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Laboratories Medical Wastes Management in the Ministry of Health, Gaza Governorates.

Najah Rajab Shaban

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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.

Signed : ……..

Najah Rajab Shaban

Date: February-2009

DEDICATION

I would like to dedicate this work to my family, especially my parents, and my husband for their continuous, endless and generous support.

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ABSTRACT

Medical laboratories generate a huge quantity of hazardous and non- hazardous wastes... The hazardous wastes when inappropriately managed may compromise the quality of work done.

Additionally, the wastes present occupational health risks to those who generate, handle, package, store, transport, treat, and dispose of them. These wastes may enhance environmental pollution and the spread of infectious diseases, including acquired immunodeficiency syndrome (AIDS), hepatitis, tuberculosis, diphtheria, cholera, and many others. So in this study the researcher will investigate the whole process of lab wastes management and explore the managerial role in this process.

235 questionnaires were distributed for MOH lab technicians and 18 questionnaires for lab manager, these questionnaires were targeting the entire lab managers and technicians in all Gaza Strip governorates. The results revealed that segregation, collection, transport and treatment of lab wastes are incorrect and quite unsafe for lab personnel, wastes handlers, clients and whole environment. In addition to that, the study revealed inadequate management system regarding the process of wastes management including poor legislation, planning, coordination and training.

The study findings indicted that there is an urgent need for raising awareness and education through lab workers training on medical waste issues. Proper waste management strategy is needed to ensure health and environmental safety.

For further study, it is needed to collect more information on impacts, disposal and management of laboratories medical wastes to draw a clear conclusion. There is need to collect information and examples from developed country which has sound medical waste management system. Find alternatives and appropriate technologies for developing countries. Need extensive study on this medical waste and its management aspects as well.

ملخص

ادارة النفايات الطبية في مختبرات وزارة الصحة الفلسطينية /محافظات قطاع غزة

لقد تنتج المختبرات الطبية الكميات الكثيرة من النفايات الخطيرة و الغير الخطيرة . هذه النفايات الخطيرة تحد من جودة العمل المقدم في المختبرات عند التعامل معها بالطريقة الغير سليمة. علاوة على ذلك فان هذه النفايات الطبية تزيد من المخاطر المهنية لكل من ينتج النفايات ويحملها وينقلها و أولئك الذين يتخلصون منها.

إن الطريقة السيئة للتعامل مع النفايا ت الطبية يؤدى إلى تفاقم مشكلة تلوث البيئة و انتشار الأمراض المعدية والتي منها مرض الايدز

ومرض التهاب الكبد الوبائي والسل و الدفتيريا والكوليرا والكثير من الإمراض المعدية. لذا فان الباحثة في هذه الدراسة ستتناول موضوع التعامل مع النفايا ت الطبية بشكل كامل في مختبرات وزارة الصحة الفلسطينية أخذة في الاعتبار الدور الإداري لهذه العملية.

لقد تم توزيع 235 استبانه لفني مختبرات وزارة الصحة الفلسطينية و 18 استبانه لمدراء المختبرات في كل محافظات قطاع غزة و قد دلت النتائج إن عملية فصلية النفايات وتجميعها ونقلها و معالجتها كانت تؤدى بشكل غير صحيح و هذا أدى الى نتائج غير امنة لكل من طاقم المختبر و البيئة بشكل عام . بالإضافة لذلك أظهرت الدراسة بان نظام إدارة النفايات الطبية لا يتضمن أي نوع من التشريعات و التخطيط والتنسيق و التدريب.

إن نتائج البحث تشير إلى حاجة ماسة لزيادة الوعي والتعليم بين فني المختبرات وذلك من خلال التدريب على هذه القضية مع وجود منهجية واضحة لإدارة النفايات الطبية لضما ن سلامة البيئة . كما انه لا بد من جمع الكثيرمن المعلومات و الأمثلة المفيدة مع الاستعانة بخبرات الدول لمتقدمة في هذا المجال و أوصت الباحثة بضرورة عمل دراسات متعمقة في مجال النفايات الطبية و الدور الادارى لذلك.

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List of Acronyms

ATSDR	Agency for Toxic Substance and Disease Register.
CDC	Center for Disease Control.
EHSC	Environmental Health and Safety Committee
EPA	Environment Protection Agency.
EQA	Environment Quality Authority
GS	Gaza Strip
HBV	Hepatitis B Virus
HCF	Health Care Facility
HCW	Health Care Wastes .
HCWM	Health Care Wastes Management.
HCV	Hepatitis C Virus.
H2E	Hospital for Environment
HIV	Human Immunodeficiency Virus.
MoH	Ministry of Health
IOF.	Israeli Occupied Forces
OPT	Occupied Palestinian Territories.
PCDD	Dibenzenop Dioxins.
PCDF	Dibenzenop Furans
PCBS	Palestinian Central Bureau of Statistics.
PHC	Primary Health Care
PM	Particulates Matter.
NISs	Needle Stick Injuries.
SPSS	Statistical Package for Social Science
SWM	Solid Wastes Management.
TB	Tuberculosis
UN	United Nations.
UNCED	United Nation Conference on Environment and Development.
USA	United States of America.
WB	West Bank
WHO	World Health Organization.

Operational Definitions

- **Medical wastes** are wastes generated by a health care facility such as hospitals, clinics laboratories, pharmacies, blood bank and other medical facilities.
- **Segregation** is the process of separation of wastes at source of generation in different special containers.
- **Collection** is the process of taking medical wastes from onsite place to offsite for final disposal.
- **Treatment** is way or techniques that used to alter the biological ,chemical, or physical characteristics of wastes to reduce its hazardous effect .
- **Incarnation** is the process of using great temperature for burning wastes
- **Legislation** is a code of rules and regulations acts as basis for improving health care wastes practices in any country.

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Chapter (1)

Introduction

1.1 Study Introduction

Since a long time till nowadays Palestinian national authority areas are witnessing an increased amount of medical wastes generation at different health care settings due to increased demand on medical care, especially emergency care. One of these settings that have large production of medical wastes is laboratories. Generally, laboratories are considered very safe places to work, only when safe methods of medical wastes management incorporated in the daily activities in the work place. But still that health care wastes pose a serious public health problem primarily because of the diversity of the individual components of the wastes which constitutes risk to health if inadequately handled, both for persons and the environment.

