1)	9 (32.1)	3 (10.7)			
Age	20-29	30-39	40-49	>50		30 (100%)
	9 (30.0)	12 (40.0)	5 (16.7)	4 (13.3)		
Monthly income NIS	500-999	1000-1499	1500-1999	2000 and more		27 (100%)
	9 (33.3)	10 (37.0)	7 (25.9)	1 (3.7)		
Gender	Male		Female			30 (100%)
	18 (60.0)		12 (40.0)			
Working period at hospitals (years)	< 1		1-3	4-7	>7	28 (100%)
	4 (14.3)		14 (50.0)	5 (17.9)	5 (17.9)	

3.2. Medical Waste Management

3.2.1 Separation of medical waste

Table 5 which is related to separation of waste indicates that 72.4% of the respondents indicated that waste is separated and classified prior to disposal; while 27.6% answered that the waste is not separated before

disposal. This confirms an important fact, that is in sometimes medical waste is not separated from ordinary waste. The existing situation should be reconsidered so as to reach to the full separation of medical waste from ordinary waste. By this we can decrease the probability of infection and transfer of some disease to the cleaning workers while dealing with medical waste.

With respect to the body that is in charge of the process of waste separation, 31.8% of the respondents indicated that medical staff is carrying on the process of separation; while 13.6% indicated that they did not know who carry on the process of separation.

With respect to the item on the location of separation; 71.4% indicated that the separation takes place at the beginning and near the source of waste, while 4.8% indicated that the process of waste separation is in the waste storage at the hospital.

According to the Environment Quality Authority (EQA) (2005) the results of a survey conducted in the HCFs in the West Bank and Gaza

Strip, it was found that only one third of the HCFs in Gaza Strip, have special bags in use for HCW collection; all other facilities consequently collecting all types of HCW together with domestic waste. Sharp items in particular are being collected in special boxes (and sometimes special plastic bottles) as a result of the WHO donating a certain number of boxes; but again this is happening in only a limited number (38%) of HCF. Color coding of HCW according to its type is recognized as being a useful tool, although only 5% of HCF to currently have system for color coding. Even the labeling system for the containers does not exist according the results of the questionnaire. A fundamental issue that was highlighted by more than half of those interviewed was that there are frequently insufficient waste containers to handle the volume of healthcare waste that is generated. Only one quarter of HCFs questioned has some sort of separation of HCW at the point of generation and there are no special carts or special routes to transport waste. The majority of HCFs have no storage rooms for the waste. More than 80% of facilities in GS have no kind of secure storage for HCW. The waste bags are piled in the toilets or sometimes in the kitchens, which is aesthetically not

accepted and can be considered as a serious hygienic problem (EQA, 2005).

In the West Bank, the survey results showed that there is no segregation of waste except for sharps. Two thirds of HCFs have acceptable sharp boxes (sometimes plastic bottles). Less than fifty percent segregate other types of waste like waste generated in operating theatres and labs which includes infectious and pathological waste. Only 7.6% of the facilities use color coding (they use red or yellow bags for infectious waste). One third of HCFs lacks proper onsite storage containers. It is very common that all healthcare waste is mixed with the general waste in open baskets that are lined with very thin plastic bags. The bags are not strong enough and in many cases can be easily punctured allowing leakage and spillage to occur. Labeling of containers is not used and there is no way to distinguish between waste coming from the kitchens or that from the laboratories (EQA, 2005).

In most hospitals in WB, there are no special carts or special routes to transport the waste. The corridors and the passengers' elevators are used. Hence, patients, workers and visitors could be subjected to health risks. Twenty five percent of the hospitals have no storage facilities and use the same containers which are located in the streets dedicated for municipal waste. Most of these containers have no protection against animals (EQA, 2005).

There is no mechanism established to separate the waste from one another, whether within the wards or whether, after collection in a special assembly in the container outside the hospital building. Also, there is no specially allocated medical waste container, which should be marked in particular mark that shows the existence of medical waste. It was also observed that workers in private hospitals transfer ordinary and medical waste manually from inside hospital to the container located on the main road outside the hospitals due to the lack of special vehicles for the transfer of such waste.

Table 5. Overall hospitals' cleaning personnel response to the survey questions regarding waste segregation (n=30)

Question	Answer	Valid Percent of respondents (%)
Are medical waste segregated?	Yes	72.4
	No	27.6
	Total	100.0
Who segregate medical wastes?	Cleaning workers	27.3
	Medical staff	31.8
	Cleaning workers and medical staff	27.3
	Don't know	13.6
	Total	100.0
Where segregation takes place?	At the beginning near the source	71.4
	After waste is collected	23.8
	At the waste storage place in the hospital	4.8
	Total	100.0

3.2.2. Containers and bags to collect waste

Table 6 is related to the containers and bags for waste. In regards whether the wastes containers or bags are defined and distinguished; it is

noted that 36.7 % indicated that it is defined and distinguished, while 63.3 % indicated that it is not defined or distinguished.

With regard to the possibility of rupture of waste sacks, it is noted that 36.7% of respondents indicated that this occurs sometimes, while 23.3% indicated that rupture takes place rarely. The rupture of sacks is considered dangerous on the safety of the cleaning workers. This is an indication that the sacks used are of low thickness so it will be more probable to be subjected to tear and rupture.

With regard transfer of waste bags from place to another easily, 96.6% answered yes always, while 3.4% indicated no. This is good indicator as transferring waste easily will decrease the possibility of drop of the waste and thus polluting the place around and thus decreasing some of health problems of the workers.

With respect to the item on the tightness of the closure of the medical bags, 96.7% answered yes always, while 3.3% answered no.

The item on the procedures implemented to prevent the leakage of fluid from the bags 96.7% indicated yes, and 3.3% answered always no.

