Handling and Management of Solid Healthcare Waste at Ramallah Hospitals

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Declaration:

- I certify that this thesis submitted for the degree of Master is the result 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.

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Dedication

This thesis is dedicated to my lovable Parents, brothers, sisters, my wife, and my two daughters; Mirna and Mirrel.

This work is also dedicated to my best friends Rana Ahed, Rana Abu Al-humus, Issam Mughanam and Burhan Daraghma.

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Abstract

The healthcare waste produced in the course of healthcare activity carries a higher potential for infection and injury than any other type of waste. The total absence of management measures to prevent exposure to hazardous healthcare waste results in the maximum health risk to the general public, patients, healthcare personnel and waste workers. It is of vital importance to note that even very limited waste management measures can dramatically reduce this risk.

Healthcare waste is a major problem in any society and particularly in developing countries. In the West Bank, healthcare waste management has not been given the proper attention during the years of Israeli occupation. With the growing number of hospitals established in the West Bank since 1996, healthcare waste management has become a primary concern particularly for health workers.

The researcher in this study explored the current status of the healthcare waste handling management and disposal procedures in Ramallah district hospitals. All ten hospitals (government, private and NGO's) in the Ramallah district were visited. A total 106 employees of the visited hospitals were invited to fill in a questionnaire that was developed especially for the purpose of this study based on the WHO developed instrument for hospital waste control and management.

A quantitative approach and design was utilized, where it systematically describes the phenomenon under investigation as it occurs in its natural environment.

It was found that almost all studied hospitals lack a system for segregation, treatment and proper disposal of healthcare waste. In addition, the lack of guidelines, legislation and a monitoring system has exacerbated the problem.

The researcher recommends that the need for a comprehensive plan should be set by the Palestinian Authority and namely the Palestinian Ministry of Health for a healthcare waste management in the West Bank as a whole and in Ramallah district in particular. The plan should include a description of the existing problems and the ways and methods to deal with them. It should develop regulations, legislations and guidelines at central and local levels to guide the operation of solid and hazardous waste systems management.

Implementation of the recommendations should be incremental, but it is of paramount importance that municipal authority and managers of Healthcare establishments are made fully aware of the need for proper waste management procedures.

الملخص التنفيذي

الفضلات الإكلينيكية تعتبر من اكثر الفضلات خطورة حيث من الثابت إنها تشكل مصدرا خطرا على المجتمع وعناصره البيئية المختلفة إذا اسيئت إدارتها.

سوء إدارة الفضلات الإكلينيكية تعتبر من أهم المشاكل التي تواجه المجتمعات وخصوصا البدائيةمنها.ففي فلسطين هذه الفضلات لم تعنى بأي اهتام خلال سنوات الاحتلال,ونظرا لنقص المعلومات حول كيفية إدارة الفضلات الإكلينيكية وبسبب الزيادة المطردة في أعدادها فقد وجد من الضروري إجراء دراسة لبحث هذه المشكلة.

إن الباحث في هذه الدراسة قام بفحص الممارسات اليومية المتعلقة بإدارة الفضلات الإكلينيكية من مصدرها إلى مرحلة التخلص منها في مستشفيات رام الله.

لقد تمت الدراسة باستخدام أسلوب الزيارات الشخصية إلى عشرة مستشفيات في رام الله من مختلف القطاعات الصحية, وقد تم دعوة 106 موظفين من هذه المستشفيات للمشاركة في تعبئة استبيان طور خصيصا لهذه الدراسة.

أظهرت نتائج الدراسة أن معظم المستشفيات المشمولة في الدراسة ليس لديها أية طريقة لمعالجة الفضلات الإكلينيكية .

إن الباحث يرى أن الحاجة ماسة إلى وضع خطة شاملة لادارة الفضلات الإكلينيكية من قبل السلطة الفلسطينية وخاصة وزارة الصحة ,إن هذه الخطة يجب أن تحتوي على طرق إدارة النفايات الطبية مثل الفصل ,المعالجة وطرق التخلص منها كما يجب أن تحتوي على قوانين وأنظمة للتعامل مع هذه الفضلات .

Chapter 1

Introduction

Recent years have manifested increasing awareness towards environmental issues. One of which was the enhanced population growth rate, which puts stress on the rural communities and environmental resources as well as the sanitation services. The health sector is one of the major service areas that were affected by the population growth. It started to grow rapidly to provide needed health services across the country. Apparently, this growth has led to higher generation of healthcare waste. Handling and disposal of healthcare waste is part of a nation's total solid waste disposal problems. Most consumers including health professions and services have exacerbated this problem due to the increasing use of disposables.

This emphasizes the importance of managing healthcare waste in view of its associated hazard, since its impact may exceed other known hazardous waste. Secondly, this waste is often treated similar to domestic waste despite its known hazard, particularly in the absence of legislations, regulations and guidelines governing the type of treatment to be pursued (Bernstein, 1989).

Healthcare waste generators should be responsible for the proper disposal of the waste they generate, in order to ensure the proper treatment and safe disposal for the sake of minimizing the risk that may be impacted on the population and the environment.

1.1 Background and Problem Statement

Healthcare waste generated is in itself hazardous to the environment and the population. It carries a major source of potential infectious and bodily injuries (from needlestick).

It may contain any of a great variety of pathogenic micro-organisms, which may enter the human body and inflict major health problems both to the health care staff and the general population. Individual cases of accidental and subsequent infections caused by health care waste are well documented (Bernstein, 1989). Many cases of infections (including HIV/AIDS and Hepatitis B and C) result from exposure to improperly managed health care waste. Apart from the fear of hazards, the general public is very sensitive to the individual impact of health waste, particularly anatomical waste, that is recognizable human body parts including fetuses (Gostin, 1997).

To eliminate the hazard of healthcare waste, adequate and appropriate methods of dealing and treating of the waste should be available and implemented by the producing parties. Management of healthcare waste is a critical part of environmental health protection.

While hospitals are considered the primary generators of healthcare waste by volume, the figures captures only a fraction of the healthcare facilities that generate healthcare waste (Rutala *et al.* 1989). Approximately 500,000 tons of healthcare waste is produced in the USA annually by about 375,000 waste generators (U.S. EPA,1991; Schmidt, 1996). Most healthcare waste (about 77%) is produced by hospitals which comprise about 2% of the total number of generators. The remainder of healthcare waste is produced by large, diverse group of generators, including physicians, clinics, dentists and pharmacies, most of which generates less than 50 pounds (22.7Kg) / month (Schmidt, 1996).

Between 75% and 90% of the waste produced by healthcare providers is non –risk or "general' health –care waste, comparable to domestic waste. It comes mostly from the administrative and housekeeping functions of healthcare establishments and may also include waste generated during maintenance of healthcare premises. The remaining 10-25% of health-care waste is regarded as hazardous and may create a variety of health risks (WHO, 1999)

Exposure to hazardous healthcare waste can result in disease or injury. The hazardous nature of healthcare waste may be due to one or more of the following characteristics (WHO, 1999):

1 it contains infectious agents;

2 it is genotoxic;

3 it contains toxic or hazardous chemicals or pharmaceuticals;

4 it is radioactive;

5 it contains sharps.

All persons exposed to hazardous waste are potentially at risk. This may include people within healthcare establishments or any other source that generates healthcare waste. It also includes people outside these sources who either handle these wastes or are exposed to it as a consequence of unchecked management. The main groups at risk are:

1. Nurses and hospital sweepers.
2. Patients in healthcare establishments or under home care; and even visitors of hospitals or labs (Anderson, 1996).
3. Workers in support services to healthcare establishment such as laundries, waste handling and transportation, and waste disposal facilities including incinerators.
4. Pharmacy personnel may be at risk from respiratory or dermal exposure to aerosols contaminated with pharmaceutical waste or solvents (Anderson, 1996).
5. General public when waste is hardly managed on sound basis.

To ascertain the above, a study was conducted with a view to surveying the prevalence of hospital- acquired infections in 14 countries between 1983- 1985. Almost 47 hospitals of different sizes ranging from 227-1502 beds were surveyed to detect the nosocomial infection among patients, hospital personnel, as well as visitors. The result showed a large range of prevalence varying from 3% -21% in individual hospitals. This clearly indicates

the importance of hospital hygiene, which depends largely on proper waste management for public health (WHO, 1997).

For the proper healthcare waste management, a short and long term management program should be implemented. Policies should be set and followed by all those that are in direct contact with healthcare waste. Establishment of a national policy and a legal framework, training of personnel and raising of public awareness is an essential element for successful healthcare waste management. Community awareness of the problem is vital for its participation in generating and implementing policies and programs.

Healthcare waste was not given any attention during the years of occupation in the West Bank. No comprehensive system dealt with healthcare waste handling, storage, transport and disposal and no data was available. In the absence of any Palestinian authority for about three decades, as the case is in almost all aspects of life, no defined policy regarding healthcare waste management was ever instituted. Each health care institute runs its own waste handling system, which is not proper in terms of segregation, storage or transportation. Moreover, the disposal of healthcare waste in the WB increases the health and environmental risks because the waste is dumped with the general waste at the dumping sites, keeping in mind that none of the Palestinian municipalities run a sanitary landfill.

The Palestinian Authority is trying to initiate a plan of action for the development of regulatory, legislative, and guidelines at central and local levels to guide the operation of solid and hazardous waste system management. To reach this stage, there is a lot to be done. The first step is to collect data regarding healthcare waste quantities, composition, and handling and disposal problems. To achieve this, it was imperative to survey the exiting healthcare waste management practices in the West Bank and to develop a framework environmental policy for hospitals (including purchasing, recycling and

pollution). Ramallah district was chosen to be the focus of this study because of the following reasons:

1. Current political situation and the hardship in moving around the West Bank with the researcher himself living in Ramallah.
2. Ramallah district has one of the largest governmental hospitals with a variety of specialty wards and laboratories.
3. It is moderately a big city with a population of 215265 (according to a 1995 survey by the Palestinian Bureau of Statistics (PBS)) and enjoys a relative pooling of facilities; both centers and hospitals.
4. The Palestinian Authority is trying to pilot a management plan for solid waste in the Ramallah District and thus, relative feasibility was expected in collecting the required information.
5. The anecdotally observed similarity in the handling procedures of healtcare waste in the whole WB (West Bank) make it possible to apply conclusions drawn from the finding of this research to other WB districts.

1.2 Study Objectives

1.2.1 Overall Objectives:

The overall objective of this study is to investigate the current status of the healthcare waste handling, management and disposal procedures in Ramallah district hospitals.

1.2.2 Specific Objectives:

The specific objectives of this study are to:

1. Identify the gaps and deficiencies in the present waste management adopted procedures.
2. Estimate the total amount of healthcare waste generated from all different sources in order to suggest means for implementing the proper treatment and disposal.

3. Investigate the means of healthcare waste handling inside the studied settings.
4. Examine the availability of on-site and off-site management plan and procedure of healthcare waste in the studied settings.
5. Explore the nature, frequency and extent to which staff is exposed to relevant training and awareness activities and programs.

Chapter 2

Literature Review

An in-depth review of the available literature revealed a substantial amount of research work being undertaken on the subject of healthcare waste worldwide. The theoretical foundations of this study was largely based on the extensive work of the Department of Protection of the Human Environment of the World Health Organization (WHO) and the WHO's European Center for Environment and Health in France. Together, the above two agencies set up an international working group to set guidelines to deal with the healthcare waste management problems in the developing countries.

The guidelines meant to complement and supplement earlier WHO work in various regions of the world. The guidelines were published as a WHO document in the form of a handbook encompassing comprehensive guidelines on all relevant issues including these tackled in this study. This handbook was published to provide a global strategy to offer national and local administrators a set guidelines on handling of healthcare waste.

2.1 Classification of Waste

Waste (solid or liquid) is a term used for all useless, unused, unwanted or discarded items or materials. Waste components can be classified according to the point of origin into: domestic, agricultural, commercial, industrial, constructional, and healthcare waste (ETCL, 1994).

2.2 Healthcare waste

Is the waste arising from medical activities such as diagnosis, treatment, and prevention of diseases. Healthcare waste can also arise from the alleviation of a handicap in humans or

animals including clinically related research under the supervision of a medical or veterinary practitioner or approved healthcare system (ETCL, 1994; Anderson, 1996; WHO, 1999).

According to the EPA, medical waste is defined as any waste generated in the diagnosis, treatment, or immunization of human beings or animals, in research pertaining thereto, or in the production or testing of biological, excluding hazardous waste. This definition includes some components that require special attention; these are:

1. Cytotoxic chemicals which are substances capable of impairing, injuring or killing cells.
2. Hazardous chemicals such as some solvents which are used in laboratories.
3. Infectious waste
4. Pathogens
5. Toxic chemicals
6. Radio-active materials

According to WHO classification in 1997, healthcare establishments can be divided in terms of the amount of waste generated by each into: major and minor sources. The major sources of waste include primarily hospitals and other curative healthcare establishments such as dialysis center and the like. While minor sources of healthcare waste include small healthcare establishments such as dental clinics and physicians offices in addition to institutions with low waste generation such as psychiatric hospitals and research laboratories and disabled persons institutions (WHO, 1997).

2.3 Hospital Waste

Hospital Waste can be classified into:

2.3.1 General Waste: Includes domestic type wastes that are produced in the preparation and serving of food including food packaging waste and surplus food, cleaning materials, commercial and clerical waste. General waste includes waste water and laundry waste (ETCL, 1994). It also includes used disposable bed pan liners, urine and feces containers, incontinence pads, stoma bags and other substances that do not pose a special handling problem or hazard to the environment (Qusus, 1988; TCOE, 1993; Rasras, 1996)

2.3.2 Healthcare Waste:

This kind of waste includes the following:

I. Pathological waste: This consists of tissues, organs, body parts, human fetuses and animal carcasses, blood, and body fluids.