Worldwide, public awareness of health care wastes has grown in recent years, especially with the emergence of human immunodeficiency virus, transmission of hepatitis B and C. Worldwide, 8-16million hepatitis B, 2.3to4.7million hepatitis C and 80 000 to160 000HIV infections are estimated to occur yearly from poor disposal of needles and syringes which is particularly common in Africa, Asia, and central and Eastern European countries (WHO.2002). In developing countries additional hazards occur from scavenging on wastes disposal sites and manual sorting of the wastes recuperated at the back doors of health care establishments. These practices are common in many regions in the world especially in our Palestinian national authority areas. The wastes handlers are at immediate risk of needle stick injuries and other exposure to toxic or infectious materials.

Although treatment and disposal of health care wastes aim at reducing risks, indirect health risks may occur through the release of toxic pollutants into the environment via treatment and disposal .This situation resulted in issuance of medical waste regulation that aimed at regulating the management processes at work place of such hazardous waste.

1.2 Problem statement.

Managing laboratory wastes is a major problem in most developing countries due to its ever growing and endless generation, coupled with lack of policies and enforcement in Eastern Mediterranean region of the world health organization. So exposing the patient, medical and support staff in health care establishments to avoidable health risks. Moreover, improper management of HCW could have serious implications for public health and the general environment. So in this research the problem of medical waste management in laboratories will be highlighted in order to bring solutions to identified problems and enhance further investigations and research.

1.3 Justification

Many studies on laboratories medical wastes management and their implications on health and environment were carried out by many people, either nationally or internationally. This topic has been an area of concern to many health care professionals. I felt compelled to study and investigate this topic for many reasons. Globally, one estimate shows that 5.2 million people (including 4 million children) die each year from wastes related diseases. Taking into consideration that the amount of solid wastes generated will be quadruple by the year 2025. (Akter et al .1999)

It's known that laboratory analyses have shown severe contamination of infectious wastes to the environment, children, adults, and animal's .All have the potential to come into contact with these wastes which may pose severe health risks to them. So, investigating the situation in Occupied Palestinian Territories (OPT) regarding medical wastes management as described by the Palestinian authority master plan (2005). It is the same as managing other medical wastes available in the different health settings. In general, most health care centers and hospitals in the OPT have no segregation processes between general and special wastes; all types of medical waste are mixed and in most cases disposed of with municipal garbage. None of the healthcare facilities in GS keep records on generation rate or quantities of healthcare waste. One third of the HCFs have special containers for HCW collection; all other facilities consequently collecting all types of HCW together with domestic waste. Sharp items in particular are being collected in special boxes (and sometimes special plastic bottles) as a result of the WHO donating a certain number of boxes; but again this is happening in only a limited number (38%) of HCF. Even the labeling system for the containers does not exist.

Waste is generally collected by the municipality in each city but the collection frequency is left uncontrolled. Only 15% of the HCFs have special containers for offsite transport. The workers in the solid waste department, in each municipality are responsible for collecting all containers and they do not distinguish between healthcare waste and domestic waste. All types of waste are transported in the same vehicle and there is no training provided for the waste collectors. No instructions are given to them for HCW collection; all other facilities consequently collect all types of HCW together with domestic wastes.

The municipalities are mostly responsible for HCW transport; make no differentiation between waste collected from residential areas and that collected from HCF. This obviously leads to a mixing of waste in the same truck and being taken to the same end dump site. About 70% of the collected HCW in GS is being incinerated, while 20% is being burnt in the open air, frequently in bins (resulting in concerns over public health). The remaining collected HCW and the ash from the incineration invariably end up in municipal waste dumps. No documentation or registry of any data on incinerated items. One common and fundamental issue that should be highlighted is that laboratory medical waste stayed several days without being eliminated outsides the heath care settings. Some clients especially children come in contact with them because they poorly sealed off and sometimes liquids come out of these medical wastes. These expose general publics to needle stick injury and other serious health care problems. The WHO (2002) estimated that worldwide over20 million infections of hepatitis B and C and HIV occur yearly due to unsafe injection practices. Beside that in our laboratories there is a large occupational risk of needle stick injury due to poor handling of medical wastes but this occurs among laboratory workers and wastes handlers. These accidents are poorly reported in our country while others keep records about these serious accidents for example CDC (2002) estimates of annual number of people injured by sharps are 800-7500 in USA and the annual number of HBV infections caused by injury is 2-15 .Above all, the chemicals used for the staining and preservation of slides and for the sterilization and cleaning of equipment and surroundings are potentially harmful to the laboratory technician and the environment. Therefore I feel this situation in Gaza strip laboratories necessitates an urgent need for investigation and study to help create proper wastes management to ensure health and environmental safety.

1.4 Contextual Background

1.4.1 Geographical, demographical and socio-economic context.

Gaza strip is a narrow piece of land lying on the coast of the Mediterranean Sea. Its position on the crossroads from Africa to Asia made it a target for occupiers and conquerors over the centuries. The last of these was Israel who occupied the Gaza Strip from the Egyptians in 1967. (See Annex 1).

Gaza Strip is a very crowded place with an area 378 sq. Km which represents about 6.1% of total area of Palestinian territory land. This small piece of land is inhabited by some 1,500,000 persons about 70% of them are refugees, mainly concentrated in the cities, small village, and eight refugee camps that contain two thirds of the population of Gaza Strip. The Gaza governorate has the highest population density with 6,593 people per km2. (PCBS, 2006).

In September, 2005 Israel redeployed its forces outside Gaza Strip according to unilateral disengagement plan, including all existing Israeli settlements (22) and all military installations. After this process there is no permanent presence of Israeli forces in the areas of Gaza Strip territory which have been evacuated.

In reality, the Israeli unilateral disengagement has imposed a huge prison for the Palestinian people introduced by Israeli government for the first time in modern world. This is the newest and most dangerous reoccupation of people with disavowal from their rights to live with self determination in their occupied land. Also, all these Israeli activities violate the UN human rights conventions and UN decisions.

