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Evaluation of Medical Waste Management in Non-Governmental Hospitals in Gaza Governorates

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Evaluation of Medical Waste Management in Non-Governmental Hospitals in Gaza Governorates

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بسم الله الرحمن الرحيم

﴿ظهر الفساد في البر والبحر بما كسبت أيدي الناس ليذيقهم بعض الذي عملوا لعلهم يرجعون﴾

صدق الله العظيم

سورة الروم _ الآية ٤١

Dedication

To my family, especially my parent, my wife and my kid Yara for their continuous support and unlimited encouragement

Yassir Fekry Nasr

Declaration

I certify that this thesis submitted for the degree of master is the results of my own research, except where otherwise acknowledged, and that this thesis or any part of the same has not been submitted for a higher degree to any other university or institution.

Signed: ***Yassir Fekry Nasr***

Date: *November 2009*

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Abstract

The management of medical waste is of great importance due to its potential environmental hazards and public health risks. In the past, medical waste was often mixed with municipal solid waste and disposed of in residential waste landfills or improper treatment facilities in many countries. In recent years, many efforts have been made by environmental regulatory agencies and waste generators to better manage the wastes from healthcare facilities. This study was carried out on 11 non-governmental hospitals in Gaza governorates. The objective of this study is to identify the factors that affect medical waste management in non-governmental hospitals in Gaza governorates.

The methodology was descriptive, quantitative analytical and consisted of the use of observational checklist and self- administered questionnaire with the administration of the healthcare facilities and with personnel involved in the management of the wastes. The sample size included 275 with a response rate of 80% who agreed to participate in the study.

The results show that medical wastes generated in hospitals were extremely heterogeneous in composition. The current situation of medical waste management in non-governmental hospitals in Gaza governorates is unsatisfactory. Only 4.1% of the health workers have taken training courses related to medical waste management. About 21.4% of the respondents reported that there is a comprehensive waste disposal plans for the disposal and technical aspects of hazardous wastes, and only 17.3% of the study subjects have seen the waste management legislation in the hospitals. There is a lack of comprehensive waste disposal plans for the disposal and technical aspects of hazardous wastes. There is a lack of treatment facilities when about 27.3% of the hospitals have an incinerator and 8.6% of them have autoclaves for treatment of pathological and infectious wastes.

The basic approach to medical waste management is to reduce the quantity of waste at source as far as possible. Hospital wastes should be recycled whenever feasible, with due regard to environmental aspect, to reduce the quantity of material entering the waste system. Waste management requires a system approach, involving the handling, storage, transport; treatment and disposal of waste by methods that at all stages minimize the risk to health and the environment.

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List of Abbreviations

BAN	Basel Action Network
CDC	Center for Disease Control and Prevention
CEHA	Center of Environmental Health Activities
EPA	Environmental Protection Agency
HBV	Hepatitis B Virus
HCV	Hepatitis C Virus
HCW	Health Care Waste
HCWHO	Health Care Without Harm Organization
MEnA	Ministry of Environmental Affairs
MOH	Ministry of Health
MSW	Municipal Solid Waste
NGOs	Non-governmental Organizations
OSHA	Occupational Safety and Health Administration
PCBC	Palestinian Central Bureau of Statistics
PCBs	Polychlorinated Biphenyls
PCDD	Polychlorinated Dibenzo-Dioxins
PCDF	Polychlorinated Dibenzo-Furans
PRCS	Palestine Red Crescent Society
PVC	Polyvinyl Chloride
SPSS	Statistical Package for Social Sciences
STD	Sexually Transmitted Diseases
TB	Tuberculosis
USEPA	United Stated Environmental Protection Agency
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

To give an introductory background about this study, the researcher provides this chapter which includes the research background, research problem, justification of the study and research objectives and questions. Moreover, this chapter presents the context of the study as well as some related operational definitions.

1.1 Research Background

The growing concerns about waste management at an international levels and the increase of waste threats on environment and on human health have increased the importance of management practices used for waste management, especially in healthcare establishments for reducing waste accumulation and contamination. It has been reported that the hazards arising from generation of wastes has generally been of great concern to environmental health engineers in developing countries (Sangodoyin and Osaigbovo, 1992).

Medical wastes come in all forms, including solid, liquid and gas. It is generated from different health care activates such as medical laboratories, medical research centers, human and veterinary pharmaceutical factories, as well as storage areas. In general, most of health care centers and hospitals in Palestine have no separation between general and medical wastes; all types of medical waste are mixed and disposed of with municipal waste without treatment (PEQA, 2006a).

Health care waste management is strongly influenced by cultural, social, and economic circumstances. A well-designed waste management policy, a legislative frame work, and plans are essential for handling of medical waste. Medical and research facilities are moving toward the achievement of a healthy and safe environment for employees and communities (Bassic and Moltin, 1998 ; Pruss, 1999).

Inappropriate management and disposable of waste can negatively affect the quality of the environment in many ways, as well as the people's quality of life (PEQA, 2006b).

About 80% of the total wastes generated by health care activities are considered domestic waste. The remaining approximately 20% of wastes are considered hazardous materials that may be infectious, radioactive or toxic (WHO, 2007).

The healthcare waste management needs to follow systematic processes starting from packaging which should specify the regulations on treatment for different waste categories, segregation, collection, storing, handling, disposal, and transporting of waste. The first step in healthcare waste management is reducing waste quantity generated by healthcare establishments by source reduction, recycling, and the careful segregation into different categories according to their types.

Inappropriate management of medical waste handling, segregation, collection, storage, transporting and disposal or treating could potentially lead to the spread of diseases and risks to public health, community and the environment.

Medical establishments play important roles in different activities by using of modern technology to serve the humans and the environment through different departments in the establishment and its firms (Bassic and Moltin, 1998).

So, this study will evaluate the current situation of medical waste management in non-governmental hospitals in Gaza Governorates.

1.2 Research Problem:

In many countries, medical waste is still handled and disposed of together with domestic waste, creating great health risks to health-care workers, municipal workers, the public, and the environment (Da Silva et al., 2005).

In 2002, the results of a WHO assessment conducted in 22 developing countries showed that the proportion of health-care facilities that do not use proper waste disposal methods ranges from 18% to 64 % (WHO, 2004).

In Gaza Strip, waste management practices have poor collection services and improper disposal at open dumpsites. Such problems become more serious with the increase in population. As a result, higher generation of waste requires special treatment at all stages, starting from patients and ending at the disposal site. In addition, there are 10-25% of the

healthcares wastes regarded as hazardous wastes and may create a variety of health risks (WHO, 1999).

Poor management of medical waste can expose health workers, waste handlers, patients, scavenging children and community to infection, injuries and toxic effects.

Lack of knowledge and awareness about medical waste hazards, insufficient human resources, financial resources, and inappropriate management of waste handling, collection, storage, transporting and disposal can cause big problems for public health, community and the environment.

Medical waste is considered as a hazardous material that may be toxic, radioactive or infections. Unsafe handling or disposal of medical waste such as contaminated syringes and needless represents a high risk and threat for public health. Sharps are considered as a very hazardous waste that can cause infection with human immunodeficiency virus (HIV) and hepatitis viruses B and C. These viruses are transmitted through contaminated sharps with human blood.

The management of medical waste is essential to protect people from hazards when handling, collecting, storing, transporting and disposing of or treating of medical wastes**.** So, the study is intended to evaluate the current situation of medical waste management in non-governmental hospitals in the Gaza Governorates.

1.3 Importance of the Study

The study findings might help in evaluating the current situation of medical waste management among health care workers and suggesting possible suitable solutions and recommendations for proper management of medical waste in non-governmental hospitals in Gaza Governorates.

1.4 Justification of the Study

Many of developing countries like Palestine don’t have appropriate management of medical waste, enforcement or regulation. Medical waste is a reservoir of harmful microorganisms that can cause infections diseases for health worker, patient and general public.

In developing countries, additional hazards occur from scavenging on waste disposal sites and manual sorting of the waste recuperated at the back doors of health-care establishments. These practices are common in many regions of the world. The waste handlers are at immediate risk of needle-stick injuries and other exposures to toxic or infectious materials (WHO, 2007).

Reasons for the selection of this topic include the following:

There is a lack of information about the quantities, characteristics, management method, and health care worker knowledge and attitudes about medical waste management in non-governmental hospitals in the Gaza Governorates.

Highlighting the importance of medical waste management for public health, occupational health, community, and the environment is needed to mitigate health hazards associated with mismanagement of medical wastes.

So, the study will describe and analyze medical waste management methods in non-governmental hospitals in the Gaza Governorates.

1.5 Aim of the Study

The aim of the study is to describe and evaluate the current situation of medical waste management in non-governmental hospitals in the Gaza Governorates.

1.6 Objectives of the Study

The specific objectives of this research are:

- Describing and analyzing the current situation of medical waste management in non-governmental hospitals.
- Evaluating knowledge, attitudes and practices about medical waste management among health care workers in non-governmental hospitals.
- Appraising the strength and weakness points encountered in medical waste management practices in non-governmental hospitals in Gaza Strip.
- Suggesting recommendations for decision makers to adopt better medical waste management practices depending on the study results.

1.7 Research Questions

1. Do the current practices follow WHO guidelines for medical waste management?
2. What are the strength points in medical waste management practices in non-governmental hospitals?
3. What are the weakness points in medical waste management practices in non-governmental hospitals?
4. Do the health care workers have proper training for medical waste management according to WHO guidelines?
5. What are the main obstacles facing medical waste management?
6. What should be done to make medical waste management more effective?

1.8 Context of the Study

1.8.1 Socio-demographic context

“Palestine constitutes the southwestern part of a large geographical entity in the eastern part of the Arab world, which is Belad El Sham. In addition to Palestine, Belad El Sham contains Lebanon, Syria, and Jordan. So, Palestine has common borders with these countries, in addition to Egypt. The entire area of Palestine is about 27000 sq. kilometers (Annex 1). Now, the remaining part of historical Palestine comprises two areas separated geographically: West bank and Gaza Strip "(MOH, 2005). Although comparatively small, in fact the equivalent of a medium-size region in a typical European country or one of the smallest states in the United States, Palestine comprises a significant variation of morphological and climatic regions, and this is making it of important geographic position (Dellapergola, 2001).

The population size in Palestine was estimated at 3,662,205 in 2007. Out of the total number, 2,274,929 in the West Bank and 1,87,276 in the Gaza Strip with percentages of 62.1% and 37.9% respectively. Al Khalil governorate has the highest population size of 13.9% of the total population, followed by Gaza governorate of 13.2%. Jericho governorate has the lowest population size of 1.2% (PCBS, 2007).

Although the Gaza Strip (Annex 2) is a narrow piece of land that is located on the coast of the Mediterranean sea, its position on the crossroad from Africa to Asia made it strategic for occupiers over centuries (MOH, 2005). Gaza Strip is a crowded place with an area of 378 Sq. km and considered as the second most populated place on earth after Hong Kong (World Bank, 2002). Gaza Strip comprises five main governorates which are: North of Gaza (17% of Gaza Strip total area), Gaza City (20.3%), Mid-Zone (15%), Khan-Younis (30.5%), and Rafah (16.2%) (MOH, 2005).

After Oslo Accords, it was expected that the Palestinian economy will go through a period of steady and rapid growth (World Bank, 2007). Gross National Product (GNP) in Palestine had been subjected to fluctuations since 2000. GNP was US $ 5,454 million in 1999 and dropped to US $ 4,169 million in 2005 (MOH, 2005). In 1999, the GDP was US $ 4,512 million. But since 2000, when Israel imposed a strict closure on Palestinian territories as a response to the second Intifada, the GDP decreased to US $ 3,557 millions in 2002 (World Bank, 2007). In 2004, the GDP recovered slightly and continued in this recovery for nearly two years. But, due to continued growth in settlements and the cut off in the direct aid as a result of last parliament elections, GDP fell again in 2006. GDP was about US $ 3,901 million in 2007 (World Bank, 2007).

According to the World Bank, the unemployment rate increased from 11.8% in 1999 to 32% in 2005. The poverty rate in Palestine was 40%, and this is largely due to Israeli restrictions on Palestinian territories (MOH, 2005). In general, the unemployment rate in the Gaza Strip was higher than that in the West Bank (World Bank, 2003).

According to the education indicators in Palestine, the MOH concluded that Palestinian community is a well- educated one and that Palestinians have always highly appreciated education (MOH, 2005).

1.8.2 Health Care System and Health Indicators

The Palestinian MOH has been fully responsible of the management of health services in the Palestinian Territories since the transfer of responsibilities from the Israeli Civil Administration to the Palestinian Authority in 1994. Gaza and Jericho were transferred to the Palestinians in May 1994, while the health systems in the remaining areas of the West Bank were transferred in December 1994 (World Health Assembly, 2005). Now MOH is the main health care provider in Palestine. MOH is the only health authority responsible of

supervision, regulation, licensure, and control for all health services. United Nations Relief and Works Agency (UNRWA), Medical Services for Police and general security, and other Nongovernmental Organizations (NGOs) are considered as second co-providers of health care services in Palestine (MOH, 2003).

The Palestinian health care system mainly includes eight components which are Primary Health Care, Laboratories and Blood Banks, Hospitals, Health Human Resources, Health Finance, Governmental Health Insurance, Treatment Abroad, and Health Projects (MOH, 2005).

The Primary Health Care (PHC) is one of the most important components of the Palestinian health care system. PHC centers provide accessible and affordable health services for all Palestinians, especially for children and other vulnerable groups (MOH, 2005). MOH is working with other health sectors in providing the primary health services, mainly UNRWA and NGOs. It is worth mentioning that the private sector plays an important role in providing PHC services to the Palestinians (MOH, 2005). Hospitals and the other aforementioned components of Palestinian health care system are also of key importance for the effective and complementary performance of the Palestinian health care system (MOH, 2005).

In Palestine, the crude death rate is 2.7 per 1000 population. The infant mortality rate is 24 per 1000 live births (62 in Turkey, 41 in Egypt, 40 in Tunisia, 21 in Jordan, and 7 in Israel) (Hamad, 2001). The leading causes of adult death are similar to developed countries including cardiovascular diseases and cancers with a high prevalence of stress and psychological trauma related diseases. On the other hand, diseases of poverty are still prevalent such as respiratory infections and diarrhea diseases that remain important causes of child mortality and morbidity (MOH, 2005). Thus, it could be said that despite the harsh difficulties facing the Palestinians, their health status is relatively good compared with other countries at a similar level of economic development.

1.8.3 Environmental health context

There are many environmental health problems in Gaza Strip which affect human and public health. The main causes of these problems are attributed to over population, poor and weak infrastructure, Israeli occupation and socio cultural habits of the people. These problems include: groundwater contamination, wastewater management, solid waste

management, medical waste management, air pollution, coastal and sea water pollution, soil salination and land pollution.

1.9 Operational Definitions

Medical waste: defined by WHO as all waste generated by health care establishments, research facilities, and laboratories (Ducel et al., 2002).

Hazardous waste: means any potentially harmful substances that have been released or discarded into the environment (ATSDR, 2007).

Infectious waste: means any waste suspected to contain pathogens (bacteria, viruses, parasites or fungi) in sufficient concentration to cause disease (Al-Shanshoury, and Al-Ayed, 2002).

Pathological waste (Anatomical waste): any waste that includes body parts, blood, placentas, or other fluids (WHO, 2007).

Radioactive waste: means any solid, liquid or gaseous substance which emits radiation spontaneously (WDNR, 2006).

Waste minimization: is a waste management approach that focuses on reducing the amount and toxicity of hazardous waste that is generated. This includes source reduction, recycling, and treatment (Health Sciences Center, 2005**).**

Legislation: the legislation involves a lot of policies and rules that follow up the process of medical waste management. These policies and work guidelines are considered as a legal work protocol covering safe management of medical wastes. Legislations are very important to obligate those who generate medical waste to conduct monitoring, testing or risk assessment and well put in place policies for safe disposal of medical waste (Rushbrook, 2000).

Handling: means the functions associated with the movement of waste after their generation (Al-Shanshoury, and Al-Ayed, 2002).

Segregation: separating different types of waste at the point of generation and keeping them isolated from each other (HCWHO, 2001).

Collection: means close the waste bags when they are three quarters full either by tying the neck or by sealing the bag (Srivastava, 2000).

Labeling: Affixed Labels to waste containers and bags with the international biohazard symbol and the word "BIOHAZARD" in a contrasting color to differentiate between waste categories (HCWHO, 2001).

Storage: means the holding of solid waste for a temporary period, at the end of which period the solid is to be treated or disposed of (WDNR, 2006).

Treatment: means any method, technique or process which is designed to change the physical, chemical or biological character or composition of waste (Al-Shanshoury, and Al-Ayed, 2002).

Disposal: means the discharge, deposit, injection, dumping or placing of any waste into or on any land or water (WDNR, 2006).

CHAPTER 2

LITERATURE REVIEW

This chapter discusses the conceptual framework and the main concepts and variables related to the study. These concepts include the identification of the factors that affect medical waste management in non-governmental hospitals in Gaza governorates. Additionally, this chapter presents some previous studies concerning the medical waste management in non-governmental hospitals in Gaza governorates.

2.1 Conceptual Framework

The study framework identifies the most common points that are associated with medical waste management process as seen in figure 2.1.

There are many factors affecting the medical waste management such as the presence of legislation, plan, worker education level, experience duration, previous training, worker knowledge, attitudes, and all of the scientific steps related to medical waste management process.

Each step of the scientific management of medical waste can have an affect on the process. These steps include waste handling, segregation, collection, storage, transport, treatment and disposal.

Legislation

The legislation involves a lot of policies and rules that follow up the process of medical waste management. These policies and work guidelines are considered as a legal work protocol covering safe management of medical wastes and safe practices for waste handling, segregation, collection, transport, treatment and disposal.

Plan

Planning is important for improving health-care waste management at the national, regional, and local levels. Planning of health-care waste management is necessary to prevent waste from adversely affecting human and environmental health.

Training

Training on medical waste management procedures is important to create awareness and facilitate implementation of medical waste rules. The content and duration of the training program varied with the target audience, whether this involves the administrators, doctors, nurses, or cleaning personnel. The awareness training program should cover management aspects, including medical waste generation, segregation, collection, storage, transportation, treatment and disposal.

Segregation

Segregation means separating different types of waste at the point of generation and keeping them isolated from each other.

Labeling

Labels affixed to infectious waste containers and bags should include the international biohazard symbol and the word "BIOHAZARD" in a contrasting color.

Collection

On site collection requires staff to close the waste bags when they are three quarters full either by tying the neck or by sealing the bag.

Transport

The basic criteria for safe transportation include segregation of infectious and non-infectious waste and the use of sharp containers to dispose of needles right after injection.

Treatment

Final treatment of medical waste can be done by technologies like incineration, autoclaving, hydroclaving, microwave, chemical treatment, or plasma pyrolysis.

Disposal

The medical waste should be completely free of pathogenic bacteria before disposal. This would ensure maximum public hygiene quality. Disposal of medical wastes is a sensitive issue and also has ethical dimensions.

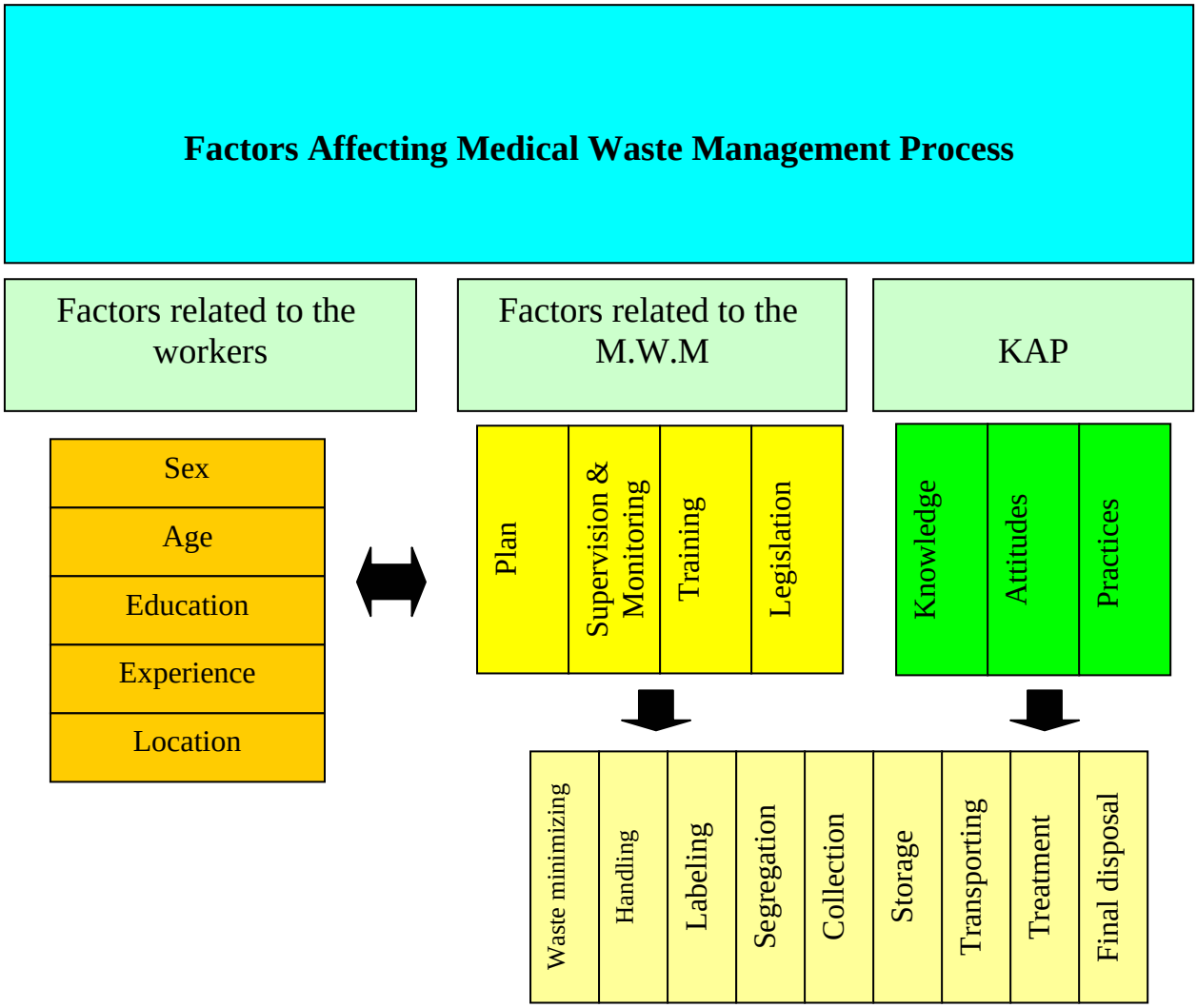


Figure 2.1: Conceptual Framework

2.2 Definitions:

There is no universally accepted definition for regulated medical waste; the definitions offered by regulatory agencies are similar. The Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC), the World Health Organization (WHO) and the Occupational Safety and Health Administration (OSHA) agree that "regulated medical waste" includes those wastes with the potential for causing infection and need special precautions (U.S. Army Center, 2001).

WHO defined health care waste (HCW) as all waste generated by health care establishments, research facilities, and laboratories (Ducel et al., 2002).

EPA defines medical waste as any waste that is generated in the diagnosis, treatment, or immunization of human beings or animals, and in the production or testing of biologicals such as surgical gloves, needless body organs and culture dishes (EPA, 2006).

Hospital waste refers to all waste, biologic or non biologic that is discarded and not intended for further use. Medical waste is a subset of hospital waste; it refers to the material generated as a result of diagnosis, treatment or immunization of patients and associated biomedical research (Rutala and Weber, 2005).

2.3 Sources of Medical Waste

The major sources of medical waste are general hospitals, specialized hospitals, psychiatric hospitals, university hospitals, clinics, blood banks, dental clinics, laboratories, dialysis centers; x-ray centers, research institutions, health care teaching institutes, animal houses and veterinary institutes and nursing homes for the elderly (Sharma, 2002 and Yimer, 2005).

2.4 Types of Waste in Medical Centers:

Waste generated by medical centers can be divided into two main types:

- Non medical waste (general waste)
- Medical waste (clinical waste)

About 80-85 % of wastes generated by medical centers are general wastes and about 15-20% are medical wastes. General waste also includes all waste generated by offices and kitchens (Harvery et al., 2002 and NICDNAC, 2004).