II. Infectious Waste: is suspected to contain pathogens (bacteria, viruses, parasites, or fungi) in sufficient concentration or quantities to cause disease in susceptible hosts.

III. Chemical Waste: consists of discarded solid, liquid, and gaseous chemicals. Chemical waste is generated from diagnostic and experimental work, from cleaning, housekeeping, and disinfecting procedures.

VI. Waste with High content of Heavy Metals: This represents a subcategory of hazardous chemical waste, and is usually highly toxic, i.e. mercury thermometers but their volume is decreasing with the substitution of solid-state electronic sensing instruments. Another source of heavy metal waste is in certain "reinforced wood panels", which is still

used in radiation proofing of X-ray and diagnostic departments. Heavy metal waste, i.e. arsenic, may be found in a number of drugs, but these are treated as pharmaceutical waste (WHO, 1999).

V. Genotoxic waste: This waste is highly hazardous and may have mutagenic, teratogenic, or carcinogenic properties. It should be given special attention as it raises serious safety problems, both inside the hospitals and after disposal.

Cytotoxic (or antineoplastic) drugs, which are used in chemotherapy treatment of cancer patients, are the principal substances in this category. Cytotoxic drugs play an important role in the therapy of various neoplastic conditions. They are also finding wider applications immunosuppressive agents in organ transplantation and in treating various diseases with an immunological basis. Cytotoxic drugs are most often used in specialized departments such as the oncology and radiotherapy units. However, their use in other hospital departments is increasing and they may also be used outside the hospital setting for home based treatment.

VI. Sharps' Waste: This includes infected needles, syringes, scalpels, saws, blades, broken glass, nails and any other item that could cause a cut or puncture (ETCL, 1994). Discarded sharps used in animal or human patient care, medical research, or industrial laboratories are also considered hazardous waste.

VII. Pharmaceutical Waste: This includes pharmaceutical products, drugs and chemicals that have been returned from wards, have been spilled, outdated, contaminated, or discarded because they are no longer required (ETCL, 1994). They also comprise discarded items used in the handling and preparation of pharmaceuticals such as bottles or boxes with residues, gloves, masks, connecting tubes or drug vials (British Medical Association, 1991; WHO, 1997).

VIII. Pressurized Containers: are often used in healthcare to store gasses such as compressed gas cylinders and disposable aerosol cans. When these are used and still contain residues, they generate reusable or disposable containers (WHO, 1997). These containers may explode if incinerated or accidentally punctured (ETCL, 1994). Most common gases used in healthcare are: oxygen, compressed air and anaesthetic gases, which include ethylene oxide which is used for sterilization.

IX. Radioactive Waste: which includes solid, liquid, and gaseous materials contaminated with radionuclides. It is produced as a result of procedures such as *in-vitro* analysis of body tissue and fluid, *in-vivo* organ image and tumor localization, and various investigative and therapeutic practices (WHO, 1999). Radionuclides used in health care are usually conditioned in unsealed (or "open") sources or sealed sources. Unsealed sources are usually liquids that are applied directly and not encapsulated during use. Sealed sources are radioactive substances contained in parts of equipment or apparatus or encapsulated in unbreakable or impervious objects such as "seeds" or needles.

2.4 Source of Waste within the Hospital

The waste categories at hospital are related to the source of origin within the hospital. The typical categories of waste generated from various departments are shown in **Table 2.1.**

Table 2.1 *Typical categories of hospitals' solid waste*

Area of Generation	Typical Waste Category
1. Administration	General Waste; Paper Goods, ETCL.
2. Maternity	Medical Waste; General Waste; Sharps.
3.Operating room; Emergency; Surgery, out-patient Clinics	General Waste; Pathological Waste; Sharps; Chemical Waste; Infectious Waste; Pharmaceutical Waste; Tissues and Blood.
4. Laboratory; Autopsy Room.	General Waste; Pathological Waste; Sharps; Infectious Waste; Chemical Waste; Blood.
5. Nursing Station.	Sharps; General Waste; Paper Goods.
6. Services and Maintenance.	General Waste.
7. Kitchen and Cafeterias.	General Waste.
8. Dialysis Unit.	General Waste; Pathological Waste; Blood and body fluids; Chemical Waste; Sharps; Infectious Waste; Pharmaceutical Waste.

Source: (Qusus, 1988)

2.5 Amount of Healthcare Waste Generation

According to the WHO (1997), the amount of healthcare waste generated depends on the income level, waste type, and the source type in different countries as illustrated in the following tables:

Table 2.2 *Healthcare waste generation according to the income levels*

Income Level	**Annual Waste Generation (kg/head of population)**
a. High- income countries	
- All healthcare waste	1.1 – 12.0
- Hazardous Healthcare Waste	0.4 – 5.5
b. Middle- income countries	
- All healthcare waste	0.8 – 6.0
- Hazardous Healthcare Waste	0.3 – 0.4
c. Low- income countries	
- All healthcare waste	0.5 – 3.0

Sources: Halbwachs, 1994 Cited in WHO, 1999

Table 2.3 *European generation rate of hospital waste / source type*

Source of Type	Waste Generation (kg/ year)
1. General Practitioners	
a. Sharps	4
b. Infectious Waste	20
c. Total Waste	100
2. Phlebotomists	
- Infectious Waste	175
3. Gynecologists	
- Infectious Waste	350
4. Nurses	
- Sharps	20
- Infectious Waste	100
5. Dentists	
- Sharps	11
- Infectious Waste	50
- Heavy metals (including Mercury)	2.5
- Total Waste	260
6. Biomedical Laboratories (60 analysis / day)	
- Infectious Waste	At least 300
7. Kidney Dialysis (3 per week)	
- Infectious Waste	400

Source: (WHO, 1999)

Table 2.4 *Generation rate of healthcare waste in Europe*

Country	Normal (1/1000 t/ pa)	Special (1/1000 t/ pa)
Denmark	32,000 tons	5,400 tons
France	400,000 tons	300,000 tons
Germany	963,000 tons	96,000 tons
Italy	150,000 tons	50-60,000 tons
Spain	190,000 tons	23,000 tons
Sweden	65,000 tons	5,000 tons
Netherlands	142,000 tons	8,000 tons
U.K.	200,000 tons	250,000 tons

Source: (Environmental Technology Consultants Limited. 1994)

Table 2.5 Hazardous Healthcare Waste Quantities Produced in Healthcare Facilities in Selected Countries of Latin America and the Caribbean:

Country	Number of Beds	Hazardous Waste Generation (Tons/year)
Argentine	150000	32850
Brazil	501660	109960
Cuba	50293	11010
Jamaica	5745	1260
Mexico	60100	13160
Venzuela	47200	10340

Source: (WHO, 1999)

2.6 Hazards from Different Waste Categories

2.6.1 Hazards from Infectious Waste

Infectious waste may cause hazard to human body through a crack or cut caused by sharps injuries. Two infections of particular concern, for which there is a strong evidence of transmission via healthcare waste are the HIV virus, and more frequently Hepatitis B and C. These are in general transmitted through injuries from needle sticks from syringes contaminated by human blood.

Another route of infection by infectious waste is through absorption through the mucus membranes. Inhalation of aerosols during uncontrolled dumping or storage which allows possible dispersion of particulates and pathogenic organisms by wind causing respiratory and subsequent systemic infection as well as ingestion of contaminated food or water.

2.6.2 Hazards from Sharps

Sharps may cause cuts and punctures and infection by introducing infectious agents into the blood, if previously contaminated. Due to this double risk of injury and disease transmission, sharps are considered an extremely hazardous waste category since it provides a direct route into the blood stream. Syringe needles are of particular concern since they are contaminated with the patient's blood (WHO, 1997).

The hazard of infection by sharps is due to the survival of the HIV, HBV viruses in the syringe in an infective dose for eight days after having been used on an infected patient (WHO, 1994).

Sharps hazards have been studied in hospitals in many countries to estimate its occupational hazard. Summaries and results of these studies are elaborated in the

following:

- Most of sharps' injuries occur as needles and syringes are being prepared for discharge into the waste stream, such as recapping needles rather than after being properly discarded in sharps containers (Burnett, *et al* 1995).
- The annual number of HBV infections in USA resulting from exposure to healthcare waste lies between 162-321 against a yearly total of 300,000 cases. **Table 2.5** shows the occupational HBV infections through injuries from sharps (WHO, 1997).

Table 2.6 *Occupational Hepatitis B Virus (HBV) infections through injuries from sharps (USA)*

Professional Category	**Annual number of injuries from sharps [persons per year]**	**Annual number of HBV infections [persons per year]**	**Percentage of HBV infected after injury [persons per year]**
Nurses			
In hospital	17,700 - 22,200	56 – 96	0.25- 0.54%
Outside hospital	28,000 - 48,000	26 – 45	0.05 –0.16%
Laboratory workers in hospital	800 -7,500	2 – 15	0.03 –1.9%
Hospital housekeepers	11,700 -45,300	23 – 91	0.05 –0.8%
Hospital technicians	12,200	24	0.20%
Physicians and dentists in hospital	100 - 400	<1	<1%
Physicians outside hospital	500 - 1,700	1 – 3	0.06 –0.6%
Dentists outside hospital	100 - 300	<1	<0.3%
Dental assistant outside hospital	2,600 -3,900	5 – 8	0.13 –0.6%
Emergency medical personal (outside hospital)	12,000	24	0.20%
Refuse workers (outside hospital)	500 -7,300	1 – 15	0.010 – 0.03%

Source: (WHO, 1997).

A study was undertaken to monitor the management of sharps by healthcare workers (including physicians, nurses, technicians, students in the emergency departments) at the University of California – San Diego Medical Center. Utilization management of 418 sharps were observed and reported the following results (Most *et al.* 1994):

- 28% were used in excess risk for the user or another person or both.
- 27% conferred excess risk to the user.
- 12% conferred excess risk to another person.
- 33% were used without risk to anybody.

In the above study, three hundred and twenty three recapable needles were used; 20% were recapped using two-handed technique; 64% were uncapped and four sharps where thrown in the trash.

A 1980 study conducted in the North Carolina Hospitals showed that needle clippers were used for 80% needle disposal. In 1989, only few (1%) were using clippers because recommendations warned of the potential for aerosolization of microorganism during the clipping process. The surface may become contaminated with Hepatitis B surface antigen. The clipping process then appeared to be an unnecessary maneuver that could result in needle – stick injuries (Rutala *et al,* 1989).

Regionally, a study in Hadassah University Hospital to assess the risk of Hepatitis B virus infection among hospital employees revealed that the highest rates of infections were found in personnel of selected departments such as haemodialysis 31.8%; haematology/ oncology 28.3% and the blood bank at 24.0%. Anti- HBC was positive in 17.2% of nurses; 15.6% of physicians and 7.8% of administrative clerks (Donchin and Shouval, 1992).

2.6.3 Hazard from Chemical and pharmaceutical waste

Many of the chemicals and pharmaceuticals used in health-care establishments are hazardous (e.g. toxic, genotoxic, corrosive, flammable, reactive, explosive, shock-sensitive). These substances are commonly present in small quantities in health-care waste; larger quantities may be found when unwanted or outdated chemicals and pharmaceuticals are disposed of. They may cause intoxication, either by acute or by chronic exposure, and injuries, including burns(WHO, 1999).

Disinfectants are particularly important members of this group: they are used in large quantities and are often corrosive. It should also be noted that reactive chemicals may form highly toxic secondary compounds (Emery, *et al* 1992).

2.6.4 Hazards from Genotoxic Waste

The severity of the hazards for health-care workers responsible for the handling or disposal of genotoxic waste is governed by a combination of the substance toxicity itself and the extent and duration of exposure. Exposure to genotoxic substances in health care may also occur during the preparation of or treatment with particular drugs or chemicals. The main pathways of exposure are absorption through the skin, and ingestion as a result of bad practices, such as mouth pipetting. It may also occur from direct contact with the bodily fluids and secretions of patients undergoing chemotherapy (Emery, et al, 1992).

2.6.5 Hazards of Radioactive Waste

The amount and type of exposure determine the type of disease caused by radioactive wastes. It can range from headaches and dizziness to vomiting. Some waste may be genotoxic and may affect the genetic material. Handling of highly radioactive sources, e.g. certain sealed sources from diagnostic instruments, may cause severe injuries and should

be handled with care (Emery, *et al* 1992).

2.6.6 Hazards of General Waste

General waste, as previously defined does not pose any risk. However, when the bacterial concentration of different healthcare waste emanating from the operating room, intensive care units and nursing stations were compared with household waste. Transmission will occur only when all factors i.e. (virulent pathogens, dose, and portal of entry and susceptible host) are present simultaneously (Rutala *et al.* 1989).

It is estimated that about 50% of hospital waste is non– clinical. Kitchen waste, is a good media for microbial growth. It may be by itself a possible source of bacterial infection,if it is not disinfected thoroughly e.g. egg album(ETCL, 1994; Anderson, 1996).

2.7 Health and Environmental Impact of Healthcare Waste-Management

Healthcare wastes may have different impacts on human and environmental source depending on the type of waste, the pretreatment method applied and the disposal method adopted by the healthcare establishment.

2.7.1 Land filling and Open Dumping

It is known that the survival of pathogenic microorganisms in the environment is limited. Temperature, humidity, and availability of organic matter all affect the mortality rate of microorganisms. For example, Hepatitis B virus can survive in ethanol or antiseptic fluid at 70% for up to 10 hours at 60°C. HIV is less resistant than HBV or HCV, where it does not survive more than 15 minutes exposure to ethanol 70% and survives only 3-7 days at ambient temperatures (WHO, 1997).