These measures increased and developed a systematic comprehensive siege imposed by Israel toward Gaza and its people; even the basic humanitarian services have been affected, in addition to all other dramatic changes that have been happening following the Hamas election victory in Jan. 2006. The international aid to the PA was widely suspended and Israel stopped the transfer of Palestinian VATs, leading to an unprecedented deterioration of the local economy, especially in Gaza strip. According to a July 2007 report by the UNDP, a majority of Palestinians (58%) live below the poverty line, about 75% of them are in Gaza strip, and about half of them live in extreme poverty.

1.4.2 Health Context

In general the health situation in the Gaza Strip and West Bank is very poor and highly affected by the siege and the current political situation as frequently declared by the MoH/Gaza. There is a sever shortage of health and medical resources in term of human and materials. According to PCBS 2005, the Infant mortality rate was 24.2 per 1.000 live births between 1999 – 2003. Main causes are premature delivery, low birth weight, respiratory system diseases, and congenial anomalies. Child mortality rate (death under the age of five years) was 28.3 per 1.000 live birth between 1999 – 2003 .Major causes are respiratory system diseases and congenital anomalies.

While the WHO, 2007 mentioned that the health system of the OPT, especially in Gaza, is heavily dependent on referral to hospitals and other health services outside the area. The recent closure of the Rafah crossing and restrictions imposed on the Erez crossing were impeding the movement not only of people but also of essential medical equipment and supplies to Gaza health sector.

As health services continue to decline, the need for referral to services outside the area, such as in East Jerusalem, Jordan, Egypt and Israel, grows. Of some 4,074 patients in Gaza who applied for travel permits on medical grounds between June-Nov.2007, only 713 have had their applications denied, more than doubling the proportion of patient who has been denied passage since Israel imposed new restrictions on the Gaza Strip. Since Oct.2007 until 23 November, 12 people died in the Gaza Strip after being either delayed at checkpoints or in being denied permits. (WHO, Press Statement, 23 November 2007.)
Either the governmental health sectors, or NGOs and private sectors are providing the people with health care mainly through the main facilities which are:

1.4.2.1 Primary health care facilities (PHCF)

Primary health care system (PHC) is a major component of Palestinian health care system; this system provided health care for all Palestinian people especially for children and other vulnerable groups. Primary health care centers in Palestine provide primary and secondary health care services as well as tertiary services.

In the last few years and after the uprising of the second Intifada (Al Aqsa), PHC centers in Palestine have been developed in a dynamic way to face the instability of Palestinian situation were Israeli occupying forces (IOF) tends to divide the Palestinian localities into isolated geographical areas. PHC centers try to offer accessible and affordable health services for all Palestinians regardless of the geographical locations. According to MOH policy, PHC centers are classified from level I to level IV. They offer different health services according to clinic level, these services include maternal and child health, care of chronic diseases, daily care, family planning, dental, mental services and other services according to center level.

Classification of PHC according to providers shows that, the MOH is considered the main provider for 63.6% from the total PHC centers, followed by the NGOs with 28.3%, then UNRWA with 8.1%. It is worth to mention that, Private sector plays an important role in providing PHC services to Palestinian people but, there is limited information about these centers. The average ratio of persons per center was 5,752 (10,774 in Gaza Strip and 4,519 in West Bank), in 2005

The Number of PHC centers per 10,000 persons was 1.7 in 2005 while it was 1.9 in 2000. At the end of 2005, there were 654 PHC centers in Palestine; these centers care for about 3.7 million people (129 centers in Gaza and 525 centers in West Bank)

1.4.2.2 Hospital services

In Palestine the secondary health services care provided by the governmental, non-governmental, UNRWA and private sectors.

The MOH is responsible for a significant portion of the secondary healthcare delivery system (60-70% of general and specialized hospital beds) and more than this proportion in hospital services (about 70% of hospital services).

In 2005, there are 72 hospitals divided as follows: 43 general hospitals with 3,726 beds, 10 specialized hospitals with a total bed capacity of 812 beds, 19 maternity hospitals at a total bed capacity of 322 beds in addition to four rehabilitation centers with a total bed capacity of 165 beds, out of these 72 hospitals, there are 22 in Gaza Strip.

1.4.2.3 The laboratory services

The laboratory services in the MOH are offered to the Palestinian people at three levels: central, intermediate, and peripheral levels.

The central laboratory is a referral one specialized for advanced analyses and receives samples from governorates. The intermediate laboratory is a hospital based serving in and out patients and collaborates with nearby hospitals. While, the peripheral laboratory is located in the PHC centers.

According to MOH's annual report 2005, there are 631 employees (WB: 261/ GS: 370) offering laboratory services in the Ministry of Health.

1.4.2.3.1 Central laboratories

The histopathology and cytology services are centralized in WB but not in Gaza. There are 7 specialists in histopathology and cytology (WB: 3/ GS: 4) in addition to 12 technologists (WB: 3/ GS: 9) providing the service. The total number of samples received was 12,496 (WB: 6871/ GS: 5,625).

In addition, there is a central medical laboratory in Gaza with the following departments: endocrinology, immunology, special chemistry, screening tests for neonatal hypothyroidism and phenylketonuria. The molecular biology section was established in the central lab of Gaza. This laboratory is specialized to test hepatitis B and C viruses qualitatively and quantitatively by PCR method. In Gaza, samples were assayed by this methodology during the second half of 2005.

1.4.2.3.2 Intermediate laboratories

There are 19 intermediate laboratories (WB: 11/GS:8) in the hospitals. The total number of lab tests done in these intermediate laboratories was 4,959,468 tests, (WB: 2,046,119/ GS: 2,913,349) in 2005.

Those tests were in the fields of microbiology, urine and stool analysis, clinical chemistry, serology, hematology, hormones, drug monitoring, and tumor markers. There were 300 specialists and laboratory technologists (WB: 124/ GS: 176) providing the service in these hospitals.

The average annual tests per technologist were 16,532 (WB: 16,501/ GS: 16,553).

1.4.2.3.3 Peripheral laboratories

There were 102 laboratories in the MOH primary health care clinics (WB: 70/ GS: 32). Twenty-one laboratories in WB belong to NGO facilities with which MOH contracted. There were 194 (WB: 110/ GS: 84) laboratory technologists working in these laboratories,

21 of them in the contracted ones. The total number of lab tests done was 1,401,883 (WB: 812,017/ GS: 589,866).
The average annual tests per technologist were 7,226 (WB: 7,382/ GS: 7,022).