General solid or liquid waste doesn't require special treatment before disposal; whil all infectious waste must be treated. The cost for disposal of infectious waste may be ten times the cost for disposal of general solid waste. Any measures that decrease the amount of infectious waste generated will simultaneously decrease the cost of infectious waste disposal (Seymour, 2001).

Health care wastes are categorized into two types such as infectious and non-infectious (Saini and Dadhwal, 1995). Infectious waste includes all those medical wastes, which have the potential to transmit viral, bacterial or parasitic diseases. It includes both human and

animal infectious wastes and waste generated in laboratories and veterinary practice. These wastes are hazardous in nature. Non infectious wastes are generated from packaging, food preparations and visitors activities. This waste is large compared to infectious waste. A large fraction is potentially recyclable but may be contaminated with infectious agents. This has to be separately stored and sterilized before sending for recycling (Sandhu and Singh, 2003).

The hazardous or special wastes include infectious waste, pathological waste, genotoxic waste, pharmaceutical waste, chemical waste, waste with high heavy metal content, pressurized containers, and radioactive waste. Most of these wastes are toxic, harmful, carcinogenic, and infectious materials (Pruss et al., 1999; Marinkovic et al., 2008).

2.5 Categorization of Medical Waste

WHO classified medical waste into the following categories: Infections waste, pathological waste, pharmaceutical waste, chemical waste, sharps, radioactive waste, pressurized containers, high heavy metal waste and genotoxic waste. (Harvery et al., 2002)

According to the Total Environment Journal (2000), Medical wastes must be classified according to their source, type and risk factors associated with their handling, storage, collection and disposal.

According to the Total Environment Journal (2000), Portuguese legislation classifies the waste stream produced through medical activities into four groups:

- ***Group I***: similar to municipal wastes (MW).

- ***Group II***: non-hazardous medical wastes that do not require specific treatment and can be considered similar to MW.
- ***Group III***: medical waste with biological risks that must be pre-treated before elimination as MW
- ***Group IV***: specific medical wastes with compulsory incineration.

2.5.1 Infections waste:

It includes laboratory cultures; isolation wards wastes, tissues, and used dressings. WHO states that 85% of hospital wastes are actually non-hazardous, whereas 10% are infectious and 5% are non-infectious but they are included in hazardous wastes. About 15% to 35% of hospital waste is regulated as infectious waste. This range is dependent on the total amount of waste generated (Glenn and Garwal, 1999).

2.5.2 Pathological waste (Anatomical waste):

It includes body parts, blood, placentas, or other fluids. Infectious and anatomic wastes together represent the majority of the hazardous waste, up to 15% of the total waste from health-care activities (WHO, 2007).

2.5.3 Pharmaceutical waste:

It includes any expired drugs or unwanted drugs, unused, and contaminated; whether the drugs themselves (sometimes toxic and powerful chemicals) or their metabolites, vaccines and sera (WHO, 2007).

2.5.4 Chemical waste:

It includes all chemicals that are used for cleaning or diagnostic work such as solvents and disinfectants**.** Chemicals and pharmaceuticals amount to about 3% of waste from health-care activities (WHO, 2007).

2.5.5 Sharps:

These include any item that can cause cuts or punctures such as needless, syringes, blades and broken glass (Harvery et al., 2002).

Throughout the world every year an estimated 12000 million injections are administered. And not all needles and syringes are properly disposed of, generating a considerable risk for injury and infection and opportunities for re-use. Worldwide, 8-16 million hepatitis B, 2.3 to 4.7 million hepatitis C and 80 000 to 160 000 HIV infections are estimated to occur yearly from re-use of syringe needles without sterilization. Many of these infections could be avoided if syringes were disposed of safely. The re-use of disposable syringes and needles for injections is particularly common in certain African, Asian and Central and

Eastern European countries. Regarding injection practices, public health authorities in West Bengal, India, have recommended a shift to re-usable glass syringes, as the disposal requirements for disposable syringes could not be enforced (WHO, 2007).

2.5.6 Radioactive waste:

It includes radioactive substances from radiotherapy and laboratory work. The use of radiation sources in medical and other applications is widespread throughout the world. Occasionally, the public is exposed to radioactive waste, usually originating from radiotherapy treatments that have not been properly disposed of. Serious accidents have been documented in Goiania, Brazil in 1988 in which four people died from acute radiation syndrome and 28 suffered serious radiation burns. Similar accidents happened in Mexico City in 1962, Algeria in 1978, Morocco in 1983 and Ciudad Juarez in Mexico in 1983 (WHO, 2007 and Johnson. 1999).

2.5.7 Pressurized containers:

These include any gas cylinders, cartridges and aerosol cans that may cause potential harm (Harvery et al., 2002)**.**

2.5.8 Heavy metal waste:

It includes any unwanted batteries, broken thermometers or blood pressure gauges. Dental Amalgam particles are a source of mercury, which is known to be neurotoxin and nephrotoxic. Fetuses and newborn babies are more sensitive to mercury than adults and there seems to be a great difference in sensitivity among individuals (Preben, 2004).

2.5.9 Genotoxic waste:

Waste containing substances with genotoxic properties such as contaminated materials (needles, syringes, gauges, vials), urine, feces or vomits from patient.

2.6 Diseases Transmission Pathway:

The first step in waste management is to identify the potential routes for disease transmission. Possible pathways between medical waste and the population include the following according to Harvery et al., 2002:

- Direct contact
- Contact through vectors
- Airborne transmission
- Pollution of water sources
- Pollution of soil
- Pollution of the environment.

2.7 Medical Waste Risks:

Those most at risk from medical waste are:

- Medical staff
- Medical waste workers
- Waste-pickers
- Patients
- Medical centre visitors
- Children playing near disposal sites
- Drug addicts who scavenge for used needles and disposed medicines

Specific groups who come directly into contact with medical waste should be targeted for appropriate education and training. This aspect should be given at least equal priority to the provision of appropriate waste management facilities (Harvery et al., 2002).

2.8 Quantity of Medical Waste

The quantities generated vary from hospital to hospital and depend on the type of health care facility and local economic conditions.

High-income countries can generate up to 6 kg of hazardous waste per person per year. In the majority of low-income countries, health-care waste is usually not separated into hazardous or non-hazardous waste. In these countries, the total health-care waste per person per year is anywhere from 0.5 to 3 kg (WHO, 2007).

The monthly estimated quantity of solid waste produced by the health care centers in Palestine is about 426 tons, including 288 tons in the West Bank and 138 tons in the Gaza

Strip. The total estimated quantity produced by the secondary health care centers in Palestine is about 121 tons (PCBS, 2006).

Every year China generates around 650000 tons of medical waste. This quantity is growing from 19% to 25% per year. The amount of MW per capita in China is at present about 8 to10 times lower than that in western countries (Run-dong et. al., 2006).

According to the 2005 report of the World Health Organization, the amount of waste generated from the hospitals in Palestine was estimated at:

• For small hospitals 1 kg/bed/day

• For general hospitals 2 kg/bed/day

• For educational hospitals 4 kg/bed/day

Cheng et. al. conducted a study in 2009 to evaluate the quantities of medical waste generated and the factors associated with the generation rate at medical establishments in Taiwan. Data on medical waste generation at 150 health care establishments were collected for analysis. General medical waste and infectious waste production at these establishments were examined statistically with the potential associated factors. These factors included the types of hospital and clinic, reimbursement payment by National Health Insurance, total number of beds, bed occupancy, number of infectious disease beds and outpatients per day. The results showed that the waste generation rates ranged from 2.41 to 3.26kg/bed/day for general medical wastes**,** and 0.19–0.88kg/bed/day for infectious wastes**.** The total average quantity of infectious wastes generated was the highest from medical centers, about 3.8 times higher than that from regional hospitals (267.8 vs. 70.3Tons/yr). The study suggested that large hospitals are the major source of medical waste in Taiwan. The fractions of medical waste treated as infectious at all levels of healthcare establishments are much greater than that recommended by the USCDC guidelines.

Taghipour and Mosaferi (2009), conducted a study to determine the quantity, generation rate, quality, and composition of medial waste generated in Tabriz the major city northwest of Iran. Among the 25 active hospitals in the city, 10 hospitals were selected to participate in the survey. Each hospital was analyzed for a week to capture the daily variations of quantity and quality. The results indicated that the average (weighted mean) of total

medical waste**,** hazardous–infectious waste, and general waste generation rates in Tabriz city is 3.48, 1.039 and, 2.439 kg/bed-day, respectively. In the hospital waste studied, 70.11% consisted of general waste, 29.44% of hazardous–infectious waste, and 0.45% of sharps waste (total hazardous–infectious waste 29.89%). The average composition of hazardous–infectious waste was determined to be 35.72% plastics, 20.84% textiles, 16.70% liquids, 11.36% paper/cardboard, 7.17% glass, 1.35% sharps, and 6.86% others. The average composition of general waste was determined to be 46.87% food waste, 16.40% plastics, 13.33% paper/cardboard, 7.65% liquids, 6.05% textiles, 2.60% glass, and 0.92% metals.

2.9 Safety and Occupational Health

Most workers in hospitals in developing countries do not have the safety tools and immunizations, a clear understanding of the principles of disease transmission or the basic steps they can take to protect themselves. To protect workers, health care facilities need to invest in training and education for workers, the purchase of personal protective tools and clothing for clinical and non clinical staff that are likely to come into contact with potentially infectious or hazardous materials, and to make sure that workers receive at least basic immunizations against tetanus or hepatitis (Health Care without Harm, 2004).

Health care staff is exposed to many body fluids in their daily work. The risk of contracting an infection depends on the prevalence of a disease, the presence of possible transmission routes to workers and the frequency of exposure. The most common form of occupational exposure experienced by medical staff and waste handlers is by pathogens present in blood, such as hepatitis B and C and HIV, through a needle-stick injury (Egyptian Ministry of Health, 2003).

According to Pruss (1999), safety measures to protect staff focus on three topics: training of staff on handling medical wastes to avoid accidents, provision of protective clothing and equipment, and establishing immunization programs or protocols.

2.10 Medical Waste Hazards

Improper waste management can lead to environmental pollution (water, air, soil and etc), unpleasant smells, can foster the growth and multiplication of insects, rodents, and worms,

and may lead to transmission of diseases like typhoid, cholera, human immunodeficiency virus (HIV), and hepatitis (B and C) (Pruss et al., 1999; Abdulla et al., 2008).

2.11 Environmental Hazards Related to Medical Waste:

The improper disposal of medical wastes may have effects on the environment that can be summarized as the following according to Akter, 2000:

1. Ground water contamination and degradation of water quality.
2. Bio-accumulation in organisms' fat tissues, and biomagnification through the food chain.
3. Some pollutants from medical waste (e.g. heavy metals and PCBs) are persistent in the environment.
4. Accumulation of toxic chemicals within soil (proximity to agricultural fields, humans, soil organisms, wildlife, cattle).
5. Repeated and indiscriminate application of chemicals over a long period of time has serious adverse effects on soil microbial population, reducing the rate of decomposition, and generally lowering the soil fertility.
6. Pathogens lead to long term accumulation of toxic substances in the soil.
7. Samples collected for analysis have the potential to cause disease and illness.
8. Through direct contact or indirectly by contamination of soil, groundwater, surface water, and air.
9. Wind blown dusts from indiscriminate dumping also have the potential to carry hazardous particulates.
10. With domestic animals being allowed to graze in open dumps, there is the added risk of reintroducing pathogenic micro-organisms into the food chain.
11. Public nuisance (e.g. odors, scenic view, block the walkway, aesthetics, etc.)
12. Improper sterilization of instruments used in labor room may cause infection to mother and child.

13. Combination of both degradable and non-degradable waste increase the degradation rate of habitat due to the increasing number of sites necessary for disposal of wastes.

14. Plastic containers and plastic-bags may contaminate the soil and reduce the chance for water percolation into the soil during precipitation.

15. Open air burning does not guarantee proper incineration, and releases toxic fumes (dioxin and furans) into the atmosphere from the burning of plastics i.e., PCBs.

2.12 Health Hazards:

Improper handling, collection, storage, and disposal of medical waste expose the health of workers, patients and the public to injuries, accidents, and infectious diseases risks.

2.12.1 Injuries and Accidents Related to Medical Waste Could be the Following:

There is a risk of injuries related to medical waste handling and collection, for example cut-injury, punctured wound, laceration, strain and sprain of the joint of limbs and backache due to load hauling.

Akter et al. (1998) reported that, there were several incidents (10 cases out of 17) of injury due to exposure to medical wastes inside or outside of hospital premises. These were as follows:

- Hands cut due to handling broken glass
- Injuries by needle, and fingers permanently damaged/ became curved
- Right hands became paralyzed due to injury by a needle
- Two legs became paralyzed due to injury by a needle
- Skin diseases on legs and hands/ body
- Pus due to injury sometimes
- Ulcer on legs

In a study about medical waste management in Gaza governorates governmental hospitals, 70.4% of subjects noted that they were exposed to occupational hazards as a result of improper management of medical waste (Massrouje, 2000).

According to Basel Action Network (BAN) and Health Care Waste Harm organization (HCWHO) 1999, sharps which include syringes and needles, have the highest disease transmission potential amongst all categories of medical waste. Almost 85% of sharp injuries are caused between their usage and subsequent disposal. More than 20% of those who handle them encounter 'stick' injuries. They also mentioned that injuries from needle-stick and sharps occur frequently in developing countries, and that safer disposal facilities and routine hepatitis B vaccine should be adopted.

According to Ismail et. al. (2007) who in their study assessed the safe injection practices among 1100 health-care workers in 25 health-care facilities in Gharbiya Governorate, Egypt. Questionnaires were used to collect information and 278 injections were observed using a standardized checklist. There was a lack of infection control policies in all the facilities and a lack of many supplies needed for safe injection. Safe needle disposal in 47.5% and safe syringe disposal in 0%. Reuse of used syringes and needles was reported by 13.2% of the health-care workers and 66.2% had experienced a needle-stick injury. Only 11.3% had received a full course of hepatitis B vaccination. There was a lack of training of all interviewed health-care workers on different practices related to safe injection.

In fact, medical and health-care wastes have sharply increased in recent decades due to the increased population, number, and size of health care facilities, as well as the use of disposable medical products (Mohee, 2005).

2.12.2 Infectious Medical Waste Risk

Infectious hospital waste represents only a small part of total medical waste because of ethical questions and infection risks; it is a focal point of public interest. Infectious waste contains different kinds of pathogens or organisms that are potentials for infection or disease if not properly disposed. These include bacteria, viruses, parasites and fungal. Examples of different pathogens and diseases caused by infectious wastes according to Akter et.al, 1998:

Bacterial

Tetanus, gas gangrene and other wound infection, anthrax, cholera, other diarrheal diseases, enteric fever, shigellosis, plague and others.

Viral

Includes hepatitis B or C, poliomyelitis, HIV-infections, TB, sexually transmitted disease (STD), rabies and others.

Parasitic

It includes amoebiasis, giardiasis, ascariasis, ancylostomiasis, taeniasis, echinococcosis, malaria, leishmaniasis and filariasis.

Fungal

Fungal infections include various diseases like candidiasis, cryptococcoses, coccidiodomycosis and others.

2.13 HIV, HBV and HCV

In the 1980s and 1990s, concerns about exposure to human immunodeficiency virus (HIV) and hepatitis B or C virus (HBV/HCV) led to questions about potential risks inherent in medical waste. Hospital waste generation has become a prime concern due to a risk factor to the health of patients, hospital staff and extending beyond the boundaries of the medical establishment to the general population (Gordon et. al., 2004 and Rao et. al. 2004).

Infectious waste can transmit diseases, especially if it finds portals of entry. There is strong epidemiological evidence from Canada, Japan and the USA, that the main concern of infectious hospital waste is the transmission of HIV/ AIDS virus and more often of hepatitis B or C virus (HBV and HCV) through injuries caused by syringes contaminated by human blood. There is a potential risk of TB/ throat infection, typhoid, dysentery, diarrhea, rabies, and other bacterial or viral diseases. So the pathological laboratories do all these analysis to diagnose the diseases (Akter et.al. 1998).

The World Heath Organization estimated in 2000 that injection with contaminated syringes caused 21 million hepatitis B infections, 2 million hepatitis C infections, and 260,000 HIV infections (Shinee et al., 2008).

The proportion of new cases of hepatitis C that were attributable to unsafe injections exceeded 40% in 1996. This may have been related to the use of improperly sterilized needles that were used to treat schistosomiasis (El Khoby et. al., 2000). As a consequence of these unsafe injections, a large reservoir of chronic infection was established that still drives hepatitis C transmission in Egypt today (WHO, 2007).

In Cairo University Hospital, Egypt, the overall carrier rate for hepatitis B virus among health-care workers is about 28% (El-Batanoni, 1995). Approximately 13% of the Egyptian population is infected with hepatitis C virus, leading to a high burden of chronic liver disease, cirrhosis and liver cancer, as well as mortality resulting from these diseases (WHO, 2007).

Sophie et. al. reported that the health-care workers who give injections in their study in Mongolia were vaccinated against hepatitis B. In Mongolia, 67.8% of health-care workers reported that they had experienced at least one needle-stick injury in the previous12 months (Logez et. al., 2004).

In Senegal, 70% of staff members of health-care facilities reported needle-stick injuries in the previous 6 months (Dicko et. al, 2000).

2.14 Legislation and Polices

The legislation involves a lot of policies and rules that follow up the process of medical waste management. These policies and work guidelines are considered as a legal work protocol covering safe management of medical wastes and safe practices for waste handling, segregation, collection, transport, treatment and disposal.

The lack of policies, strategies and enforcement of legislation for the handling and disposing of medical waste in many developing countries could potentially lead to the spread of diseases and risks to public health, community and the environment. Moreover, improper management of medical waste could have serious implications for public health and the general environment (CEHA, 2002).

According to Visvanathan (2006), there is no specific legislation directly related to medical waste in many South Asian countries like Bangladesh, and Nepal. There are some basic legislations related to healthcare in some countries e.g. India but there is a lack of enforcement and unsatisfactory implementation.

Coker et. al. (2009), The study entailed a representative classification of nearly 400 healthcare facilities in Ibadan city, Nigeria from 11 local government areas. Primary data sources included field measurements, waste sampling and analysis and a questionnaire, while secondary information sources included public and private records from hospitals and government ministries. Results indicated the management practices in most facilities expose patients, staff, waste handlers and the population to health risks. The study proffers recommendations to include a 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 ,an obligation 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.

2.15 Planning

Formulation of objectives and planning are important for improving health-care waste management at the national, regional, and local level. Planning requires the definition of a strategy that will facilitate careful implementation of the necessary measures and the appropriate allocation of resources according to the identified priorities. This is important for the motivation of authorities, health-care workers, and the public, and for defining further actions that may be needed (WHO, 2009).

Planning of health-care waste management is necessary to prevent waste from adversely affecting human and environmental health. For the successful implementation of any medical waste management plan, a fundamental prerequisite is the availability of sufficient and accurate information about the quantities and composition of the waste generated (Qdais et al., 2007).

The development of the plan at a health care institution not only reduces the potential for occupational accidents, but also gives staff and managers the opportunity to address improvements in waste management activities. In addition, planning encourages cost-effective use of resources and materials associated with the safe handling, treatment and disposal of medical waste, and strengthen the relationship between health care institutions and national authorities and agencies (CEHA, 2002).

2.16 Training for Health Care Workers

Only 8.6% of the participants have taken previous training relating to medical waste management in Gaza governorates governmental hospitals (Massrouje, 2000).

Shaban (2009), in a study about medical waste management in laboratories of MOH in Gaza governorates, found that only 14.1% of lab technicians have received training relating to medical waste.

According to Bekir (2003), Under the World Bank–financed projects, state health departments offered training on HCW management procedures to government hospitals. The purpose of the training was to create awareness and facilitate implementation of India's Biomedical Waste Rules. The content and duration of the training program varied with the target audience, whether this involved the administrators, doctors, nurses, or cleaning personnel. The awareness training program covered issues as such waste minimization measures as the use of no disposable sterilized glass syringes instead of disposable syringes, and electronic thermometers instead of mercury thermometers. In general, medical officers and doctors were reported to be the group of hospital personnel who had given the least attention to the waste management issues.

Yong et. al. (2009), their study objective was to analyze and evaluate the present status of medical waste management in the light of medical waste control regulations in Nanjing, China. A comprehensive inspection survey was conducted for 15 hospitals, 3 disposal companies and 200 patients. 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 public awareness. The results indicated that the medical waste generation rate ranges from 0.5 to 0.8kg/bed/day with a weighted average of 0.68kg/bed/day. The segregated collection of various types of medical waste has been conducted in 73% of the hospitals, but 20% of the hospitals still use unqualified staff for medical waste collection, and 93.3% of the hospitals have temporary storage areas. Additionally, 93.3% of the hospitals have provided training for staff; however, only 20% of the hospitals have ongoing training and education. It was found that the centralized disposal system has been constructed based on incineration technology. The results also showed that there is not sufficient public understanding of medical waste management.

In Romania, 91% of health-care workers had attended at least one training session on universal precautions for infection control, including safe injection practices (Popesu et al, 2001).

2.17 Medical Waste Management Committee

Where a large, organized health care waste system is to be introduced, particularly at large health care establishments, a waste management committee could be set up.

This should include many of the infection control committee members, supplemented by a finance officer. One of the senior ranking members with good experience and motivation would also be designated as waste management officer and be responsible to the senior manager for the day-to-day operation and monitoring of health care waste management system (Pruss et.al.,1999 and Zghondi, 2002).

2.18 The Scientific Management of Medical Waste

Handling, waste minimization, segregation, collection, storage, transportation, disinfection and final disposal are vital steps for safe and scientific management of medical waste in any establishment (Acharya and Singh M., 2000). Inappropriate management of medical waste handling, segregation, collection, storage, transporting and disposal or treating could potentially lead to the spread of diseases and risks to public health, community and the environment.

2.18.1 Waste Minimization

Waste minimization is a waste management approach that focuses on reducing the amount and toxicity of hazardous waste that is generated. The EPA encourages waste minimization techniques that focus on preventing waste from ever being created (source reduction) and recycling. There are three general methods of waste minimization: source reduction, recycling, and treatment (Health Sciences Center, 2005).

2.18.2 Source Reduction

According to the Division of Environmental Health and Safety (2007), Source Reduction, defined as any practice which includes the following:

- Reduction of the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment prior to recycling, treatment, or disposal

- Reduction of hazards to public health and the environment associated with their release.

2.18.3 Recycling

Another method of waste minimization is recycling. Recycling is when a waste material is used for another purpose, treated and reused in the same process or reclaimed for another process. Recyclable products are the materials that may be recycled, either on-site or off-site (EMRO, 1996).

2.18.4 Segregation

The key to minimization and effective management of medical waste is separation and identification of the waste. The most appropriate way of identifying the categories of medical waste is by sorting the waste based on color. This has to be segregated into containers or bags at the point of generation (Indian Ministry of Environment and Forests Notification, 1998).

Segregation means separating different types of waste at the point of generation and keeping them isolated from each other. By segregating waste, appropriate resource recovery and recycling techniques can be applied to each separate waste stream. Another important reason for segregation has to do with the consequences of introducing hazardous or radioactive substances into treatment systems for infectious waste. For example that chlorinated plastics, such as polyvinyl chloride (PVC), burnt in an incinerator produce intermediate chemicals that react to form dioxins and furans, which escape the incinerator stack through the fly ash (HCWHO, 2001).

Shaban (2009) found that 81.9% of participants used safety boxes to segregate needles and syringes in laboratories of MOH in Gaza governorates.

Oweis et. al. (2005), their study was conducted in the form of a case study at one of Jordan’s leading medical centers, namely, the King Hussein Medical Center (KHMC). Its purpose was to report on the current status of medical waste management at KHMC and

propose possible measures to improve it. In general, it was found that the center's administration was reasonably aware of the importance of medical waste management and practiced some of the measures to adequately handle waste generated at the center. The study recommended that the present situation need to be addressed in the future including efficient segregation, the use of coded and colored bags, better handling and transfer means, and better monitoring and tracking techniques, as well as the need for training and awareness programs for the personnel.

2.18.5 Techniques for Segregation

Segregation entails separating certain types of waste into appropriate containers at the point of generation. Infectious waste should be segregated in clearly marked containers that are appropriate for the type and weight of the waste. Except for sharps and fluids, infectious wastes are generally put in plastic bags, plastic-lined cardboard boxes, or other leak-proof containers that meet specific performance standards. In the United States, red or orange bags are commonly used to designate infectious waste, while general waste is placed in black, white, or clear bags (HCWHO, 2001).