Waste transporting from healthcare establishments to the landfill or open dumpsite appears to pose problems to the general public if not properly performed or if spilled while transporting. (Anderson, 1992; ETCL, 1994).

Disposal site, whether it is a landfill or an open dump, ought to be thoughtfully considered due to the problems that may be encountered with soil and ground- water contamination resulting from run off and seepage from waste in landfills (Watts *et al.* 1992).

Municipal landfills in many developing countries do not meet the acceptable standards, where waste is not collected daily and it is not controlled. The difficulty of control and supervision of the municipal disposal sites is another problem. A twenty-four hour guard would be necessary if real supervision is required (WHO, 1994).

A significant increase in health hazard is associated with healthcare waste, when it is disposed of in conjunction with other municipal waste particularly if not either sterilized or incinerated at source. The role of vectors and their control on the dumpsite is very important, where flies and rats can spread disease and contaminate food since they find shelter and possibly food, in piles of solid waste (Anderson, 1996).

Garbage collectors may act as carriers of certain disease if they undertake their daily activities among residential communities, which might cause indirect risk to the public at large (Anderson 1996).

2.7.2 Burning and Incineration

An important type of pollution that can expose human health to infection is air pollution resulting from certain disposal processes, namely burning and incineration. Open site burning results in the generation of large amounts of particulate as well as probable viable

microorganism emissions. Incineration, the acceptable method, is defined as the controlled burning of solid, liquid or gaseous combustible wastes to produce gases and residues containing little or no combustible material (Manns, 1995).

2.7.3 Waste Water

In 1996 Anderson discussed the source of wastewater in hospital and healthcare units to be:

- **Domestic** which may include toilets, baths, and wash, food preparation, non-infectious wards, and infectious wards.
- **Treatment** which may include therapy and dialysis.
- **Spillage** which may include chemicals, treatment wards and blood banks (in addition to outdated pharmaceuticals).
- **Chemical Waste** which may include photography, x-ray, radioactive, cleaning fluids, and solvents which should not be discharged to sewer.

In the draft handbook; Safe management of wastes from health-care activities by WHO, (1997) the topic of waste water was discussed. It considered sewage from healthcare establishment similar to domestic, but may in addition include pathogens like bacteria, viruses, helminthes and chemical and pharmaceutical and radioactive isotopes.

2.7.4 Effect of Healthcare Waste Water on Waste Water Treatment Plant Function

Nemerow in 1978 studied the effect of healthcare wastewater on wastewater treatment plants. He found that the sewage dosed up to 7 mg/L of streptomycin (an antibiotic) that did not affect the treatment, whereas 12 mg/L caused inhibition of biological action (Knoch *et al.*1992). The other effect would be the prevention of beneficial use of sludge and treatment of wastewater (TCOE, 1993). Furthermore the WHO in 1997 added that sludge might contain high concentration of helminthes and other pathogens (WHO, 1997). Climatic conditions may change a normal infectious disease to an epidemic one.

Healthcare establishments in hot climates need to be more alert to avoid any spread of epidemic disease because of mismanaged waste (Anderson, 1996).

2.8 Handling of Waste within the Hospital

Handling of waste is defined as the linkage between packaging, storage and transport. It starts in the clinical departments and is done as hygienically and economically as possible to minimize the risk to the health of the employees and the environment. Therefore, waste segregation, which is one of the most practical and cost-effective waste management policies, allows special attention to be given to each kind of waste separately to decrease the amount of waste that needs special attention (WHO, 1994).

2.9 Treatment/ Management of Waste within the Hospital premises

The term treatment refers to the process that modifies the waste in a certain method before it is finally disposed of (WHO, 1999). Treatment is required for the following reasons:

1. To disinfect or sterilize the waste so that it is no longer the source of pathogenic organisms. The methods used may include chemical disinfecting or thermal sterilization, irradiation, autoclaving, gas/vapor, microwave sterilization, or incineration. After such treatment, residues can be handled more safely and with fewer precautions.

2. To reduce the bulk volume of waste in order to reduce the requirements for storage and transportation.

3. To make surgical waste (especially body parts) unrecognizable and therefore less aesthetically unacceptable.

4. To make recyclable items unusable, especially syringes (WHO, 1994).

Due to the wide range of waste categories, no single method is satisfactory for all. That signifies the importance of waste segregation to facilitate the application of the best suitable treatment method for each kind of waste separately and properly.

Appendix A summarizes the advantage and disadvantage of each treatment and disposal method. The treatment options can be summarized in **table 2.7.**

Table 2.7 Treatment Option of Healthcare Waste

Treatment of Disposal Option	Type of Waste
Incineration	• Combustible chemical waste • Cytotoxic and genotoxic drugs • Human tissue, limbs, placenta, infected carcasses and dialysis waste. • Sharps except mercury bearing wastes • All pathological wastes • Soiled surgical dressings, swabs and contaminated wastes
Landfill	• Ashes from incinerators • General waste • Pressurized cylinders provided that they should not be incinerated, punctured or subjected to sunlight
Recycling and Recovery	• Recyclable hazardous and non-hazardous chemical waste • Noxious wastes
Sterilization/ Autoclaving	• High risk infectious waste
Discharge to Sewer	• Aqueous radioactive wastes
Concentration and storage	• Solid Radioactive waste

Source (Atyani, 1996)

2.10 External Waste Management

2.10.1 Off-Site Transport of Healthcare Waste

In some healthcare facilities where hazardous chemicals, infectious or pathological waste is transported over the public road to another location (another hospital, or to a central incinerator or a landfill), provisions should be made to keep healthcare waste separated from other materials carried by the vehicle to prevent contamination. Any vehicle used to transport healthcare waste should follow the WHO guidelines (WHO, 1999).

2.10.2 Waste Collection

Waste collection from healthcare establishments should be performed as often as needed according to the rate of waste generated. It may be done daily or 2-3 times a week. The most favorable conditions is the collection of waste as soon as possible from the generation time to reduce its hazard, especially if the storage facilities are not available or inadequately designed and do not provide secure storage. (WHO, 1999)

2.10.3 Waste Disposal

Waste disposal means the placing of waste in its final resting-place. Solid waste should never be disposed of in water because of the risk of chemical or microbiological pollution. The only disposal option left is landfilling (Deane, 1994).

2.10.4 Landfilling

Landfilling is an accepted disposal method for healthcare waste since it was found that the highest portion of waste is non-hazardous and will be diluted when co-disposed with urban waste. Although waste dilution does not occur due to the fact that healthcare waste is delivered separately and

Personnel should not spread it. Not all forms of healthcare waste can be disposed of by landfilling because it is an ideal medium for microbial growth. The presence of antibiotics among the waste may affect the microbial population in the landfill. (WHO, 1999)

2.11 Healthcare Waste Management Plan

The United Nations Conference on the Environment and Development (UNCED) 1990, recommended the following options for hazardous waste management as the foundation for a comprehensive healthcare management plan. These are:

- Prevent and minimize waste production;
- Reuse or recycle the waste to the extent possible,
- Incinerate (with heat recovery and gas flue cleaning);
- Use alternative treatment to incineration;
- Landfill the ultimate residues into confined and well conceived sites.

Two issues were given high regards in the literature so as to take into account in any healthcare waste management plan. It also pointed out the need for formulating a special team to work on an appropriate plan, these are:

1. **Cost**: The economic aspect of waste management must be carefully considered. It is clear that good healthcare waste management is not free of charge but when all is included it represents only a very minor part of the total hospital cost-probably around 0.1 — 0.2% of the total hospital running cost (WHO, 1994) or 1-2% (Woolhandler and Himmeistein, 1997). Therefore, saving on this item is of little significance in proportion to the total expenditures. To minimize cost; waste segregation, recycling and reusing should be adopted, as well as proper dimensioning of all elements with expected expansions, which prevent costly modification.

2. **Record Keeping:** In the hospital, record keeping of waste is of great importance. Records should include the amount of waste generated by each department; and by the entire facility; direct cost for suppliers and materials used for collection; transport; storage; disposal decontamination (WHO, 1999)

2.12 Waste Management Plan Development

To develop a waste management plan in the hospital a team should be formed. This team should include the head of the hospital, department heads, Infection Control Officer, Chief Pharmacist, Radiation Officer, Senior Matron, Hospital Supervisor and Engineer. The Head of the hospital should appoint the team and inform each member of his/her responsibility within the team. A Waste Management Officer must be appointed for the overall responsibility to develop the plan and monitor and supervise day to day operations. (WHO, 1999)

2.13 Staff Responsibilities, Training and Awareness

Appropriate handling and disposal of healthcare waste is important for community health, and every member of the community should have the right to be informed about potential health hazards.

All healthcare establishments should have written policies on waste handling procedures. It should be stressed that the key to effective waste management policy is not legislation but education and training of the employees, where if policies are applied daily in a consistent and accurate way it would lead to success.

People responsible for implementing these policies should be clearly identified. Waste handling procedure; color-coding, labeling system and imperatively the definition and waste categories adopted by the establishment, should be well known to all employees who generate, segregate, transport, store, treat or dispose the

waste.

The employee's responsibilities should be made clear to show their importance in the success of the management plan. Subordinates' suggestions should be seriously considered and encouraged by their superiors. This makes the staff feel as a part of the group who share responsibilities and would motivate them to apply the policies accurately. (WHO, 1999)

Training is the key element in developing awareness in participants for health, safety, and environmental protection. Training should include senior management personnel, medical doctors, nurses and assistant nurses, hospital cleaners and waste handlers, operators, and the general public.

A five year study of needle stick injuries performed by (Haiduven *et al.* 1992) showed a decrease of 60% in needle stick injuries among employees as a result of sound management, extensive educational programs, and the convenient placement of sharps containers. Employees were all asked to report any needle stick injury during the study period. Communication of the results and discussing it with employees helped in achieving this progress. This study confirmed the importance of continuous hands-on-training, where staff are involved and informed about results of their efforts.

In Canada, a study which sought the compliance rate with given guidelines to prevent HIV transmission, was performed. Three areas in the hospital were studied to show the importance of modification of employees practices. Only 31.3% of employees showed compliance with the given guidelines. The most non-compliant was with handling and disposal of needles (Dajczman *et al.* 1992). This study emphasized that training should be repeated periodically, usually annually, and a follow-up of the trained employees will provide data about the retention of

information, and the need for refreshing courses.

Burnett amid Chesher (1995) found that reduction of risk from needle stick injury could be achieved by applying Continuous Quality improvement (CQI). Five folds reduction in the number of syringes arriving at the clinical chemistry lab attached to the needles, took place due to providing the staff with pre-heparinized blood gas syringe that include the cap within the package. In 1997 the WHO pointed out the importance of employees training on waste minimization provided with training in hazardous waste management, especially to the staff of departments with major generation of hazardous waste.

The study performed by Ring in 1993 confirms the above idea. In this study a program of delay in storage, incineration, special packing techniques of radioactive waste, and increasing training and awareness of handling such waste was implemented in a large university and medical research complex. The results showed that following the implementation of the set plan caused a marked cut down on the amount of disposed waste to be buried. Waste generation declined from 98% to 1.61%, at the same time the volume of waste generated/lab declined by almost 45% (Ring *et al*, 1993)

2.14 Legislative, Regulatory and Policy Aspects

National legislation establishes legal control and gives permits for the national agency responsible for the disposal of healthcare waste. The Ministry of Health (MOH) is responsible for making sure that all legislations are followed. The MOH legislations should specify regulations on the treatment of different waste categories, segregation, collection, storage, handling, disposal and transport of waste. Training requirements should also be the responsibility of the MOH. Before initiating any national legislations the resources and facilities available in the specific country and any cultural aspects of waste handling should be considered.

Prior to initiating any national legislation, the following points should be carefully considered (WHO, 1999):

1. A clear definition of the legal obligations of the healthcare waste.
2. A precise indication of the legal obligations of the healthcare producer.
3. Specifications for record-keeping and reporting
4. Specifications for an inspection system.

2.15 Worldwide Healthcare Waste Management

The WHO report on hospital waste management in developing countries (1994) cited that in Africa, some urban hospitals burn their waste in open air within the hospital premises.

In the Western Pacific Region, very primitive and very advanced situation co- exist side by side. Some hospitals do not have toilets, while in some other countries; they are developing their own guidelines for healthcare waste management. In most cases healthcare waste is segregated at the source before storage and transportation, but hazardous waste are land filled with municipal waste and left exposed to scavengers (WHO, 1994).

In Latin America and the Caribbeans, the situation was reviewed in a document of the Pan- America Health Organization. Most problems were identified as infectious injuries from sharps, nosocomial infections, and the risk of infections outside the hospitals among waste handlers, scavengers, and the general public (WHO, 1994).

The technical problems were the poor segregation of hazardous waste at the source due to the rudimentary awareness of personnel in charge, which results in having hazardous components being 10-40% of the total instead of less than 10%. There is also a lack of proper storage of sharps, which explains the numerous injuries among

In 1994 the World Health Organization summarized the situation in the Eastern Mediterranean Region as follows: "local health authorities are very aware of healthcare waste problems and will deeply appreciate any guidelines on this situation" (WHO, 1994).

In the Western Arab countries, the situation regarding sorting and segregation of healthcare waste is better, but most existing incinerators are malfunctional. In Egypt a baseline study results showed that the situation in Egypt is different from one area to another, since there are no guidelines or regulations to be followed. There is much improvement in the disposal technology of waste, and change from open dumps to mechanized sanitary landfills and incineration. Little information is available about the quantities, characteristic or exact disposal practices for waste generated from hospitals in Egypt. Most types of waste are disposed of together with municipal waste, which creates health hazards for the general populations. The lack of financial capacities is attributed to the mismanagement of waste within the health facility, while the improper management outside the healthcare establishments is due to the lack of awareness, and waste segregation by hospitals and lack of disposal facilities (Johannessen, 1997).