1.4.2.3.4 Blood transfusion services

The blood banking services are mostly hospital based in both MOH and other sectors. Each governorate is almost self – sufficient of blood and products with minimal exchange among them. The total number of blood banks in Palestine is 26 (WB: 19 /GS:7). In WB 7 blood banks belong to MOH and 12 to NGO and private hospitals. While, in GS 6 belong to MOH and 1 to NGO facility.

1.4.2.3.5 Lab licensing

The laboratories and blood banks directorate collaborates with the directorates of the primary health care and the private medicine department to inspect private and NGO laboratories for license issue. In WB, 24 new private laboratories and 15 new laboratories within medical centers were licensed.
Also, 93 pre-existed private laboratories and 80 laboratories within medical centers were re-licensed. In GS, 4 new private laboratories and 6 new laboratories in NGO medical centers were licensed. Also, 13 pre-existed private laboratories and 6 laboratories within NGO medical centers were re-licensed.

1.4.3 Environmental context

According to PCBS 2006, 9.7% (WB: 13.7%; GS: 1.9%) of the Palestinian households did not have solid waste collection service. Local authorities collected solid waste for 69.4% of households. The average household daily production of household waste was estimated to be 4.6 kg, and the average per capita daily production at 0.8 kg. The total daily produced quantity of household waste is estimated to be 2,844 tons.

Moreover some 54% of Palestinian households were connected to a public sewage network (WB: 44.9%, GS: 71.8%). The wastewater disposal method of 45.3% of WBGS households was the sewage network, while 54% used cesspits, and 0.7% used other methods.

In 2005, the PCPS stated that the majority of Palestinian localities (56%) were provided with some form of solid waste collection services, in most cases – 68.9% - by the respective local authorities (else by UNRWA, private companies and other collectors). However, some 166 West Bank localities – almost half of them in the Hebron district – had no such services.

1.5 Objectives of the study

1.5.1 Main goal:

To contribute in studying the technical and managerial aspects of dealing with medical wastes in laboratories of ministry of health.

1.5.2 Specific objectives:

- To explore the management methods of medical wastes in laboratories of ministry of health.
- To identify the areas of weakness and strength in the process of medical wastes management.
- To recognize the organizational role in the process of laboratories medical wastes management.
- To develop recommendation that could create laboratories functioning well and according to universal standards

1.6 Research questions

1. What are the used segregation, collection, transport, and disposal methods in the laboratories of ministry of health?

2. Are there differences between laboratories medical waste management in laboratories of hospitals and primary health care clinics?

3. What are the factors that enhance and deteriorate the process of medical wastes management?

4. What are the areas of strengths in the process of managing laboratory medical wastes?

5. Is the medical wastes management process in the laboratories running in the appropriate way?

6. What are the areas of weakness in the process of managing laboratories medical wastes?

7. Are laboratories of MOH working according to defined plan and a work guideline?

8. Is there supervision for the total process of laboratories medical wastes management?

9. Is there a legislation that controls the process of medical wastes management in MOH laboratories?

10. Are people working at MOH laboratories satisfied with current situation of laboratories wastes management?

11. What are the suggested recommendations to improve the process of laboratories medical wastes management?

Chapter (2)

Literature review

2.1 Conceptual Framework

A review of lab medical wastes management claims that, there are many interrelated factors that affect this process. First of all the presence of legislation which is a legal framework that regulates the work of the national agency to be responsible for the disposal of their own health care wastes.

This legislation involves a lot of policies and rules that follow up the process of medical wastes management. Secondly from these policies, lab work guidelines are withdrawn and it's considered as a legal work protocol covering safe management of health care wastes and safe practices for wastes segregation, collection, transport and treatment.

In this guideline every work practice should be mentioned so this guideline includes a national management plan that will permit healthcare waste-management options to be optimized on a national scale. A national plan relating to disposal of healthcare waste-management system will provide the relevant agency with a basis for identifying actions on a district and national basis, taking into account conditions, needs, and possibilities at each level. An appropriate, safe, and cost-effective plan should cover not only the technical aspects related to wastes management but all essential components in sustaining the operation of HCWM systems.

The process of medical wastes management includes lab wastes segregation which is the separation of lab wastes at point of generation; collection which is putting lab wastes in special containers sealed properly and labeled to be transported either onsite or off-site . Finally treatment is using the suitable technologies for final disposal of wastes. To do these processes efficiently and in a way that ensure safety there should be enough supplies .But to ensure the process is running according to the plan there should be continuous follow up and control that responds to the ongoing needs of the lab, focusing on the ongoing need for training and improving performance. (See Annex 2).

A lot has been written about medical wastes, but the term medical wastes are extremely complex. It involves chemicals that are so hazardous to wastes that are close to municipal solid wastes, and despite the attention given to that term by the public and all levels of the government still many terms like hospital wastes, medical wastes, regulated medical wastes and infectious wastes poorly defined.

2.2 Conceptual definitions of medical care wastes.

According to Rutala, et al 1992, no standard universally accepted definitions for these terms exist, and these appear to be as many definitions of these in use as there are government agencies and other groups involved in this issue.

SoThe Medical Waste Tracking Act of 1988 of the defines medical waste as "any solid waste that is generated in the diagnosis, treatment, or immunization of human beings or animals, in research pertaining thereto, or in the production or testing of biological samples." This definition includes, but is not limited to:

- blood-soaked bandages
- culture dishes and other glassware
- discarded surgical gloves
- discarded surgical instruments
- discarded needles used to give shots or draw blood
- cultures, stocks, swabs used to inoculate cultures
- removed body organs (e.g., tonsils, appendices, limbs)
- discarded lancets (e.g., medical sharps)

(Ragsdale et al, 1996) defined"Biohazardous waste" as any of the following:

Laboratory waste, including, but not limited to, all of the following:

- Human or animal specimen cultures from medical and pathological laboratories.
- Cultures and stocks of infectious agents from research and industrial laboratories.
- Wastes from the production of bacteria, viruses, or the use of spores, discarded live and attenuated vaccines used in human health care or research vaccines, as identified by the department, and culture dishes and devices used to transfer, inoculate, and mix cultures.
- Waste containing any microbiologic specimens.