2.18.6 Labeling

Labels affixed to infectious waste containers and bags should include the international biohazard symbol and the word "BIOHAZARD" in a contrasting color. To improve segregation efficiency and minimize incorrect use of containers, the proper placement and labeling of containers must be carefully determined to differentiate between waste categories (HCWHO, 2001).

2.18.7 Collection

Improper waste collection when the infectious waste is mixed with general waste can render all of the waste potentially infectious and hazardous (Chaerul and Tnaka 2008).

On site collection requires staff to close the waste bags when they are three quarters full either by tying the neck or by sealing the bag. Storage area needs to be impermeable and hard standing with good drainage. It should provide an easy access to waste collection vehicle (Srivastava, 2000). According to WHO, infectious waste should be packaged in yellow bags and pathological waste in red bags labeled with the international biohazard symbol. (Al-Shanshoury, and Al-Ayed, 2002).

Massrouje (2000) found that medical wastes are collected in domestic waste bags and there are no special or color coding bags in Gaza governorates governmental hospitals.

Shaban (2009) found that about half of labs wastes are collected by domestic bags in laboratories of MOH in Gaza governorates.

Birpinar et. al. (2009), their study objective was to analyze the present status of medical waste management in the light of the Medical waste Control Regulation (MWCR) in Istanbul, the largest city in Turkey. The first regulation about medical waste management in Turkey was published in 1993, and as a candidate state, it was changed in 2005 in accordance with EU Environmental Directives. In this work, a survey of 14 questions about the amount, collection, and temporary storage of medical wastes was applied to 192 hospitals in Istanbul through face-to-face interviews. It was found that the estimated quantity of medical waste from the hospitals is about 22 tons/day and the average generation rate is 0.63kg/bed-day. Recyclable materials are collected separately at a rate of 83%. Separate collection of different types of wastes is consistently practiced, but 25% of the hospitals still use inappropriate containers for medical waste collection. Almost 77% of the hospitals use appropriate equipment for the medical waste collection personnel. The percentage of the hospitals that have temporary storage depots is 63%.

2.18.8 Transportation

The basic criteria for safe transportation include segregation of infectious and non-infectious waste and the use of sharp containers to dispose needles right after injection. Infectious waste must be decontaminated before transportation to final disposal. If the health facility has a formal agreement with a public or private central treatment plant those must be certified by a regulatory body or endorsed by professional associations and the community. Transportation of HCW needs to conform to legal requirements. If such do not exist at national levels, international standards should be considered (WHO, 2005).

Massrouje (2000) showed that medical waste is transported manually in domestic waste bags by 97.4% in Gaza governorates governmental hospitals.

Al-Khatib and Khatib(2006), studied medical waste management in a Palestinian hospital in the West Bank and the role of municipality in this management. In general, “good management practices” were inadequate; there was insufficient separation between

hazardous and non-hazardous wastes, an absence of necessary rules and regulations for the collection of wastes from the hospital wards and the on-site transport to a temporary storage location inside and outside the hospital and inadequate waste treatment and disposal of hospital wastes along with municipal garbage. Moreover, training of personnel was lacking and protective equipment and measures for staff were not available. No special landfills for hazardous wastes were found within the municipality.

2.18.9 Storage

According to EPA technical guidelines (2003), the requirements of medical waste storage are as the following:

- Contain medical waste in a manner that is not offensive and that minimizes the threat to health, safety or the environment.
- Store all containers of medical waste in a secure location.
- Ensure that all necessary equipment required to clean and disinfect the area in case of accidental spillage is easily available and accessible.
- Treat any waste mixed with medical waste, as medical waste.
- Sharps such as needles, syringes with needles and surgical instruments should be handled as the following:

1- The disposal of sharps should not incorporate cutting, bending or any other manipulation that could generate aerosols or splatter contaminated fluids.

2- Place sharps into a suitable container that is puncture-resistant, leak-proof, shatter-proof and able to withstand heavy handling

3- Display the universal biohazard label clearly indicating the nature of the contents.

4- The container should have an opening which is accessible, safe to use, and designed so that it is obvious when the container is full

5- That is sealed when full or ready for disposal

6- Can be handled without danger of the contents spilling or falling out.

7- Place all medical waste other than sharps in clearly labeled heavy duty yellow plastic bags or wet strength paper bags. Bags intended for domestic use are unsuitable for this waste.

8- Tie the bags so as to prevent leakage or expulsion of solid or liquid wastes during storage, handling or transport and ensure they will not be subject to compaction by any compacting device.

The Massrouje (2000) study found that there were closed rooms for storage in Gaza governorates governmental hospitals.

2.18.10 Treatment

Treatment means any method, technique or process which is designed to change the physical, chemical or biological character or composition of waste (Al-Shanshoury, and Al-Ayed, 2002).

The last technique for waste minimization is treatment of waste. Wastes that are neutralized or detoxified and managed at the source can reduce environmental risks that might occur during transportation and handling. For example neutralization of acids or bases and chemical treatment of toxic chemicals as the final step of the experiment. These steps either decrease or eliminate toxicity or help to reduce the volume of waste (Environmental Health and Safety Department, 2002).

Final treatment of medical waste can be done by technologies like incineration, autoclave, hydroclave or microwave (Rao, 1995).

The waste treatment methods vary in their capabilities, cost, availability to generation and impacts on the environment. The various methods include incineration, autoclaving, chemical methods, thermal methods (low and high), ionizing radiation process, plasma system, deep burial and microwave. Incineration and autoclaving are considered traditional methods (Cassedy, 1991 and Veda et. al., 2007).

It was observed that 23.7% of medical waste is disposed with domestic waste, 2.6% in landfills and 39.4 by incinerator in Gaza governorates governmental hospitals (Massrouje, 2000).

2.19 Selection of Treatment Technologies

The selection of the most appropriate system for medical waste treatment depends on the composition of the medical waste, the volume of waste to be treated, staffing requirements for the system in terms of both numbers and education levels of employees, support capabilities of the vendor, and initial and continuing operating costs. Several critical factors which should be considered in the selection of an alternative treatment technology.

2.19.1 Incineration

Incineration is a complex technology that is used to burn waste. The problem of medical waste is one of disinfecting the waste and not of destroying it. With the increased use of disposables in medicine, the amount of plastic going for incineration has increased manifolds. The burning of plastics, especially in an unregulated incinerator, creates a new problem of toxic chemicals, some of which are super toxins even in extremely small quantities. Incineration of medical waste converts a biological problem into a chemical problem.

The major advantages of incineration are significant reduction in the volume of material, and destruction of pathogens and hazardous organics.

The main disadvantage is that incineration may emit trace amounts of unwanted pollutants such as polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzo–furans (PCDF), in addition to acidic gases and heavy metals usually in cities due to the typical location of hospitals. Incineration has been the most widely used treatment technology for the disposal of medical wastes. The health effects of toxins produced by medical waste incinerations; in an attempt to destroy pathogens the chemical hazards are created, which are extremely expensive to monitor and control. The different types of toxic air emissions from incinerators may include acidic gases, dioxins and furans and heavy metals.

According to Nazareth and Rathi (2008), the different types of toxic air emissions from incinerators are as the following:

Acid gases including nitrogen oxide, which has been shown to cause acid rain formation and affect the respiratory and cardiovascular systems. As large amounts of plastics are incinerated, hydrochloric acid is produced. This acid attacks the respiratory system, skin, eyes and lungs with side effects such as coughing, nausea and vomiting.

Dioxins and furans are organochlorines, which are formed as a result of the combination of chlorine molecules in plastics polyvinyl chloride (PVC) with organic materials. Organochlorines mimic hormones and do not break down or biodegrade. So, they bio-accumulate and magnify up in the food chain. They are proven carcinogens and endocrine disrupters; they also weaken the immune system and damage the male and female reproductive organs.

Heavy metals are released during incineration of medical waste. Mercury, when, incinerated vaporizes and spreads easily in the environment. Lead and cadmium present in the plastics also accumulate in the ash. Acute and chronic exposure to lead can cause metabolic, neurological, and neuropsychological disorders. It has been associated with decreased intelligence and impaired neurobehavioral development in children.

Cadmium has been identified as a carcinogen and is linked to toxic effects on reproduction, development, liver, and nervous system.

According to Hoyos et. al. (2008), a survey was conducted to measure the total suspended particulate (TSP), polychlorinated dibenzodioxin (PCDD) and dibenzofuran (PCDF) emissions in combustion gases from 12 hospital waste incinerators in Antioquia, Colombia. A Base line data of TSP, PCDD and PCDF emissions was used to improve the management of medical waste**.** Emissions amount of these incinerators were measured indicating of poor control of operation parameters. Several suggestions are made to improve medical waste management practices in Colombia.

As a consequence of a monitoring program of a new municipal waste incinerator initiated in 1998, a large data-base of dioxin and furan concentrations in the atmosphere of the metropolitan area of Porto, in northern Portugal, has been collected. Dioxin emissions from these facilities were measured indicating emissions 100 to 1000 times larger than recent European Union directive limits. Data show that the shutdown of these two units had a clear effect on the improvement of air quality in the region that was observed either on the overall level of dioxins and furans (Coutinho et. al., 2006).

Sabiha et. al. (2008), their study objective was to investigate the concentration of heavy metals remained in ash of the incinerated waste. Ash samples from 5 incinerators were collected for 5 weeks and 25 samples were analyzed for investigation of toxic heavy metals in them. The concentration of Cd, Cr, Cu, Pb and Zn was measured using FAAS (flame

atomic absorption spectrometer). The concentration of Pb and Zn was found relatively higher than that of other constituents in the waste. Average concentration of Pb was 3.9, 3.2 and 4.6 μg/g whereas that of Zn was 6.6, 5.3 and 6.7 μg/g respectively in the waste from Hospital 1, Hospital 2 and Hospital 3. The main source of these metals in the incinerated ash was the presence of PVC (polyvinyl chloride) material in the waste. A wide variation in concentration of metals was due to diversity in the initial waste composition, design of the incinerator, and operating conditions.

Medical waste incinerator generates ash that is potentially hazardous. In the United States, medical waste incinerators have become less common; however the technology is still being exported (Gonzaga, 2006).

Finally, the incineration of medical wastes must be controlled and validated by continuous monitoring of operating parameters that include physiochemical ones through measurement of pollutant concentrations in effluent gases in addition to biological tests (Blenkhan, 2005).

2.19.2 Low-temperature systems

In general, low-heat thermal technologies operate between 93°C to about 177°C. Two basic categories of low-heat thermal processes are wet heat (steam) and dry heat (hot air) disinfection. Wet heat treatment involves the use of steam to disinfect and sterilize waste and is commonly done in an autoclave.

Microwave treatment is essentially a steam disinfection process since water is added to the waste and destruction of micro-organisms occurs through the action of moist heat and steam generated by microwave energy. In dry heat processes, no water or steam is added. Instead, the waste is heated by conduction, natural or forced convection, and/or thermal radiation using infrared heaters (Health Care without Harm, 2004).

2.19.2.1 Autoclave disinfection (Low-temperature systems)

Even with the numerous alternatives available, autoclaves are the most popular methods of treatment because of their history of use in the healthcare. Waste must be shredded. This is followed by heating to a high temperature using high pressure steam. Pathogens are destroyed by heat conduction and high pressure steam. Large volumes of steam are produced but with re-condensation of waste vapor off-gases have low pollution potential.

No weight reduction is achieved but there is some volume reduction from the shredding. The method requires trained staff with maintenance skills for high-pressure steam systems. These are usually available in most countries (Rushbrook and Zghondi, 2005).

A new generation of autoclaves has been developed that may be considered alternative treatment technologies. These technologies use shredding during the treatment process to ensure better penetration of steam. Additionally, these systems achieve significant volume reduction (up to 85%). These technologies include Tempico "US", Hydroclave "Canada", Lajtos "France", and Stericomat "Germany" (Krisiunas, 2005).

2.19.2.2 Microwave disinfection (Low-temperature systems)

Microwaves are defined as those with a frequency in between those of radio and infrared waves in the electromagnetic spectrum. When used in the treatment of medical waste, they stimulate the pre shredded and moistened waste to generate heat (95 degrees C or greater) and release steam (Krisiunas, 2005)**.**

Waste must be shredded first then dampened, before being heated by microwave generators. Pathogens are destroyed by heat conduction and heat radiation. Since this is a non-combustion process fewer off-gases are produced. In addition, some volume reduction occurs due to pre-shredding of the waste. There is no weight reduction and the system requires trained staff and some reliance on international sources of spare parts (Rushbrook and Zghondi, 2005).

2.19.3 High-temperature systems

High-temperature technologies operate between 545°C to about 6000°C. Two basic categories of high-temperature processes are Pyrolysis and Plasma Technology. Pyrolysis involves the treatment of waste in the absence of oxygen. In a plasma system, an electric current is used to ionize an inert gas to create high temperatures.

2.19.3.1 Pyrolysis system

Pyrolysis involves the high temperature (545 to 1,000 degrees C) treatment of waste in the absence of oxygen. In generating these high temperatures, the systems treat, destroy and reduce the volume of medical waste (Krisiunas, 2005).

2.19.3.2 Plasma Technology

In a plasma system, an electric current is used to ionize an inert gas (e.g., argon) to cause the formation of an electric arc to create temperatures as high as 6,000 degrees C. The medical waste within the system is brought to temperatures between 1,300 to 1,700 degrees C, destroying potentially pathogenic microbes and converting the waste into a glassy rock or slag, ferrous metal, and inert gases (Krisiunas, 2005).

2.19.4 Chemical treatment

Chemical technologies use disinfecting agents in a process that integrates internal shredding or mixing to ensure sufficient exposure to the chemical. Chemical processes often involve shredding, grinding, or mixing.

Chemical treatment systems have an extensive and well history in disinfecting and sterilizing environmental surfaces and medical devices (Jagger et.al., 1989). Inherent in the operation of such systems is the fact that the waste must first be shredded prior to exposure to such agents as sodium hypochlorite, chlorine dioxide, peracetic acid, glutaraldehyde, quaternary ammonium compounds, etc (Krisiunas, 2005).

2.19.5 Irradiative processes

Irradiation-based technologies involve electron beams, Cobalt-60, or UV irradiation. These technologies require shielding to prevent occupational exposures. Electron beam irradiation uses a shower of high-energy electrons to destroy micro-organisms in the waste by causing chemical dissociation and rupture of cell walls. The pathogen destruction efficacy depends on the dose absorbed by the mass of waste, which in turn is related to waste density and electron energy (Health Care without Harm, 2004).

2.20 Treatment Technologies Comparison

The waste treatment methods vary in their capabilities, cost, availability to generation and impacts on the environment. Several critical factors which should be considered in the selection of an alternative treatment technology.

Treatment technologies comparison according to Visvanathan, (2006) as seen in table (2.1).

Table (2.1): Treatment technologies comparison

Treatment technologies					
	Incineration	**Autoclave**	**Microwave**	**Chemical disinfection**	**Plasma pyrolysis**
Investment/ Operating cost	High	Moderate	High	Low	High
Suitability of the waste	Not for radioactive	All except Pathological, Pharmaceuticals, and chemicals	All except Cytotoxic& radioactive	Liquid waste	All
Easy of operation	No	Yes	Yes	Yes	No
Waste Volume Reduction	Significant	Less	Significant	--	Significant
Odor problems	Yes	Slight	Slight	Slight	--
Environmental Friendly	No	Yes	Yes	No	Yes

2.21 Waste Disposal

Disposal means the discharge, deposit, injection, dumping or placing of any waste into or on any land or water (WDNR, 2006).

In developing countries, additional hazards occur from scavenging on waste disposal sites and manual sorting of the waste recuperated at the back doors of health-care establishments. These practices are common in many regions of the world. The waste handlers are at immediate risk of needle-stick injuries and other exposures to toxic or infectious materials (Liss, 1990).

Although very little disease transmission from medical waste has been documented, both the American Dental Association (ADA) and Center for Disease Control recommend that medical waste disposal must be carried out in accordance with regulation (Harrison 1991).

Chitnis et. al. (2003), have devised a solar heating system for disinfecting infectious waste in economically less developed countries. They obtained a considerable reduction in

the amount of viable bacteria by this method. The medical waste should be completely free of pathogenic bacteria before disposal. This would ensure maximum public hygiene quality.

Bdour et. al. (2007), their study included a survey of the procedures available, techniques, and methods of handling and disposing of medical waste at over 100 beds of healthcare facilities located in Irbid city, Jordan (a total of 14 healthcare facilities, including four hospitals and 10 clinical laboratories). The study took into consideration both the quantity and quality of the generated wastes to determine generation rates and physical properties. Results of the survey showed that healthcare facilities in Irbid city have less appropriate practices when it comes to the handling, storage, and disposal of wastes generated in comparison to the developed world. There are no defined methods for handling and disposal of these wastes and there are no specific regulations or guidelines for segregation or classification of these wastes. Average generation rates of total medical wastes in the hospitals were estimated to be 3 to 6 kg/patient/day (1.9 to 4 kg/bed/day). For medical laboratories, rates were found to be in the range of 0.053–0.065kg/test-day for governmental laboratories, and 0.034–0.102kg/test-day for private laboratories.

In addition, perceived risks related to health-care waste management may be significant. In most cultures, disposal of health-care wastes is a sensitive issue and also has ethical dimensions (Marcus, 1988).

CHAPTER 3

METHODOLOGY

This chapter illustrates the research methodology which was used to conduct this study. The chapter presents the study design, study population, study setting, and the ethical procedures that were considered in the study. Tools and instruments that were used in the study, their validity and reliability, piloting, data collection and analysis processes are also presented in this chapter. The chapter also presents the selection criteria and the limitations of the study.

3.1 Study Design:

A quantitative analytical descriptive design was used in this study to describe the present status of the level of knowledge, attitude and practice of medical waste management among health care workers of non-governmental hospitals in Gaza Governorates. This type of design is suitable because it enables the researcher to describe, explore, and analyze the status of the phenomenon being studied (Polit and Hingler, 1999).

3.2 Study Population:

The study population is diverse and included two sub-populations; the first sub-population is all health care professionals and personnel (administrative, physicians, nurses, and health workers) involved in the medical waste management process according to the hospital size in non-governmental hospitals in Gaza Governorates. The second population is the medical waste management departments in non-governmental hospitals that are located within Gaza Governorates and are recognized by the Palestinian Ministry of Health as licensed non-governmental hospitals.

3.3 Sample Size:

The estimated total number of employees in non-governmental hospitals that are located within Gaza Governorates and are recognized by the Palestinian Ministry of Health as licensed non-governmental hospitals is 1171 health care workers according to each hospital's director, 2009. The total number of workers who come in contact with potential medical waste is about 1020. Health care workers who don’t deal with medical waste like

secretaries or clerks and secretaries were excluded. Annex 7 details the number of health workers in each of the non-governmental hospitals.

The sample size was estimated by using Epi-info program version 6. The confidence level was 95% = 1.96 and with margin of error 5%. The sample size included 275 health care professionals and personals of non-governmental hospitals in Gaza Strip who were randomly selected.

To ensure good representation, the percentage of representation was calculated as shown in Table 3.1

Table 3.1 Classification of sample size

Target	No. of all hospitals	No. of included hospitals	No. of excluded hospitals	Study population	Sample size	Number of respondents	Response rate
Health care workers	13	11	2	1020	275	220	80%

3.4 Response rate

The response rate in this study was 80% representing those who agreed to participate in the study. This was in part due to the instrument used in this study which encouraged the target group to participate.

3.5 Setting of the Study:

The study was conducted in non-governmental hospitals that are located within Gaza Governorates and are recognized by the Palestinian Ministry of Health as licensed non-governmental hospitals. This includes 13 of the non-governmental hospitals. The study covered 11 non-governmental hospitals that are located within Gaza Governorates that because Mahdi hospital was excluded from the study which has less than ten health care workers and Arab-Ahli hospital refused to participate. The study was conducted in Gaza governorates including (Gaza, north, middle and south area). The questionnaire was distributed to cover the geographical locations over Gaza Strip. These hospitals are distributed as follow:

• ***One hospital (***North Gaza Governorate***):*** Al-Awdaa hospital

•***Six hospitals (***Gaza Governorate***):*** Patient's Friends' Benevolent society, Alwafa', Al Quds-PRCS, Public Service hospital, Al Hellou hospital, and, Specialist Eye hospital.

• ***One hospital (***Middle Gaza Governorate***):*** Yafa hospital

• ***Three hospitals (***Southern Gaza Governorate***)***: Dar Al Salam hospital, Al Amal hospital-PRCS and Al Kuwait specialist hospital**.**

Table (3.2) shows the non-governmental hospitals in Gaza Governorates according to the Ministry of Health in Gaza, 2009 and PCBS, 2008a).

Table 3.2: The non-governmental hospitals in Gaza Governorates

Hospital	Governorate	No. of beds
Al-Awdaa hospital	North	32
Patient's Friends Benevolent	Gaza	42
Arab-Ahli hospital	Gaza	58
Al Wafa'	Gaza	51
Al Quds-PRCS	Gaza	51
Medical Central for Obstetric and Surgery, Public Service hospital	Gaza	9
Al Hellou hospital	Gaza	20
Mahdi hospital	Gaza	14
Specialist Eye hospital, (Public service)	Gaza	8
Yafa hospital	Middle	26
Dar Al Salam hospital	Khan Yunis	16
Al Amal hospital- PRCS	Khan Yunis	30
Al Kuwait specialist hospital	Rafah	6

3.6 Period of the study

The study was conducted in the year 2009, starting with the literature review in February 2009. The proposal was approved by the School of Public Health-Al Quds University in May 2009. An administrative approval from the General Directorate of Hospitals and an ethical approval from Helsinki Committee were obtained in June 2009. Pilot study was conducted in June 2009, while actual data collection took place in July 2009. Data analysis was completed by September 2009 and the final results were available by November 2009.

3.7 Selection Criteria

3.7.1 Inclusion criteria

- All health care professionals and personnel of non-governmental hospitals involved in the medical waste management process according to the hospital size and specialty in Gaza Governorates were included.
- Non-governmental hospitals that are located within Gaza Governorates and are recognized by the Palestinian Ministry of Health as licensed non-governmental hospitals, and with ten or more health care workers.

3.7.2 Exclusion criteria

- All non-governmental hospitals which have less than ten health care workers in Gaza Governorates were excluded.
- Health care workers professionals and personals of non-governmental hospitals who were not involved in the medical waste management process according to the hospital size and specialty in Gaza Governorates were excluded.
- Health care workers who don't deal with medical waste like secretaries or clerks were excluded.
- Illiterate cleaners were excluded from the study.

3.8 Ethical and administrative measures

The study highly respected the research ethical principles so and before conducting the study, the researcher obtained an ethical approval from both the School of Public Health-Al Quds University and the Helsinki Committee (Annex 3). The researcher attached an explanatory letter that clarifies the purpose of the study, study confidentiality, and the voluntary right of participation in the study to each person who was eligible to participate.

3.9 Research Instruments:

3.9.1 Self- Administered Questionnaire

The questionnaire was designed in Arabic language to avoid language difficulties that might interfere with data collection (Annex 4), and an English translation was also attached (Annex 5). The questionnaires developed with close-ended and open-ended questions to identify gaps and weakness in the medical waste management process. It was designed to be a self-administered questionnaire. The questionnaire contained the following categories of data:

3.9.1.1 Questionnaire Design:

Questionnaires are extremely critical components of the research process because they identify which information is important and the opinion of the participants about the problem discussed. The design of the questionnaire requires very careful consideration. One should aim at formulating the questions such that no misinterpretation is possible. The questionnaire contained the following categories of data:

- Demographic characters.
- Training, supervision and legislations related to medical waste management.
- Knowledge about medical waste management.
- Attitudes about medical waste management.
- Medical waste management practices which include handling and segregation, collection, storage, transport, treatment and disposal.

3.9.2 Checklist

A checklist was used to document observation of the existing situation of medical waste management in different wards or departments in the non-governmental hospitals. Observational checklist was prepared in English language to monitor the medical waste management practices (Annex 6). The checklist consisted of the following data:

- Plan and legislations related to medical waste.
- Types of medical wastes generated.
- Method of medical waste handling, segregation and labeling.
- Method of medical waste collection and storage.
- Method of medical waste treatment and disposal.

3.10 Pilot study

After revision and modification of the study questionnaire and checklist by field-related specialists, a pilot study was conducted on 5 interviewees to detect its suitability and appropriateness and to detect if there were further needed modifications.