The situation in Sudan as reported by WHO/ UNEP, Regional Workshops of Medical Waste Management in West Asia /Eastern Mediterranean Regions (1994) was described. Healthcare waste is dumped and collected with the domestic waste. Waste is burned in open air or it is dumped in uncontrolled dumping areas (WHO/UNEP, 1994).

In Syria, the above report also mentioned that color-coded plastic bags and containers are used to segregate waste. Special vehicles collect waste on daily basis to a remote area near composting plant where incinerators are provided with special

waste handlers. Very frequently, healthcare waste is dumped together with municipal garbage. Hospital incinerators are used, however, they seem not to operate satisfactorily. Some consultants of WHO reported that the situation in Southern and Eastern European countries is not better than in developing countries, particularly in smaller communities and smaller medical establishments (WHO, 1994).

In Ireland there are no national standards or guidelines for the segregation, storage, handling or disposal of healthcare waste (Deane and Douglas, 1994). A recent survey by air pollution control unit of Dublin Corporation revealed that segregation policies for healthcare waste were poorly organized and implemented haphazardly in many Dublin city hospitals (WHO, 1997). The two main methods used in Ireland to dispose of healthcare waste are deep burial at landfills sites and incineration. Both methods of waste disposal have shown to cause problems, such as generation of toxins that can reach people through air, water, and food. There are no Irish standards concerning design criteria or emission control limits for incinerators. In Irish hospitals, healthcare waste is separated from domestic waste by the use of color-coded plastic bags, whereas color-coded rigid containers are used for contaminated sharps (WHO, 1997).

In South Eastern Asia, it seems that most problems arise from hospitals that are not aware of the need for special care in handling infectious waste. In big hospitals the situation is a little better but the sorting and separate collection of hazardous waste are not far from adequate. Few big hospitals operate incinerators but do not accept infectious waste from other sources. Liquid waste is discharged into municipal sewers without pretreatment. Solid wastes are often buried together, both the hazardous and non- hazardous fractions, inside the hospital premises. There is an acute need for training on hospital hygiene for all the non- professional hospital staff (WHO/UNEP, 1994).

filters to prevent air pollution. In addition, maps are used to facilitate waste collection from different generators; ashes and remnants of incineration are disposed of in a sanitary landfill (WHO/UNEP, 1994).

Even in high-income countries, hazardous waste is often not segregated from the general hospital waste. The disposal methods are land filling (often uncontrolled) but a few incinerators are available. In the same report, the situation in Saudi Arabia was described where most of the hospitals use in- house incineration, with different degrees of effectiveness. Military hospitals are using a new technology process, reducing the size of waste and chemical treatment (Halbwachs, 1994).

2.16 The Situation in the West Bank

Together with the Gaza strip, the West Bank constitutes what is currently known as the occupied Palestinian Territories (OPT). The OPT is that part of Palestine which was occupied by Israel in 1967, the total area of the West Bank is 5750 km^2. According to the Palestinian Handbook, the population of the West Bank in the Year 1997 was calculated 2,102,360. **Table 2.8** shows the distribution of the WB population by age group.

Table 2.8 *Distribution of population by specific age group in the West Bank*

Age Group	West Bank
0-4	369,279
1-4	314,486
5-19	788,902
20-59	837,700
60 +	106,479
Total	**2,102,360**

Source: (MOH, 2002)

Health Services in the West Bank are provided by the Palestinian National Authority (PNA), non-governmental organizations (NGOs), UNRWA and the private sector. The major components of these services are provided through hospitals through which most of the healthcare waste is generated. The total number of the hospitals in the West Bank is 48, among which 9 are governmental hospitals. The total capacity of the hospitals is 2726 beds as shown in **table 2.9.**

Table 2.9 *The distribution of hospitals and beds by sector*

Provider	West Bank	
	No. Of Hospitals	No. Of Beds
Ministry of Health	9	1,110
UNRWA	1	38
NGOs	20	1,156
Private	18	422
Total	**48**	**2,726**

Source: (MOH, 2002)

In Ramallah district there are 10 hospitals; 1 governmental, 6 private and 3 NGOs. These hospitals serve the Ramallah districts in addition to all the villages around them, they serve a total population of 215265 inhabitants according to a 1995 survey by the Palestinian Bureau of Statistics. Amongst the 10 hospitals there are 329 beds of all different specialties.

Healthcare waste handling and management in the West Bank is one of the most neglected areas in the health and environment sectors at this time, while this issue is one of the top priorities in many countries in the world. Many years ago, the World Health Organization (WHO) advocated that healthcare waste should be regarded as

special waste. Many categories of healthcare waste are dangerous and should be handled and disposed of in such a way that the risk of transmitting diseases will be minimized (MOH, 2002).

To date, Palestinian researchers came across the healthcare waste management issues in two occasions only. The first was in 1996, were a Master's degree thesis was prepared and presented by Taghreed Atyni to the University of New Castle and was titled "Clinical Waste Management in the West Bank/Palestine". In her findings, she pointed out that the country lacks legislation and defined policies regarding waste management. She showed that the handling procedures of healthcare waste does not meet the WHO recommendations in terms of segregation, storage, transportation and disposal. She also presented that the waste generated in healthcare centers is dumped with the general waste. She recommended a comprehensive plan that should be followed by the Palestinian Authority for clinical waste management for the whole West Bank. She also recommended the introduction of central incinerators placed in certain positions so as to serve all districts. A code of practice should also be set that governs all stages of waste handling and a computerized system where all data about waste quantities and generation points are stored (Atyni, 1996). In her research, Atyani quantified the amount of waste generated in the different departments in Ramallah Hospital **(Table 2.10).** The quantity of waste generated was calculated based on the total waste generated divided by the number of beds multiplied by the occupancy rate.
The quantity of waste generated per bed per day= 398.1/136 x 0.83 = 3.53 kg/bed/day.

Table 2.10 Waste Generation in Ramallah Hospital

Department	Clinical Waste(Kg/Day)	General Waste (Kg/Day)
Pediatrics	1.5	36
Maternity	39	39
Surgery	9	36.4
Operations	16	12.5
Kidney Unit	13.5	10
Pharmacy	50/month	3
Laboratory	29.8	3.3
Emergency Unit	9.4	9.4
Intensive Care Unit	8.9	13.4
Internal Medicine	9	42
X-ray department	400Kg/year	4
Outpatient Clinics	2.5	6
Kitchen	-	37
Administration Offices	-	2
Sharps	2.74	-
Total	**144.1**	**254**

Source: (Atyani, 1996)

Dr. Issam El-Khatib, Birzeit University, is currently conducting the second study that focuses on clinical waste management in the West Bank. He is also studying dental waste in dental clinics and hospitals. Dr. El-Khatib's work has not yet been

published although a workshop titled "Clinical Waste Management" was given on November 19,2002, where the subject was intensively discussed (personal communication with Dr. El-Khatib, 2002).

2.17 Healthcare Waste Legislation in the West Bank

Before 1967, the Jordanian law was applied in the WB. It continued to be applied after the WB was occupied by Israel. Handling and disposal of the waste resulting from health care activities were included in the General Health Act number 43/1966 and the Profession and Industries Act number 16/1953 which were issued in Jordan. Four sections in the General Health act dealt indirectly with clinical waste:

- Section 8: Discusses the disposal of solid waste to remote areas so that it doesn't endanger the health of others.
- Section 9: The term health jeopardy was defined as any disposal that might endanger the general health of others.
- Section 10: Defines the waste in general.
- Section 11: Discusses the professions, industry and peddlers that affect the public health and also includes the usage of all types of radiating materials.

The Israel Civil Administration issued the order Number 653/1975 regarding the control of special materials. It includes a list of some hazardous chemicals which requires special handling procedures. However, it is clear enough that no legislation was available considering healthcare waste directly.

At the end of 1995, all authorities in the WB were transferred to the Palestinian National Authority (PNA). The PNA was offered legislative projects for the protection of the environment. Such projects were prepared by the Palestinian

NGOs; Applied Research Institute of Jerusalem (ARIJ) and the Land and Water Establishment. The articles proposed legislative projects related to the waste management are:

Article 35

- The constructions should be up to specific technical standards of the purpose of preventing and lessening the precipitation of harmful materials and refining it if possible.
- Getting rid of wastes that can't be refined in a way that won't affect negatively the environment and public health.
- The combustion of waste and solid waste is prohibited in places other than the areas specified for that purpose.
- Prohibiting the excess of the radial activities used in the medical centers or other places.

Article 36

This article discusses the necessity of protecting the health and environment from any danger while marketing; transport, storage, usage or disposal dangerous or hazardous materials.

Article 37

Transportation, import and export of any harmful material and waste are treated in a specific system set by the Ministry of Environment in co- operation with the council.

Article 39

Discusses a specific system for the protection of sea water, underground water and surface water from pollution:

- It is prohibited to have dumping sites in sensitive area where pollution of groundwater is possible;

- It is prohibited to throw waste or discharge waste water to surface water.

The law which was prepared by ARIJ (Solid Waste Management) discussed directly medical waste:

"The disposal of the medical and infections waste should be in a proper way: the director along with the advice of official Bodies in the Ministry of Health and specialists in the scientific and medical research as well as specialists in the health care set systems that include proper treatment, transportation, storage and disposal of medical and infectious waste" (ARIJ, 1996).

The Ministry of Environmental Affairs (MEnA) proposed an environmental law No 7 in the year 1999, that was approved by the Palestinian Authority. The law is clear in assigning tasks and responsibilities to the MEnA and the other specialized agencies, without creating duplication of tasks, or interference with each other activities. The articles of the above law that relate to the healthcare waste management are: (MEnA, 1999)

Article 11

The MEnA with collaboration with the specific agencies will issue a list of all Hazardous waste.

Article 12

No person is allowed to produce, store, distribute, use, treat and dispose of any hazardous waste, whether it is liquid, solid or gaseous, should be done according to set guidelines.

Article 13

a. It is prohibited by law to import any hazardous waste to Palestine.
b. It is prohibited to pass hazardous waste through the Palestinian Territories without an appropriate permission from the MEnA.

Chapter 3

Methodology

In this chapter the researcher will present the methodology of his research, the sample population and the method for conducting the study. The researcher will also explain the data collection method, the sampling frame, sample size and selection method in addition to the study technique and response rate.

3.1 Method and Settings

This is a descriptive study, wherein the researcher intended to systematically describe the phenomenon under investigation as it occurs in its natural environment. A quantitative approach was adopted through the administration of a questionnaire that was developed especially for the purpose of this study based on the WHO developed instrument. (WHO, 1999).

Ten hospitals were visited in the Ramallah district. The hospitals were mostly established in the 1990's; except for Ramallah and the Red Crescent, which were established in 1963 and 1975 respectively. Ramallah hospital is the only government owned and operated hospital in the area. Of the visited hospitals; six are privately owned and 3 are run by non-government organizations (NGOs). **(Appendix B).**

The hospitals offer a variety of services ranging from inpatient to outpatient clinics. They deliver a wide range of services from general to specialized care; including maternity, surgical, ophthalmic, rehabilitation and emergency and trauma care. Except for Al-Razi hospital, all surveyed hospitals have their own labs, and their own radiology departments. All the hospitals offer inpatient pharmacy service. Only Ramallah hospital has a haemodialysis unit and a blood bank. All the visited hospitals offer outpatient clinics. None of the hospitals have a pathology department or a public relations department. Only the

Arab Care hospital has a nuclear medicine department. Two hospitals; Ramallah and the Red Crescent, have their own libraries **(Appendix C).**

The total number of beds for the hospitals visited was 329 (see **appendix B** for bed distribution), with an annual percentage occupancy rate ranging from 4.3-98.7%. The big gap in the occupancy rate relates to the governing agency of each hospital. Ramallah hospital, government run, had an occupancy rate of 98.7%, the three NGO's run hospitals had an average occupancy rate of 69.6%, while the private hospitals had an occupancy rate of 29.5%. This is due to the fact that government and NGO"s run hospitals offer a low cost or free of charge treatment and for those who are covered by governmental health insurance. On the other hand, the remaining hospitals are of variable sizes, they range from a 10 bed facility to a maximum of 33 beds depending on the type of medical service provided.

In summary the hospitals visited were considered a good selection of the hospitals in the West Bank as they vary in size, location, specialty and ownership.

3.2 Study population

The population of this study encompasses all the staff in the studied hospitals. The total number of employees at the targeted hospitals was 638 in all areas and specialties.

The employees in each hospital differ in number and job description depending on the size and services offered by the hospital and its affiliation. Ramallah hospital has the largest staff (242 staff members) followed by Arabcare with a staff of 130.

3.3 Data collection Instrument

This study was primarily based on data collected through a questionnaire targeted at Ramallah district hospital administrators and staff. A self administered open and closed ended questionnaire was utilized to collect the data. The most part of the questionnaire

was designed based on the WHO handbook guidelines (WHO, 1999), due to its effectiveness in obtaining information about various hospital characteristics, types and quantities of waste generated, and the handling and disposal practices of healthcare waste. The questionnaire also touched on the problems encountered in the process of management of healthcare waste and the respondents' awareness of hazards related to the clinical waste in the Ramallah district hospitals. The questionnaire also tried to identify the gaps and deficiencies in the present healthcare waste management adopted procedures. The instrument was also meant to quantify the amount of healthcare waste generated and to identify its sources in order to suggest proper treatment and disposal methods. The availability of an on-site and off-site management plan was examined. The accessibility of guidelines and protocols for the management of healthcare waste in each hospital was observed and the nature, frequency and extent to which staff is exposed to training and awareness programs were observed.