Wastes are disposed in ordinary waste containers, except for disposal of sharp instruments which are collected and after that it is also transported into municipality vehicles. There, they are pressed and transferred to the sanitary landfill "Zahrat Al Finjan". For the truncated human parts, and embryos resulting from abortions, they are dealt with through legal religious ways, where they are delivered to their owners to be buried.

From observations during field work, it should also be addressed that hazardous waste and waste resulting from the high-risk laboratory dishes at the three hospitals, such as incubation dishes or blood samples are treated using a sterile heat until it is sterilized at a certain temperature to get rid of remaining bacteria and to be disposed of with regular and medical waste. Generally speaking, in all hospitals in the West Bank, autoclaving is used to treat positive bacterial cultures, blood samples, syringes or any waste produced from testing or treatment of patients who are infected by AIDS which is generated in operating theatres and labs .The liquid waste, which contains pathogens, blood and hazardous

chemicals, about 92% of it is disposed of in the public sewer system. It is likely that the remaining part is disposed of together with solid waste (Environmental Quality Authority, 2005).

The nursing staff and other medical personnel should ensure that waste bags are closed tightly when these bags are filled up to two third. Light bags can be closed at the neck of the bag by linking, but heavy bags, must be closed by a plastic tape, and must not close the bags using metal clamps.

The tools container which is closed tightly should not be put in the bag of infectious health care waste which has the yellow card pre-transfer from the hospital ward or department. It must not be allowed the accumulation of waste at the point of production. A routine program must be developed for the collection as part of a plan of health care waste management.

Table 6. Overall hospitals' cleaning personnel response to the survey questions regarding containers and waste sacks (n=30)

Question	Answer	Valid percentage of respondents (%)
Are containers identified and distinguished?	Yes	36.7
	No	63.3
	Total	100.0
Are waste sacks subjected to tear?	Yes always	3.3
	Sometimes	36.7
	Rarely	23.3
	No	36.7
	Total	100.0
Are waste sacks transferred from place to place easily?	Yes always	96.6
	No	3.4
	Total	100.0
Are waste sacks fastened properly?	Yes always	96.7
	No	3.3
	Total	100.0
Are provisional measures carried out to prohibit liquids running out from waste?	Yes always	96.7
	No	3.3
	Total	100.0

3.2.3 Waste storage inside and outside hospital

There are no places for the storage of waste, whether ordinary or medical, but wastes are transferred from within the department or the hospital to the container in the vicinity of these hospitals by vehicles devoted for the transfer of waste (ordinary and medical). This is clear from the study that shows 40% of the cleaning workers said that the

medical waste is transferred using the ordinary waste sacks. The other 40% said that waste is transferred using special vessels, as shown in Table 7. The other 20% indicated that needles are stored in special vessels. This is an indication that there is no special place for storing the medical waste in the hospital. It is usually put in a corner till transferring to the outside container. This is also clear from the answers of the workers on whether the storage area inside the hospital is enough. As 50% said they do not know,16.7% yes it is enough, while 33.3% said it is not enough.

20% of the workers mentioned that the storage area is not closed properly, and 40% of them answered yes always and 40% said they do not know. In addition, 42.9% of them answered that the storage area inside hospital is protected well, 28.6% indicated that is was not and 28.6% indicated they do not know.

The other point of interests is that 66.7% of the cleaning workers said there is no special mark distinguishing ordinary waste from the hazardous health waste. It is worth to note that it is not allowed to

transfer ordinary and medical waste together in the same vehicle, but it is supposed to allocate vehicle for each of the medical waste and ordinary waste.

According to WHO regulations, the storage of waste within the hospital should not exceed 72 hours in winter, 48 hours and summer (in cold areas). But, in the hot areas, storage should not exceed 48 hours in winter and 24 summer hours (WHO, 2005)

Comparing the transferring and storing conditions of the medical waste with the WHO regulations, it is clear that there is a great gab. This gab must be decreased to minimum to ensure the safety of the workers, staff, patients and visitors of the hospitals.

Table 7. Overall hospitals' cleaning personnel response to the survey questions regarding medical waste storage (n=30)

Question	Answer	Valid percentage of respondents (%)
Where is medical waste stored in the hospital?	Waste sacks	40.0
	Special vessels	40.0
	Needles are stored in closed place	20.0
	Total	100.0
Is there a specific mark showing the storage area of medical waste?	Yes	22.2
	No	66.7
	don't know	11.1
	Total	100.0
Is storage area sufficient inside hospital?	Yes	16.7
	No	33.3
	don't know	50.0
	Total	100.0
Is the storage area closed properly?	Yes always	40.0
	No	20.0
	don't know	40.0
	Total	100.0
Is the storage area protected well?	Yes	42.9
	No	28.6
	don't know	28.6
	Total	100.0
Where is medical waste stored outside hospital?	container	100.0
	Total	100.0
Is there specific mark	Yes	10.7
	No	78.6

showing the storage area of medical waste outside hospital?	don't know	10.7
	Total	100.0
Is storage area sufficient outside hospital?	Yes	13.8
	No	79.3
	don't know	6.9
	Total	100.0
What is the storage period in days?	1	100.0
	Total	100.0
Is the storage area outside hospital closed properly?	Yes always	3.3
	No	80.0
	don't know	16.7
	Total	100.0
Is the storage area outside hospital protected well?	Yes	10.3
	No	79.3
	don't know	10.3
	Total	100.0

And as said before, the medical waste is collected put into the containers of the municipality without any separation from the ordinary waste. As appears from the answers there is no specific mark showing the storage area of medical waste outside hospital (78.6%). The storage area is insufficient outside hospital (79.3%). All said that the storage period is one day, and this means that the municipality truck takes the waste every day. The fear here is that the storage area outside the hospital is not protected well (79.3%). This will increase the risk of someone or animal playing with these wastes and thus carrying the infection.