Participants of the pilot study were asked about any ambiguities and their opinion about the questionnaire and the other tools. Some vague questions in the questionnaire were changed to be more accurate after the pilot study which was a helpful exercise for the later data collection process. Then actual data collection began at the selected non-governmental health hospitals.

3.11 Data collection

Two instruments were used to collect the data, the self-administered questionnaire and a checklist. The self-administered questionnaire was answered by all health care professionals and personnel of non-governmental hospitals involved in the medical waste management process according to the hospital size and specialty in Gaza Governorates were included. The collected questionnaires were checked and overviewed for completeness, then were entered into the computer for statistical analysis.

The researcher completed the checklist in unannounced visits to the non-governmental hospitals and then all collected data were entered into the computer to undergo statistical analysis.

3.12 Data management

3.12.1 Data entry

Filled questionnaires were checked and overviewed again. Then after that, data was entered into the computer using SPSS software version 13 to be analyzed. After finishing the data entry process, data cleaning was done to guarantee that all data were entered accurately and in appropriate way. Data cleaning was conducted through selecting and checking out a random number of the filled questionnaires, and also through operating frequencies and descriptive statistics for most variables.

3.12.2 Data analysis

After collecting and revising the filled questionnaire and checklist, the next step was coding the questionnaires and the checklist using the computer software statistical package for social science (SPSS) version 13.0. Then, the coded questionnaires and checklist were entered into the computer by the researcher with the help of the supervisor and statistical advisor. Data cleaning was done through checking out a random number of the questionnaire and through exploring descriptive statistic frequencies for all variables. Means and standard deviations were computed for the continuous numeric variables and then coded. Reliability was tested to ensure the internal validity of the findings. Scores were computed individually based on the specified study domains. Means were appropriately calculated. In addition, to examine the potential relationships between the different variables, and independent t-test and one way ANOVA test were used. T-test was used to examine the differences in the mean scores for variables with two possibilities. ANOVA test was used to examine differences in the mean scores for variables with more than two possibilities.

3.13 Reliability and validity

3.13.1 Reliability

Reliability of an instrument is the degree of consistency and stability with which it measures the attribute it is supposed to be measuring (CSU, 2009). The used tools are

internationally tested by many researchers to ensure its reliability. However, the researcher had also tested these tools again to ensure that the reliability in this study is high and congruent with previous studies.

3.13.2 Validity

Validity of an instrument is considered to be an important issue that have been discussed and stressed out by many researchers. Before data collection, the questionnaire has been reviewed by different experts with different backgrounds, academic, managers, and researchers, in order to ensure its face and content validity.

Face validity is the extent to which the items of a test or procedure appear superficially to be acceptable and appealing to the subject (CSU, 2009). So, face validity is concerned with popularity or common acceptance rather than scientific truth and doesn't depend on established theories for support. In contrary, content validity refers to the degree to which an instrument adequately covers the items it is supposed to be measuring (CSU, 2009). The previously mentioned eight experts reviewed the instrument and consensus about the questions was reached. Additional validity measures were implemented and included training of the researcher assistant, standardization of implementation, standardization of tools, reviewing the filled questionnaires and data cleaning.

3.14 Limitations of the study

The researcher considered the following points as limitations he faced during conducting his study:

- The unsettled general political situation in the Gaza Strip and political conflict between Palestinian factions which influenced the health sector may affect the way in which some employees responded to the questionnaire.
- Limited scientific resources and few literatures on health waste management in Gaza Strip faced the researcher during the literature review writing.
- The frequent cut-offs of electricity.

CHAPTER 4

RESULTS AND DISCUSSION

This chapter presents the results of the study and discusses its key findings. This chapter shows the descriptive analysis of the study findings in general and of the respondent's characteristics in particular. Also, it presents an evaluation of the current situation of medical waste management in the non-governmental hospitals in the Gaza Governorates.

Medical waste management questionnaire and checklist

4.1 Hospitals location

Medical waste management questionnaires were distributed in 11 hospitals in Gaza governorates and the medical waste management process was observed using a checklist in these hospitals. The hospitals were distributed in Gaza governorates as follow: 6 hospitals in Gaza governorate, 1 hospital in the north governorate, 1 in the middle governorate, 2 in Khanyounis governorate and 1 in Rafah governorate. Out of the 11 hospitals included in the study, 6 (54.5 %) were located in Gaza governorate, as shown in table 4.1.

Table 4.1: Distribution of the study hospitals within Gaza Governorates

Location	No.	%
North	1	9.1
Gaza	6	54.5
Mid-zone	1	9.1
Khanyounis	2	18.2
Rafah	1	9.1
Total	**11**	**100**

275 questionnaires were distributed among health care workers in 11 nongovernmental hospitals in Gaza governorates, 220 subjects responded and the response rate was 80%. Table 4.2 shows the distribution of questionnaires among non-governmental hospitals and the table in annex 8 shows the numbers of questionnaires distributed in hospitals' wards.

Table 4.2: Distribution of questionnaires among the study hospitals

Hospital	No. of Questionnaires	Percentage%
Eye specialist, (Pubic service)	8	3.6
Al Amal	20	9.1
Al Hellou	11	5.0
Al Kuwait specialist	14	6.4
Al Quds-PRCS	37	16.8
Dar Al Salam	20	9.1
Al Wafa'	21	9.5
Al-Awdaa	25	11.4
Patient's Friends Benevolent	20	9.1
Obstetric and Surgery, (Public service)	21	9.5
Yafa	23	10.5
Total	**220**	**100**

4.2 Socio-demographic characteristics

The study respondents were from diverse socio-demographic characteristics. As illustrated in table 4.3, the greater proportion of the study respondents were males who represented about 63.6% of the total respondents while females represented only 36.4%. This result indicates that males are more involved in the working force than females in nongovernmental hospitals, as with other sectors in the Palestinian health care system where males usually constitute the greater portion of the workforce in Gaza Strip (PCBS, 2007).

The mean age of all workers who participated in this study was 31.5 years. About 56.3% of the study subjects with experience 5 years or less. As for education level, the most of study subjects have bachelor degree by 51.8 % and master degree by 16.8 %. This finding agrees with the finding of MOH (2005) about education indicators in Palestine, the MOH concluded that Palestinian community is a well- educated one and that Palestinians have always highly appreciated education. The distribution of the occupation for the study subjects is follows: 22% physicians, 1.4% dentists, 40.4% nurses, 0.5% dental technicians, 11% lab tech., 5.5% x-ray tech. 8.3% pharmacists, 9.6% workers, and 1.4% other.

About 19.5% of the respondents have management responsibilities, and 24.4% of the respondents who have management responsibilities have high administration responsibilities. Decision makers have different strategies; the most suggested strategy is the establishment of medical waste management directorate. The directors of health care

establishment are responsible for health protection and safety at work place and bear a legal responsibility for the safe disposal of medical waste generated in their hospitals. They should take all responsible measures to prevent medical waste from causing environmental pollution or adverse effects on human health (Al-Shanshoury et. al., 2002).

Table 4.3: Socio-demographic characteristics of the study participants

	Item	**No.**	**%**
1.	**Sex**		
	Male	140	63.6
	Female	80	36.4
	Total	**220**	**100**
2.	**Age**		
	30 Yrs and less	127	58.3
	From 31 to 40 Yrs	60	27.5
	More than 40 Yrs	31	14.2
	Total	**218**	**100**
	(Mean 31.5 = MD=29.0 Std= 9.6)		
3.	**Years of experience**		
	5 Yrs and less	120	56.3
	From 6 to 10 Yrs	43	20.2
	More than 10 Yrs	50	23.5
	Total	**213**	**100**
	(Mean =7.3 MD= 5.0 Std=2.1)		
4.	**Level of education**		
	Less High School	5	2.3
	High school	13	5.9
	Diploma	51	23.2
	B. Sc	114	51.8
	Master and more	37	16.8
	Total	**220**	**100**
5.	**Occupation**		
	Physician	48	22
	Dentist	3	1.4
	Nurse	88	40.4
	Dental tech.	1	0.5
	Lab. tech.	24	11
	X-ray tech.	12	5.5
	Pharmacist	18	8.3
	Worker	21	9.6
	Other	3	1.4
	Total	**218**	**100**
6.	**Have a management responsibility**		
	Yes	41	19.5
	No	179	80.5
	Total	**220**	**100**
7.	**Level of management responsibility**		
	High admin.	10	24.4
	Mid Admin.	21	51.2
	Low Admin.	10	24.4
	Total	**41**	**100**

4.3 Medical waste compositions

Wastes generated by various activities carried out in the hospitals can be classified into infectious, pathological, pharmaceutical, chemical, sharps, radioactive, pressurized containers, high heavy metal and genotoxic wastes (Harvery et al., 2002). The waste composition of the study hospitals is shown in table 4.4.

Table 4.4: Medical waste composition in the study hospitals

Sn.	Item	Present		Not Present		Total	
		No.	%	No.	%	No.	%
1.1	Infectious waste	11	100.0	0	0.0	11	100.0
1.2	Sharps	11	100.0	0	0.0	11	100.0
1.3	Pathological waste	11	100.0	0	0.0	11	100.0
1.4	Pharmaceutical waste	10	90.9	1	9.1	11	100.0
1.5	Radioactive waste	0	0.0	11	100	11	100.0
1.6	Chemical waste	10	90.9	1	9.1	11	100.0
1.7	Pressurized containers	8	82.7	3	27.3	11	100.0
1.8	Heavy metal waste	0	0.0	11	100	11	100.0

Infectious waste includes laboratory cultures; isolation wards wastes, tissues, and used dressings. It was observed that this waste category is generated by all hospitals. Based on the total amount of waste generated, about 15% to 35% of hospital waste is regulated as infectious waste (Glenn and Garwal, 1999). Sharps include any item that can cause cuts or punctures such as needless, syringes, blades and broken glass. Infectious waste and sharps are generated by all hospitals in the study (100%).

Pathological waste (Anatomical waste) that includes body parts, blood, placentas, or other fluids. It is generated by all hospitals (100%).

Pharmaceutical waste that includes any expired drugs or unwanted, unused, and contaminated drugs is generated by the majority of the hospitals (90.9%).

Radioactive waste that includes radioactive substances from radiotherapy and laboratory work is not generated in any of the study hospitals, and that is because the radiotherapy is not present in Gaza Strip, and cancer patients who need radiotherapy have to travel abroad to get the required medical treatment.

Chemical waste that includes all chemicals used for cleaning or diagnostic work such as solvents and disinfectants is generated by the majority of the hospitals (90.9%).

Pressurized containers include any gas cylinders, cartridges and aerosol cans that may cause potential harm. It is generated by 82.7% of the hospitals.

Heavy metal waste includes any unwanted batteries, broken thermometers or blood pressure gauges. Dental Amalgam particles are a source of mercury, which is known to be neurotoxin and nephrotoxic. Fetuses and newborn babies are more sensitive to mercury than adults and there seems to be a great difference in sensitivity among individuals (Preben, 2004). It was not observed in any of the study hospitals.

4.4 Training, supervision and legislation

It was found that only 4.1% of the study subjects went through training courses related to medical waste management as noted in table 4.5. This finding agrees with the findings of Massrouje (2000), her study found that only 8.6% of the participants have taken previous training relating to medical waste management in Gaza governorates governmental hospitals. The results also agree with the findings of Abu Alqomboz (2002), in his study about hazardous wastes management in Gaza Strip which indicated that only 17.6% of the health workers received training on wastes management. Also the results also agree with Al-Khatib and Khatib (2006) study about the medical waste management in a Palestinian hospital in the West Bank, which concluded that there is a lack of training for personnel. Shaban (2009), in a study about medical waste management in laboratories of MOH in Gaza governorates, found that only 14.1% of lab technicians have received training relating to medical waste.

About 35.5% of the study subjects reported that a specialized person to supervise the process of medical waste management is available in their hospitals, while 40.5% say there is no such person available and 24% said that they don’t know.

Only 24.1% of the study subjects reported that there is a waste management committee in their hospitals. About 21.4% of the study subjects have seen medical waste management plans in their hospitals, 15.5% said yes but they have not seen any plans, while it was observed during the visits to the different hospitals that there are no published plans for medical waste management in all hospitals. This result is in line with Abu Alqumboz study (2002) which found that 55% of institutions that deal with hazardous waste lack a waste management plan. Planning of health-care waste management is necessary to prevent waste from adversely affecting human and environmental health.

As shown in table 4.5, only 17.3% of the study subjects have seen waste management legislation in the study hospitals, while it was observed that there is no legislation for medical waste management in all hospitals that were visited as seen in table 4.6. This goes with what was reported by Visvanathan (2006), that there was no specific legislation directly related to medical waste in many South Asian countries likes Bangladesh and Nepal.

There was a difference between reported (through questionnaire), and observed through checklist). This is what happened when asking about the availability of plan and legislation related to medical waste management. Observation to each non-governmental hospital was carried on several visits, so it is more reliable than reported answers that because in reporting it is difficult to go deep into the participants and know the truth. Sometimes people do not say the truth to attract attention to focus on the problem or to give better impression.

The study showed that 76.8% of the participants haven't seen a manual or guideline document related to medical waste in their work place. Similar observations were noted by Al-Khatib and Khatib (2006) in the West Bank. This West Bank study showed that there is an absence of necessary rules and regulations for the collection of wastes from the hospital wards. Study on medical waste management in Bangladesh hospitals had found that health workers are not interested in reviewing guidelines related to medical waste process management (Akter, 2000). Also, Bdour et. al. (2007) study which was conducted in 14 healthcare facilities located in Irbid city, Jordan indicated that there are no specific regulations or guidelines for segregation or classification of medical wastes.

Table 4.5: Training, supervision and legislations related to M.W.M.

	Items	No.	%
1.	**Given any specialized training**		
	Yes	9	4.1
	No	211	95.9
	Total	**220**	**100**
2.	**Is there a specialized person to supervise the process of medical waste management**		
	Yes	78	35.5
	No	89	40.5
	Don't Know	53	24.1
	Total	**220**	**100**
3.	**Does your hospital have a waste management committee**		
	Yes	53	24.1
	No	93	42.3
	Don't Know	74	33.6
	Total	**220**	**100**
4.	**Does the hospital that you work in have a waste management plan**		
	Yes seen	47	21.4
	Yes not seen	34	15.5
	No	50	22.7
	Don't Know	89	40.5
	Total	**220**	**100**
5.	**Is there a waste management legislation in the hospital**		
	Yes seen	38	17.3
	Yes not seen	28	12.7
	No	57	25.9
	Don't Know	97	44.1
	Total	**220**	**100**
6.	**Is there a guideline document on management of M.W available in your hospital**		
	Yes seen	51	23.2
	Yes not seen	34	15.5
	No	57	34.1
	Don't Know	60	27.3
	Total	**220**	**100**

Table 4.6: Medical waste management legislations and plans that were observed during visits

	Items	Present		Not Present		Total	
		No.	%	No.	%	No.	%
1.	**Legislations**	0	0.0	11	100.0	11	100.0
2.	**Plan**	0	0.0	11	100.0	11	100.0

4.5 Knowledge

The study found that 93.2% of the study subjects had good knowledge about medical waste hazards as seen in table 4.7. Also, about 92.7% of the participants had good knowledge about the effects of medical wastes on the environment. Improper waste management can lead to environmental pollution (water, air, soil, etc) and unpleasant smells, can foster the growth and multiplication of insects, rodents, and worms, and may lead to transmission of diseases like typhoid, cholera, human immunodeficiency virus (HIV), and hepatitis B and C (Pruss et al., 1999; Abdulla et al., 2008). The improper disposal of medical wastes may have effects on the environment such as degradation of water quality, accumulation of toxic chemicals within soil and air pollution (Akter, 2000).

The study found that 93.6% had knowledge about the impacts of medical waste on the public and 80% had knowledge about the danger of medical waste handling and disposal as seen in table 4.7. This finding agrees with the findings of Massrouje (2000), in her study about medical waste management in Gaza governorates governmental hospitals, 87.7% of the study group noted that medical waste could be hazardous and sharps are considered hazardous by 89.2%.

In the Cairo University Hospital, the overall carrier rate for hepatitis B virus among health-care workers is about 28%, and most of that is due to improper handling of needles (El-Batanoni, 1995).

About 92.7% of the study subject reported that medical waste must be separated from regular waste (table 4.7). In many countries, medical waste is still handled and disposed of together with domestic waste, creating great health risks to health-care workers, municipal workers, the public, and the environment (Da Silva et al., 2005). Improper waste collection when the infectious waste is mixed with general waste can render all of the waste potentially infectious and hazardous (Chaerul and Tnaka 2008). Hence, the separation is a must.

Table 4.7: Knowledge level related to M.W.M of the study participants

	Item	Yes		No		Don't Know	
		No.	%	No.	%	No.	%
1.	Medical waste hazardous to health care workers	205	93.2	8	3.6	7	3.2
2.	Medical wastes have any environmental effects	204	92.7	8	3.6	8	3.6
3.	Medical wastes have adverse health impacts on the public	206	93.6	6	2.7	8	3.6
4.	A danger in medical wastes handling and disposal	176	80.0	33	15.0	11	5.0
5.	Medical waste must be separated from regular waste	204	92.7	9	4.1	7	3.2

4.6 Attitudes

The study found that 93.6% of the study subjects had positive attitudes toward the need for training of health care workers on medical waste management as seen in table 4.8. This finding agrees with the findings of Massrouje (2000), her study showed that about 96.9% had positive attitude toward the need of training relating to medical waste management in Gaza governorates governmental hospitals. Also this agrees with Atyani's (1996) thesis that there is a strong positive attitude towards training of health care workers on medical waste management. Also the study found that 93.2% had positive attitudes toward the need to a specialized person to supervise the process of medical waste management in the hospital.

As shown in table 4.8, about 82.7% of the participants believe that there should be a legislation to control the medical waste management process. This result agrees with a study in Ibadan city, Nigeria which concluded that there is a need for a medical waste legislation and policy, and there is a need for the monitoring and enforcement of such policies (Coker, 2009).

About 92.2% of the participants think that instructions are necessary for handling medical waste as seen in table 4.8. This finding agrees with the findings of Massrouje (2000), her study showed that about 90.5% of the study group responded positively towards the necessity of presence of instructions concerning medical waste in Gaza governorates

governmental hospitals. Also this result also goes in line with the conclusions of a study that took place in Irbid city, Jordan that there are no instructions for handling and disposal of these wastes present in the hospital (Bdour, 2007).

The study found that 83.2% of the study subjects supported the principle of waste minimization, through the reduction in the amount of toxicity and or waste generated by their hospitals. The EPA encourages waste minimization techniques that focus on preventing waste from ever being created, (source reduction) and recycling. There are three general methods of waste minimization: source reduction, recycling, and treatment (Health Sciences Center, 2005).

Table 4.8: Attitudes level related to M.W.M. of the study participants

Sn.	Item	Yes		No		Don't Know	
		No.	%	No.	%	No.	%
1.	A need for training of health care workers on medical waste management	206	93.6	9	4.1	5	2.3
2.	Do you believe that there should be a specialized person to supervise the process of medical waste management	205	93.2	8	3.6	7	3.2
3.	Do you believe that there should be a legislation that controls the medical waste management process	182	82.7	13	5.9	25	11.4
4.	Do you think that instructions are necessary for handling medical waste	204	92.7	6	2.7	10	4.5
5.	Do you support the principle of waste minimization, through the reduction in the amount of toxicity and/or waste generated by a facility	183	83.2	12	5.5	25	11.4

4.7 Medical waste practices

Handling, waste minimization, segregation, collection, storage, transportation, disinfection and final disposal are vital steps for safe and scientific management of medical waste in any establishment (Acharya and Singh M., 2000). Inappropriate management of medical waste handling, segregation, collection, storage, transporting and disposal or treating could potentially lead to the spread of diseases and risks to public health, community and the environment.

4.7.1 Occupational health and safety

As shown in table 4.9, the participants' response is that some of the safety items are available with easy access like masks 73.6%, gloves 96.8%, and some of them are not available that easy like safety shoes, eye glasses, and overalls. This was supported by the researcher observation, as it was observed that safety items are provided easily in items such as masks and gloves as seen in table 4.10.

About 28.6% of the participants reported that they were exposed to diseases or injury as a result of dealing with medical waste. The diseases or injuries which they were exposed to include: needle prick (92.1%), skin diseases (15.9%), respiratory diseases (27%), gastrointestinal diseases (12.7%), and eye diseases (12.7%) as seen in table 4.9. The study agrees with Kamal et al (1994) study which was conducted in Egypt and found that 99% of the study subjects had needle prick injuries, and that 16% of the conditions involved contamination with infectious agents.

In a study about medical waste management in Gaza governorates governmental hospitals, 70.4% of subjects noted that they were exposed to occupational hazards as a result of improper management of medical waste (Massrouje, 2000).

Table 4.9: Occupational health and safety of the study participants

.	Item	Yes		No		Total	
		No.	%	No.	%	No.	%
1.	**Which of the following safety items is provided within the hospital with easy access when needed**						
1.1	Masks	162	73.6	58	26.4	220	100.0
2.2	Gloves	213	96.8	7	3.2	220	100.0
3.3	Safety shoes	84	38.2	136	61.8	220	100.0
4.4	Eye glasses	21	9.5	199	90.5	220	100.0
5.5	Overall	69	31.4	151	68.6	220	100.0
2.	**Were you exposed to a disease or injury as result of dealing with medical waste?**	**63**	**28.6**	**157**	**71.4**	**220**	**100.0**
2.1	Needle prick	58	92.1	5	7.9	63	100.0
2.2	Skin diseases	10	15.9	53	84.1	63	100.0
2.3	Respiratory diseases	17	27.0	46	73.0	63	100.0
2.4	Gastrointestinal diseases	8	12.7	55	87.3	63	100.0
2.5	Eye diseases	8	12.7	55	87.3	63	100.0

Table 4.10: The observation of safety items provided within the hospital with easy access when needed

	Items	Yes		No		Total	
		No.	%	No.	%	No.	%
1.	Mask	9	81.8	2	18.2	11	100.0
2.	Gloves	11	100.0	0	0.0	11	100.0
3.	Safety shoes	7	36.4	7	63.6	11	100.0
4.	Eye glasses	0	0.0	11	100.0	11	100.0
5.	Other "overall"	5	45.5	6	54.5	11	100.0

The needle pricking incidents were as follow: 41.4% had one to three incidents, 15.5% had four to ten incidents, and 43.1% had unknown number of incidents, as seen in table 4.11. This agrees with many studies such as the study in Mongolia which reported that 67.8% of health-care workers reported that they had experienced at least one needle-stick injury in the previous12 months (Logez et. al., 2004).

Table 4.11: Number of times of exposed to needle prick of the study participants

Number of times	1 to 3	4 to 10	Unknown	Total
Frequency	24	9	25	**58**
Percent %	41.4	15.5	43.1	**100%**

4.7.2 Handling and segregation

Segregation means separating certain types of waste into appropriate containers at the point of generation. Infectious waste should be segregated in clearly marked containers that are appropriate for the type and weight of the waste. Except for sharps and fluids, infectious wastes are generally put in plastic bags, plastic-lined cardboard boxes, or other leak-proof containers that meet specific performance standards. In the United States, red or orange bags are commonly used to designate infectious waste, while general waste is placed in black, white, or clear bags (HCWHO, 2001).

The study found that 51.4% of the subjects reported that there is a clear procedure for collection and handling of wastes in their work place as seen in table 4.12, while the observation showed that there are clearly defined procedures for collection and handling of wastes in specified unit in 8 hospitals (72.7%) as shown in table 4.13.

About 49.5% of the subjects reported that there is a waste segregation in departments or wards as seen in table 4.12, while it was observed that there is a waste segregation in use in medical department or wards in 9 hospitals (81.8 %) as seen in table 4.13.

The study found that 42.3% reported that the waste containers or bags are color-coded as seen in table 4.12, while it was observed that the waste containers are color-coded in 3 hospitals (27.3%). About 71.1% of the study subjects reported that the waste containers or bag were always used as intended as seen in table 4.13

According to Al Khatib (2001) study about medical waste management in the primary health care centers in west Bank and Gaza Strip, 10.8% of the clinics segregate their medical waste. Abu Shomar (2007) found in her study about work load at ministry of health in Gaza Strip that about 18.8% of labs segregate their medical waste. Yong et. al. (2009), study indicated that the segregated collection of various types of medical waste has been done in about 73% of the hospitals in Nanjing (China); while Al-Khatib and Khatib (2006) found that there was insufficient separation between hazardous and non-hazardous wastes in a Palestinian hospital in the West Bank.