3.4 Sampling frame, size and selection method

When distributing the questionnaire, the researcher used a percentage of the number of staff as his base. The sample size of each hospital was a sixth of the existing staff. **Table 3.1** shows the exact number of questionnaire distributed and collected from each hospital.

To determine the equivalence of one sixth of the staff in each hospital their totals were obtained from the personnel department in each hospital, which was then used as the sampling frame. As for the sample selection the study followed the convenience non-random sampling method where each member who was present at the time the researcher was collecting his data was invited to participate in the study regardless of his or her job or position. In each site, this process continued until the sixth of the site employees is obtained.

Table 3.1 Name of Hospital by Number of Questionnaires delivered in each

Name of hospital	Number of questionnaire distributed
Ramallah	40
Red Crescent	9
Arab Care	22
Shiek Zayed	13
Al-mustaqbal	2
Abu Raya	10
Al-Rahmah	3
Waild El-Nather	4
Khalid Tarifi	2
Al-Razi	1
Total	**106**

3.5 Study technique

When the researcher initiated his research he had hoped to study all the hospitals in the WB. Due to the Israeli Occupation and the hardship in traveling around the WB areas the researcher opted to narrow his research to Ramallah area hospitals.

A letter was drafted and sent to the Director General of hospitals of the Ministry of Health. In the letter the objectives of the study were explained and permission to visit the hospitals by the researcher was requested **(Appendix D).** The researcher then contacted in person the administrators of each of the private and NGO run hospitals requesting their

permission to visit their facility and explaining purpose, procedure and duration of study. After obtaining the permission the researcher himself visited all the studied hospitals and made himself available to respondents throughout the data collection phase, so as to facilitate consistent questionnaire completion either by assisting the respondent in filling it in, or doing that himself based on the respondent verbal response. This was done to maximize response rate and to guarantee more authentic and reliable information. The respondents were different in their cooperation; some were accurate and gave complete information, while others answered very briefly. Some respondents opted to answer the questionnaire by themselves rather than with the researcher, which affected the control and the amount of data handed back. The researcher then returned to the hospital to collect those left. The responses in turn depended on the respondent's education, frankness, expertise, willingness to cooperate, all of which are not easily controlled.

3.6 Response Rate

A total of one hundred and six questionnaires were distributed to and collected from the different hospitals in Ramallah area; of these, ten were ten administrators at high levels and the rest were hospital staff from the various hospital departments. Due to the tight control on the questionnaire a response rate of 100% was obtained. That is to say, all those who were invited to participate agreed to do so with no single case of rejection.

3.7 Limitations of the Study

The researcher recognizes some circumstantial and methodological limitations in this study, including;

a) Mobility restrictions brought about by the political escalation reflected negatively on the sample size and prohibited random selection of hospitals from among all those operating in the different West Bank directorates.

b) The answers sought are all provider-driven and are potentially biased especially that a complement to the data collection method such as an observation element was not possible due to human and material constraints.

Chapter 4

Findings and Data Analysis

The researcher visited ten hospitals and invited one hundred and six staff members to participate in the study. All were positive and participated by filling the developed questionnaire. Nursing staff compromise the largest staff in any hospital. Hence, it was no surprise that the majority of our surveys were answered by nurses (44). The following table **(Table 4.1)** summarizes the job/profession of the study respondents.

Table 4.1 Study respondents by Job/profession

Job/profession of respondents	Number of respondents
1. Physicians	17 (10 administrators)
2. Staff nurses	32
3. Practical nurses	12
4. Pharmacists	9
5. Microbiologists (laboratory)	10
6. Physiotherapists	3
7. House keeping staff (Sanitary workers)	12
8. Kitchen staff	5
9. Laundry staff	2
10. Guards	3
11. Porters	1

4.1 On site handling of Healthcare Waste

Participants in all the studied hospitals were asked if the hospital has a method to estimate the amount of healthcare waste it generates. Eighty four percent think that the hospital doesn't have such a method. Some staff estimated the amount of waste by the number of healthcare waste bags they generate **(Fig 4.1)**

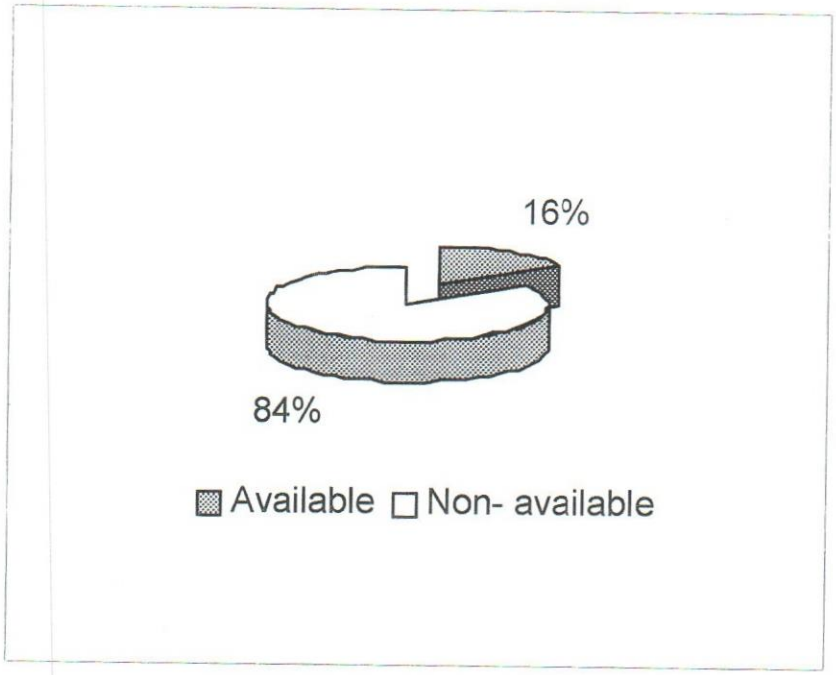

Fig 4.1: Availability of Healthcare Waste Estimation Method as Viewed By Respondents

None of the studied hospitals have any plans in the near future for decreasing the generation of hazardous waste, respondents reported. All staff showed willingness to commit to any change that will decrease the amount of waste generated; whether it is initiating a recycling program or buying new equipment that will replace the use of older and more hazardous equipment, such as autoclaving.

The identification of the origin of the waste was possible only in 10% of the hospitals surveyed (Ramallah hospital). In Ramallah hospital, dressings from surgery departments are placed in a bag attached to the nurse's treatment cart. In addition to the fact that it is not strongly fixed to the cart, no labels are used to indicate that the bag contains healthcare waste. There is no way the staff can differentiate between this kind of waste and any other hospital waste.

Sixty percent of the respondents reported that color-coding bags were used in their hospitals; those hospitals use special sharp containers **(Fig 4.2).** These containers are then collected and disposed of with the general waste, they reported.

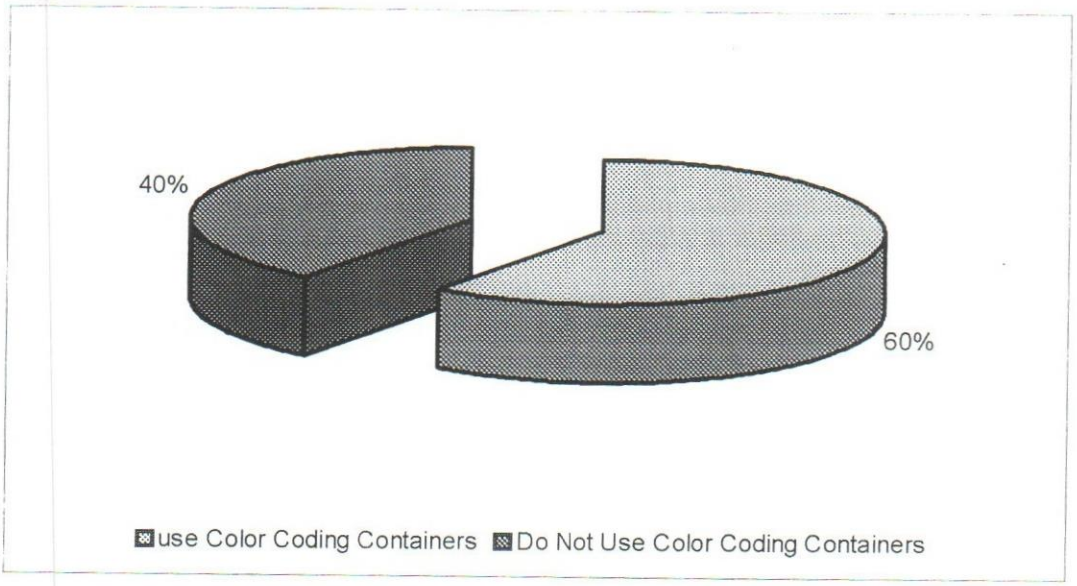

Fig 4.2: Use Of Color Coded Containers in Ramallah District Hospitals

Seventy percent of the respondents reported that their hospitals do not have healthcare waste pre-treatment; Both Arabcare and Sheik Zayed staff claimed that they have waste pre-treatment procedures in their hospitals **(Fig 4.3)**. Autoclaving of HBV blood samples sometimes takes place before disposing. In Ramallah hospital, staff reported that blood samples are placed in open baskets lined with thin bags. The bags are then disposed of with the general waste. Blood units which have the HIV or HBV are autoclaved sometimes. It is left to the manager of the laboratories and blood bank to decide whether to pre-treat the blood units before disposal or not, they agreed. Any type of waste generated from any type of tests done on a patient who has AIDS is always autoclaved before disposed of within other types of waste.

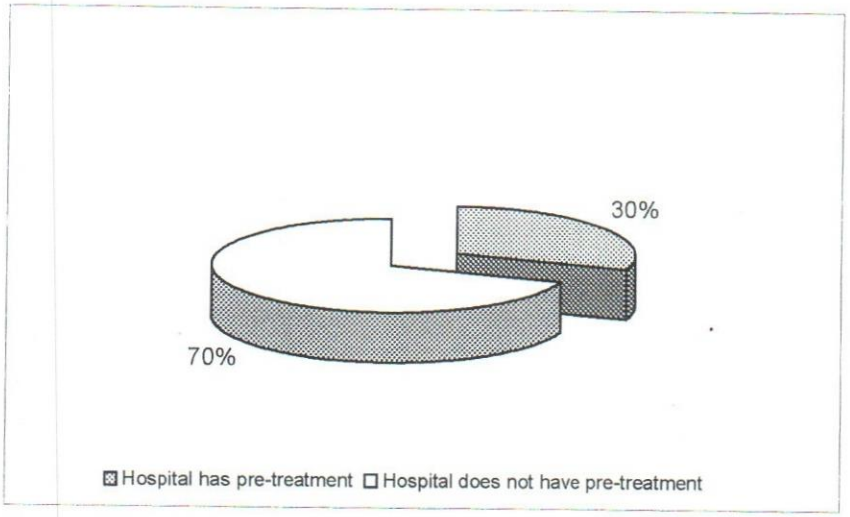

Fig 4.3: Pre-treatment of Healthcare Waste In Ramallah Hospitals

None of the studied hospitals have a separate storage area for their healthcare waste. Healthcare waste is transported from the point of origin to the municipality bulk bins located outside the main building, by the use of special carts in one of the hospitals (Ramallah Hospital). Ramallah hospital is the oldest establishment of the studied hospitals and is the only one that has special transport carts, although the researcher observed that those carts are not designated for waste transport only and are used for transporting other non-hazardous healthcare waste. The rest of the hospital transport of healthcare waste is done manually by the house keeping staff **(Fig 4.4).**

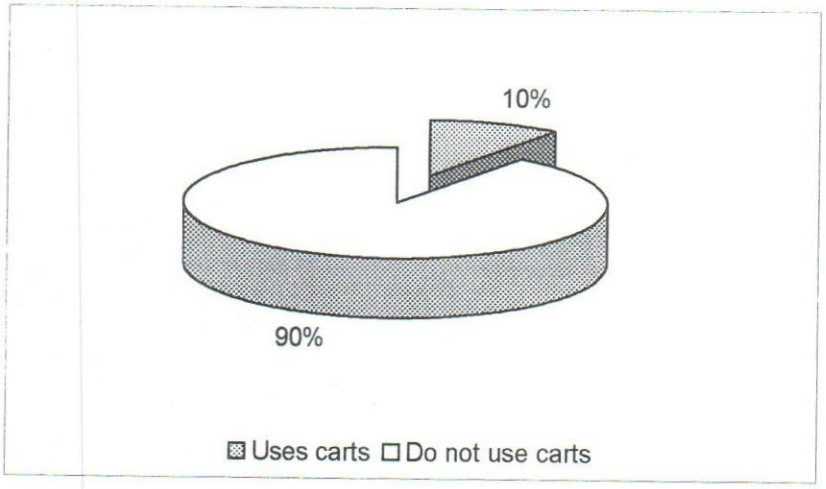

Fig 4.4: Use of Carts for Transporting Healthcare Waste in the Hospitals

4.2 On-site Management Plan and Procedure

When asked about the current disposal arrangements in their facilities, all surveyed staff responded that pathological waste and amputated limbs are given to the patients' families who usually bury them. Fetuses from maternity departments are given to their families for proper burial. The rest of the healthcare waste is disposed of with the general waste. There are no special arrangements for healthcare waste. All waste, regardless of its origin, is disposed of in the municipality landfills, including the healthcare waste.