- Human surgery specimens or tissues removed at surgery or autopsy, which are suspected by the attending physician and surgeon or dentist of being contaminated with infectious agents known to be contagious to humans.
- Animal parts, tissues, fluids, or carcasses suspected by the attending veterinarian of being contaminated with infectious agents known to be contagious to humans.
- Waste, which at the point of transport from the generators site, at the point of disposal, or thereafter, contains recognizable fluid blood, fluid blood products, containers, or equipment containing blood that is fluid or blood from animals known to be infected with diseases which are highly communicable to human shall thereafter be considered solid waste.

Medical waste does not include any of the following: (Jager et al, 1998)

- Waste containing microbiological cultures used in food processing and biotechnology and any containers or devices used in the preparation and handling of these cultures that is not considered to be an infectious agent
- Urine, feces, saliva, sputum, nasal secretions, sweat, tears, and vomits, unless they contain fluid blood. Waste which is not biohazardous , such as paper towels, paper products, articles containing non-fluid blood, and other medical solid waste products commonly found in the facilities of medical waste generators.

2.2.1 Health-care waste:

The WHO(1999),defines health-care wastes as all the waste generated by health-care establishments, research facilities, and laboratories including the waste originating from minor or scattered sources such as that produced in the course of health care undertaken in the home (dialysis, insulin injections, etc.).

The Ministry of Environmental Affairs (1999), defined medical wastes under hazardous wastes which defined as*:* waste generated by the various activities and operations or the ash, which preserve the characteristics of hazardous substance which have no uses, such as atomic waste, medical waste, or refuse emanating from manufacturing of pharmacological products, medicines, organic solvents, dyes, painting, pesticides or any other substances.

Nessa (2001), defined hospital wastes as "all wastes, biological or non-biological, which are discarded and not intended for further use. About 85% of these wastes are actually, non-hazardous wastes, 10% are infectious wastes, and 5% are non-infectious but hazardous wastes."

Health care environmental centers, department of solid waste regulations USA, (2003) defines medical waste as laboratory waste consisting of discarded cultures and stocks of infectious agents and associated microbiological, pathological wastes, selected isolation waste, used and unused discarded sharps, animal waste, human blood or blood products, and other wastes defined as "regulated waste."

- Cultures and stocks means discarded cultures and stocks of infectious agents and associated microbiological, including human and animal cell cultures from medical and pathological laboratories, cultures and stocks of infectious agents from research and industrial laboratories, waste from the production of biological, discarded live and attenuated vaccines, and culture dishes and devices used to transfer, inoculate, or mix cultures of infectious agents;
- Pathological waste means discarded pathological waste, including human tissues, organs, and body parts removed during surgery, autopsy, or other medical procedure;
- Selected isolation waste means discarded waste material that is contaminated with excretions, exudates, and secretions from patients with highly communicable diseases, and that is treated in isolation. A selected isolation waste includes blood and blood components, and sharps;
- Sharps means discarded implements or parts of equipment used in animal or human patient care, medical research, or industrial laboratories, including hypodermic needles, syringes, Pasteur pipettes, scalpel blades, blood vials, needles with attached tubing, broken or unbroken glassware that has been in contact with an infectious agent, slides, cover slips, and unused, discarded implements or parts of equipment;
- Animal waste means discarded material originating from an animal inoculated with an infectious agent during research, production of biological, or pharmaceutical testing and animal wastes including the carcass, body parts, blood, and bedding of any animal known to have been in contact with an infectious agent;
- Blood and blood products means discarded waste human blood and blood components, including serum and plasma, and materials containing free-flowing blood and blood components; and
- Other wastes defined as "regulated waste”.

The environment protection agency(US EPA,2007)defines Medical waste as all waste materials generated at health care facilities, such as hospitals, clinics, physician's offices, dental practices, blood banks, and veterinary hospitals ,clinics, as well as medical research facilities and laboratories.

2.3 Classification of medical wastes

There are many classifications to medical wastes; some people classify them according to their state or character and others according to their source and effects.

The WHO 1999, Classification of Medical Wastes

2.3.1 Infectious waste

Infectious waste is suspected to contain pathogens (bacteria, viruses, Parasites, or fungi) in sufficient concentration or quantity to cause disease in susceptible hosts. This category includes:

- ✓ Cultures and stocks of infectious agents from laboratory work;
- ✓ Waste from surgery and autopsies on patients with infectious diseases (e.g. tissues, and materials or equipment that have been in contact with blood or other body fluids); waste from infected patients in isolation wards (e.g. excreta, dressings from infected or surgical wounds, clothes heavily soiled with human blood or other body fluids);
- ✓ Waste that has been in contact with infected patients undergoing haemodialysis (e.g. dialysis equipment such as tubing and filters, disposable towels, gowns, aprons, gloves, and laboratory coats);
- ✓ Infected animals from laboratories;
- ✓ And any other instruments or materials that have been in contact with infected persons or animals.

Note: Infected sharps are a subcategory of infectious waste

Cultures and stocks of highly infectious agents waste from autopsies, animal bodies, and other waste items that have been inoculated, infected, or in contact with such agents are called highly infectious waste.

2.3.2 Pathological waste

Pathological waste consists of tissues, organs, body parts, human fetuses and animal carcasses, blood, and body fluids. Within this category, recognizable human or animal body parts are also called anatomical waste.

This category should be considered as a subcategory of infectious waste, even though it may also include healthy body parts.

2.3.3 Sharps

Sharps are items that could cause cuts or puncture wounds, including needles, hypodermic needles, scalpel and other blades, knives, infusion sets, saws, broken glass, and nails. Whether or not they are infected, such items are usually considered as highly hazardous health-care waste.

2.3.4 Pharmaceutical waste

Pharmaceutical waste includes expired, unused, spilt, and contaminated pharmaceutical products, drugs, vaccines, and sera that are no longer required and need to be disposed of appropriately. The category also includes discarded items used in the handling of pharmaceuticals.