Table 4.12: M.W.M. handling and segregation among the study participants

	Item	Yes		No		Don't Know	
		No.	%	No.	%	No.	%
1.	Are there clearly defined procedures for collection and handling of wastes from specified units in the hospital	113	51.4	55	25.0	52	23.6
2.	Is there a waste segregation system in use in medical departments or wards	109	49.5	57	25.9	54	24.5
3.	Are the waste containers or bags color-coded	93	42.3	97	44.1	30	13.6
4.	Are they always used the way that it is intended	64	71.1	20	22.2	6	6.7

Table 4.13: The observation of medical waste segregation during visits in the study hospitals

	Items	Present		Not Present		Total	
		No.	%	No.	%	No.	%
1.	There are clearly defined procedures for collection and handling of wastes from specified unit	8	72.7	3	27.3	11	100.0
2.	There is a waste segregation in use in medical department of wards	9	81.8	2	18.2	11	100.0
3.	The waste containers are color-coded	3	27.3	8	72.7	11	100.0

4.7.3 Collection

About 84.1% of the study subjects reported that needles and sharps are being put into sharps boxes, while 8.2 % reported that they don't use them as seen in table 4.14, while the observation found that sharps boxes were used to dispose of needles and sharps in 11 hospitals (100%) as seen in table 4.15. This means that the hospital workers realize the importance of using special boxes to collect sharps, but the problem is that these boxes then get disposed of with the general waste instead of disposing the sharp waste alone to decrease the risk of needle prick injuries for health works, patients, and children.

About 69.6% of the study subjects reported that the sharp boxes that were used were solid and 78.9 % reported that the boxes were leak proof boxes as seen in table 4.14. This was supported by observation; it was observed that sharp boxes were solid, and leak proof in 7 hospitals (63.6%) as seen in table 4.15.

The study found out that 72.8% of the study subjects reported that the sharps boxes were labeled with the international biohazard symbol as seen in table 4.14; and it was observed that sharp boxes were labeled with international biohazard symbol in 7 hospitals (63.6%) as seen in table 4.15. Labels affixed to infectious waste containers and bags should include the international biohazard symbol and the word "BIOHAZARD" in a contrasting color. To improve segregation efficiency and minimize incorrect use of containers, the proper placement and labeling of containers must be carefully determined to differentiate between waste categories (HCWHO, 2001).

The study found that the color and type of the waste bags that were used for infectious waste collection in the hospitals were as follow: 31.8 % general waste bags, 8.8% red bags, and 5.1% yellow bags as seen in table 4.14, while the observation found that all hospitals did not use different types or color bags for infectious waste table 4.15. This does not go in line with an Istanbul, Turkey study which found that the separate collection of different types of wastes is consistently practiced, but 25% of the hospitals still use inappropriate containers for medical waste collection (Birpinar, 2009). Rashid (1996) found that most of hospitals in Bangladesh collected wastes in open waste bins and they remain for days before disposing. According to WHO, infectious waste should be packaged in yellow bags labeled with the international biohazard symbol. (Al-Shanshoury, and Al-Ayed, 2002).

The study found that the color and type of the waste bags that were used for pathological waste collection in the hospitals were as follow: 30 % general waste bags, 6 % red bags, and 4.6 % yellow bags as seen in table 4.14, while the observation found that all hospitals did not used different type or color bags for pathological waste as seen in table 4.15. This finding agrees with the findings of Massrouje (2000), her study found that medical wastes are collected in domestic waste bags and there are no special or color coding bags in Gaza governorates governmental hospitals. Shaban (2009) found that about half of labs wastes are collected by domestic bags. According to WHO, pathological waste should be packaged in red bags labeled with the international biohazard symbol. (Al-Shanshoury, and Al-Ayed, 2002).

Table 4.14: Medical waste collection among the study participants

	Items	**No.**	**%**
1.	**Are needles and sharps all together being put into sharps boxes?**		
	Yes	185	84.1
	No	17	7.7
	Don't use	18	8.2
	Total	**220**	**100**
1.1	**Are the boxes solid?**		
	Yes	129	69.6
	No	56	30.3
	Total	**185**	**100.0**
1.2	**Are they leaking proof**		
	Yes	146	78.9
	No	39	21.1
	Total	**185**	**100.0**
1.3	**Are they labeled with the international biohazard symbol**		
	Yes	134	72.8
	No	51	27.2
	Total	**185**	**100.0**
2.	**How are the infectious wastes collected in your hospital**		
	With general waste bags	69	31.8
	Red bags	19	8.8
	Yellow bags	11	5.1
	Other	105	48.4
	Don't use	13	6
	Total	**217**	**100**
3.	**How are the pathological wastes collected in your hospitals**		
	With general waste bags	65	30
	Red bags	13	6
	Yellow bags	10	4.6
	Other	124	57.1
	Don't use	5	2.3
	Total	**217**	**100**

Table 4.15: The observation of medical waste collection during visits in the hospitals

	Items	Present		Not Present		Total	
		No.	%	No.	%	No.	%
1	Syringes and needles are together put into sharps boxes	11	100.0	0	0.0	11	100.0
2	Sharp boxes are solid , leak proof	7	63.6	4	36.4	11	100.0
3	Sharp boxes labeled with international biohazard symbol	7	63.6	4	36.4	11	100.0
4	Pathological waste is contained in red biohazard symbol	0	0.0	11	100.0	11	100.0
5	Infectious waste is contained in yellow biohazard bags and labeled with the international biohazard symbol	0	0.0	11	100.0	11	100.0

4.7.4 Storage

The study found that 24.7 % of bins, bags and temporary storage containers were color coded as seen in table 4.16, while the observation found that all storage bins, bags and containers weren't color coded as seen in table 4.17. About 74.1% of the subjects reported that sharps boxes were not stored near the patient areas (table 4.16), and the observation found that all hospitals did not store sharps boxes near the patient areas (table 4.17); 75.8% of the subjects reported that the infectious wastes were not stored near the patient areas (table 4.16), while the observation found that 90.9% of the hospitals did not store sharps boxes near the patient areas (table 4.17). There was a difference between reported and observed. Observation is more reliable than reported answers. Sometimes people do not say the truth to attract attention to focus on the problem.

Also, the table shows that 24.5% of the study subjects reported that medical wastes were stored in containers in a special room, while 43.2% reported that medical wastes are stored in a general waste container. The Massrouje (2000) study found that there were closed rooms for storage in Gaza governorates governmental hospitals. Yong et. al. (2009) study indicated that 93.3% of the hospitals have temporary storage areas, and Birpinar et. al. (2009) study about medical waste management in Istanbul, Turkey indicated that the percentage of the hospitals that have temporary storage area was 63%. General waste should be stored in a separate location from the hazardous waste to avoid the risks (Dasilva, 2004).

About of the subjects 31.4% reported that the infectious waste bags and general waste were mixed and 38.6% reported that the waste bags were kept separate, while it was observed

that all hospitals mix general wastes bags and infectious waste bags as seen in table 4.17. In many countries, medical waste is still handled and disposed of together with domestic waste, creating great health risks to health-care workers, municipal workers, the public, and the environment (Da Silva et al., 2005).

The observation found that the storage containers weren't properly labeled with Biohazard in all hospitals. It was observed that biohazards wastes are stored for no longer than 48 hours in 6 hospitals (54.5%). The observation found that the appropriate warning signs weren't posted around the storage area in 100% of the hospitals as seen in table 4.17. This result does not go in line with the EPA technical guidelines (2003) about the requirements of medical waste storage that requires hospitals to store all containers of medical waste in a secure location, and to treat any waste mixed with medical waste, and to place sharps into a suitable container that is puncture-resistant, leak-proof, shatter-proof and able to withstand heavy handling, and to display the universal biohazard label clearly indicating the nature of the contents and place all medical waste other than sharps in clearly labeled heavy duty yellow plastic bags.

Table 4.16: Medical waste storage among the study participants

	Items	**No.**	**%**
1.	**Are bins, bag holders and temporary storage containers color coded**		
	Yes	54	24.7
	No	94	42.9
	Don't use	71	32.4
	Total	**219**	**100**
2.	**Are sharps boxes stored near the patient areas?**		
	Yes	13	5.9
	No	163	74.1
	Don't use	44	20
	Total	**220**	**100**
3.	**Are potentially infectious wastes stored near the patient areas**		
	Yes	6	2.7
	No	166	75.8
	Don't use	47	21.5
	Total	**219**	**100**
4.	**In your work place, medical waste is stored in**		
	Containers in special room	54	24.5
	General waste container	95	43.2
	Don't know	71	32.3
	Total	**220**	**100**
5.	**Are general wastes and infectious waste bags mixed or kept separate**		
	Mixed	69	31.4
	Separate	85	38.6
	Don't know	66	30
	Total	**220**	**100**

Table 4.17: The observation of medical waste storage during visits

	Items	Present		Not Present		Total	
		No.	%	No.	%	No.	%
1	Bin, bag holders and temporary storage containers are color coded	0	0.0	11	100.0	11	100.0
2	Sharps boxes are not stored near the patient area	11	100	0	0.0	11	100.0
3	Potentially infectious wastes are not stored near the patient area	10	90.9	1	9.1	11	100.0
4	General wastes and infectious waste bags are kept separate	0	0.0	11	100	11	100.0
5	Storage containers are properly labeled with Biohazard	0	0.0	11	100	11	100.0
6	Biohazard waste is stored no longer than 48 hours	6	54.5	5	45.5	11	100.0
7	Appropriate warning signs are posted around the storage area	0	0.0	11	100	11	100.0

4.7.5 Transportation

The study found out that 45.9% of the respondents reported that medical waste is transported in general waste bags or containers, while it was reported to be transported in special containers or trolleys by 24.2% of the respondents. Most of the workers (87.3%) who are in charge of transporting the medical waste were regular workers and were not trained as seen in table 4.18 a. This agrees with the finding of Al-Khatib and Khatib (2006) study which found an absence of necessary rules and regulations for the on-site transport to a temporary storage location inside and outside in a Palestinian hospital in the West Bank. This finding also agrees with the findings of Massrouje (2000), her study showed that medical waste is transported manually in domestic waste bags in Gaza governorates governmental hospitals. These findings violate the WHO recommendations for the safe transport of medical waste in health facilities. WHO recommends that hazardous waste should not be carried in and transported by hands to avoid personal injures and to protect workers health. Medical waste should be transported within the hospital by wheeled trolleys that are not used for other purpose, and the trolleys should be easy to load and unload, without sharp edges that could damage waste bags, and to be easy to clean. General waste and medical waste should not be carried in the same trolley, separate trolleys should be designed for each type of waste, and the vehicles should be cleaned and disinfected periodically (Rushbrook and Zghondi, 2005).

The observation found that are 27.3% of hospitals used special containers or trolleys for medical waste transportation as seen in table 4.18 b. Hazardous waste should not be carried in and transported by hand to avoid personal injuries and to protect worker's health. (Al-Shanshoury, and Al-Ayed, 2002).

Table 4.18 a: Medical waste transportation among the study participants

	Items	**No.**	**%**
1.	**Which of the following is used in internal transport of medical waste**		
	With general waste bags or containers	101	45.9
	Special containers or trolleys	53	24.2
	Other	4	1.8
	Don't Know	62	28.2
	Total	**220**	**100**
2.	**The workers who transport the medical waste from your work place are**		
	Trained workers	15	6.8
	Regular workers	192	87.3
	Private sector	6	2.7
	Other	7	3.2
	Total	**220**	**100**

Table 4.18 b: The observation of medical waste transportation during visits in the study hospitals

	Items	**Present**		**Not Present**		**Total**	
		No.	**%**	**No.**	**%**	**No.**	**%**
1	Medical wastes are transported by special containers or trolleys.	3	27.3	8	72.7	11	100.0

4.7.6 Medical waste treatment and disposal

Final treatment of medical waste can be done by technologies like incineration, autoclave, hydroclave or microwave (Rao, 1995). Table 4.19 shows the distribution of the available medical waste treatment equipment in hospitals as reported by the subjects: 27.3% incinerator, 8.6% autoclave, 2.7% microwave, 8.6% other tools and 55.9% of them did not know of any equipment.

Table 4.20 shows the method of treatment or disposal that was used for the different types of medical waste. Most of the infectious waste, pathological, chemical, pharmaceutical, and pressurized containers are disposed of with general waste.

The selection of the most appropriate system for medical waste treatment depends on the composition of the medical waste, the volume of waste to be treated, staffing requirements for the system in terms of both numbers and education levels of employees, support capabilities of the vendor, and initial and continuing operating costs. Incineration has been the most widely used treatment technology for the disposal of medical wastes. The main disadvantage is that incineration may emit trace amounts of unwanted pollutants such as dioxins and furans, in addition to acidic gases and heavy metals.

The Massrouje (2000) study observed that 23.7% of medical waste is disposed with domestic waste, 2.6% in landfills and 39.4 by incinerator in Gaza governorates governmental hospitals. Al-Khatib and Khatib, (2006) studied medical waste management in a Palestinian hospital in the West Bank. The study indicated inadequate waste treatment or disposal of hospital wastes and no special landfills for hazardous wastes were found within the municipality. According to Al Khatib (2007), the incineration is the most commonly used (70.6%) method for medical waste treatment in west bank and Gaza Strip.

WHO recommended that the chlorinated plastic bags or boxes shall not be introduced into the incinerator and should not be used for packaging waste before its incineration to avoid dioxin and furnace production (Pruss, et al., 1999).

Table 4.20 shows that 34.1% of the participants reported that sharps were treated by incineration. Even with the numerous alternatives available, autoclave is the most popular methods of treatment because of their history of use in the healthcare. The method requires trained staff with maintenance skills for high-pressure steam systems. These are usually available in most countries (Rushbrook and Zghondi, 2005). Chemical treatment systems have an extensive and well history in disinfecting and sterilizing environmental surfaces and medical devices (Jagger et.al., 1989).

According to British Medical Association (1994), objections to the landfill disposal of medical waste are based on the risk of transmission of microorganisms directly or indirectly to individuals and the pollution of ground water. In 2002, the results of a WHO assessment conducted in 22 developing countries showed that the proportion of health-care facilities that do not use proper waste disposal methods ranges from 18% to 64 % (WHO, 2004).

Table 4.19: Available methods for medical waste treatment in the hospitals according to the study participants

	Item	Yes		No		Total	
		No.	%	No.	%	No.	%
1.	Incinerator	60	27.3	160	72.7	220	100.0
2.	Autoclave	19	8.6	201	91.4	220	100.0
3.	Microwave	6	2.7	214	97.3	220	100.0
4.	Other	19	8.6	201	91.4	220	100.0
5.	Don't Know	123	55.9	97	44.1	220	100.0

Table 4.20: Percentage of methods of treatment or disposal used for medical waste according to the study participants

	Item	With general waste	Autoclave	Incineration	Landfill	Other (specify)	I don't use it
1.	Infectious	26.8	4.1	20.0	10.5	0.0	38.6
2.	Pathological	24.5	0.9	11.8	6.8	1.4	54.5
3.	Sharps	10.0	3.2	34.1	15.5	6.8	30.5
4.	Chemicals	16.0	0.5	15.5	10.5	0.9	56.6
5.	Pharmaceutical	27.9	0.9	20.5	13.7	0.9	36.1
6.	Radioactive	6.4	0.5	10.0	4.1	0.9	78.1
7.	Pressurized container	15.5	0.5	6.4	10.5	0.0	67.3

Table 4.21 shows the on-site treatment method of highly infectious waste that is available in the hospitals during visits. None of the hospitals use on-site treatment before disposing. So, the shortage or inaccessibility of facilities and equipment, acts as an obstacle for improvement. Knowledge and positive attitude without the necessary tools and facilities makes development difficult and impossible.

There was a difference between reported, and observed. This is what happened when asking about the availability of medical waste treatment facilities in each hospital. Observation to each non-governmental hospital was carried on several visits, so it is more reliable than reported answers that because in reporting it is difficult to go deep

into the participants and know the truth. Sometimes people do not say the truth to give better impression.

Table 4.21: On-site treatment of highly infectious waste is available during visits

	Items	Yes		No		Total	
		No.	%	No.	%	No.	%
1.	Incineration	0	0.0	11	100.0	11	100.0
2.	Autoclave	0	0.0	11	100.0	11	100.0
3.	Microwave	0	0.0	11	100.0	11	100.0

4.8 Testing hypothesis

Table 4.22 shows that there is no relationship between the sex of the participants (male or female) and the level of knowledge, segregation, collection, storage, transportation and treatment of medical waste (p-value >0.05) which is not statistically significant.

But there is a relationship between the attitudes toward medical waste and sex (male or female), p- value <0.05, statistically significant, the result show that males have positive attitudes toward medical waste management more than females as seen in table 4.22.

Table 4.22: Relationship between the sex of the study participants and medical waste management domains

	Items	Sex	No.	Mean	Std	t	Sig.
1.	**Knowledge**	Male	140	0.91	0.17	0.561	0.576
		Female	80	0.90	0.23		
2.	**Attitude**	Male	140	0.91	0.17	2.020	0.045
		Female	80	0.86	0.25		
3.	**Segregation**	Male	140	0.45	0.35	1.281	0.202
		Female	80	0.39	0.35		
4.	**Collection**	Male	140	0.32	0.17	0.843	0.400
		Female	80	0.30	0.16		
5.	**Storage**	Male	140	0.12	0.17	0.665	0.506
		Female	80	0.10	0.19		
6.	**Transportation**	Male	140	0.18	0.28	1.767	0.079
		Female	80	0.11	0.23		
7.	**Treatment**	Male	140	0.12	0.19	-1.228	0.221
		Female	80	0.15	0.20		

Table 4.23 shows that there is no relation between training related to medical waste management and level of knowledge, attitude, segregation, collection storage, transportation and treatment (p-values >0.05) which are not statistically significant. This finding agrees with the findings of Massrouje (2000), her study showed that previous training was not associated with knowledge of medical waste in Gaza governorates governmental hospitals.

Table 4.23: Relationship between medical waste management domains and training of the study participants

	Items	Training	No.	Mean	Std	t	Sig.
1.	**Knowledge**	Yes	9	0.96	0.09	0.819	0.414
		No	211	0.90	0.19		
2.	**Attitude**	Yes	9	0.93	0.10	0.647	0.519
		No	211	0.89	0.20		
3.	**Segregation**	Yes	9	0.44	0.37	0.120	0.905
		No	211	0.43	0.35		
4.	**Collection**	Yes	9	0.26	0.15	-1.058	0.291
		No	211	0.32	0.17		
5.	**Storage**	Yes	9	0.19	0.18	1.282	0.201
		No	211	0.11	0.18		
6.	**Transportation**	Yes	9	0.06	0.17	-1.132	0.259
		No	211	0.16	0.27		
7.	**Treatment**	Yes	9	0.22	0.24	1.480	0.140
		No	211	0.12	0.19		

Table 4.24 shows that there is no relationship between the hospital location (governorate) and the level of knowledge, attitude, segregation, collection, storage, and transportation of medical waste (p-value ›0.05) which is not statistically significant. This might have resulted from the fact that the limited area of Gaza Strip does not reflect gap in knowledge, attitudes, and practices in different governorates. But there is a relationship between the hospital location and the method of medical waste treatment (p-value = 0.005) which is highly statistically significant. The Massrouje (2000) study found that there is no relationship between knowledge and the difference in location in Gaza governorates governmental hospitals.

Table 4.24: Relationship between medical waste management domains and governorates of the study hospitals

	Items	Gov	No.	Mean	Std	F	Sig.
1.	**Knowledge**	North	25	0.89	0.28	0.822	0.512
		Gaza	118	0.91	0.19		
		Mid zone	23	0.93	0.13		
		Khanyounis	40	0.88	0.18		
		Rafah	14	0.97	0.07		
		Total	220	0.90	0.19		
2.	**Attitude**	North	25	0.88	0.29	0.397	0.810
		Gaza	118	0.89	0.19		
		Mid zone	23	0.94	0.11		
		Khanyounis	40	0.88	0.19		
		Rafah	14	0.90	0.23		
		Total	220	0.89	0.20		
3.	**Segregation**	North	25	0.47	0.41	0.727	0.574
		Gaza	118	0.43	0.34		
		Mid zone	23	0.42	0.34		
		Khanyounis	40	0.46	0.35		
		Rafah	14	0.29	0.32		
		Total	220	0.43	0.35		
4.	**Collection**	North	25	0.31	0.09	0.565	0.688
		Gaza	118	0.31	0.16		
		Mid zone	23	0.36	0.24		
		Khanyounis	40	0.33	0.14		
		Rafah	14	0.31	0.21		
5.	**Storage**	North	25	0.05	0.12	1.411	0.231
		Gaza	118	0.11	0.19		
		Mid zone	23	0.10	0.19		
		Khanyounis	40	0.16	0.18		
		Rafah	14	0.10	0.16		
		Total	220	0.11	0.18		
6.	**Transportation**	North	25	0.10	0.20	0.461	0.464
		Gaza	118	0.17	0.28		
		Mid zone	23	0.13	0.22		
		Khanyounis	40	0.15	0.30		
		Rafah	14	0.14	0.23		
		Total	220	0.15	0.27		
7.	**Treatment**	North	25	0.05	0.16	3.822	0.005
		Gaza	118	0.11	0.19		
		Mid zone	23	0.20	0.22		
		Khanyounis	40	0.20	0.18		
		Rafah	14	0.07	0.19		
		Total	220	0.13	0.19		

Table 4.25 shows that there is no relationship between the age of the study subjects and the level of knowledge, attitude, collection, storage, transportation and treatment of medical

waste with p-value ›0.05 which is not statistically significant. But there is a relationship between age of the respondents and segregation of medical waste (p-value = 0.009) which is very highly statistically significant where the tendency to separate decreases with age increase.

Table 4.25: Relationship between medical waste management domains and the ages of the study participants

	Items	Age	No.	Mean	Std	F	Sig.
1.	**Knowledge**	30 Yrs and less	127	0.92	0.18	0.849	0.429
		31 to 40 Yrs	60	0.88	0.21		
		More than 40 Yrs	31	0.92	0.10		
		Total	218	0.91	0.18		
2.	**Attitude**	30 Yrs and less	127	0.89	0.19	0.326	0.722
		31 to 40 Yrs	60	0.90	0.19		
		More than 40 Yrs	31	0.92	0.20		
		Total	218	0.89	0.19		
3.	**Segregation**	30 Yrs and less	127	0.41	0.34	4.815	0.009
		31 to 40 Yrs	60	0.54	0.36		
		More than 40 Yrs	31	0.31	0.34		
		Total	218	0.43	0.35		
4.	**Collection**	30 Yrs and less	127	0.33	0.16	0.341	0.712
		31 to 40 Yrs	60	0.31	0.16		
		More than 40 Yrs	31	0.30	0.20		
		Total	218	0.32	0.17		
5.	**Storage**	30 Yrs and less	127	0.10	0.17	0.876	0.418
		31 to 40 Yrs	60	0.13	0.21		
		More than 40 Yrs	31	0.12	0.16		
		Total	218	0.11	0.18		
6.	**Transportation**	30 Yrs and less	127	0.17	0.29	0.566	0.569
		31 to 40 Yrs	60	0.15	0.25		
		More than 40 Yrs	31	0.11	0.21		
		Total	218	0.16	0.27		
7.	**Treatment**	30 Yrs and less	127	0.12	0.20	0.445	0.641
		31 to 40 Yrs	60	0.15	0.19		
		More than 40 Yrs	31	0.12	0.20		
		Total	218	0.13	0.19		

Table 4.26 shows that there is no relationship between the experience of the study subjects and the level of knowledge, attitude, segregation, collection, transportation and storage of medical waste (p-value ›0.05) which is not statistically significant. But there is a good relationship between the experience and the method of medical waste treatment in the hospitals (p-value = 0.028) which is statistically significant. This finding agrees with the findings Massrouje (2000), her study found that there is no relationship between

knowledge and experience in Gaza governorates governmental hospitals. Cointreau (2000) indicated that years of experience increase the level of performance. Also, Abu Alqomboz (2002) showed that when the training is accompanied by good experience, it affects positively the knowledge and performance of the process of medical wastes management.