None of the studied hospitals sell any of their healthcare waste to any outside company, responses indicated. Nore do any of them have an incinerator on-site or any other means of healthcare waste disposal.

4.3 Off-site Management Plan and Procedure

Seventy five percent (75%) of the respondents claimed that they do not know what becomes of the waste once it leaves the hospital grounds (**Fig 4.5**). Twenty five (25%) claimed that they are aware of the fact that all waste end up in the municipality landfill.

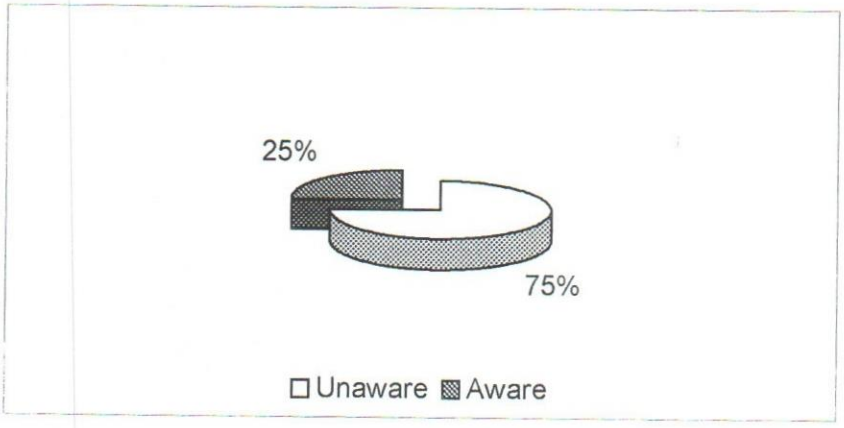

Fig 4.5: Staff awareness of Healthcare Waste Destination

None of the hospitals, whether government run, NGO's or privately owned have any special contracts with any company to transport their waste to the landfills. All waste transport is done by the municipality sanitary employees in the municipality trucks to the municipality landfills. No

special packaging or handling is observed of the clinical waste in any of the Ramallah area hospitals.

Ninety percent of the studied hospitals have daily garbage pickup by the hospital sanitary workers to the municipality bulk bins located on the hospital grounds **(Fig 4.6)**. The city municipality workers empty the bulk bins daily in 5 hospitals, twice weekly in 4 hospitals, and once weekly in 1 hospital. Respondents from Al-Razi hospital stated that their sanitary workers pick up the garbage 3 times a week. This may be due to the size of the hospital and the amount of clinical waste generated.

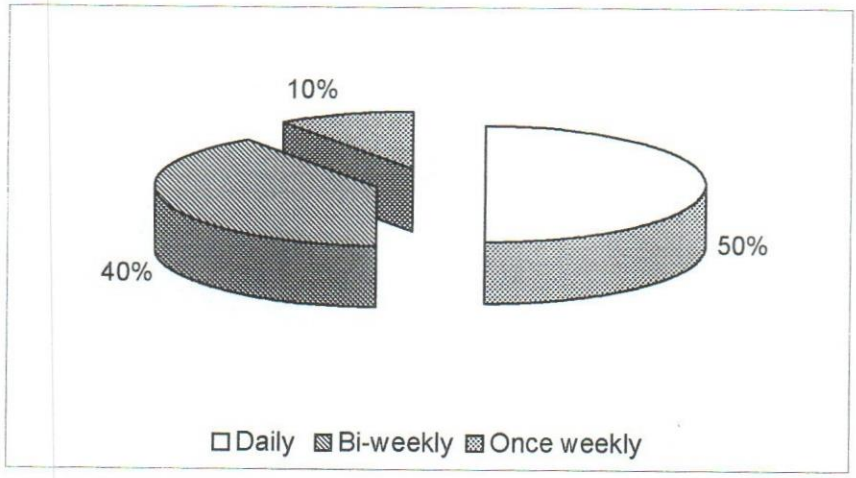

Fig 4.6: Municipality Scheduled Garbage Pickup

The researcher asked the staff to freely remark on the status of the waste management in their hospitals and what they would like to improve in their current waste management system.

The following is a compilation of their remarks:

- Most of the staff would like to have a color coding system to identify the healthcare waste from other hospital waste. They also suggested that special color coded labeled containers be used for infectious waste so that employees can take proper precautions when handling that waste.

- Healthcare waste generated in the hospitals should be segregated from other hospital waste.
- Special storage areas for healthcare waste should be available inside the health care establishment. Special carts should be solely dedicated for healthcare waste transport inside and outside the facility.
- The staff stated that they often observe liquid leaking from the garbage bins. They recommended that bags used to place infectious and pathological waste should be strong and water proof.
- All workers should be trained in the proper procedures for handling of healthcare and especially infectious waste and should be provided with the proper protective clothing to reduce the chance of infections.
- All staff should be offered free of charge the Hepatitis B vaccine.
- Waste collection should be done more frequently both on-site and off-site.

4.4 Availability of Protocols and guidelines

Seventy percent (70%) of the respondents stated that they do not have specific guidelines for the proper management of their healthcare waste **(Fig 4.7).** The remaining 30% claimed that their hospital has guidelines and procedures.

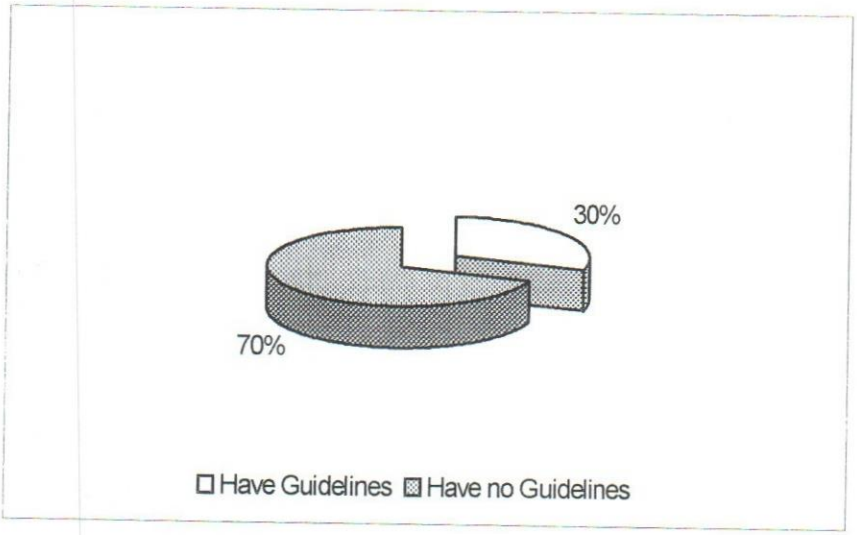

Fig 4.7: Availability of Waste Management Guidelines in Ramallah Hospitals

The three hospitals that have protocols and guidelines; Sheik Zayed, an NGO hospital, and two privately owned hospitals; Arab care and Al-mustaqbal. It appears that the newly established hospitals take more responsibility in managing of their healthcare waste theoretically but practically all healthcare waste is disposed of with the general waste in the municipality landfill. Sheik Zayed hospital has written guidelines while the other 2 hospitals claimed that the guidelines are verbally communicated. When asked about the origin of their guidelines, the respondents claimed that their guidelines are a mixture of national and international guidelines, Sheik- Zayed staff stated that the guidelines they follow were developed by their hospital. Ramallah hospital, a government operated hospital and the largest and oldest hospital, still lack guidelines and protocols for the disposing of their healthcare waste.

Ninety percent of the respondents who stated that their hospitals do not have any waste management guidelines showed great enthusiasm and willingness to follow guidelines if they were made available. The staff of Al-Razi hospital, the smallest and the only ophthalmic hospital in the area, affirmed that there is no need for any guidelines for waste management as the waste that they generate is non-hazardous and can be disposed of with the general waste.

When asked about any problems resulting from the adopted healthcare waste management procedures; 2 hospitals (Ramallah hospital and Red Crescent) reported problems with infection of hospital workers due to needle sticks injuries **(Fig 4.8).** Operating rooms waste is collected by the hospital staff and disposed of in the municipality bulk bins outside the hospital. One hospital claimed that the municipality bulk bins are placed in an open area accessible to children and animals (cats, dogs and rodents). This in turn may cause the spread of infectious diseases in the surrounding neighborhoods and community at large.

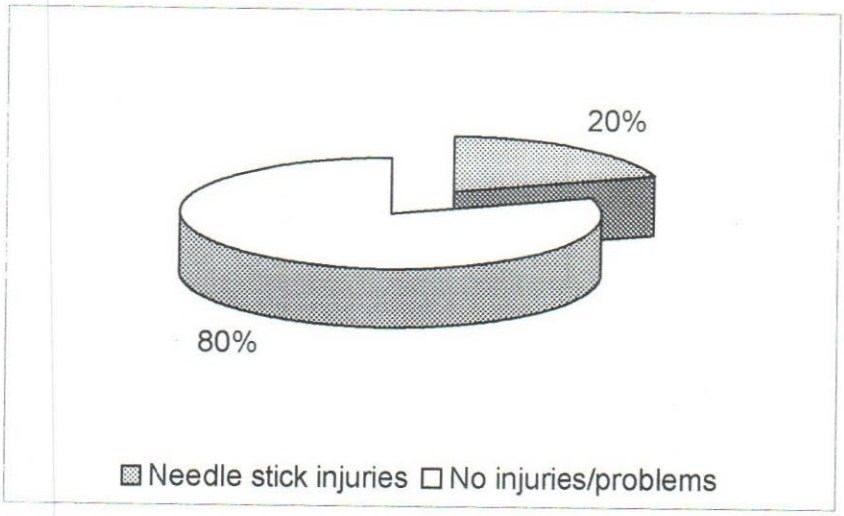

Fig 4.8: Respondents' Acknowledgement of Problems Resulting From Healthcare Waste

The major problem encountered by all studied hospitals is the accumulation of garbage during closure periods. Due to the most recent Israeli re-occupation of Ramallah; the municipality garbage collectors were unable to pick up on their assigned days. This has lead to the spread of insects and rodents. During the period that the researcher was conducting this study, the Israeli occupation prohibited the municipalities from using the city's landfill in El-Bireh, next to Pssagot settlement. This in turn led to the accumulation of garbage in neighborhoods for more than one week.

All respondents also pointed out that there is no set visiting hours or a control of the visitors for each patient. One often finds kids alone in hallways looking in garbage pails outside patient rooms.

Respondents from Ramallah hospital stated that it uses a privately owned cleaning company which provides staff that are not trained in handling healthcare waste and often perform their functions on a level less than acceptable. The company staff, which collects the waste, do not bother if they find sharps within other types of waste. At the same time, the instructions regarding the special handling of sharps are not strict and it is left to the staff members to behave in a responsible way.

This gives good indication about the urgent need for training and raising awareness among both the workers and the staff, which all needs to be backed by supporting policies, rules and regulations.

Plans concerning improvement of waste management practices include the following:

- A better handling system of clinical waste;
- Bagging of clinical waste in separate containers or using color-coded bags and containers.

All respondents claimed that respective hospitals have plans for improvement including waste segregation and the introduction of incineration to the institutions.

Also, all claimed that they are willing to cooperate with other hospitals to reduce hazards posed by the generated waste and reduce the cost of disposal if it is made available. Additionally they expressed their preparedness to adhere to any change that will decrease the amount of waste generated; whether it is initiating a recycling program or buying new equipment that replaces the use of older more hazardous equipment, such as autoclaving.

None of the respondents reported having a record of environmentally associated accidents in their hospital. Nor did they report the presence of record keeping mechanism for documenting types of waste generated in its various departments. When asked about the reasons behind that, 10% (Arabcare) stated that this is not a priority at their institution at the present time, 40% (Ramallah hospital, Red Cresent, El-Mustqbal and El-Rahmah) stated that it is too costly and the remaining hospitals stated that it is not written in their hospital guidelines

As per the role of the Ministry of Health (MOH) in controlling healthcare waste, all affirmed that the role of the MOH is very limited. The respondents mentioned that the present political situation has caused the MOH to focus on other more urgent matters. For example, concentrating all of the ministry's resources on providing emergency medical care to the ever growing number of injured and victims of political upheaval in the Occupied Palestinian Territories. The respondents also

suggested that it is the role of the MOH to follow up the hospitals and control their healthcare waste disposal methods. They also would like to see the MOH to provide training and awareness courses on the dangers of illegal disposal of healthcare waste to both health care employees and to the general public. The general public plays a major role in controlling the spread of disease from healthcare waste in their neighborhoods.

Furthermore, respondents stated that the MOH should provide hospitals with guidelines and inform them of regulations for the treatment of healthcare waste and that the MOH should monitor the application of these guidelines nationally. The MOH should assign trained and specialized staff to monitor the enforcement of these guidelines by making spot-checks and pre-assigned visits to the hospitals. They should impose great monetary fees and other form of punishment of those hospitals that do not abide by the set guidelines.

What is reassuring is that ninety percent (90%) of the respondents said they would comply to any regulations on healthcare waste disposal if they were made available.