3.2.4 Sharp Boxes

From Table 8 it is clear that there is no medical waste burning inside hospital as 94.1%indicated that and the other 5.9% said they do not know. Most of the respondents (89.3%) said that vessels used to discard needles are not vulnerable to punching. This is a positive indicator as risk on workers safety will decrease. On the other hand, 28.6% said that these vessels are not difficult to open while 64.3% answered yes it's difficult to open, and this is a good indicator for the health protection of both employee and waste pickers.

In addition there is a risk of being open by someone may cause a serious danger. The most serious and dangerous point is that there is no specific mark indicating the contents of the sharp box (80%) no while 6.7% said they do not know and 13.3%answered yes. This is a real danger and there must be a system of providing distinguishing marks for these boxes.

Table 8. Overall hospitals' cleaning personnel response to the survey questions regarding medical waste sharp box (n=30)		
Question	**Answer**	**Valid percentage of respondents (%)**
Is waste burned in hospital?	No	94.1
	Don't know	5.9
	Total	100.0
Is the containers used to discard needles vulnerable to punching?	Yes	7.1
	No	89.3
	Don't know	3.6
	Total	100.0
Is the containers used to discard needles difficult to open?	Yes	64.3
	No	28.6
	Don't know	7.1
	Total	100.0
Are there specific marks indicating waste type inside hospital?	Yes	13.3
	No	80.0
	Don't know	6.7
	Total	100.0

3.2.5 Transport of waste inside the hospital

Table 9 which is related to the presence of the means for the transfer of medical waste indicates that 43.3% indicated the absence of any means, 40% indicated the presence of common means, while 16.7% indicated the presence of special means to do so.

The item related to the control of the means of transport of medical waste showed that 65.0% answered they easily control the transport mean while a rate of 5.0% answered no.

Item on the presence of some person to clean transport mean, where 62.5% indicated the presence of the cleans, and 18.75% they do not know and 18.75% without.

The item on who is in charge of the transfer mean where 92.9% indicated that they are the workers themselves, while 7.1% indicated that specialized workers do so. The item on the smoothness touch of the means of transport of medical waste indicated that 80.0% indicated it is smooth, while 6.7% said it is not smooth.

Item on the permeability of liquids of transport mean indicated that 92.3% said it is not permeable, while 7.7% answered it is permeable.

In regard to transportation of medical waste and whether the vehicle is devoted to one ward or different wards, 78.6% indicated that it is devoted for different wards, while 14.3% indicated it is devoted for a specific ward and 7.1% answered they do not know.

The transfer of health-care waste sites must be within the hospital by wheeled vehicles or by other vehicles or containers fitted with hand wheels that are not used for any other purpose. The transfer mean must meet the following standards:

1. Easy loading and unloading.

2. The absence of sharp edges that can cause severe damage to the waste bags or containers during loading and unloading.

3. Easy cleaning and must be clean and sterilized every day using the appropriate purgatory. All bags must be closed tightly and must be sound at the end of transport operations (WHO, 2005)

Table 9. Overall hospitals' cleaning personnel response to the survey questions regarding medical waste transport method (n=30)

Question	Answer	Valid percentage of respondents (%)
Is there any mean for transferring medical waste?	Yes special mean	16.7
	Yes common mean	40.0
	No mean	43.3
	Total	100.0
Do you feel it is easy to control the transfer mean?	Yes	65.0
	No	5.0
	Not applicable	30.0
	Total	100.0
Does anyone clean the transferring mean?	Yes	62.5
	No	18.75
	don't know	18.75
	Total	100.0
Who is in charge of the waste transferring mean?	Special worker	7.1
	Workers	92.9
	Total	100.0
Is the waste transferring mean surface smooth?	Yes	80.0
	No	6.7
	Don't know	13.3
	Total	100.0
Is the waste transferring mean permeable to liquids?	Yes	7.7
	No	92.3
	Total	100.0
Is the transferring mean devoted to one ward or to different wards?	Specific ward	14.3
	Different wards	78.6
	Don't know	7.1
	Total	100.0

3.2.6 Transport of waste outside the hospital and its treatment

According to the Environmental Quality Authority (2005), segregation and management of HCW inside HCFs will remain the responsibility of the HCF itself, under the supervision of the MoH. Once the HCW leaves the HCF, it will be the responsibility of the municipalities to collect and transport the HCW to its final destination. Disposal of HCW in landfill sites will be the responsibility of the municipalities. Treatment facilities (incinerators, autoclaves, etc) will be the responsibility of the operator in each case (could be a HCF under the supervision of MoH, could be a municipality). However, overall regulatory responsibility will lie with the EQA, with technical assistance from the MoH, where necessary.

The process of the transfer of waste collected in containers after a initial collection is regular; where the waste is transferred within a specific itinerary by municipal trucks. Municipality has four waste transport trucks- as each truck is responsible for the transfer of waste from a certain area. Then the waste is deported to "Zahrat Al Finjan" sanitary

landfill specified for municipal general waste by the collecting truck itself, without storing in a transition station.

In respect to the transfer of medical waste from hospitals, they are mixed with regular waste, without any classification or treatment of such waste, whether hazardous or infectious as well as the sharp tools that combine. It is transferred by the same compactor truck; it mixes with the rest of the regular and medical waste.

The amount of municipal waste produced within the Jenin area is estimated between 40 to 50 tons per day. The truck capacity is approximately 10 tons of waste after compaction.

As for municipal workers, they are followed-up and monitored by the Director of the Health Section in the municipality of Jenin. He supervises the procedures and regulations for their safety in terms of taking the necessary precautions, wearing gloves, precaution towel to the legs, and the helmets cover, in addition to blood tests. Blood tests include the examination of Hepatitis B in order to avoid their infection resulting from exposure to stings administered within the waste.