Table 4.26:Relationship between M.W.M and the experience of the study participants

	Items	Age	No.	Mean	Std	F	Sig.
1.	**Knowledge**	5 Yrs and less	120	0.90	0.20	0.016	0.984
		6 to 10 Yrs	43	0.90	0.24		
		More than 10 Yrs	50	0.90	0.14		
		Total	213	0.90	0.19		
2.	**Attitude**	5 Yrs and less	120	0.87	0.21	1.113	0.331
		6 to 10 Yrs	43	0.91	0.20		
		More than 10 Yrs	50	0.91	0.19		
		Total	213	0.89	0.20		
3.	**Segregation**	5 Yrs and less	120	0.45	0.34	1.051	0.351
		6 to 10 Yrs	43	0.44	0.34		
		More than 10 Yrs	50	0.37	0.36		
		Total	213	0.43	0.35		
4.	**Collection**	5 Yrs and less	120	0.31	0.15	0.242	0.785
		6 to 10 Yrs	43	0.32	0.18		
		More than 10 Yrs	50	0.33	0.19		
		Total	213	0.32	0.17		
5.	**Storage**	5 Yrs and less	120	0.09	0.16	1.190	0.306
		6 to 10 Yrs	43	0.13	0.22		
		More than 10 Yrs	50	0.13	0.18		
		Total	213	0.11	0.18		
6	**Transportation**	5 Yrs and less	120	0.17	0.29	0.401	0.670
		6 to 10 Yrs	43	0.17	0.29		
		More than 10 Yrs	50	0.13	0.22		
		Total	213	0.16	0.27		
7.	**Treatment**	5 Yrs and less	120	0.10	0.18	3.637	0.028
		6 to 10 Yrs	43	0.19	0.18		
		More than 10 Yrs	50	0.15	0.23		
		Total	213	0.13	0.20		

Table 4.27 shows that there is a very strong association between the level of education of the study subjects and the level of knowledge and attitude about medical waste (p-value =0.001) very highly statistically significant. There is association between the level of education of the study subjects and segregation of medical waste (p-value =0.045) which is statistically significant. But there is no association between the education level and the method of medical waste collection, storage, transportation and treatment in the hospitals (p-value ›0.05) which is not statistically significant.

Table 4.27: Relationship between medical waste management domains and the education of the study participants

	Items	Education	No.	Mean	Std	F	Sig.
1.	**Knowledge**	Less High School	5	0.56	0.41	9.367	0.001
		High school	13	0.72	0.22		
		Diploma	51	0.95	0.12		
		BSc	114	0.93	0.17		
		Master and more	37	0.89	0.21		
		Total	220	0.90	0.19		
2.	**Attitude**	Less High School	5	0.76	0.22	6.347	0.001
		High school	13	0.66	0.34		
		Diploma	51	0.89	0.18		
		BSc	114	0.93	0.15		
		Master and more	37	0.88	0.24		
		Total	220	0.89	0.20		
3.	**Segregation**	Less High School	5	0.05	0.11	2.475	0.045
		High school	13	0.37	0.36		
		Diploma	51	0.49	0.36		
		BSc	114	0.45	0.35		
		Master and more	37	0.36	0.33		
		Total	220	0.43	0.35		
4.	**Collection**	Less High School	5	0.20	0.18	1.021	0.397
		High school	13	0.36	0.09		
		Diploma	51	0.31	0.12		
		BSc	114	0.32	0.19		
		Master and more	37	0.30	0.17		
		Total	220	0.32	0.17		
5.	**Storage**	Less High School	5	0.00	0.00	1.435	0.224
		High school	13	0.03	0.09		
		Diploma	51	0.11	0.21		
		BSc	114	0.13	0.17		
		Master and more	37	0.11	0.18		
		Total	220	0.11	0.18		
6.	**Transportation**	Less High School	5	0.00	0.00	1.816	0.127
		High school	13	0.27	0.39		
		Diploma	51	0.20	0.30		
		BSc	114	0.15	0.26		
		Master and more	37	0.09	0.20		
		Total	220	0.15	0.27		
7.	**Treatment**	Less High School	5	0.07	0.15	1.781	0.134
		High school	13	0.00	0.00		
		Diploma	51	0.14	0.18		
		BSc	114	0.13	0.20		
		Master and more	37	0.15	0.22		
		Total	220	0.13	0.19		

4.9 Percentage of knowledge, attitudes, and practices

As seen in table 4.28, the percentages of knowledge, attitudes, and practices related to medical waste management of the study participants are as follows: 90.4% for knowledge, 89.1% attitudes, and 35.1% practices. For practices there was not a difference between reported and observed. Percentages of practices related to medical waste management that were observed during visits in the study hospitals was 36.3% as seen in table 4.29.

It's noticed that a large proportion of respondents reported high knowledge, strongly positive attitudes, and weak practices of medical waste management. This may reflect the shortage or inaccessibility of facilities and equipment, which act as an obstacle for improvement.

Table 4.28: Percentage of knowledge, attitudes, and practices among the study participants:

Questions / **Item**	**No. of questions**	**1 %**	**2 %**	**3 %**	**4 %**	**5 %**	**6 %**	**7 %**	**8 %**	**9 %**	**10 %**	**Total %**
Knowledge	**5**	93.2	92.7	93.6	80.0	92.7	-	-	-	-	-	**452.2**
	5 Question ► Total % = 452.2 ► Total Knowledge % = 452.2/ 5 = 90.4%											
Attitudes	**5**	93.6	93.2	82.7	92.7	83.2	-	-	-	-	-	**445.4**
	5 Question ► Total % = 445.4 ► Total Attitudes % = 445.4/ 5 = 89.1%											
Segregation	**4**	51.4	49.5	42.3	71.1	-	-	-	-	-	-	**214.3**
Collection	**6**	84.1	69.6	78.9	72.8	5.1	6	-	-	-	-	**316.5**
Storage	**5**	24.7	74.1	75.8	24.5	38.6	-	-	-	-	-	**237.7**
Transport	**2**	24.2	6.8	-	-	-	-	-	-	-	-	**31**
Treatment	**10**	27.3	8.6	2.7	24.1	11.8	37.3	10.5	13.7	4.1	10.5	**150.6**
Total	**27 Question ► Total % = 950.1 ► Practices % = 950.1 / 27 = 35.1%**											

Table 4.29: Percentage of practices related to medical waste management that were observed during visits in the study hospitals

Questions / Item	No. of questions	1 %	2 %	3 %	4 %	5 %	6 %	7 %	Total %
Segregation	**3**	72.7	81.8	27.3	-	-	-	-	**181.8**
Collection	**5**	100	63.6	63.6	0	0	-	-	**227.2**
Storage	**7**	100	90.9	9.1	0	0	54.5	0	**254.5**
Transport	**1**	27.3	-	-	-	-	-	-	**27.3**
Treatment	**3**	0	0	0	-	-	-	-	**0**
Total	**19 Question ►Total % = 690.8 ►Practices % = 690.8 / 19 = 36.3%**								

According to Pruss et. al., 1999, the following first steps to improved waste management is described by WHO:

• Establish a three-bin system in a medical area.

• Color code containers, e.g. black for general health care waste, yellow for both potentially infectious health care waste bags and used sharps boxes.

• Minimize transmission routes. Keep waste containers covered.

• Assign different locations for black and yellow waste containers to reduce incorrect segregation.

• Fill bags no more than three-quarters full to minimize spillage. Minimize the number of containers in use at one time.

• Seal filled containers and label and date to identify the medical area, to enable inadequate segregation to be traced back.

• Fix a collection schedule for containers for each waste category.

• Identify places for local temporary storage (e.g. housekeeping room or dedicated waste storage room) or use colored 240-litre wheeled bins.

• Differentiate between trolleys and carts for general and potentially infectious health care waste components.

• Assign central segregated storage for potentially infectious health care wastes awaiting on-site or off-site treatment and disposal. Without refrigeration in warm climates, maximum storage time is 24 hours in the hot season, 48 hours in the cool season.

• Pre-treat highly infectious waste from laboratories and isolation wards and patients before it enters the hazardous health care waste stream (preferably using an autoclave).

Body fluids (e.g. vomit and stools from patients with cholera) should be disinfected (e.g. simple disinfection with sodium hypochlorite).

• Train staff.

The status of poor waste management currently practiced may cause a big risk towards the health of the general people, patients, and professionals, directly and indirectly through environmental degradation.

So, it is recommended that there should be a cooperation between the governmental sector and the private sector for appropriate management of medical waste management to avoid risks.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

This chapter provides the main conclusions of this study as well as some recommendations for decision makers that may help in adopting the better medical wastes management based on the results of this study.

5.1 Conclusion

The management of medical waste is of great importance due to its potential environmental hazards and public health risks. In the past, medical waste was often mixed with municipal solid waste and disposed in residential waste landfills or improper treatment facilities in many countries. In recent years, many efforts have been made by environmental regulatory agencies and waste generators to better managing the wastes from healthcare facilities. The objective of this study is to identify the factors that affect medical waste management in non-governmental hospitals in Gaza governorates. The main conclusions that could be driven from the study are as follows:

The current situation of medical waste management in non-governmental hospitals in Gaza governorates is unsatisfactory. The status of poor waste management currently practiced may cause a huge risk towards the health of the general public, patients, and professionals, directly and indirectly through environmental degradation.

The percentage of knowledge, attitude, and practice of study participants are as follows: 90% for knowledge, 89% attitudes, and 35.1% practices. It has been noticed that a large proportion of respondents reported high knowledge, strong positive attitudes, and weak practices of medical waste management. This may reflect the lack or inaccessibility of facilities and equipment, which act as an obstacle for improvement of the medical waste management.

Medical waste generated in non-governmental hospitals are some how similar to WHO classification, except for radioactive waste and heavy metal waste that are not observed to be found in any of the hospital included in the study.

The study found that only 4.1% of the study subjects have taken training courses related to medical waste management. About 24.1% of the study subjects reported that there is a waste management committee in their work place and 23.2% have seen a manual or a guideline document related to medical waste in their work place.

About 21.4% of the study subjects have seen the plan of medical waste management in their work place, while it was observed that there is no any plan for medical waste management in all hospitals

Only 17.3% of the study subjects have seen the waste management legislation in the hospitals, while it was observed that there is no any legislation for medical waste management in all hospitals.

It was observed that there is a waste segregation in use in about 81.8 % of the medical department. Waste containers were not color-coded in most of the hospitals. The study showed that most of the bins, bags and containers weren't color coded.

The results of collection show that most of the different types of medical waste are collected with general waste bags, except sharps which are collected in safety boxes.

About 28.6% of the participants reported that they were exposed to diseases or injury that results from dealing with medical waste. The distribution of diseases or injury was as follows 92.1% needle pricks, 15.9% skin diseases, 27% respiratory diseases, 12.7% gastrointestinal diseases, and 12.7% eye diseases.

It was observed that safety tools are provided within the hospitals with easy access for masks 81.8%, and gloves 100 %, while the safety shoes 36.4 %, eye glasses 0 %, and overall 45.5%.

The study showed that medical waste in 45.9% of the hospitals is transported with general waste bags or containers. About 87.3% of workers who transport the medical waste are regular workers and they are not trained staff. Also, on-site treatment method of highly infectious waste is not available in the hospitals.

There is a relationship between the attitudes toward medical waste and sex (male or female); the result shows that males have attitudes toward medical waste management more than females. Also there is a relationship between the hospital location and the

method of medical waste treatment. There is a good relationship between the experience and the method of medical waste treatment in the hospitals and there is a high positive association between the level of education of the study subjects and the level of knowledge, attitude, and separation of medical waste.

The following are some of the problems and procedures associated with medical wastes management in non-governmental hospitals in Gaza governorates:

-Lack of comprehensive waste disposal plans for the disposal and technical aspects of hazardous wastes.

-Lack of treatment facilities such as incinerator or autoclaves for treatment of pathological and infectious wastes.

-Lack of proper segregation, collection, transportation and final disposal of infectious and other medical wastes.

-Lack of knowledge and awareness among the personnel in hospitals about the consequences of the potential risk of infectious, hazardous waste and environmental impact.

-Lack of proper guidelines, legislation, regulations and instructions on health care waste management such as segregation, collection and disposal of various categories of wastes in suitable manner to render it harmless.

- Disposal of liquid waste into the municipal sewerage system without any prior treatment.

5.2 Recommendation

-The basic approach to medical waste management is to reduce the quantity of waste at source as far as possible. Hospital wastes should be recycled whenever feasible, with due regard to environmental aspect, to reduce the quantity of material entering the waste system.

-Waste management requires a system approach, involving the handling, storage, transport; treatment and disposal of waste by methods that at all stages minimize the risk to health and the environment.

-All hospital personnel should be made aware of the potential risk of mishandling waste. This study has created awareness regarding the magnitude of the problem of waste management in non-governmental hospitals in Gaza governorates and has generated interest for systematic control efforts for hospital waste disposal. Hospital waste management cannot succeed without the willing co-operation and participation of all categories of personnel.

- The need for a clear definition of medical waste in each section of the health institutions.

- The Ministry of Health needs to implement a monitoring system to control all disposal methods used in medical centers.

- Work on the issuance of laws and regulations for dealing with medical waste and on the application in their respective fields.

- Activating the role of the private sector in the management of medical waste, in terms of rehabilitation and training to deal with proper medical waste, as well as playing a role which complements the work of relevant ministries in an integrated manner.

- Immunizing those in contact with medical waste against certain diseases, e.g. hepatitis B and tetanus.

- Implementing good hygiene practices when dealing with waste (e.g. hand washing).

- Designing systems to minimize contact (e.g. good storage facilities, more effective transportation, etc.).

- Direct contact between people and hazardous waste can be prevented by providing personal protective clothing and equipment (e.g. heavy duty gloves, safety glasses, overalls, etc).

- Indirect contact between people and hazardous waste can be reduced by applying vector control methods (e.g. covering waste).

- Selection of safe and environmentally-friendly management options to protect people from hazards when collecting, handling, storing, transporting, treating or disposing of medical waste.

- Actual hazards resulting from medical waste can be reduced by segregating general waste from medical waste and labeling of hazardous wastes.

- Efficiently separating different categories of medical waste at the point of generation. Each category of medical waste should be kept in different colored bags labeled with biohazard symbol.

- Medical waste should be collected daily and transported to the temporary storage area.

- Provide special containers for medical waste collection and provide vehicles to transport medical waste containers with the availability of suitable specifications.

- Medical waste should be stored in temporary special area then treated or disposed of within 48 hours.

- Provide different effective treatment facilities to treat hazardous waste before disposing.

- Disposing of different categories of medical waste into appropriate disposal systems after implementing appropriate treatment.

- Implementing final disposal by construction of a special landfill site for toxic and hazardous waste.

- Writing information about medical waste and keep them in special records.

REFERENCES

- Abdulla F, Qdais HA, Rabi A. (2008): *Site Investigation on Medical Waste Management Practices in Northern Jordan.* Waste Management; 28(2):450–8.

- Abu Al qomboz, A. (2002) : *Environmental Assessment of Hazardous Waste Management at Selected Sites in Gaza Strip*, Master Thesis, Al Quds University, Palestine.

- Abu Shomar, R. (2007): *Work Load Measurement in Governmental Primary Health Care Medical Laboratories in Gaza Strip*, Master thesis, Al Quds University, Palestine.

- Acharya, D.B & Singh M. (2000): *The Book of Hospital Waste Management*. (1st edition.). New Delhi: Minerva.

- Akter, N. (2000) : *Medical Waste Management*: *A Review*, Asian Institute of Technology, Thailand

- Akter, N., Acott, R., and Chowdhury, S. (1998): *Medical Waste Disposal at BRAC Health Centers: An Environmental Study*. BRAC Research, Research and Evaluation Division, Mohakhali , Dhaka

- Al Khtib, I.(2007) : *Medical Waste Management in Healthcare Centres in the Occupied Palestinian Territory*, Eastern Mediterranean Health Journal, 12:637-652

- Al-Khatib, I., A. and Khatib, R., A. (2006) : *Assessment of Medical Waste Management in a Palestinian Hospital*, Eastern Mediterranean Health Journal, Vol. 12, No. 3/4, 2006

- Al-Shanshoury, M.A., and Al-Ayed, H. (2002) : *Safe Handling of Health Care Waste in the Kingdom of Saudi Arabia: Operational Manual*, Ministry of Health and EMRO-WHO, Saudi Arabia

- Anderson, G. (1992): *Clinical Waste Disposal*, Amman, World Health Organization.

- ATSDR "The Agency for Toxic Substances and Disease Registry", (2007) : *Definitions of Terms*, Atlanta.

- Atyani, T., H. (2005): *Clinical Waste Management in the West Bank in Palestine*, Master of Science Thesis, University of Newcastle.

- Bakarman, B., A. (2005): *Risk Assessment and Analysis for Construction Contractors*, Master thesis, Arab Academy for Science, Technology and Maritime Transport, Egypt.

- BAN & HCWH. (1999): *Medical Waste in Developing Countries*. An analysis with a case study of India and a critique of the Basel-TWG guidelines. Basel Action Network (BAN) secretariat, Asia Pacific Environmental Exchange, USA.

- Bassic I., N., Moltin A., J. (1998): *Encyclopedia of Environmental Control Technology: Controlled Air Multistage Solid Waste Incinerator with Energy Recovery*, Volume1, Paul N Cheremisinoff Guff Publication Company, p.268-273.

- Bdour, A., Altrabsheh, B., Hadadin, N., and Al-Shareif, M.,(2007), *Assessment of Medical Wastes Management Practice: A Case Study of the Northern Part of Jordan*, Waste; Jun2007, Vol. 27 Issue 6, p746-759, 14p

- Bdour A, Altrabsheh B, Hadadin N, Al-Shareif M. (2006): *Assessment of Medical Wastes Management Practice: A Case Study of the Northern Part of Jordan*. Waste Manage; 27(6):746–59.

- Bekir, O. (2003) : *Health Care Waste Management in India: Lessons from Experience*, The World Bank, India, p12

- Bell, J. (1993): *Doing Your Research Project*, Buckingham: Open University Press, UK.

- Birpinar, E., Bilgili, S., Erdogan, T. (2009) : *Medical Waste Management in Turkey: A Case Study of Istanbul*, Waste Management; Jan2009, Vol. 29 Issue 1, p445-448, 4p

- Blenkharn J., I. (2005) : *Safe Disposal and Effective Destruction of Clinical Wastes*, Journal; of Hospital Infection, London, p.295-297, 2p

- Blenkharn, J.I. (1995): *The Disposal of Clinical Wastes*. Journal of Hospital Infection, 30, 514-520.

- British Medical Association (1994): *Clinical Waste, Environmental and Occupational Risk of Health Care*, Britain, 85-97.

- Burns, S. and Grove, K. (1997): *Practice of Nursing Research*, W.B. Saunders, Mosby, USA.

- Cassedy I., H. (1991): *Medicine in America. Amalgamation*: The New Medical Establishment as Colossus, Chapter 4, Johns Hopkins University Press, London.

- CEC "Commission of the European Communities" (1993): *Analysis of Priority Waste Streams HealthCare Waste*. Brussels and MRM Partnership, Bristol.

- Center of environmental health activities (CEHA) : *Preparation of Health Care Waste Management Plans for Health Care Establishments*, World Health Organization, Amman, Jordan, 2002

- Chaerul M, Tnaka M. (2008): *a System Dynamics Approach for Hospital Waste Management*. Waste Management 2008; 28(2):442–9.

- Cheng, Y.W., Sung, F.C., Yang, Y., Chung, Y.T. (2009) : *Medical Waste Production at Hospitals and Associated Factors in Taiwan,* Waste Management; Jan2009, Vol. 29 Issue 1, p440-444, 5p

- Chitnis V., Chitnis S., Patil S., and Chitnis D. (2003) : *Solar Disinfection of Infectious Biomedical Waste: A New Approach for Developing Countries*, Lancet, 362: 1285-6

- Cointreau, S. (2000): *Occupational and Environmental Health Issues of Solid Waste Management,* Roxbury, USA.

- Coker, A., Sangodoyin, A., Sridhar, M., Booth, C., Olomolaiye, P., Hammond, F.(2009) : *Medical Waste Management in Ibadan, Nigeria: Obstacles and Prospects*, Waste Management; Feb2009, Vol. 29 Issue 2, p804-811, 8p

- Coutinho, M., Pereira , M., Rodrigues, R., and Borrego, C.(2006) : *Impact of Medical Waste Incineration in the Atmospheric PCDD/F levels of Porto, Portugal,* Science of the Total Environment, Vol. 362, p157-165, 8p

- CSU "Colorado State University" (2009), *Reliability and Validity,* http://writing.colostate.edu/guides/research/relval/com2a1.cfm, [Electronically accessed 20 October, 2009.]

- Da Silva C.E., Hoppe A.E., Ravanello M.M., and Mello N. (2005): *Medical Wastes Management in the South of Brazil.* Waste Manage 2005; 25(6):600–5.

- Dasilva, C., et. al. (2004), H*azardous Wastes Management in the South of Brazil,* Journal of waste management, 35:600-605.

- Dellapergola, S. (2001): *Demography in Israel/Palestine: Trends, Prospect, and Policy Implications.* The Hebrew University of Jerusalem, Israel.

- Dicko M. et al. (2000) : *Safety of Immunization Injections in Africa*: Not Simply a Problem of Logistics, Bulletin of the World Health Organization, 78:163–9.

- Division of Environmental Health and Safety (2007) : *Waste Minimization Guide,* University of South Florida, USA, P 2

- Ducel, G., Fabry, J., and Nicolle, L. (2002) : *Prevention of Hospital-Acquired Infections*, A practical guide, 2nd edition WHO, Malta

- Egyptian Ministry of Health, (2003): *National Guidelines for Infection Control. Part 1: Standard Procedures,* Cairo, Egypt.

- El Khoby T., et al. (2000): *The Role of Parenteral Anti-Schistosomal Therapy in the Spread of Hepatitis C virus in Egypt*, Lancet, 355:887–91.

- El-Batanouni, M. (1996): *Impact of Health Waste on Human Health and the Environment*, Paper Presented at the 11th Annual Conference of the Egyptian Society of Community Medicine, Cairo.

- El-Batanoni M. (1995): *Hospital Waste Management in Cairo University Hospitals*. Paper presented at the 9th Annual Scientific Conference on Occupational and Environmental Medicine. Faculty of Medicine, Cairo University

- EMRO (1996): *Waste Minimization, Recycling, and Reuse*, World Health Organization.

- Environmental Health and Safety Department, (2002) : *Waste Minimization Plan*, Florida Atlantic University, USA

- Fellows, R., and Liu, A. (2003): *Research Methods for Construction*, Blackwell Science Ltd.

- Freeman, H.M. (1998): *Standard Handbook of Hazardous Waste Treatment and Disposal*, (2nd ed.). USA: McGraw-Hill.

- Glenn, M.R & Garwal, R. (1999): *Clinical Waste in Developing Countries*: *an Analysis with a Case Study of India, and a Critique of the Basle TWG Guidelines.*

- Gonzaga, N. (2006) : *Medical Waste Incinerator is a Killer*, Saudi Arabia

- Gordon G., Rein H., and Denys A. (2004): *Medical Waste Management in Mayhall*, Hospital epidemiology and infection control, 3rd ed., Lippincott Williams and Wilkins publication. Pages: 1773-85.

- Hamad, B. (2001): *Determinants of Job Satisfaction and Motivation among Gaza Nurses*. Sheffield Hallam University, UK.

- Harrison B (1991): *States Act to Regulate Medical Waste*, JADA, 122: 118-20.

- Harvery, P.A., Baghri, S. and Reed, R.A. (2002): *Emergency Sanitation*: *Assessment and Programme Design*, WEDC, Loughborugh university, UK.

- Health Care without Harm, (2004) : *Non-Incineration Medical Waste Treatment Technologies in Europe*, Prague, Czech Republic, Europe

- HCWHO "Health Care without Harm Organization", (2001): *Non-Incineration Medical Waste Treatment Technologies*, Washington, DC.

- Health Sciences Center, (2005) : *Waste Minimization Program*, Office of Environmental Health and Safety, New Orleans, p1

- Holloway, I., and wheeler, S. (1996): *Qualitative Research for Nurses*, Oxford :Black well science, UK.

- Hoyos, A.,Cobo, M.,Aristizabal, B.,Cordoba, F., and Montes de Correa, C. (2008) : *Total Suspended Particulate (TSP), Polychlorinated Dibenzodioxin (PCDD) and Polychlorinated Dibenzofuran (PCDF) Emissions from Medical Waste Incinerators in Antioquia, Colombia,* Chemosphere; Aug2008 Supplement, Vol. 73 Issue 1, pS137-S142, 6p

- Indian Ministry of Environment and Forests Notification, (1998): *Bio-medical Waste (Management and Handling) Rules*, New Delhi.