4.5 Staff responsibility, Training and Awareness

As mentioned earlier, in Ramallah hospital, an outside contractor is responsible for cleaning the hospital. This contractor provides the staff to clean, collect and dispose of all the hospital waste. No special precautions are taken when handling healthcare waste. There is no hospital supervision or training from the hospital management on the proper handling of healthcare waste. The remaining nine hospitals have their own house keeping staff that provide the cleaning of their hospitals. These housekeeping staff members are also not trained in the proper handling of healthcare waste **(Fig 4.9).**

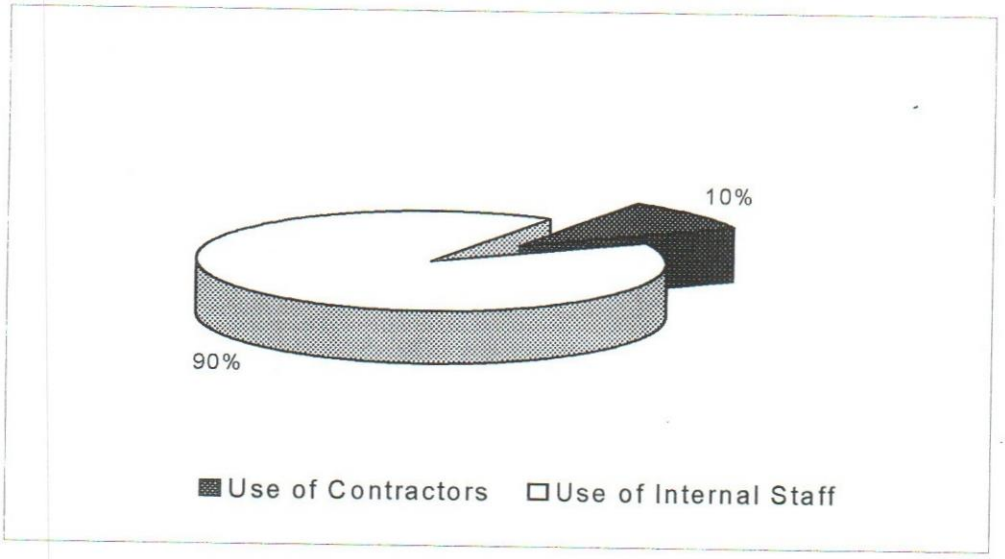

Fig 4.9: Hospital Cleaning Staff

None of the studied hospitals have an infection control committee. The researcher asked the respondents on their opinion of the responsibilities of the infection control team if it was available in their facility. Ninety percent (90%) of all respondents specified that training of the staff should be the major role of such a committee, followed by the monitoring of all the staff on handling waste, especially house keeping staff on the application of the training courses.

Waste management is considered very important by 70% of surveyed staff. Twenty percent (20%) of them consider it important and the remaining staff thinks that it is less important than other issues in the hospital **(Fig 4.10).**

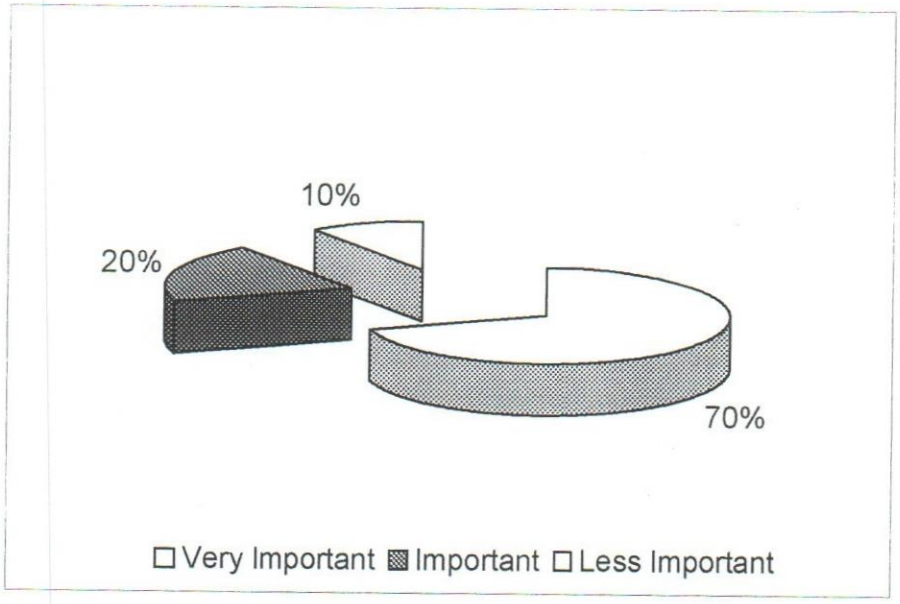

Fig 4.10: Respondents View of the Importance of Waste Management

However, they all agreed that healthcare waste poses major risk to the environment and especially the general public health.

As for the training of the employees, respondents from five hospitals claimed that they have training program **(Fig 4.11)**. Two offer workshops; Al- Rahmeh and Al-mustaqbal. Two hospitals offer in house seminars; Red crescent and Sheik-Zayed. One hospital offer special practical training; Arab Care. An outside lecturer gives training in 4 of the hospitals and by an infection control nurse in one of the hospitals. These programs are offered once a year in all five hospitals. The respondent staff think that the training programs should be attended by physicians, nurses, and all employees who are in direct contact with clinical waste (cleaners, engineers, pharmacists and support staff).

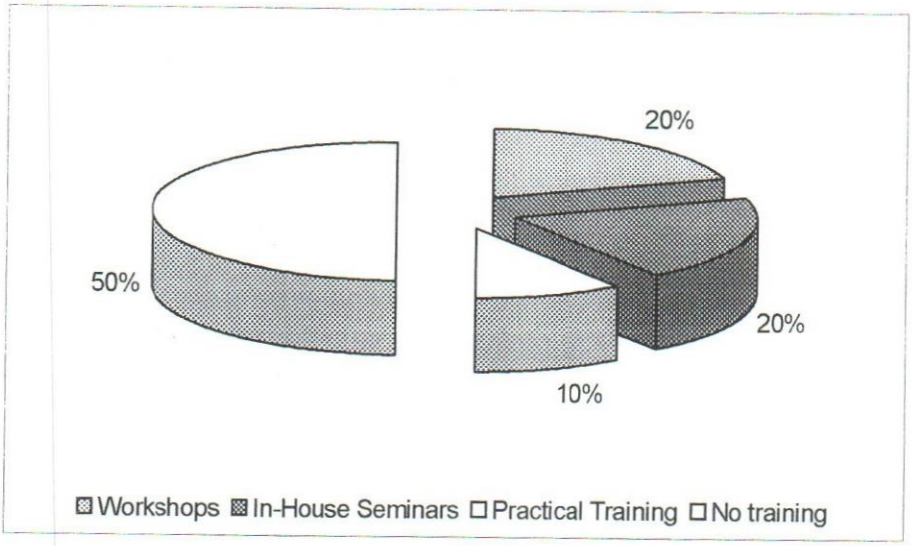

Fig 4.11: Training Options Offered to Staff

The remaining five hospital staff is unaware of any training and awareness programs in their hospitals, although they all agreed that there should be such programs. They also mentioned that they were never oriented about the health hazards of clinical waste when they started working at their facility. Upon further questioning the researcher concluded that no orientation was provided to the new staff regardless of the date that they have started working at their hospital. The irony in all this is that although all the staff regardless of their job description in the hospital, agreed on the hazards and the risk posed by healthcare waste. None have developed practices to better control those hazards. Either because of ignorance or because of lack of funds and financial problems or because the decision-makers in the hospital are not convinced enough to adopt the proper methods for dealing with hospital waste.

The following are the major improvements that the respondents would like to see in their facilities as articulated to the researcher;

- Training and education programs for personnal involved in all aspects of health care.
- Raising of public awareness about the risk posed by healthcare waste through leaflets or posters placed in key areas in the neighborhoods.
- Legislations concerning the proper management of healthcare waste should be set.

- A monitoring body should exists and should have the power to enforce any defined legislation
- A waste management plan should be set by the head of the institution.
- A well trained person who works collaboratively with a special committee should be responsible for monitoring and implementation of the waste management plan.
- Incineration should be considered as the optimum option for the disposal of healthcare waste.
- Most surveyed Lab technicians want the blood and urine samples taken from highly contagious patients flagged as such, in order for them to take special precautions in handling of those samples.

Chapter 5

Conclusions and Recommendation

Healthcare waste management is a vital element of any hospital. It needs special and urgent attention. It must be realized that the improvement of the situation cannot be accomplished immediately, because of lack of resources, but it needs to be started immediately.

5.1 Conclusions

- The study has shown that the only available options of waste containers are open landfills which present a highly risky environmental hazard.
- The study revealed that about (80%) of hospital waste in our studied hospitals is general waste– if segregated – can be disposed of similarly to domestic waste. This indicates that segregation of waste is highly cost effective by reducing the quantity of waste that needs special treatment.
- Hospital managers could not evaluate the real cost of waste management, which reflects the low regard they give to this issue manifesting itself in the deficiency in relevant record keeping. It should be noted, however, that waste management would be costly, but hospitals have to make a trade- off between sound management and financial burden, guided by the principle: prevention is much more effective than cure in the long term.
- Few hospitals use a color coding system for segregating healthcare waste.
- Municipality sanitary workers do not pick up the waste from the larger and busier hospitals often enough. Their staff is not properly trained in the proper handling of healthcare waste. This means that a legislative proposal should incorporate elements that oblige the municipality to obey.
- No set guidelines for the proper disposal of healthcare waste are available in most of the Ramallah district hospitals. The hospitals whose staff claimed they have guidelines, whether written or oral, were not sure about the origin of those guidelines and none of them could give the researcher a copy of them. This means the development and standardization of national guidelines is a top priority in this regards. In addition, all the staff should be fully

informed and adequately trained on the implementation of the technical instructions of the adopted guidelines.

- Almost all questioned staff consider waste management training very important, which shows that awareness of the hazards of healthcare waste is improving. Employees must be made aware of their responsibilities and their role in the waste management chain in their hospital. Handbooks must be prepared and handed to each staff member describing the waste management system, waste identification and categories.

5.2 Recommendations

5.2.1 Internal Management of Waste

- The key factor in managing healthcare waste is to segregate waste at its source. This would help minimize quantity of hazardous waste generated, and enhance the reuse, recycling, as well as identifying the hazardous waste that needs special treatment by placing it in color-coded bags and containers.
- The color coding system of bags and containers should be applied nationwide and it must be simple and easily identified by all employees, transporters, treatment facilities, disposers of waste to decrease the amount of misplacement of waste and increase the care when handling hazardous waste containers.
- Storage of hazardous waste must be separated from non-hazardous waste. The storage area must be available and must be ventilated, secured, provided with clean – up facilities for the involved employees.
- Waste treatment option may vary from one hospital to another depending on its situation. They all must comply with guidelines that ensure protection of employees, waste handlers, patients, visitors, general population and the environment.
- Each hospital should develop a waste management team, to introduce a waste management plan that must be followed by all staff. A Waste Management Officer must be assigned as a liaison between all the hospital employees, and refers to the hospital manager.

- Hospital management should develop a system to properly dispose of the waste in a safe and effective way.
- Healthcare waste pre-treatment is essential to control the spread of infectious diseases. Autoclaving of HBV/HIV blood samples should take place in all hospitals prior to disposing of such samples. To control the cost of autoclaving, Ramallah hospitals could develop a system to collect the samples in a place convenient to all area hospitals and dispose of them in a shared autoclave.
- Employees must be provided with needed personal protective equipment depending on their job specification. They should be trained on the importance of adhering to the PPE and monitored for their proper use.
- Training is an essential element for improving hospital care. All hospital staff and any outside contractors working in the hospital should be trained on the proper methods for handling of all clinical waste.
- Immunization of healthcare employees that are at high risk against Hepatitis A and B to follow –up any injury by serolotest after 6 months to ensure non- infection.
- Incineration of healthcare waste can be considered as the best option for waste disposal. Operators' training and continuous monitoring and maintenance of incinerator, as well as incinerating the proper waste category that fits the incinerator design are key factors of successful management.
- Due to the fact that almost all landfills in the West Bank are open dumps, a clear need exists to change from this system to the controlled sanitary landfills. Landfills should be supervised for operating accessibility to site.

5.2.2 External Management of Waste

- Transportation of hazardous waste – if needed – should be done by a liable and well trained company which should comply with established guidelines.

- Labeling system of each kind of waste should be adopted and applied to any transported waste. If the generator and the transporter fail to do this they should be incriminated and punished.
- Legislation concerning the proper management of healthcare waste should be set. The legislations should include:
  - The definition of healthcare waste including these components which require special management.
  - The standards for the control of the risks associated with the waste handling
  - Promotions for the reduction of waste and recycling or recovery of materials providing that no new health risks are created.
  - Written procedure for the safe handling of waste, storage, transport and treatment. On the other hand, a written procedure about dealing with accidents and spillage should be included.

5.2.3 Responsibility Matrix for Healthcare Waste

5.2.3.1 The Role of the Ministry Of Health

- Designate a central department to be responsible for waste management in the West Bank including hazardous waste, whose responsibility is to draw strategies, regulations, standards and guidelines to be applied nationwide.
- Provide experts for training on treatment or management of special kinds of waste and preparing a "train the trainer" activities and ensure the presence of competent and qualified centers for training programs.
- Work on collaboration with NGOs and other partners for enforcement by the PA on all aspects of proper healthcare waste management with special emphases on syringes.
- Put in operation a national data base on healthcare waste management through demanding an appropriate and complete record keeping on all relative details.
- Adding a separate chapter to licensing acts of hospitals, labs, pharmacies, drug stores, and drug factories describing waste management for each kind of facility.

- Enforce the performance of Environment Impact Assessment (EIA) to assess waste dumps and incinerator's locations. The negative impacts should be supplemented with the necessary migration measures.

5.2.3.2 The Role of Healthcare Waste Generators

Waste management should be taken into account in the case of planning any new hospitals. The following are a few points that should be considered:

- Develop a waste management team, to introduce a waste management plan that must be followed by all the staff.
- Providing separate areas for segregation of healthcare waste, and providing separate corridors and elevators for transporting waste.
- Providing the cleaning staff with special carts for transporting of healthcare waste.
- Provdidng an off-site area for incineration of hazardous healthcare waste.