2.3.5 Chemical waste

Chemical waste consists of discarded solid, liquid, and gaseous chemicals, for example from diagnostic and experimental work and from cleaning, housekeeping, and disinfecting procedures. Chemical waste from health care may be hazardous or non hazardous; in the context of protecting health, it is considered to be hazardous if it has at least one of the radioactive substances used in health care and generating waste. Radioactive waste includes solid, liquid, and gaseous materials contaminated with radionuclide. It is produced as a result of procedures such as *in-vitro* analysis of body tissue and fluid, *in-vivo* organ imaging and tumor localization, and various investigative and therapeutic practices.

According to the Technical Guidelines on Environmentally Sound Management of Biomedical and Health-care waste provided by the Conference of the Parties to the Basel Convention on the Control of Trans-boundary Movements of Hazardous Waste and their Disposal (December 2002), health-care wastes are classified as following:

A- Non-risk HCW

Non-risk HCW includes all the waste that has not been infected like general office waste, packaging or left over food. They are similar to normal household or municipal waste and can be managed by the municipal waste services. They represent between 75% and 90% of the total amount of HCW generated by medical institutions. Three groups can be established:

A1-Recyclable waste

It includes paper, cardboard, non-contaminated plastic or metal, cans or glass that can be recycled if any recycling industry exists in the country.

A2- Biodegradable HCW

This category of waste comprises for instance, left over food or garden waste that can be composted.

A3- Other non-risk waste

This category includes all the non-risk wastes that do not belong to categories A1 and A2.

B- Biomedical and health-care waste requiring special attention

B1-Human anatomical waste

This category of waste comprises non-infectious human body parts, organs and tissues and blood bags.

Examples of such wastes: tissue waste, removed organs, amputated body parts, placentas, etc…

B2- Waste sharps

Sharps are all objects and materials that are closely linked with health-care activities and pose a potential risk of injury and infection due to their puncture or cut property. For this reason, sharps are considered as one of the most hazardous waste generated in the HCF and they must be managed with the utmost care.

Examples of such wastes: all types of needles, broken glassware, ampoules, scalpel blades, lancets, vials without content

B3- Pharmaceutical waste

The term "pharmaceuticals" embraces a multitude of active ingredients and types of preparations.

The spectrum ranges from teas through heavy metal containing disinfectants to highly specific medicines. Waste management therefore requires the use of a differentiated approach. This category of waste comprises expired pharmaceuticals or pharmaceuticals that are unusable for other reasons (e.g. call-back campaign). Pharmaceutical wastes are divided into three classes. Their management occurs in a class-specific manner (see below).

B3.1 *-Non-hazardous pharmaceutical waste*

This class includes pharmaceuticals such as chamomile tea or cough syrup that pose no hazard during collection, intermediate storage and waste management. They are not considered hazardous wastes and should be managed jointly with municipal waste.

B3.2- *Potentially hazardous pharmaceutical waste*

This class embraces pharmaceuticals that pose a potential hazard when used improperly by unauthorized persons. They are considered as hazardous wastes and their management must take place in an appropriate waste disposal facility.

B3.3- *Hazardous pharmaceutical waste*

Class B3.3 pharmaceutical waste comprises heavy metal containing and unidentifiable pharmaceuticals as well as heavy metal containing disinfectants, which owing to their composition require special management. They must be considered as hazardous wastes and their management must take place in an appropriate waste disposal facility.

B4 Cytotoxic pharmaceutical waste

Cytotoxic pharmaceutical wastes are wastes that can arise by use (administration to patients), manufacture and preparation of pharmaceuticals with a cytotoxic (antineoplastic) effect.

B5 Blood and body fluids waste

It includes wastes that are not categorized as infectious waste but are contaminated with human or animal blood, secretions and excretions. It is warranted to assume that these wastes might be contaminated with pathogens.

Examples of such wastes: Dressing material, swabs, syringes without needles, infusion equipment without spike, bandages.

C. Infectious and highly infectious waste

Infectiousness is one of the hazard characteristics listed in annex II of the Basel Convention. Special requirements regarding the management of infectious wastes must be imposed whenever waste is known or – based on medical experience – expected to be contaminated by causative agents of diseases and when this contamination gives cause for concern that the disease might spread. In this category two groups can be considered depending on the degree of infectiousness that is expected.

C1- Infectious waste

This class comprises all biomedical and health-care waste known or clinically assessed by a medical practitioner or veterinary surgeon to have the potential of transmitting infectious agents to humans or animals. Waste of this kind is typically generated in the following places: isolation wards of hospitals; dialysis wards or centers caring for patients infected with hepatitis viruses (yellow dialysis); pathology departments; operating theatres; medical practices and laboratories which mainly treat patients suffering from the diseases specified above. It includes:

- Discarded materials or equipment contaminated with blood and its derivatives, other body fluids or excreta from clinically confirmed infected patients or animals with hazardous communicable diseases. Contaminated waste from patients known to have blood-borne infections undergoing haemodialysis (e.g. dialysis equipment such as tubing and filters, disposable sheets, linen, aprons, gloves or laboratory coats contaminated with blood);
- Carcasses as well as litter and animal faeces from animal test laboratories, if transmission of the above-mentioned diseases is to be expected.

Examples of such wastes: *Blood* from patients contaminated with HIV, viral hepatitis, brucellosis, Q fever. Faeces from patients infected with typhoid fever, enteritis, cholera. Respiratory tract s*ecretions* from patients infected with TB, anthrax,
rabies, poliomyelitis…

D- Other hazardous waste

This category of waste is not exclusive to the health-care sector. They include: gaseous, liquid and solid chemicals, waste with high contents of heavy metals such as batteries, pressurized containers, etc…

Chemical waste consists of discarded chemicals that are generated during disinfecting procedures or cleaning processes. Not all of them are hazardous but some have toxic, corrosive, flammable, reactive, and explosive, shock sensitive, cyto- or genotoxic properties. They must be used and disposed of according to the specifications provided with each type of chemical.

Waste with high contents of heavy metals and derivatives are potentially highly toxic. They are considered as a sub-group of chemical waste but should be treated specifically. Pressurized containers consist of full or emptied containers or aerosol cans with pressurized liquids, gas or powdered materials.

Examples of such wastes: thermometers, blood-pressure gauges, photographic fixing and developing solutions in X-ray departments, halogenated or non-halogenated solvents, organic and in-organic chemicals.

E- Radioactive health-care waste

Radioactive waste includes liquids, gases and solids contaminated with radionuclides whose ionizing radiations have genotoxic effects. The ionizing radiations of interest in medicine include X and γ-rays as well as α- and β- particles.