- Ismail, N., Aboul Ftouh, A., El-Shoubary, W., and Mahaba, H. (2007) : *Safe Injection Practice among Health-Care Workers in Gharbiya Governorate, Egypt*, Eastern Mediterranean Health Journal, WHO, Volume 13 No. 4 July - August, 2007

- Jagger, F., Hunt, E.H., Brand-Elnaggar, J., and Peasron, R.D. (1989): *Rates of needle-stick injury caused by various devices in a university hospital*. N Eng J Med, 319(5):284-288.

- Johnson L. (1999) : *Impact of Hazardous Waste on Human Health*, Lewis Publisher, USA

- Kamal, A., Shouman, A., Kamal, M., and Koth, M. (1994): *Needle Prick Injuries in Ain Shams University Hospital*. Paper presented at the 3rd pan African conferences on occupational health, Cairo, mimeo.

- Krisiunas, E.(2005) : *Emerging Technologies for the Treatment of Medical Waste: Considerations for the Commonwealth of Dominica,* WNWN International, Inc., Burlington, Connecticut, USA

- Liss, G., Crimi, C.(1990) : *Improper Office Disposal of Needle and Other Sharps: An Occupational Hazard Outside of Health Care Institutions,* Canadian Journal of Public Health,81(6):417-420.

- Logez S. et al. (2004): *Rapid Assessment of Injection Practices in Mongolia,* American Journal of Infection Control, 32(1):31–7.

- Manyele, S., Anicetus, H., Bilia, M. (2003): *Globalization and its Effects on Medical Waste Management,* Annual conference and general meeting, Tanzania.

- Massrouje, H. (2000): Medical *Waste Management among Health Workers in Gaza Governorates*, Master Thesis, Al-Quds University, Palestine.

- Marcus ,R. (1988) :*Surveillance of Health Care Workers Exposed to Blood from Patients Infected with Human Immunodeficiency Virus,* The New England Journal of Medicine,319(17):1118-1123.

- Marinkovic N, Vitale K, Holcer NJ, Dzakula A, Pavic T. (2008): *Management of Hazardous Medical Waste in Croatia*. Waste Management; 28(6):1049–56.

- Messick, S. (1989) : *Validity in Linn*, Educational Measurement, New York: Macmillan, USA

- MOH "Ministry of Health" (2005): *Health Status in Palestine,* Annual Report, Palestinian Health Information Center, Palestine.

- MOH "Ministry of Health" (2003): *Health Status in Palestine,* Annual Report, Palestinian Health Information Center, Palestine.

- Mohee R., (2005): *Medical Wastes Characterization in Healthcare Institutions in Mauritius.* Waste Management; 25(6):575–81.

- National Institute of Communicable Diseases and National AIDS Control Organization "NICDNAC", (2004): *Laboratory Diagnosis, Biosafety and Quality Control*, Delhi. P 26-41.

- Nazareth ,S., Rathi, M. (2008) : *Medical Waste Incineration*: *Fact Sheet*, electronically, www.cmar-india.org/Newsletter/NewsLetter5.pdf, Nov. 2008

- Nessim, D., (1996): *Health Education on Hospital Waste Management among Health Care Workers*, Master of public health thesis, Ain Shams University, Cairo.

- Oweis, R., Al-Widyan, M., Al-Limoon, O. (2005) : *Medical Waste Management in Jordan: A Study at the King Hussein Medical Center*, Waste Management; Jul2005, Vol. 25 Issue 6, p622-625, 4p

- PCBS "Palestinian Central Bureau of Statistic" (2008a) : *Distribution of Hospitals by Specialty, Governorate, Sector and Total Beds*, Palestinian National Authority

- PCBS "Palestinian Central Bureau of Statistic", (2008b): *Demographic and Socioeconomic Status in Palestinian People at the end of 2007*, Ramallah, Palestine2008, 25-45.

- Palestinian Central Bureau of Statistics "PCBS", (2007) : *General Census of Population and Buildings*, Palestinian National Authority

- Palestinian Central Bureau of Statistics (2006) : *Environmental Survey for Health Care Centers*, Palestinian National Authority

- PEQA "Palestinian Environmental Quality Authority" (2006a) : *Hazardous Waste*: *The Status of the Palestinian Environment*, chapter nine, Palestine

- PEQA "Palestinian Environmental Quality Authority" (2006b) : *Solid Waste Management: The Status of the Palestinian Environment* ,chapter eight, Palestine

- Polit, D., Hingler, B. (1999): *Nursing Research Principle and Method*, Lippincott, USA.

- Popesu D. et al. (2001): *Injection Practices among Nurses*, Valcea, Romania, morbidity and mortality weekly report, 50(4):59–61.

- Preben B.(2004): *Amalgam Toxicity: Environmental and Occupational Hazards*, J Dentist, 32: 359-65.

- Pruss A, Giroult E, Rushbrook P. (1999): *Safe Management of Waste from Health-Care Activities.* Geneva: World Health Organization.

- Qdais HA, Rabi A, Abdullah F. (2007): *Characteristics of the Medical Waste Generated at the Jordanian Hospitals*. Clean Techno Environment Policy; 9:147–52.

- Rao K., Ranyal K., Bhatia S., and Sharma R. (2004): *Biomedical Waste Management*: *An Infrastructural Survey of Hospitals*, MJAFI, Vol. 60, (4).

- Rao, H. (1995): *Disposal of Hospital Wastes in Bangalore and their Impact on Environment.* In the third international conference on appropriate waste management technologies for developing countries, Nagpur, 839–842.

- Rashid, S. (1996): *Medical Waste Disposal in Dhaka City: A Survey*. North-South University, Bangladesh, Dhaka.

- Run-dong, L., Yong-feng, N., Raninger, B., and Lei, W.(2006) : *Options for Healthcare Waste Management and Treatment in China,* The Chinese Journal of Process Engineering, Apr. 2006, Vol.6 No.2

- Rushbrook, P., and Zghondi, R. (2005): *Better Health Care Waste Management: An Integral Component of Health Investment*, WHO(CEHA) and the World Bank, Amman

- Rushbrook P., Chandra C., Gayton S. (2000): *Starting Health Care Waste Management in Medical Institutions: A Practical Approach*. World Health Organization, Copenhagen, Denmark.

- Rutala W., A., Weber DJ. (2005): *Disinfection, Sterilization and Control of Hospital Waste*: Mandell, Douglas and Bennett's principles and practice of infectious diseases (6th ed.). Elsevier Churchill Livingstone Publication. Pages: 3331-47

- Rutala, V. (1992): *Management of Infectious Waste in Hospitals,* Journal of Infection Control, USA, 4:98-204.

- Shaban, N.(2009):*Laboratories Medical Wastes Management in the Ministry of Health, Gaza Governorates*, Master Thesis, Al-Quds University, Palestine.

- Sabiha, J, Tufail, M.., *and* Khalid, S. (2008): *Heavy Metal Pollution from Medical Waste Incineration at Islamabad and Rawalpindi, Pakistan*, Microchemical Journal; Oct2008, Vol. 90 Issue 1, p77-81, 5p

- Saini, R.S. & Dadhwal, P.J.S. (1995): *Clinical Waste Management: A case Study, Journal of Indian Association for Environmental Management,* 22, 172–174.

- Sandhu, T.S. & Singh, N.A. (2003) : *Hazard Going Unnoticed –Biological Waste is a Threat to the Community at Large,* The Tribune, Online edition, Chandigarh, India.

- Sangodoyin, A.Y. and Osaigbovo, J. (1992): *Case Study Evaluation of Domestic Waste Components, Services and Pollution Aspects,* Journal of Engineering for International Development, 23-29.

- Science of the Total Environment Journal (2005): *Impact of Medical Waste Incineration.*

- Seymour B. (2001), *Disinfection, Sterilization and Preservation*, Lippincott Williams and Wilkins publication, (5th ed.)

- Sharma M., (2002): *Hospital Waste Management and its Monitoring*, Jaypee Brothers Medical Publication, (1st ed.)

- Shinee E., Gombojav E., Nishimura A., Hamajima N., and Ito K.(2008) : *Healthcare Waste Management in the Capital City of Mongolia*. Waste Management; 28(2):435–41.

- Singh, I., B.(1998) :*Legal Aspect of Hospital Wastes Management and the Biomedical Waste Rules,* Journal of Forensic Medicine and Toxicology, 15(1):103-115

- Srivastava, J.N. (2000): *Hospital Waste Management Project at Command Hospital*, National Seminar on Hospital waste Management, Bangalore.

- Taghipour, H., and Mosaferi, M.(2009) : *Characterization of Medical Waste from Hospitals in Tabriz, Iran,* Science of the Total Environment; Feb2009, Vol. 407 Issue 5, p1527-1535, 9p

- U.S. Army Center, (2001): *a Commander's Guide to Regulated Medical Waste Management at Army Medical Treatment Facilities,* U.S. Army Center for Health Promotion and Preventive Medicine.

- UNEP (1997): *Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal*, 1989, and Decisions Adopted by the First (1992), Second (1994) and Third (1995) Meetings of the Conference of the Parties. Geneva, United Nations Environment Program

- US Environmental Protection Agency "EPA", *Medical Waste Definition,* www.epa.gov/epaoswer/other/medical/, [Electronically accessed 15th October 2006.]

- USEPA (2003): *Medical Waste Storage, Transport and Disposal*, EPA technical guidelines no.2, South Australia.

- Veda H., Kulkarni R., and Ajantha G.,(2007) : *Biomedical Waste Management*, Journal of Oral and Maxillo Facial Pathology, Vol. 11 Issue 1 Jan - Jun 2007

- Visvanathan, C. (2006) : *Medical Waste Management Issues in Asia,* Environmental Engineering & Management Program, Asian Institute of Technology, Thailand

- World Bank (2007): *Investing in Palestine Economic Reform and Development. Report for the Pledging Conference*. World Bank, Palestine

- World Bank (2003): *West Bank and Gaza Update: Report on Impact of Intifada*. World Bank, Palestine.

- World Bank (2002): *West Bank and Gaza: Medium-Term Development Strategy for Health Sector*. World Bank, USA

- WDNR "Wisconsin Department of Natural Resources", (2006): *Medical Waste: Definitions of Terms*, WDNR publication WA 820, Madison, USA

- World Health Assembly (2005): *The Relationship between the Israeli Ministry of Health and Palestinian Health Authority*, 58th WHA, 17 May 2005, WHO, Geneva.

- WHO "World Health Organization" (2009a): *Non-Governmental Hospital*s in Gaza Strip, www.emro.who.int/palestine/health facilities, World Health Organization, Regional Office for the Eastern Mediterranean, Gaza Office,[Electronically accessed 8 July, 2009.]

- WHO, (2009b): *Health Situation in Gaza Strip, World Health Organization, Gaza Strip*

- WHO, *Health-Care Waste Management Planning*, World Health Organization.,www.who.int/entity/water_sanitation_health/medicalwaste, [Electronically accessed 20 June, 2009.]

- WHO (2007) : *Wastes From Health-Care Activities*, Fact sheet No. 253 , Geneva, WHO Media centre

- WHO, (2005) : *Management of Solid Health-Care Waste at Primary Health-Care Centers: A Decision-Making Guide*, Geneva, Switzerland, p.10

- WHO (2004) : *Health-care Waste Management*, Fact sheet No. 281, Geneva, WHO Media centre

- WHO-CEHA (1999): *Health Care Waste Practical Information,* Series No. 2. WHO-EM/CEH/100/E/L", Regional Office for the Eastern Mediterranean, Regional Center for Environmental Health. Activities (CEHA). Amman, Jordan.

- Williams, E. (2006): *Medical Wastes Management in Lagos,* Environmental Health Journal, 3:133-139.

- Yimer, S. (2005): *Healthcare Waste Management in Ethiopia*. IOHA Pilansberg, P1-5.

- Yong, Z., Gang, X.**,** Guanxing, W.**,** Tao, Z., and Dawei, J. (2009) : *Medical Waste Management in China: A Case Study of Nanjing,* Waste Management; Apr2009, Vol. 29 Issue 4, p1376-1382, 7p

- Zghondi R. (2002): *Basic Steps in the Preparation of Health Care Waste Management Plans for Health Care Establishments,* WHO (CEHA), Waste Management Practical Information Series No.2, Amman, Jordan.

- Zoarob, Z., K. (1997): *Hazardous Waste Management in Gaza Strip,* Master of Science Thesis, International Institute for Infrastructural, Hydraulic Environmental Engineering.

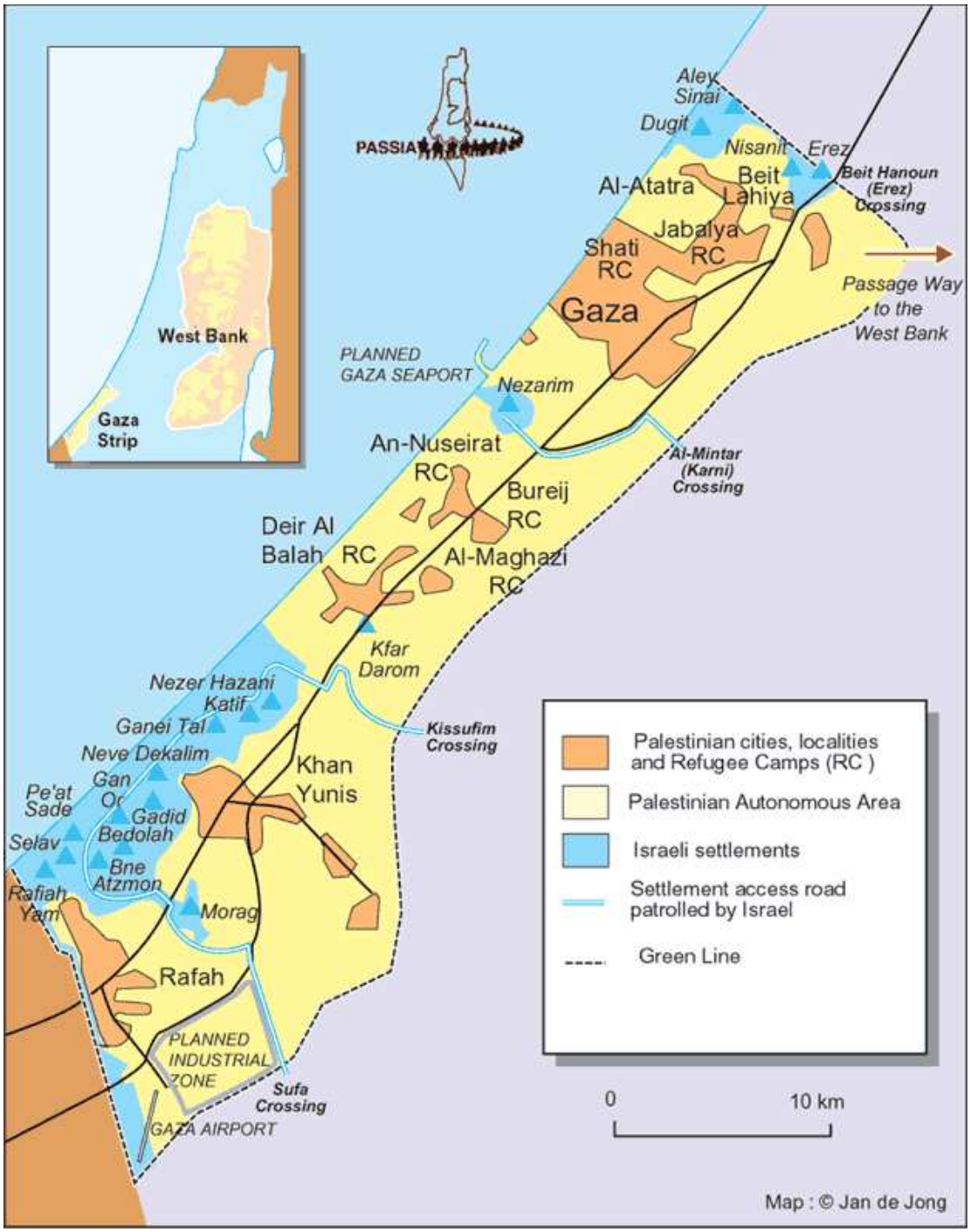
Annex 1

Map of Palestine

Source: www.palestinefacts.org

Annex 2

Map of Gaza Strip



Source: Palestinian Academic Society for the Study of International Affairs (PASSIA)

www.passia.org

Annex 3

Helsinki Committee Approval Letter

Palestinian National Authority
Ministry of Health
Helsinki Committee

السلطة الوطنية الفلسطينية
وزارة الصحة
لجنة هلسنكي

التاريخ2009/6/3

Name:

الاسم: ياسر فكري ياسر نصر

I would like to inform you that the committee has discussed your application about:

Evaluation of Medical Waste Management in Non-Governmental Hospitals in Gaza Strip

نفيدكم علماً بأن اللجنة قد ناقشت مقترح دراستكم حول:-

In its meeting on June 2009
and decided the Following:-
To approve the above mention research study.

و ذلك في جلستها المنعقدة لشهر 6 2009

و قد قررت ما يلي:-

الموافقة على البحث المذكور عاليه.

Signature
توقيع

Member
عضو

Member
عضو

Chairperson

Ministry of Health
Helsinki Committee

Conditions:-

- Valid for 2 years from the date of approval to start.
- It is necessary to notify the committee in any change in the admitted study protocol.
- The committee appreciate receiving one copy of your final research when it is completed.

Annex 4

بسم الله الرحمن الرحيم

عزيزي المشارك

السلام عليكم ورحمة الله وبركاته وبعد.....

شكراً لك لمشاركتك في هذه الدراسة حيث تم اختيارك لأنك تحقق المعايير المطلوبة للمشاركة.

أفيدك بأني أحد طلاب الدراسات العليا بكلية الصحة العامة بجامعة القدس وأقوم حاليا بهذه الدراسة ضمن متطلبات الحصول على شهادة الماجستير في برنامج الصحة العامة/صحة البيئة، جامعة القدس، فلسطين.

الغرض من هذه الدراسة هو وصف وتحليل الوضع الحالي لإدارة النفايات الطبية في المستشفيات غير الحكومية في قطاع غزة. من المتوقع أن تكون نتائج هذه الدراسة ذات اثر كبير على الصحة العامة، وستقدم نتائج مفيدة للجميع بأذن الله.

أرجو منك التكرم بالمشاركة في تعبئة الاستبيان المرفق بالمعلومات المطلوبة والتي تشكل عنصرا مهما في نجاح البحث ولك الحرية في المشاركة أو الانسحاب في أي وقت علما بان جميع المعلومات المتحصل عليها سوف يتم تحليلها بصورتها الإجمالية وستعامل بسرية تامة وعلى أن تستخدم لغرض البحث العلمي فقط وسوف تنشر النتائج بصورة جماعية وليست فردية.

مع علمي المسبق بحجم المسئوليات المناطه بك والتي تستحوذ على جل وقتك، إلا أن مشاركتك في هذه الدراسة سيكون لها بالغ الأثر على النتائج المتحصل عليها، مع تقديري لتعاونك المتوقع في تعبئة الاستبيان والذي لن يأخذ أكثر من ١٠ دقائق من وقتك الثمين.

شاكرا لك مسبقا كريم تعاونك معي وتقبل تحياتي.

ملاحظة: أرجو الاتصال بالباحث للاستفسار عن أي معلومات تتعلق بالاستبيان

- الباحث: ياسر نصر
- بريد اليكتروني: yassir2651@hotmail.com

الرقم التسلسلي ( )

استبيان إدارة النفايات الطبية

الرجاء وضع إشارة √ أمام الإجابة المناسبة:

أ- الخصائص الديموغرافية:

١- اسم المستشفى _____

٢- القسم _____

٣- مكان العمل: ☐ شمال القطاع ☐ مدينة غزة ☐ المنطقة الوسطى ☐ خان يونس ☐ رفح

٤- الجنس: ☐ ذكر ☐ أنثى

٥- العمر: _____

٦- سنوات الخبرة: _____

٧- مستوى التعليم: ☐أقل من ثانوية ☐ ثانوية أو أقل ☐ دبلوم ☐ بكالوريوس ☐ ماجستير أو أكثر

٨- المهنة: ☐ طبيب ☐ طبيب أسنان ☐ ممرض ☐ فني أسنان ☐ فني مختبر
☐ فني أشعة ☐ صيدلي ☐عامل ☐ أخرى (حدد) _____

٩- هل أنت مكلف بمهام عمل إداري ؟

☐ نعم ☐ لا

١٠- إذا كانت الإجابة نعم في السؤال السابق، فماهو مستوى عملك الإداري؟

☐ إدارة عليا ☐ إدارة وسطى ☐ إدارة دنيا ☐ أخرى (حدد) _____

ب- التدريب، الإشراف والتشريعات:

١١- هل التحقت بأي تدريب متعلق بإدارة النفايات الطبية؟

☐ نعم ☐ لا

١٢- إذا كانت الإجابة **نعم** في السؤال السابق أكمل الجدول التالي:

موضوع التدريب	المكان	السنة

١٣- هل هناك شخص مختص يشرف على عملية إدارة النفايات الطبية في مكان عملك؟

☐ نعم ☐ لا ☐ لا اعرف

١٤- هل يوجد في المستشفى لجنة مختصة لإدارة النفايات الطبية؟

☐ نعم ☐ لا ☐ لا اعرف

١٥- هل يوجد في المستشفى خطة خاصة بإدارة النفايات الطبية؟

☐ نعم شوهدت ☐ نعم لم تشاهد ☐ لا ☐ لا اعرف

١٦- هل هناك تشريعات تتعلق بإدارة النفايات الطبية في المستشفى؟

☐ نعم شوهدت ☐ نعم لم تشاهد ☐ لا ☐ لا اعرف

١٧- هل هناك دليل أو إرشادات تتعلق بإدارة النفايات الطبية في المستشفى؟

☐ نعم شوهدت ☐ نعم لم تشاهد ☐ لا ☐ لا اعرف

ج- المعرفة بالنفايات الطبية:

١٨- هل تشكل النفايات الطبية خطورة للعاملين في الرعاية الصحية؟

☐ نعم ☐ لا ☐ لا اعرف

١٩- هل للنفايات الطبية أي تأثيرات على البيئة؟

☐ نعم ☐ لا ☐ لا اعرف

٢٠- هل تشكل النفايات الطبية خطورة على الصحة العامة ؟

☐ نعم ☐ لا ☐ لا اعرف

٢١- هل هناك خطر من التعامل والتخلص من النفايات الطبية؟

☐ نعم ☐ لا ☐لا أعرف

٢٢- هل بالضرورة فصل النفايات الطبية عن النفايات العادية؟

☐ نعم ☐ لا ☐ لا اعرف

د - اتجاهاتك نحو إدارة النفايات الطبية:

٢٣- هل تعتقد أن هناك حاجة لتدريب العاملين في الرعاية الصحية على إدارة النفايات الطبية؟

☐ نعم ☐ لا ☐ لا اعرف

٢٤- هل تؤمن بأهمية وجود شخص مختص يشرف على عملية إدارة النفايات الطبية في مكان عملك؟

☐ نعم ☐ لا ☐ لا اعرف

٢٥- هل تؤمن بوجود تشريعات تعمل على تنظيم عملية إدارة النفايات الطبية؟

☐ نعم ☐ لا ☐ لا اعرف

٢٦- هل تعتقد أن الإرشادات العملية ضرورية للتعامل مع النفايات الطبية؟

☐ نعم ☐ لا ☐ لا اعرف

٢٧- هل تدعم مبدأ التقليل من النفايات الطبية،والذي يشمل تقليل سمية النفايات وكميات إنتاجها؟

☐ نعم ☐ لا ☐ لا اعرف

ه - الممارسات المتعلقة بإدارة النفايات الطبية:

I- السلامة والصحة المهنية

٢٨- أي الوسائل الوقائية التالية متوفرة في مكان عملك وسهل الحصول عليها؟

☐كمامات ☐ كفات ☐ أحذية ☐نظارات ☐ افرهول ☐ أخرى(حدد _____)

٢٩- هل تعرضت لمشاكل صحية أو إصابات نتيجة التعامل مع النفايات الطبية ؟

☐ نعم ☐ لا

٣٠- **إذا كانت الإجابة نعم** في السؤال السابق فما هي هذه المشاكل؟

☐ وخز إبرة(عدد المرات.....) ☐ أمراض جلدية

☐ أمراض تنفسية ☐ أمراض معوية ☐ أمراض عيون

II- التعامل والفصل

٣١- هل هناك إجراءات واضحة للتعامل مع النفايات الطبية وتجميعها في المستشفى؟

☐ نعم ☐ لا ☐ لا اعرف

٣٢- هل هناك نظام لفصل النفايات الطبية في الأقسام؟

☐ نعم ☐ لا ☐ لا اعرف

٣٣- هل هناك حاويات للنفايات الطبية ذات ألوان مميزة؟

☐ نعم ☐ لا ☐ لا اعرف

- **إذا كانت الإجابة <u>لا</u> أو <u>لا اعرف</u> انتقل للسؤال ٣٦:**

٣٤ - ماهي الألوان المستخدمة؟ ..... و..... و.....