There is no special treatment to get rid of sharp tools, or hazardous waste or infectious waste. This is because of the absence of any treatment facility to eliminate the negative effects resulting from this waste. What happens is the transfer of all such waste to the Zahrat al-Finjan sanitary landfill, where it is buried with all of these residues together without any treatment. Zahrat al-Finjan sanitary landfill has fences, but it does not prevent access by stray animals; burying of the hazardous waste mixed with domestic waste in spite of the fact that it was established for domestic waste only and not for hazardous healthcare waste.

Due to the current financial difficulties, all healthcare facilities in Jenin city can merge with each other in order to overcome their financial problems. Therefore, they can find some cost-effective treatment or disposal means of their wastes. Palestinian cities such as Nablus have lots of well trained technicians and entrepreneurs that most of them own small workshops and are able to manufacture highly sophisticated equipments. Some of these entrepreneurs have an engineering background and others had their training while working at the Israeli

industries. While searching through these workshops it was noticed that some of them have the capability of producing an outstanding quality autoclave with much lower cost than those produced in Israel or abroad (Al-Khatib et al., 2009). Such technology could be used for the treatment of healthcare waste generated from healthcare facilities in Jenin governorate.

3.2.7 Hygiene and sanitation

Hygiene and sanitation in hospitals are important items that help in proper healthcare waste management. Table 10 which is related to the item on the cut off of the water during the past two years indicates that 41.4% answered yes and 41.4% answered no, while 17.2% did not answer as they do not know. This indicates the possibility of interruption of the water and the spread of dirt and waste and disease. As the presence of water is important for cleaning the carts and storage facilities and other equipment used in medical waste management.

For the item on the cleanliness of the toilets in hospitals, 50.0% answered that toilets are not clean and 46.7% said always clean, while a 3.3%

sometimes- this indicates the toilets are not clean sometimes. This will increase the risk of infection of workers in addition to other staff and patients and visitors.

For the item on the causes of dirtiness of the toilets, 37.5% answered that the patients are the reason for the toilets to be dirty, 31.3 percent answered that visitors are the reason, 6.2% said it is because of misuse, and 6.2% answered workers are the reason. There must be a monitoring system to ensure the toilets are clean all the time. In addition to install guide boards that pay attention of the staff, patients, and visitors to keep all sections including toilets clean.

The task of cleaning is essential to reduce the risks resulting from the circulation of health-care waste, and must provide adequate washing and hygiene and with warm water and soap for the workers associated with this task. The particular importance of these services appears in the areas of storage and incineration.

As waste management is a complementary part of health care for the cleanliness of the hospital and infection control. The health-care waste must be viewed as repository of pathogenic micro-organisms, which can

cause pollution and infection. If the management of waste was done inappropriately, these microbial organisms can be transmitted by direct contact, in air or by various insect vectors. The infectious waste contributes -in this way- in the risk of infection for hospital workers and patients and putting them at risk.

Table 10. Overall hospitals' cleaning personnel response to the survey questions regarding water and sanitation in the hospitals (n=30)

Question	Answer	Valid percentage of respondents (%)
Has the water been cut off during the last two years?	Yes	41.4
	No	41.4
	Don't know	17.2
	Total	100.0
Do you feel that toilet inside hospital are clean?	Yes always	46.7
	Sometimes	3.3
	No	50.0
	Total	100.0
What are the reasons for the dirtiness of toilets?	Visitors	31.3
	Citizens	12.5
	Patients	37.5
	Companion	6.3
	Misusing	6.2
	Workers	6.2
	Total	100.0

3.2.8 Training

Table 11 related to the training of cleaning workers. It shows that 67.9% answered they receive training, while 32.1% answered that they do not receive training.

For the period of training, the Table shows that 33.3% receive training for duration of 1-3 days, and 6.7% for one-year.

The item on the training of new staff shows that 70.0% said that new staff is trained; while 30.0% answered that they are not trained.

The above figures and percentages show that training is not given that importance. It is worth to say that the hours spent in training will reduce the potential of infection.

Training must be in the field of health and safety of workers and their understanding of the potential risks associated with health-care waste, also it must include appropriate training for workers and the provision of equipment and protective clothing and the development of effective occupational health program.

A comprehensive risk assessment of all activities associated with the management of waste during the preparation of health care waste

management plan will allow the identification of the protection measures necessary: We must establish such procedures to prevent exposure to hazardous substances or other risk or at least make the

exposure within safe limits.

The type of protective clothing depends on the size of the risks associated with health-care waste. However, we must work to provide the following equipment and supplies for all persons who collect or handle health care waste.

Table 11. Overall hospitals' cleaning personnel response to the survey questions regarding training (n=30)

Question	Answer	Percentage of respondents (%)
Have you been trained?	Yes	67.9
	No	32.1
What was the training period	1-3 days	33.3
	5-7 days	33.3
	1 month	20.0
	1 year	6.7
	3 months	6.7
	Total	100.0
Are new workers trained?	Yes	70.0
	No	30.0
	Total	100.0

There is a statically significant relationship between the hospital and training of workers (p-value = 0.000) as shown in Table 12. It can be noticed that the workers in Dr. Khalil hospital have received training more than other two hospitals.

Table 12. Cross tabulation between hospital and training of workers				
Have you been trained?	Hospital			
	Al Amal	Al Razi	Dr Khalil	Total
Yes	1 14.3%	5 62.5%	13 100.0%	19 67.9%
No	6 85.7%	3 37.5%	0 .0%	9 32.1%
Total	7 100.0%	8 100.0%	13 100.0%	28 100.0%

(Chi-Square=15.474, p-value= 0.000)

From the cross-tabulation between hospital and training of new workers, it is found that there is a statistically significant relationship between them (p-value = 0. 049) as shown in Table 13. It seems that new workers receive training at Dr. Khalil governmental hospital more than the other two hospitals.