2.3.6 Classification of Hospital Waste by Eigenheer & Zanon (1991).

They classified medical waste according to their liquid and solid state. This is shown in the following table.

Table# (Classification of Hospital Waste)

Type	*Typical examples*
1. Liquid Wastes	
1.1 Biological waste 1.2 Chemical waste 1.3 Over-date medicines 1.4 Radioactive waste	Blood, excrement, body fluid etc. Solutions, inorganic salts etc. Unused drugs, over-date drugs Wastes from radiology (iodine 125, iodine 131 etc.)
2. Solid Wastes	
2.1 Perforating and cutting wastes	Needles, syringes, scalpels, blades, broken glass, vials
2.2 Non-perforating and non-cutting wastes	2.2.1 Wastes from treatment (dressings, stool napkins, plaster cast etc.) 2.2.2 Parts of the body: organs, placentas, tissue etc. 2.2.3 Over-date medicines (Expired drugs) 2.2.4 Household-type wastes: other wet and dry waste

2.3.6.1 Sources of Healthcare Wastes:

Laboratories aren't the only sources of medical wastes but they are the part of the main sources of medical waste generation, medical wastes are generated from different settings as the following and according to (WHO 1999)

2.3.6.2 Major sources are:

Hospitals with its different departments related laboratories and research centers, e.g. (a) medical and biomedical laboratories, (b)biotechnology laboratories and institutions, (c) medical research centers; (d) mortuary and autopsy centers; (e) animal research and testing facilities; (f) blood banks and blood-collection services; and (g) nursing homes for the elderly.

2. Minor sources are: small healthcare establishments, e.g. physician’s office, dental clinics, and ambulance services

3. Support service sources are: pharmacy, laundry, kitchen, engineering, administration, and patient's attendance.

2.3.6.3 Generation of Healthcare Wastes by Region

Generation of wastes differs not only from country to country, but also within country and from place to place within the health care establishment itself (Drausch, 1999). Generation of wastes depends on numerous factors, such as waste-management methods, type of healthcare establishments, hospital specializations, proportion of reusable items employed in healthcare, and proportion of patients treated on a daily basis. Generation of wastes also varies according to the type of healthcare establishments.

Results of surveys show that the total generation of healthcare wastes is varied in different regions. The total generation of healthcare wastes in North America is 7-10 kg/bed/day, Latin America is 3 kg/bed/day, Western Europe is 3-6 kg/bed/day, Eastern Europe is 1.4-2 kg/bed/day, Middle East is 1.3-3 kg/bed/day, East Asia (high-income countries) is 2.5-4 kg/bed/day, and East Asia (middle-income countries) is 1.8-2.2 kg/bed/day. According to a study conducted by Abu Qdais, et al , 2006 in Jordan, average generation rates of total medical wastes in the hospitals were estimated to be 6.10 kg/patient/day (3.49 kg/bed/day), 5.62 kg/patient/day (3.14 kg/bed/day), and 4.02 kg/patient/day (1.88 kg/bed/day) for public, maternity, and private hospitals, respectively. For medical laboratories, rates were found to be in the range of 0.053–0.065 kg/test-day for governmental laboratories, and 0.034–0.102 kg/test-day for private laboratories.

In Gaza, there is no estimate for the generated amount of laboratory medical wastes but they are estimated under the hospital wastes. The draft guidelines developed by MOH in 2001 mentioned that quantities of 0.93 Kg/bed/day of HCW generated in GS, and 1.23 Kg/bed/day of HCW generated in the WB in Ram Allah Hospital, and according to (SWMP 2005) estimated generation rate in Gaza 1.3 kg/bed/day.

2.4 Medical Care Waste Management.

2.4.1 Waste segregation

Segregation is one of the most important steps to successfully manage HCW (Slack et al, 2004). Given the fact that only about 10-25% of the HCW is hazardous, treatment and disposal costs could be greatly reduced if a proper segregation were performed. Segregating hazardous from non hazardous waste reduces also greatly the risks of infecting

workers handling HCW (WHO, 2004). Actually, the part of the HCW that is hazardous and requires special treatment could be reduced to some 2-5% if the hazardous part were immediately separated from the other waste.

The segregation consists of separating the different waste streams based on the hazardous properties of the waste, the type of treatment and disposal practices that are applied. A recommended way of identifying HCW categories is by sorting the waste into color-coded and well-labeled bags or containers.(Renn and Covello ,1998).
All the specific procedures of HCW segregation, packaging and labeling should be explained to the medical and ancillary staff and displayed in each department on charts located on the walls nearby the HCW containers that should be specifically suited for each category of waste. (Glasson, 1994).

2.4.1.1 According to WHO (2005a), segregation should

- Always take place at the source, that is at the ward bedside, operation theatre, medical analysis laboratory, or any other room or ward in the hospital where the waste is generated;
- Be simple to implement for the medical and ancillary staff and applied uniformly throughout the country;
- Be safe and guarantee the absence of infectious HCW in the domestic waste flow;
- Be well understood and well known by the medical and ancillary staff of the HCFs;
- Be regularly monitored to ensure that the procedures are respected.

2.4.1.2 Color coding system

The application of a color coding system aims at ensuring an immediate and non equivocal identification of the hazards associated with the type of HCW that is handled or treated. In that respect, the color coding system should remain simple and be applied uniformly throughout the country. (Greenblot,1996)

2.4.2 Collection and On-Site transportation

In order to avoid accumulation of the waste, it must be collected on a regular basis and transported to a central storage area within the HCF before being treated or removed. The collection must follow specific routes through the HCF to reduce the passage of loaded carts through wards and other clean areas. The carts should be

1) Easy to load and unload;
2) Have no sharp edges that could damage waste bags or containers; and
3) Easy to clean.

2.4.2.1 Waste handling (Wada, 1998)

Great care should be taken when handling HCW. The most important risks are linked with the injuries that sharps can produce. When handling HCW, sanitary staff and cleaners should always wear protective clothing including, as minimum, overalls or industrial aprons, boots and heavy duty gloves.