5.2.3.3 The Role of The Municipalities

- Provide a well trained team to handle healthcare waste.
- Special sanitary trucks should be provided for transporting healthcare waste from the point of origin to the landfill
- A more frequent pick-up schedule should be provided for healthcare facilities
- Changing all open landfills to controlled sanitary landfills in the West Bank

5.2.3.4 The Role of the Ministry of Environmental Affairs (MEnA)

- Ensure that the law No. 7 in the year 1999 which deals with healthcare waste is being implemented by all appropriate departments.

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Appendix A:

Summary of main advantages and disadvantages

of treatment and disposal options

Treatment/ Disposal Method	Advantages	Disadvantages
Rotary kiln	Adequate for all infectious waste, most chemical waste, and pharmaceutical waste.	High investment and operating costs.
Pyrolytic Incineration	Very high disinfection efficiency. Adequate for all infectious waste and most pharmaceutical and chemical waste.	Incomplete destruction of cytotoxics. Relatively high investment and operating costs.
Single chamber	Good disinfection efficiency.	Significant emissions of atmospheric pollutants.
Incineration	Drastic reduction of weight and volume of waste. The residues may be disposed of in landfills. No need for highly trained operators. Relatively low investment and operating costs.	Need for periodic removal of slag and soot. Inefficiency in destroying thermally resistant chemicals and drugs such as cytotoxics.
Drum or brick Incinerator	Drastic reduction of weight and volume of the waste. Very low investment and operating costs.	Destroys only 99% of microorganisms. No destruction of many chemicals and pharmaceuticals. Massive emission of black smoke, fly ash, toxic flue gas, and odours.
Chemical disinfection	Highly efficient disinfection under good operating conditions. Some chemical disinfectants are relatively inexpensive. Drastic reduction in waste volume.	Requires highly qualified technicians for operation of the process. Uses hazardous substances that require comprehensive safety measures. Inadequate for pharmaceutical, Chemical and some types of infectious waste.
Wet thermal treatment[a]	Environmentally sound. Drastic reduction in waste volume. Relatively low investment and operating costs.	Shredders are subject to frequent breakdowns and poor functioning. Operation requires qualified technicians. Inadequate for anatomical, Pharmaceut-ical, and chemical waste and waste that is not readily steam-permeable.
Microwave irradiation	Good disinfection efficiency under appropriate operating conditions. Drastic reduction in waste volume. Environmentally sound.	Relatively high investment and operating costs. Potential operation and maintenance problems.
Encapsulation	Simple, low cost, and safe. May also be applied to pharmaceuticals.	Not recommended for non sharp infectious waste.
Safe burying	Low costs. Relatively safe if access to site is restricted and where natural infiltration is limited.	Safe only if access to site is limited and certain precautions are taken.
Inertization	Relatively inexpensive.	Not applicable to infectious waste.

Source: (WHO, 1999)

Appendix B

General Information about Ramallah Hospitals

Name of Hospital	Sector	Date of establishment	Specialty	No. of Beds	% of Bed occupancy	No. of Employees
Ramallah	Government	1963	General	146	98.7	242
Red Crescent	NGO	1975	Surgical/Maternity	29	80 Maternity 54 Surgical	56
Arab Care	Private	1995	General	30	43.4	130
Sheik Zayed	NGO	1996	Emergency/Trauma and Surgery	15 Emergency 18 Inpatient	70	77
Al-Mustaqbal	Private	1999	General/emergency and Maternity	14	48.1	10
Abu Raya	NGO	1990	Rehabilitation	27	72.1	60
Al-Rahmah	private	1996	General/Maternity	12	27	19
Walid El-Nather	Private	1992	Maternity	12	30	26
Khaild Tarifi	Private	1991	Surgical/Maternity	16	24.3	10
Al-Razi	Private	1995	Opthalmic	10	4.3	8

Appendix C

The Different Departments in Ramallah Hospitals

Department / Name of Hospital	lab	Pharmacy	Pathology	Hemodialysis	Radiology	Outpatient clinics	Nucelar medicine	Public relation	Library	Blood banks
Ramallah	Y	Y	N	Y	Y	Y	N	N	Y	Y
Red Crescent	Y	Y	N	N	Y	Y	N	N	Y	N
Arab Care	Y	Y	N	N	Y	Y	Y	N	N	N
Sheik Zayed	Y	Y	N	N	Y	Y	N	N	N	N
Al-Mustaqbal	Y	Y	N	N	Y	Y	N	N	N	N
Abu Raya	Y	Y	N	N	Y	Y	N	N	N	N
Al-Rahmah	Y	Y	N	N	Y	Y	N	N	N	N
Walid El-Nather	Y	Y	N	N	Y	Y	N	N	N	N
Khaild Tarifi	Y	Y	N	N	Y	Y	N	N	N	N
Al-Razi	N	Y	N	N	N	Y	N	N	N	N

Y= Yes **N= No**

Appendix D

The Permission Request addressed to the Director General for Hospitals West Bank-MOH

l – Quds University
Jerusalem
School of Public Health

جامعة القدس
القدس
كلية الصحة العامة

٢٠٠٢/١١/٦

حضرة الدكتور موسى أبو حميد
مدير عام المستشفيات
وزارة الصحه الفلسطينيه

تحيه طيبه وبعد،

يقوم الطالب يوسف الميمي الملتحق ببرنامج الماجستير في الصحه العامه- الإدارة الصحيه بالعمل على اتمام رسالة الماجستير والتي موضوعها : كيفية التعامل مع الفضلات الإكلينيكيه في مستشفيات الضفه الغربيه ومدى معرفة العاملين من صحيين وغيرهم بالأصول الخاصه بذلك. ولهذه الغايه فقد عمل الطالب على تطوير أداة خاصه لجمع المعلومات من المستشفيات المشموله في الدراسه.
نرجو من حضرتكم الموافقه على اتمام الجانب الميداني من الدراسه في المستشفيات التابعه للوزارة والإسعاف لمن يلزم بتسهيل مهمته.

ولكم منا فائق الشكر وعظيم الإمتنان

د. عائشه الرفاعي
منسق البرنامج والإستاذ المشرف

مرفق: نسخه عن الاستبانه

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فرع القدس/ تلفاكس ٢٩٥٩٢٧٨-٠٢
فرع غزة/ تلفاكس ٢٨٧٨١٦٦-٢٨٧٨١٧٧-٠٧

Questionnaire on Handling and Management of Medical Waste at Ramallah Hospitals

A. Background information

1. Name of Hospital _____
2. Date of Establishment _____
3. Position of Respondent _____
4. Ownership:

   a. ☐Private b. ☐Government

5. Is the Hospital specialized: ☐Yes ☐ No

   If Yes, Specify its specialty _____

6. Other services offered by the Hospital (Mark all the appropriate choices)

	Yes	*No*
a. Lab	☐	☐
b. Pharmacy	☐	☐
c. Pathology	☐	☐
d. Haemodialysis	☐	☐
e. Radiology	☐	☐
f. Out-Patient clinics	☐	☐
g. Nuclear medicine	☐	☐
h. Public Relations	☐	☐
i. Library	☐	☐
j. Blood Banks	☐	☐

k. Others, Please specify _____

7. Please indicate the number of the employees identified below:

Employees	**Number**
1. Physicians	
2. Dentists	
3. Staff nurses	
4. Practical nurses	
5. Assistant nurses	
6. Pharmacists	
7. Microbiologist	
8. Quality assurance team	
9. Physiotherapist	
10. Support staff	
10.1. Dieticians	
10.2. Sanitary workers	
10.3. Inspectors	

10.4. Kitchen Staff	
10.5. Laundry Staff	
10.6. Guards	
10.7. Porters	
11. Others (please specify)	

8.Total number of Beds in the hospital _____

9. Annual percentage of bed occupancy _____

B. On-Site Handling of Clinical Waste

10. Does your hospital have a method to estimate the amount of clinical waste produced by the hospital?

☐Yes ☐No

11. Is it likely to make any change in your hospital that would affect the amount of waste generated during the next five years?

☐Yes ☐No

12. If you answer yes, how is this affecting the waste in your hospital?

a. Increase b. decrease

13. Are there any plans to decrease the generation of hazardous waste in your hospital?

☐Yes ☐ No

14. If yes, what are they?

1) _____

2) _____

15. Are there any plans for recycling?

☐Yes ☐ No

16. Is there a method to identify the source and kind of clinical waste?

☐Yes ☐ No

17. Please fill in the following table:

Kind of waste produced	Estimated amount produced Kg/day	Form of waste: liquid, solid, gas			Color coding is used for segregation		Marked bags/containers are used for segregation	
		L	*S*	*G*	*Yes*	*No*	*Yes*	*No*
1. Pathological								
2.Radioactive								
3. Chemical								
4. Infectious								
5. Sharps								

6. Pharmaceuticals								
7.Pressurized containers								
8. Others (please specify)								

18. Is pretreatment applied to clinical waste?

☐ Yes ☐No

19. Where is the Clinical Waste stored on site?

a) In a separate storage area
b) Together with the other waste
c) Don't know

20. How is clinical waste transported within the hospital premises?

a) Dedicated vehicles
b) Ordinary vehicle
c) Don't know

C. On-Site Management Plan and Procedures

21. What are your current disposal arrangements for each type of waste?

Type of waste	Local authority	Contractor	Self	Incinerator	Sanitary Landfill	Open Dump
1. Pathological						
2. Radioactive						
3. Chemical						
4. Infectious						
5. Sharps						
6. Pharmaceutical						
7.Pressurized containers						
8.Others (please specify)						

22. Does your hospital sell any of the waste to other companies?

☐ Yes ☐No

23. If Yes, Please list two of these companies

1)_____
2) _____

24. Is there an incinerator onsite? (If yes, Please continue. Otherwise, go to section D)

☐Yes ☐No

25. Does your incinerator have any special devices to remove pollutants from the flue gas?

☐Yes ☐ No

26. Does it remove particulates alone?

☐Yes ☐ No

27. What other pollutants would it remove?

a. _____

b. _____

28. Is the incinerator maintained?

a) Periodically
b) As needed
c) Do not know

29. Who does its maintenance? _____

30. How is the medical waste transported to the incinerator?

a) From the source to the storage area? _____

b) From the storage point to the Ultimate point? _____

31. Does the staff who maintain the incinerator have personal protective equipment? (Mark all the choices that apply)

	Yes	No
a. Special clothing	☐	☐
b. Gloves	☐	☐
c. Masks	☐	☐
d. Shoes	☐	☐
e. Face shields	☐	☐

D. Off-Site Management Plan and Procedures

32. Do you know what happens to the waste after it is transported from your hospital?

☐ Yes ☐ No

33. What follow-up procedures are taken off-site ?

a) A contractor takes care of the waste
b) A special landfill is used
c) None are taken
d) Don't know

34. How is the waste transported to the external location? (Private or public)

_____

_____

35. How is clinical waste transported from the hospital to the disposal site?

a) Dedicated vehicles
b) Ordinare vehicles
c) Don't know

36. Is the vehicle totally enclosed?

☐ Yes ☐ No

37. Is the waste systemically packed in a specific way?

☐ Yes ☐ No

38. Waste collection is done _____ times per week.

39. Please, feel free to add any remarks you may have concerning the waste management in your hospital._____

E. Availability of Protocols and Guidelines

40. Does your hospital have protocols or guidelines for clinical waste management?

☐Yes ☐No

41. If "Yes", are the guidelines you follow

	Yes	No
a. Developed by your hospital?	☐	☐
b. National guidelines?	☐	☐
c. International guidelines?	☐	☐

42. Does your hospital apply these guidelines?

a. Verbally
b. In writing
c. Doesn't apply them
d. Other (please specify)

43. Will you be willing to follow guidelines on hospital waste management plan if they are made available?

☐ Yes ☐ No

44. What are the problems you encounter concerning the current disposal practices adopted by your hospital?

a. Infection of hospital workers?

☐ Yes ☐ No

b. Finding limbs in the incinerator?

☐ Yes ☐ No

c. Children reach the storage area?

☐ Yes ☐ No

d. Any other problems? Give examples (1)_____

(2) _____

45. Do you have plans for improvement?

☐Yes ☐ No

If yes, Please specify _____

46. Are you willing to cooperate with other hospitals

	Yes	No
a. To reduce hazards used by generated waste	☐	☐

b. To reduce the cost of disposal ☐ ☐

47. Do you keep a record of environmentally associated accidents?

☐Yes ☐ No

48. Do you keep records of any type of waste?

*a. If yes; when did you start this record keeping?*_____

b. If No, Why is that? (Mark all the choices that apply)

i. Not a priority at the present time
ii. Too costly
iii. Not in the hospital guidelines
iv. Other (please specify) _____

49. What is your opinion of the role of the Ministry of Health in controlling hospital waste? _____

_____

F. Staff Responsibilities, Training and Awareness

50. Is there a specific unit that deals with clinical waste management in your hospital?

☐ Yes ☐ No

51. How many employees are in this unit? _____

52. What are the responsibilities of the staff?

a. Inspection	☐ Yes	☐ No
b. Follow up on segregation	☐ Yes	☐ No
c. Monitoring	☐ Yes	☐ No

53. Do you have any hospital waste audits or self inspection?

☐ Yes ☐ No

54. In your opinion, is waste management?

i. Very important
ii. Important
iii. Less important than other issues
iv. Not important

55. Do you agree that hospital waste poses risks to the environment and the public health?

i. Agree
ii. Disagree
iii. Do not know

56. Are there any training and awareness programs for the staff in clinical waste management in your hospital?

☐ Yes ☐ No

If yes, please continue with the questionnaire.