Table 13. Cross-tabulation between hospital and training of new workers				
Are new workers trained?	Hospital			
	Al Amal	Al Razi	Dr Khalil	Total
yes	3 42.9%	6 60.0%	12 92.3%	21 70.0%
No	4 57.1%	4 40.0%	1 7.7%	9 30.0%
Total	7 100.0%	10 100.0%	13 100.0%	30 100.0%

(Chi-Square=6.013, p-value= 0. 049)

3.2.9 The occupational safety of cleaning workers

In the item relating to the disposal of gloves weather with medical waste or not, 46.7% get rid of them with ordinary waste and 13.3% with medical waste.

Item on pressing on the bags of medical waste by the hand of cleaning workers indicates that 83.3% do not make any pressure on the waste to press it and 6.7% use their hand sometimes to press the waste.

Table 12 related to the occupational safety of cleaning workers. Item on the gloves wearing for cleaning workers indicates that 90.0% always wear the gloves. Those who answered sometimes were 6.7%, and 3.3 % rarely wear these gloves. This is not a small percent as one accident may cause infection of the worker. Those who use the gloves more than one time were 3.3% as rarely and 3.3% as sometimes. Then they get rid of these gloves with ordinary waste 46.7%, while 13.3% with medical waste and the rest (40%) sometimes with medical waste and sometimes with ordinary waste.

For the item on wearing special clothes when working indicated that 80.0% always wear special clothes, while 3.3% wear sometimes special

clothes and 16.7% they do not wear special clothes. These figures show how much the underestimation of the medical waste hazard in these hospitals are.

Item on weather special clothes can prevent the needles from penetrating the clothes of the workers in the hospital, indicated that 93.3% answered it cannot prevent needle from penetrating the cloth, and 6.7% answered it can prevent needles penetrating cloth.

The most fearing percent was on whether the worker has been exposed to needles after wearing the special clothes. It was found that 46.7% have been subjected to needles after wearing these clothes, while 53.3% have not been exposed to that.

Item on the extent of exposure to wounds from sources other than needles indicated that 70.0% have not been exposed to that, while 30% have been exposed.

The satisfaction of the worker will make him enthusiastic to do his work perfectly. The good relationship between the employer and the employee has significant role in performing the worker to his tasks. The psychological

relaxation of the employee will push him for more faith and accuracy in his work.

Item on weather the employer take care of the workers indicated that 83.3% said that the employer takes care of them, while 3.3% answered no. The other 13.3% said that the employer sometimes take care of them.

Item about testing the worker before employment indicated that 58.6 percent have been tested while 41.4% have not been tested.

Item about testing workers after employment indicated that 56.7 percent said yes and 43.3 said no.

It is clear that there is no system of testing all cleaning workers before and after employment. From that the company responsible for the workers can change them at any time without testing them. This is a clear shortage of the existing system.

Item on getting vaccinations to prevent certain diseases, indicated that 56.7 percent said they have got it, while and 43.3% said they have not got it.

Item on the conviction with the work indicated that 53.3% are satisfied too much, and 20% are satisfied moderately.

Table 14. Overall hospitals' cleaning personnel response to the survey questions regarding safety measures of cleaners (n=30)

Question	Answer	Percentage of respondents (%)
Do you wear cloves?	Yes always	90.0
	Sometimes	6.7
	Rarely	3.3
	Total	100.0
Do you use same gloves more than once?	Sometimes	3.3
	Rarely	3.3
	No	93.3
	Total	100.0
Where do you get rid of gloves?	With medical waste	13.3
	With ordinary waste	46.7
	With medical and Ordinary waste	40.0
	Total	100.0
Do you put your hand in the medical waste to press it or for any other reason?	Sometimes	6.7
	Rarely	10.0
	No	83.3
	Total	100.0
Do you wear special clothes during work?	Yes always	80.0
	Sometimes	3.3
	No	16.7
	Total	100.0
Are the special clothes you wear preventive so needles cannot penetrate?	Yes preventive	6.7
	Non preventive	93.3
	Total	100.0
Have you been subjected to needles after wearing these clothes?	Yes	46.7
	No	53.3
	Total	100.0
Have you been exposed to injury other than needles	Yes	30.0
	No	70.0

during work?	Total	100.0
Does your employee take care of your health?	Yes always	83.3
	Sometimes	13.3
	No	3.3
	Total	100.0
Have you been tested before you were employed?	Yes	58.6
	No	41.4
	Total	100.0
Have you been tested after you were employed?	Yes	56.7
	No	43.3
	Total	100.0
Have you been give vaccination to prevent specific diseases?	Yes	56.7
	No	43.3
	Total	100.0
Are you satisfied about your work?	Very much	53.3
	Yes	26.7
	Moderately	20.0
	Total	100.0

There is a statically significant relationship between hospital and workers' wear of special clothes during work (p-value = 0.028). It can be concluded that workers at al Razi hospital admit to wearing special clothes during work more than Al Amal and Dr. Khalil hospitals as shown in Table 15.

Table 15. Cross tabulation between hospital and workers' wear of special clothes during work (number and percent).

Do you wear special clothes during work?	hospital			
	Al Amal	Al Razi	Dr Khalil	Total
Yes always	6	10	8	24
	85.7%	100.0%	61.5%	80.0%
Sometimes	1	0	0	1
	14.3%	.0%	.0%	3.3%
No	0	0	5	5
	.0%	.0%	38.5%	16.7%
Total	7	10	13	30
	100.0%	100.0%	100.0%	100.0%

(Chi-Square=10.907, p-value= 0.028)

There is a statistically significant relationship between hospital and workers' exposure to injuries (p-value = 0.000). It can be noticed that the workers at Al Razi hospital have been exposed to injuries more than the other two hospitals as shown in Table 16.