٣٥ - هل تستخدم بالطريقة المفروض أن تستخدم فيها دائما ؟ ☐ نعم ☐ لا ☐ لا اعرف

III-التجميع

٣٦- هل يتم تجميع الإبر والمشارط في صندوق خاص بالمواد الحادة؟

☐ نعم ☐ لا ☐ لا أتعامل معها

- **إذا كانت الإجابة لا أو لا أتعامل معها انتقل للسؤال ٤٠**

٣٧- هل صندوق المواد الحادة صلب؟ ☐ نعم ☐ لا

٣٨- هل هو مقاوم للتسرب؟ ☐ نعم ☐ لا

٣٩- هل يحمل الشعار الدولي للمواد الخطرة؟ ☐ نعم ☐ لا

٤٠-كيف يتم تجميع النفايات المعدية في المستشفى؟

☐مع النفايات العادية ☐ أكياس حمراء اللون ☐ أكياس صفراء اللون
☐لا أتعامل معها ☐ أخرى (حدد) _____

٤١-كيف يتم تجميع بقايا الأنسجة الحيوية في المستشفى؟

☐مع النفايات العادية ☐ أكياس حمراء اللون ☐ أكياس صفراء اللون
☐لا أتعامل معها ☐ أخرى (حدد) _____

IV - التخزين:

٤٢- هل هناك حاويات وأكياس لتخزين النفايات الطبية ذات ألوان مميزة؟

☐ نعم ☐ لا ☐ لا اعرف

٤٣- هل يتم تخزين الصناديق الخاصة بالمواد الحادة بالقرب من منطقة المرضى؟

☐ نعم ☐ لا ☐ لا اعرف

٤٤- هل يتم تخزين النفايات المعدية بالقرب من منطقة المرضى؟

☐ نعم ☐ لا ☐ لا اعرف

٤٥-كيف يتم تخزين النفايات الطبية في مكان عملك؟

☐حاويات في غرفة خاصة ☐ حاويات النفايات العادية ☐لا اعرف

٤٦-كيف يتم تخزين أكياس النفايات العادية وأكياس النفايات المعدية؟

☐ مختلطة ☐ منفصلة ☐لا اعرف

V – النقل

٤٧-كيف يتم نقل النفايات الطبية داخل المستشفى؟

☐ في حاويات أو أكياس النفايات العادية ☐ حاويات أو عربات خاصة

☐ أخرى(حدد)_____ ☐ لا اعرف

٤٨- العمال الذين يقومون بنقل النفايات الطبية في مكان عملك هم:

☐عمال مدربين على ترحيل النفايات إلى مجمعاتها ☐عمال عاديون يقومون بهذا العمل

☐متعهد خاص يقوم بهذا العمل ☐ أخرى(حدد) _____

VI- المعالجة والتخلص

٤٩- أي الوسائل التالية متاحة لمعالجة النفايات الطبية في مكان عملك؟

☐ محرقة خاصة ☐ اتوكلاف ☐ ميكروويف ☐ أخرى (حدد) _____ ☐ لا اعرف

- ماهي الطريقة المستخدمة للمعالجة والتخلص من النفايات الطبية التالية في المستشفى؟ **(ضع علامة √)**

ت	***الطريقة*** / ***نوع النفايات***	مع النفايات العادية	الاتوكلاف	الميكروويف	محرقة خاصة	المكب	أخرى (حدد)	لا أتعامل معه
٥٠	النفايات المعدية							
٥١	بقايا الأنسجة الحيوية							
٥٢	المواد الحادة							
٥٣	المواد الكيميائية							
٥٤	الأدوية							
٥٥	المواد المشعة							
٥٦	العلب المضغوطة							
٥٧	أخرى(حدد)							

انتهى

شكرا لك

Annex 5

Explanatory letter

Medical Waste Management Questionnaire

Dear Participant,

Thank you for participation in this research; you were selected because you meet the selection criteria of participation.

This study is carried out as a part of the requirement for the master degree in Public Health AlQuds University- Palestine.

The study aims to describe and evaluate the current situation of medical waste management in non-governmental hospitals in Gaza Strip.

Your participation is voluntary, and you have the right to withdraw at any time during data collection. Your answers will be kept confidential and they will be used for the scientific research purposes only.

We appreciate your cooperation in answering this questionnaire, which may take less than 10 minutes of your time.

If you have any inquiry about the questionnaire, do not hesitate in contacting me.

Reseracher,
Yassir Nasr
E-mail: yassir2651@hotmail.com

Serial No.( )

MEDICAL WASTE MANAGEMENT QUESTIONNAIRE

Please put √ on the appropriate answer:

A- Demographic characters:

1. Name of the hospital: _____

2. Department _____

3. Location: ☐North ☐Gaza ☐Middle Zone ☐Khan Younis ☐Rafah

4. Sex: ☐ Male ☐ Female

5. Age ……..

6. Years of experience: ……

7. Level of education: ☐ Less than secondary ☐ Secondary ☐ Diploma ☐ Bachelor ☐ Master or above

8. Occupation:

☐ Physician ☐ Dentist ☐ Nurse
☐ Dental technician ☐ Lab technician ☐ X-ray technician
☐ Pharmacist ☐ Cleaner ☐ Others _____

9. Do you have a management responsibility?

☐Yes ☐No

10. **If the answer is yes**, in the previous question, In which capacity your management responsibility?

☐Senior ☐Middle ☐Lower ☐Other _____

B- Training, supervision and legislations:

11. Were you given any specialized training related to medical waste management?

☐Yes ☐No

12. **If the answer is yes**, in the previous question, complete the following table:

Training topic	Location	Year

13. Is there a specialized person to supervise the process of medical waste management in your work place?

☐Yes ☐No ☐Don't know

14. Does your hospital have a waste management committee?

☐Yes ☐No ☐Don't know

15. Does the hospital that you work in have a waste management plan?

☐Yes seen ☐Yes not seen ☐No ☐Don't know

16. Is there a waste management legislations in the hospital?

☐Yes seen ☐Yes not seen ☐No ☐Don't know

17. Is there a manual or a guideline document on management of medical wastes available in your hospital?

☐Yes seen ☐Yes not seen ☐No ☐Don't know

C- Medical waste knowledge:

18. Do you know that medical waste hazardous to health care workers?

☐Yes ☐No ☐Don't know

19. Do you know that medical wastes have any environmental effects?

☐Yes ☐No ☐Don't know

20. Do you know that medical wastes have adverse health impacts on the public?

☐Yes ☐No ☐Don't know

21. Do you know there is a danger in medical wastes handling and disposal?

☐Yes ☐No ☐ Don't know

22. Do you know that medical waste must be separated from regular waste?

☐Yes ☐No ☐ Don't know

D- Medical waste management attitudes:

23. Do you think that there is a need for training of health care workers on medical waste management?

☐Yes ☐No ☐ Don't know

24. Do you believe that there should be a specialized person to supervise the process of medical waste management?

☐Yes ☐No ☐ Don't know

25. Do you believe that there should be a legislation that controls the medical waste management process?

☐Yes ☐No ☐ Don't know

26. Do you think that instructions are necessary for handling medical waste?

☐Yes ☐No ☐ Don't know

27. Do you support the principle of waste minimization, through the reduction in the amount of toxicity and/or waste generated by a facility?

☐Yes ☐No ☐ Don't know

E- Medical waste management practices:

I- Safety and occupational health:

28. Which of the following safety items provided within the hospital with easy access when needed?

☐ Masks ☐ Gloves ☐ Safety shoes ☐ Eye glasses ☐ Overall ☐Other_____

29. Were you exposed to disease or injury as result of dealing with medical waste?

☐ Yes ☐ No

30. **If the answer is yes**, in the previous question, what are these problems?

☐ Needle prick (the no. of times _____) ☐ Skin diseases

☐ Respiratory diseases ☐ Gastrointestinal diseases ☐ Eye diseases

II- Handling and segregation:

31. Are there clearly defined procedures for collection and handling of wastes from specified units in the hospital?

☐Yes ☐No ☐Don't know

32. Is there a waste segregation system in use in medical departments or wards?

☐Yes ☐No ☐Don't know

33. Are the waste containers or bags color-coded?

☐Yes ☐No ☐Don't know

- **If the answer is <u>No</u> or <u>don't know</u> go to question 36**

34. Which colors are used? _____&_____&_____

35. Are they always used the way that it is intended? ☐Yes ☐No ☐Don't know

III- Collection

36. Are needles and sharps all together being put into sharps boxes?

☐Yes ☐No ☐ I don't use it

- **If the answer is <u>No</u> or <u>don't use it</u> go to question 40**

37. Are the boxes solid? ☐Yes ☐No

38. Are they leaking proof? ☐Yes ☐No

39. Are they labeled with the international biohazard symbol? ☐Yes ☐No

40. How are the infectious wastes collected in your hospital?

☐ With general waste bags ☐ Red bags ☐ Yellow bags

☐ Other (specify) _____ ☐ I don't use it

41. How are the pathological wastes collected in your hospital?

☐ With general waste bags ☐Red bags ☐Yellow bags

☐ Other (specify) _____ ☐ I don't use it

IV- Storage

42. Are bins, bag holders and temporary storage containers color coded?

☐Yes ☐No ☐Don't know

43. Are sharps boxes stored near the patient areas?

☐Yes ☐No

44. Are potentially infectious wastes stored near the patient areas?

☐Yes ☐No

45. In your work place, medical waste is stored in:

☐ Containers in special room ☐General waste container ☐Don't know

46. Are general wastes and infectious waste bags mixed or kept separate?

☐Mixed ☐Separate ☐Don't know

V- Transportation

47. Which of the following is used in internal transport of medical waste?

☐ With general waste bags or containers ☐Special containers or trolleys

☐ Other (specify) _____ ☐ I don't know

48. The workers who transport the medical waste from your work place are:

☐ Trained workers ☐ Regular workers

☐ Private sector ☐ Other (specify) _____

VI- Treatment and disposal

48. Which of the following is available for medical waste treatment in your work place?

☐ Incinerator ☐ Autoclave ☐ Microwave ☐ Other (specify) _____

- What is the method of treatment or disposal used for the following items of medical waste: ***(Please put √)***

Q.	Item	With general waste	Autoclave	Microwave	Incineration	Landfill	Other (specify)	I don't use it
50	Infectious							
51	Pathological							
52	Sharps							
53	Chemicals							
54	Pharmaceutical							
55	Radioactive							
56	Pressurized container							
57	Other(specify)							

Thank you

Serial No. ( ) **Annex 6**

MEDICAL WASTE MANAGEMENT CHECKLIST

1- Hospital Name: _____

2- Location: ☐ North ☐ Gaza ☐ Middle Zone ☐ Khan Younis ☐ Rafah

Put (√) mark when appropriate

- ***3- Types of Medical Wastes Generated:***

Items	**Present**	**Not present**	**Comments**
***Infections Waste*:** laboratory cultures; isolation wards wastes, tissues, and used dressings.			
***Sharps*:** syringes, needles, blades, broken glass.			
***Pathological Waste (Anatomical Waste)*:** body parts, blood, placentas, tissues removed surgically or by autopsy and other fluids.			
***Pharmaceutical Waste*:** any expired drugs or unwanted drugs.			
***Radioactive waste*:** radioactive substances from radiotherapy and laboratory work.			
***Chemical waste*:** chemicals that are used for cleaning or diagnostic work.			
***Pressurized containers*:** any gas cylinders, cartridges and aerosol cans that may cause potential harm.			
☐ ***Heavy metal waste*:** any unwanted batteries, broken thermometers or blood pressure gauges.			
☐ ***Other*** (Specify): ……..			

- ***Medical Waste Inspection:***

Items	**Present**	**Not present**	**Comments**
4- Legislations:			
5- Plan:			
6- The following safety items provided within the hospital with easy access when needed: ☐ Masks ☐ Gloves ☐ Safety shoes ☐ Eye glasses ☐ Others _____			
7-There are clearly defined procedures for collection and handling of wastes from specified units in the hospital.			
8-There is a waste segregation in use in medical department or wards.			
9- The waste containers are color-coded.			
10-Syringes and needles are together put into sharps boxes.			
11- Sharps boxes are solid, leak proof and labeled.			
12- Sharps waste is contained in sharps containers, labeled with the international biohazard symbol and the word "BIOHAZARD."			
13- Pathological waste is contained in red biohazard bags and labeled with the international biohazard symbol and the word "BIOHAZARD."			
14-Infectious waste is contained in yellow biohazard bags and labeled with the international biohazard symbol and the word "BIOHAZARD."			
15-Bin, bag holders and temporary storage containers are color coded.			

16- Sharps boxes are not stored near the patient areas.			
17-Potentially infectious wastes are not stored near the patient areas.			
18-General wastes and infectious waste bags are kept separate.			
19-Storage containers are properly labeled with the international biohazard symbol and the word "BIOHAZARD."			
20- Biohazard waste is stored no longer than 48 hours.			
21- Appropriate warning signs are posted around the storage area.			
22- Garbage outside boxes			
23- Needles in the roads			
24- Children playing with waste			
25- Medical wastes are transported by special containers or trolleys.			
25-On-site treatment of highly infectious waste is available. ☐ Incineration ☐Autoclave ☐Microwave ☐ Other_____			

Annex 7

Workers in non-governmental hospitals in Gaza governorates according to each hospital's director, 2009:

Hospital name	Medical Central for Obstetric and Surgery, Public Service hospital
District	Gaza
Hospital director	Dr. Awni Al-Aklouk
Medical staff	**No.**
Doctors	32
Nurses	25
Midwives	6
Pharmacists	4
Laboratory technicians	4
X-ray technicians	3
Worker	15
Administrative personnel(directors, secretaries, clerks)	14
Total	**103**

Hospital name	Ahli Arab hospital
District	Gaza
Hospital director	Sohaila Tarazi
Medical staff	**No.**
Doctors	18
Nurses	41
Midwives	3
Pharmacists	2
Laboratory technicians	5
X-ray technicians	3
Worker	10
Administrative personnel(directors, secretaries, clerks)	36
Total	**118**

Hospital name	Dar Al Salam hospital
District	Khan Yunis
Hospital director	Mr. Ibrahim Al-Ghlban
Medical staff	**No.**
Doctors	25
Nurses	10
Pharmacists	3
Laboratory technicians	5
X-ray technicians	5
Worker	6
Administrative personnel(directors, secretaries, clerks)	10
Total	**62**

Hospital name	Al Amal hospital
District	Khan Yunis
Hospital director	Mr. Waeal Meaki
Medical staff	**No.**
Doctors	30
Nurses	29
Pharmacists	4
Laboratory technicians	7
X-ray technicians	5
Worker	10
Administrative personnel(directors, secretaries, clerks)	26
Total	**111**

Hospital name	Al Quds hospital (PRCS)
District	Gaza
Hospital director	Mr. khalid Jouda
Medical staff	**No.**
Doctors	40
Nurses	70
Pharmacists	6
Laboratory technicians	9
X-ray technicians	6
Worker	14
Administrative personnel(directors, secretaries, clerks)	61
Total	**206**

Hospital name	Al Wafa' hospital
District	Gaza
Hospital director	Mr. Taiseer al-Beltaji
Medical staff	**No.**
Doctors	10
Nurses	51
Pharmacists	3
Laboratory technicians	3
X-ray technicians	1
Worker	7
Administrative personnel(directors, secretaries, clerks)	10
Total	**85**

Hospital name	Mahdi hospital
District	Gaza
Hospital director	DrMahdi Mahdi
Medical staff	**No.**
Doctors	3
Nurses/ Midwives	4
Midwives	2
Pharmacists	0
Laboratory technicians	0
X-ray technicians	0
Administrative personnel(directors, secretaries, clerks)	0
Total	**7**

Hospital name	Patient's Friend Benevolent
District	Gaza
Hospital director	Mr. Baker Al-Khzendar
Medical staff	**No.**
Doctors	52
Nurses/ Midwives	29
Pharmacists	4
Laboratory technicians	6
X-ray technicians	4
Health workers	21
Administrative personnel(directors, secretaries, clerks)	12
Total	**128**

Hospital name	Al Awda hospital
District	North Gaza- Jabalya
Hospital director	Mr.Naeal Deyab
Medical staff	**No.**
Doctors	47
Nurses/ Midwives	58
Pharmacists	2
Laboratory technicians	8
X-ray technicians	5
Workers	18
Administrative personnel(directors, secretaries, clerks)	14
Total	**152**

Hospital name	Eyes Specialist hospital, Public Service
District	Gaza
Hospital director	Dr. Awni Al-Aklouk
Medical staff	**No.**
Doctors	5
Nurses	4
Optical Specialist	1
Pharmacists	0
Laboratory technicians	0
X-ray technicians	0
Workers	2
Administrative personnel(directors, secretaries, clerks)	5
Total	**17**

Hospital name	Al Hillou hospital
District	Gaza
Hospital director	Dr. Tharwat Al-Hellou
Medical staff	**No.**
Doctors	3
Nurses	4
Operations technician	3
Pharmacists	2
Laboratory technicians	6
X-ray technicians	0
Workers	2
Administrative personnel(directors, secretaries, clerks)	4
Total	**24**

Hospital name	Yafa hospital
District	Middle
Hospital director	Mr. Hatim Hussain
Medical staff	**No.**
Doctors	15
Nurses/ Midwives	26
Operations technician	3
Pharmacists	4
Laboratory technicians	5
X-ray technicians	2
Physiotherapy	2
Workers	2
Administrative personnel(directors, secretaries, clerks)	10
Total	**74**

Hospital name	Al Kuwait Specialist hospital
District	Rafah
Hospital director	Mr. Abed Al Latif Al Najedi
Medical staff	**No**.
Doctors	37
Nurses/ Midwives	18
Pharmacists	4
Laboratory technicians	6
X-ray technicians	1
Workers	6
Administrative personnel(directors, secretaries, clerks)	8
Total	**84**

► **Total of all non-governmental hospitals workers ≈ 1171**

► **Total workers concerned with medical waste ≈ 1020**

Annex 8

Numbers of questionnaires were distributed in hospitals wards

Hospital / Department	Eye specialist	Al-Amal	Hellou	Kuwait	Al-Quds	Al-Salam	Al-Wafa'	Al-Awdaa	Patient's Friend	Public service	Yafa	Total
OR	2	1		3	7			6	1	2	3	**25**
Emergency		5		2	6	5		3	2		1	**24**
Surgery		4		1	4	2	17		3	6	4	**41**
E.N.T.				1						1		**2**
Orthopedic						1						**1**
Pediatric						1				1		**2**
Dermatology		1							1			**2**
Obstetric		3	8	3	2	1		9	2	3	4	**35**
Eye	2					1			2			**5**
ICU					3							**3**
Clinics					8	1		3	1	1	4	**19**
Dental		1		1					2			**4**
Laboratory		2	3	1	2	3	2	3	2	1	4	**23**
Pharmacy		1		1	2	2	1	1	2	3	2	**15**
X-ray		2		1	3	2	1		1	2	1	**13**
Stores									1	1		**2**
Total	**8**	**20**	**11**	**14**	**37**	**20**	**21**	**25**	**20**	**21**	**22**	**220**

Annex 9

ملخص الدراسة

تقيم إدارة النفايات الطبية في المستشفيات غير الحكومية في محافظات غزة

مع ازدياد الوعى والإدراك البيئي والصحي لمدى خطورة النفايات الطبية المتولدة من مؤسسات الرعاية الصحية على البيئة والإنسان، زاد الاهتمام بالإدارة السليمة للنفايات الطبية، والغرض منها هو حماية الصحة العامة من جهة والبيئة من جهة أخرى، وقد بذلت المؤسسات البيئية التشريعية العديد من الجهود في السنوات الأخيرة من اجل تحسين وضع إدارة النفايات الطبية. وتهدف هذه الدراسة إلى بحث واقع إدارة النفايات الطبية في المستشفيات غير الحكومية في محافظات غزة، وذلك عن طريق معرفة وجهات نظر ذوي العلاقة وتقييمها ومناقشتها، ومن ثم اقتراح الحلول المناسبة للمشاكل القائمة لإدارة هذه النفايات.

أهداف الدراسة الخاصة

- وصف وتحليل الوضع الحالي لإدارة النفايات الطبية في المستشفيات غير الحكومية.
- تقيم معرفة العاملين واتجاهاتهم المعرفية وممارساتهم في معالجة النفايات الطبية.
- التعرف على نقاط الضعف والقوة للممارسات المتعلقة بإدارة النفايات الطبية.
- اقتراح توصيات لصانعي القرار لتحسين إدارة للنفايات الطبية بناءا على نتائج الدراسة.

محيط الدراسة وأدواتها

تم استخدم المنهج الوصفي التحليلي في هذه الدراسة لوصف الوضع الحالي لمستوى المعرفة والاتجاهات بالإضافة إلى الإجراءات المتعلقة بإدارة النفايات الطبية، أما بالنسبة لأدوات الدراسة فقد تم استخدام قوائم التدقيق بالإضافة إلى استبيانات تم توزيعها على العاملين في مجال الرعاية الصحية وقد شملت عينة الدراسة على 275 من العاملين في 11 مستشفى غير حكومي في محافظات غزة وكانت نسبة المشاركة في هذه الدراسة 80%.

تحليل البيانات

تم استخدام البرنامج الإحصائي SPSS وتم استخدام t-test لإيجاد الفروق بين متغيرين و ANOVA لأكثر من متغيرين لتوضيح الفروق بين العوامل المؤثرة في الدراسة.

نتائج الدراسة

أظهرت الدراسة أن الوضع الحالي لإدارة النفايات الطبية غير مرض في المستشفيات غير الحكومية في قطاع غزة. 4.1% فقط من العاملين المشاركين التحقوا بدورات تدريبية متعلقة بإدارة النفايات الطبية، و 21.4% ذكروا أن هناك خطه للتخلص من النفايات الخطرة في أماكن عملهم، و 17.3% ذكروا أن هناك تشريعات متعلقة بإدارة النفايات الطبية في أماكن عملهم، و 28.6%من المشاركين تعرضوا لأمراض أو إصابات نتيجة سوء التعامل مع النفايات الطبية، كما أن معظم النفايات الطبية تجمع مع النفايات العادية عدا المواد الحادة كالإبر، فتوضع في صناديق خاصة بالمواد الحادة موضح على هذه الصناديق الشعار الدولي للنفايات الخطرة.

أما بالنسبة لحاويات النفايات الطبية فلم تكن ذات ألوان مميزة حسب توصيات منظمة الصحة العالمية وغير موضح على هذه الحاويات الشعار الدولي للنفايات الخطرة. كما أوضحت الدراسة أن هناك نقص واضح لأجهزة معالجة النفايات الطبية الخطرة في المستشفيات.

أوضحت الدراسة أن المعرفة بخطورة النفايات الطبية كانت عالية لدى العاملين بنسبة 90.4% و أيضا الاتجاهات نحو الإدارة السليمة للنفايات الطبية كانت مرتفعة بنسبة 89.1%، أما الإجراءات السليمة المتعلقة بإدارة النفايات الطبية فقد كانت منخفضة بنسبة 35.1%.

التوصيات

- ضرورة توفير الأجهزة الملائمة لمعالجة النفايات الطبية في كل مستشفى.
- ضرورة أن تقوم وزارة الصحة برقابة الطرق الحالية وتطوير طرق جديدة للتخلص الآمن من النفايات الطبية.
- ضرورة سن قوانين وتشريعات للتخلص من النفايات الطبية الخطرة.
- تدريب وتثقيف جميع العاملين في مجال الرعاية الصحية لتحسين إدارة النفايات الطبية.
- إتباع خطوات علمية عملية للتعامل مع النفايات الطبية بشتى أنواعها بالإضافة لطريقة جمعها وتخزينها ونقلها ومعالجتها قبل التخلص منها.