Table 16. Cross tabulation between hospital and workers' exposure to injuries (number and percent)				
Have you been exposed to injury other than needles during work	hospital			
	Al Amal	Al Razi	Dr Khalil	Total
Yes	0 0.0%	8 80.0%	1 7.7%	9 30.0%
No	7 100.0%	2 20.0%	12 92.3%	21 70.0%
Total	7 100.0%	10 100.0%	13 100.0%	30 100.0%

(Chi-Square=17.985, p-value= 0.000)

Prevalence of hepatitis B and health risks among cleaning personnel

Results of serological tests for Hepatitis B in cleaning personnel revealed that 29 cleaning personnel (13 in Dr Khalil hospital, 9 in Al-Razi hospital, 7 in Al-Amal hospital), were negative for hepatitis B. Only one worker was positive (at Al Razi hospital) for the disease (3.33%). It is worth mentioning here that none of the 30 cleaning personnel were vaccinated for hepatitis B. However, the

incidence of the disease may be higher than revealed by this work because cleaning personnel are usually employed by private companies for one year and many of them leave work during their first year. The disease has a long incubation period (up to 6 months) and hence some of the workers could have been positive but without showing the disease (Al-Khatib et al. 2009).

3.3 Generation and classification of hospital waste

Solid waste generated by each hospital was weighed, and the average quantity of waste was determined. A summary of generation rates from different types of hospitals is presented in Tables from 17 to 28.

The highest generation rate of 1.8 kg/bed/day hazardous waste was found in Al Amal hospital, followed by 1.18 kg/bed/day in Al Razi Hospital. The lowest rate of 0.54 Kg /bed /day was found in the Dr. Khalil Hospital. . The average generation rate of hospital hazardous waste was 0.78 kg/bed/day. Waste generation rates depend upon several factors, such as the type of healthcare establishment, level of instrumentation, and location. The higher generation rates at Al Amal hospital were due to the fact that it is a more developed and private hospital with modern facilities, and thus serving patients with higher

economic level in comparison with other hospitals, mainly Dr. Khali hospital. It should be noted that the average waste generation rate obtained in this study lies within the range of values estimated by WHO (1.3–3 kg/patients/day) for countries in North Africa and the Middle East (Sawalem et al. 2009).

The hospital waste analyzed was comprised of 44.6 % hazardous waste and 55.4 % general waste (Fig. 4). The qualitative analysis of general waste (Fig. 5) determined paper as the primary component (33.7%), followed by plastics (29.7%). The high plastic content is due to the widespread use of disposables rather than reusable for various purposes (e.g. bottles, packaging materials and bags used for food). Food had the third highest percentage (24.5%). Classification of hazardous waste indicates that pathological and mixed infectious waste represents about 56% of all hazardous waste as shown in Fig. 6.

Table 17. Average general healthcare waste generation rates in all surveyed hospitals

Generation rate	Type of general healthcare waste						Total general healthcare waste
	Plastics	Textiles	Glass	Metals	Paper	Food	
gm/bed/day	287.0	18.8	77.4	20.3	325.2	236.4	965.1
gm/total patients/day	228.6	15.0	61.7	16.2	259.1	188.3	768.9
gm/in-patient/day	581.1	38.1	156.7	41.1	658.5	478.6	1,954.0
gm/employee/day	113.2	7.4	30.5	8.0	128.2	93.2	380.6

Table 18. Average hazardous healthcare waste generation rates in all surveyed hospitals

Generation rate	Type of hazardous healthcare waste					Total hazardous healthcare waste
	Sharps	Pathological	Mixed inf.	Absorbents	Discarded	
gm/bed/day	56.7	233.4	200.6	119.7	166.4	776.8
gm/total patients/day	45.1	185.9	159.8	95.4	132.6	618.9
gm/in-patient/day	114.7	472.6	406.2	242.4	336.9	1,572.8
gm/employee/day	22.3	92.0	79.1	47.2	65.6	306.3

Table 19. Average healthcare waste generation rates in all surveyed hospitals

Generation rate	Type of healthcare waste		Total healthcare waste
	Total general	Total hazardous	
gm/bed/day	965.1	776.8	1,742.0
gm/total patients/day	768.9	618.9	1,387.8
gm/in-patient/day	1,954.0	1,572.8	3,526.8
gm/employee/day	380.6	306.3	686.9

Table 20. Average general healthcare waste generation rates in Al Amal Hospital

Generation rate	Type of general healthcare waste						Total general healthcare waste
	Plastics	Textiles	Glass	Metals	Paper	Food	
gm/bed/day	452.3	5.2	71.9	35.0	429.3	543.4	1,537.0
gm/total patients/day	368.1	4.2	58.5	28.5	349.4	442.3	1,251.1
gm/in-patient/day	879.4	10.1	139.8	68.1	834.7	1,056.7	2,988.7
gm/employee/day	162.4	1.9	25.8	12.6	154.1	195.1	551.8

Table 21. Average hazardous healthcare waste generation rates in Al Amal Hospital

Generation rate	Type of hazardous healthcare waste					Total hazardous healthcare waste
	Sharps	Pathological	Mixed inf.	Absorbents	Discarded	
gm/bed/day	105.7	422.3	788.4	328.6	197.8	1,824.8
gm/total patients/day	86.1	343.7	641.7	267.5	161.0	1,500.0
gm/in-patient/day	205.6	821.2	1,533.0	638.9	384.5	3,583.3
gm/employee/day	38.0	151.6	283.0	118.0	71.0	661.5

Table 22. Average healthcare waste generation rates in Al Amal hospital

Generation rate	Type of healthcare waste		Total healthcare waste
	Total general	Total hazardous	
gm/bed/day	1,537.0	1,824.8	3,379.9
gm/total patients/day	1,251.1	1,500.0	2,751.0
gm/in-patient/day	2,988.7	3,583.3	6,571.9
gm/employee/day	551.8	661.5	1,213.3

Table 23. Average general healthcare waste generation rates in Al Razi Hospital

Generation rate	Type of general healthcare waste						Total general healthcare waste
	Plastics	Textiles	Glass	Metals	Paper	Food	
gm/bed/day	326.9	26.6	113.4	36.9	577.9	429.3	1,511.0
gm/total patients/day	154.1	12.5	53.5	17.4	272.5	202.4	712.4
gm/in-patient/day	446.9	36.4	155.1	50.4	789.9	586.8	2,065.3
gm/employee/day	99.4	8.1	34.5	11.2	175.7	130.5	459.3

Table 24. Average hazardous healthcare waste generation rates in Al Razi hospital

eneration rate	Type of hazardous healthcare waste					Total hazardous healthcare waste
	Sharps	Pathological	Mixed inf.	Absorbents	Discarded	
g/bed/day	56.5	135.5	606.9	195.2	188.4	1,182.5
g/total patients/day	26.7	63.9	286.1	92.0	88.8	557.5
g/in-patient/day	77.3	185.3	829.6	266.8	257.5	1,616.4
g/employee/day	17.2	41.2	184.5	59.3	57.3	359.5

Table 25. Average healthcare waste generation rates in Al Razi hospital

Generation rate	Type of healthcare waste		Total healthcare waste
	Total general	Total hazardous	
gm/bed/day	1,511.0	1,182.5	2,693.5
gm/total patients/day	712.4	557.5	1,269.9
gm/in-patient/day	2,065.3	1,616.4	3,681.8
gm/employee/day	142.5	359.5	818.8

Table 26. Average general healthcare waste generation rates in Dr. Khalil Hospital

Generation rate	Type of general healthcare waste						Total general healthcare waste
	Plastics	Textiles	Glass	Metals	Paper	Food	
gm/bed/day	257.3	18.0	67.4	13.8	239.5	146.3	742.3
gm/total patients/day	256.5	18.0	67.2	13.8	238.8	145.8	740.0
gm/in-patient/day	610.2	42.7	159.8	32.7	568.0	346.8	1,760.2
gm/employee/day	112.5	7.9	29.5	6.0	104.7	64.0	324.6

Table 27. Average hazardous healthcare waste generation rates in Dr Khalil hospital

Generation rate	Type of hazardous healthcare waste					Total hazardous healthcare waste
	Sharps	Pathological	Mixed inf.	Absorbents	Discarded	
gm/bed/day	51.4	241.7	17.2	74.8	156.5	541.7
gm/total patients/day	51.2	241.0	17.1	74.6	156.0	540.0
gm/in-patient/day	121.8	573.2	40.7	177.5	371.2	1,284.4
gm/employee/day	22.5	105.7	7.5	32.7	68.4	236.9

Table 28. Average healthcare waste generation rates Dr Khalil hospital			
	Type of healthcare waste		
Generation rate	Total general	Total hazardous	Total healthcare waste
gm/bed/day	742.3	541.7	1,283.9
gm/total patients/day	740.0	540.0	1,280.0
gm/in-patient/day	1,760.2	1,284.4	3,044.6
gm/employee/day	324.6	236.9	561.5

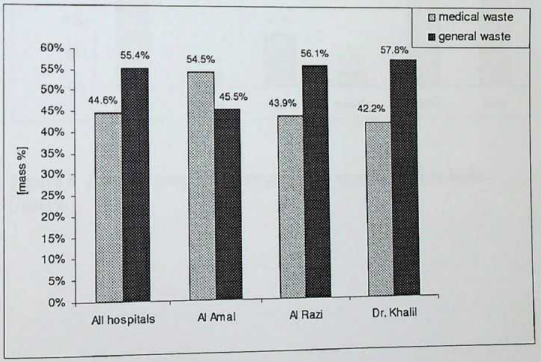

Figure 4. Percentage distribution of medical (hazardous) and general healthcare waste in Jenin (mass %)

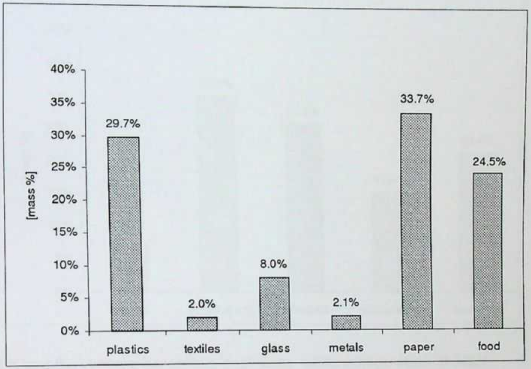

Figure 5. Average general healthcare waste composition in Jenin (mass%)

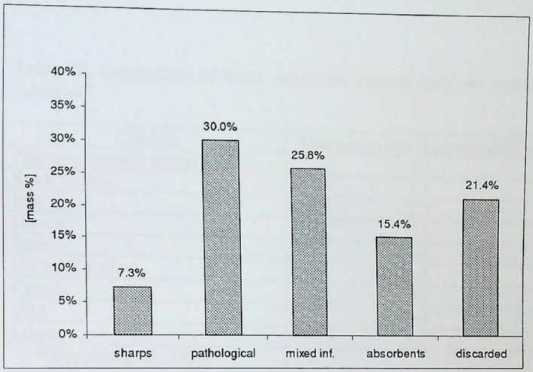

Figure 6. Average hazardous healthcare waste composition in Jenin (mass %)

Table 29 shows the comparison of waste generation rates in different countries. The generation rate in Jenin hospitals is the same as those of Libyan hospitals and is almost similar to Saudi Arabian hospitals. Developed countries such as France, UK, Spain, Canada and USA generate more than developing countries as is the situation in Jenin Hospitals.

Table 29. Comparison of waste generation rates at hospitals in other countries*.

Country	Generation rate (kg/patient/dday)
Palestine (present study)	1.3
Saudi Arabia	1.1
Iran	2.7
France	3.3
Spain	4.4
United Kingdom	3.3
Canada	4.1
USA	4.4
Libya	1.3

*(Sawalem et al. 2009)

Conclusions and Recommendations

The study has demonstrated that medical waste management in Jenin hospitals is facing many challenges because this sector is almost ignored in terms of segregation, collection, transport, treatment and final disposal. In this study, waste characterization has been performed for all (three hospitals) available in Jenin governorate as there had been a lack of data on the quantities and nature of the waste generated. Such baseline data are of utmost importance for meaningful planning of waste management procedures. Moreover there is no formal policy or directive put in place by stakeholders or the government. Currently, the management of infectious waste is normally governed by the activities of largely untrained and uneducated waste handlers from poor backgrounds. The recycling of hazardous or general wastes is below acceptable medical waste standards. Collectively, this study indicates important implications for the health of the handlers. Average healthcare waste generation rates -in all surveyed hospitals- was 0.96 and 0.77 kg/bed/day for total general and hazardous wastes respectively.

From the results of this study, the following recommendations are hereby made:

- Concerned ministries should agree on a clear specification of responsibilities towards medical waste management in Palestine. It is suggested for the Environmental Quality Authority to put laws and regulations related to medical waste management outside health care institutions; and for the Ministry of Health to put laws and regulations related to medical waste management within health care establishments; and for the Ministry of Health in coordination with the Ministry of Local Government and the Environmental Quality Authority to devise a mechanism for monitoring medical waste management outside health care establishment.
- There is need for sustained cooperation among all key actors (government, hospitals and waste managers) in implementing a safe and reliable medical waste management strategy, not only in legislation and policy formation but also particularly in its monitoring and enforcement. This can be achieved through the cooperation between the Ministry of Health, Environmental

Quality Authority, Ministry of Local Government, and Non Governmental Organizations working in related fields.

- There should be an obligation for each Health care facility(HCF)to ensure a safe and hygienic system of medical waste handling, segregation, collection, storage, transportation, treatment and disposal, with minimal risk to handlers, public health and the environment through the coordination between the related persons in the MoH according to their responsibilities.
- All staff and waste handlers in each hospital should be well trained at the beginning of their work at hospitals, and regularly updated with pre-employment and in-house specialized training, which provides them with a knowledge base about the process of waste management and associated health risks.

- Economically and environmentally sustainable technological options for waste treatment, which can be well operated and maintained, should be considered for medical waste management.

- There should be a hazardous waste landfill specially designed for the final disposal of treated hazardous healthcare waste. Its specifications are well known in the international literature and we should benefit from that.

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Personal Interviews

1. Mohammad Abu Sroor Director of health department in Jenin municipality, 4/2009

2.Eng. Bashar Daragmeh- Director of Jenin environmental health department, 11/2007

3.Abdul-menum shehab- Director of Jenin environmental Quality Authority

Appendix

Field work description

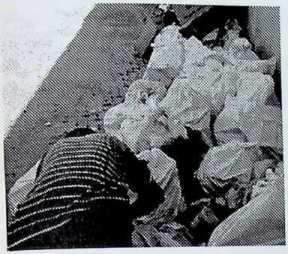

Figure A1. collection of medical and general waste

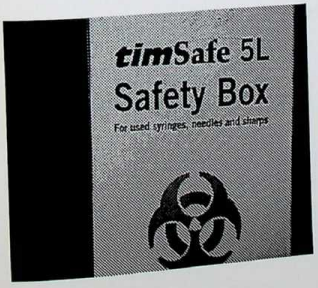

Figure A2. Used safety box in the study which is special for sharp waste disposing.

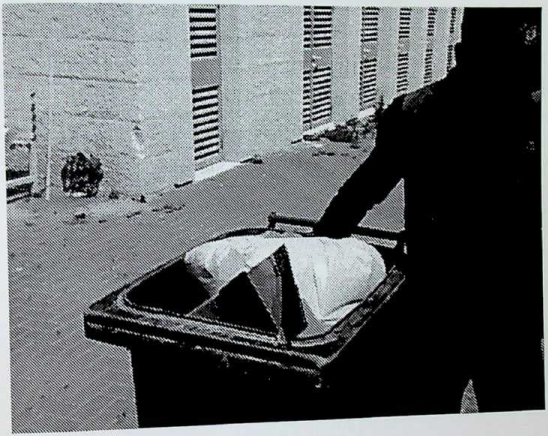

Figure A3. Internal transportation of medical and general waste

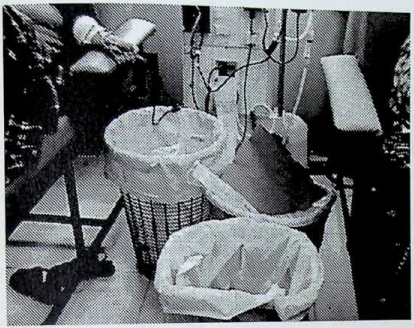

Figure A4. separation of medical and general waste in the dialysis department (Dr Khalil Hospital)

Medical waste management is of great importance due to its infectious and hazardous nature that can cause undesirable effects on humans and the environment. The objective of this study was to analyze and evaluate the present status of medical waste management in the light of medical waste control regulations recommended by the WHO in Jenin governorate. The management of Medical wastes in Palestine as well as in many developing countries is not given the proper attention. Still there are lacks of legislation and defined policies regarding this issue.

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