2.4.2.2 Minimal observance for waste collection and transportation (WHO_EMERO 2002)

- Each HCF should have an HCWM plan which should include collection points and routes of waste transport. A timetable of the frequency of collection should also be set-up;
- Provide heavy duty gloves, industrial boots and apron for waste collectors;
- Ensure that waste containers are appropriately sealed, removed and replaced immediately when they are no more than three-quarters full;
- Ensure that hazardous / infectious HCW and non-risk HCW are collected on separate trolleys which should be marked with the corresponding color (black/yellow) and washed regularly.

2.4.2.3 Off-site transportation

Off-site transportation is required when hazardous HCW is treated outside the HCF. The waste producer is then responsible for the proper packaging and labeling of the containers that are transported. One of the reasons for labeling HCW bags or containers is that in case of an accident, the content can be quickly identified and appropriate measures taken (Manyele, 2004). The labeling system should comply with the United Nations Recommendations and contain at least:

1. The proper shipping name and the total quantity of waste covered by the description (by mass or volume);
2. The date of collection.

The transportation should always be properly documented and all vehicles should carry a consignment note from the point of collection to the treatment facility. Furthermore, the vehicles used for the collection of hazardous / infectious HCW should not be used for any other purpose. They shall be free of sharp edges, easy to load and unload by hand, easy to clean / disinfect, and fully enclosed to prevent any spillage in the hospital premises or on the road during transportation.

2.4.3 On-site storage (WHO,2004)

HCW are temporarily stored before being treated / disposed of on-site or transported off-site. A maximum storage time should not exceed 24 hours. Non-risk HCW should always be stored in a separate location from the infectious / hazardous HCW in order to avoid cross-contamination.

A storage facility, sized according to the volume of waste generated as well as the frequency of collection, must be found inside all HCFs. The facility should not be situated near to food stores or food preparation areas and its access should always be limited to authorized personnel. It should also be easy to clean, have good lighting and ventilation, and designed to prevent rodents, insects or birds from entering.

2.4.3.1 Minimal observance for on-site storage of HCW (Berkeley, 2000)

- Ensure that a dedicated place, lockable and with no possibility for animals / insects to have access is designed to store hazardous / infectious HCW;
- Ensure that HCW isn't stored for more than 24 hours before being treated / disposed of.

2.4.4 Treatment and disposal

Because laboratory medical wastes produced in different categories, no one way could be satisfactory to treat all wastes. So segregation method is very important step for correct treatment and disposal method.(Slack et al,2004) . There different methods of treatment **as the following and according toH2E (hospitals for environment USA, 2006)**

2.4.4.1 Incineration

Its the method of choice for the most hazardous medical wastes, its high temperature that reduce organic and combustible wastes to inorganic, incombustible matter, so reducing the volume and weight of the medical waste significantly.

Incineration method for medical waste disposal, when compared with alternative treatments such as steam sterilization, microwave heating, and chemical treatments, has been the most widely used treatment technology for medical waste disposal. (Driver et al,1990). The objective in treating medical wastes is to reduce their hazardous .nature with respect to human contact in the short term and to protect the environment in the long term. The major advantage of incineration process is that the volume of material can be reduced, and pathogens and hazardous organics are destroyed. Solid waste incineration, especially the medical waste is one of the causes of air pollution if not operated properly,(Blenkham and Oakland,1989).

In this regard, the emission of the dioxins/furans from the medical waste incinerator should be seriously considered and monitored. Therefore, the disadvantage of the incineration process may produce unwanted pollutants such as Polychlorinated DibenzoDioxins (PCDD), Dibenzofurans (PCDF), and metal particulates if incinerators are not well designed and operated. Incineration is still somewhat controversial, particularly among environmental groups. The major argument against incineration appears to be about the amount of carbon dioxide liberated into the atmosphere and the need to minimize this greenhouse gas. The second argument is about the emission of heavy metals and products of incomplete combustion such as dioxins.

The majority of pollutants emitted from incinerators are classified as criteria pollutants, which include particulate matter (PM), acid gases (HCl, HF, and SO2 nitrogen oxides (NOx) and carbon monoxide (CO), (Reimann, 1992),.

2.4.4.2 Chemical treatment

Chemicals treatment, used routinely in health care, they are added to medical wastes to kill or inactivate the pathogen it contains this result in disinfection than sterilization. Chemical disinfection is most suitable for treating liquid wastes such as blood, urine, and stool. However, even highly hazardous solid wastes including microbiological cultures and, sharps, can be disinfected chemically,(Bauer,1989)

The obvious disadvantage of chemical treatment systems is that they consume chemicals. In addition, even if they are effective in rendering the waste noninfectious, the products of the chemical reactions they undergo are present in the waste, and may pose problems of their own. However, chemical treatment systems are convenient, and may be suitable in some situations, particularly when small quantities of waste are involved.

One of the most common constituents of chemical treatment systems is chlorine, either in the form of sodium hypochlorite solution (common bleach), or as the more powerful (and correspondingly more hazardous) gas, chlorine dioxide. These compounds are relatively cheap and effective. However, in the course of reacting with organic compounds, they tend to form objectionable byproducts such as chloroform and other persistent toxins,(Lipworth,2005).

The chlorine compounds work by "oxidizing" (stripping electrons from) organic compounds, including the constituents of pathogenic microorganisms. The original "oxidizer" is, of course, atmospheric oxygen. Although it is, in fact, a fairly powerful oxidizing agent, ordinary oxygen is not harmful. However, when oxygen (O2) is converted to ozone (03), a much stronger oxidizer, it becomes toxic to most life forms. Ozone acts as an effective sterilizer without the tendency to generate the types of by-products found with chlorine compounds. The major problem encountered with ozone systems is the need to avoid exposure to anyone in the vicinity of the treatment system, since ozone is highly injurious to lungs (Harber et al, 1999)

2.4.4.3 Thermal treatment (autoclave and microwave)

In contrast to incineration, some thermal treatment methods can use the high water content of medical waste to advantage. Water can provide an effective heat transfer medium, to help distribute heat throughout the mass of the waste.

One problem with water as a heat transfer medium is that the temperature at which water boils at normal atmospheric pressure is not sufficiently high to kill some of the hardier microorganisms (spore-forming species). One common solution is to carry out the treatment in a pressure chamber. As the pressure is raised, the boiling point of water increases which is sufficient to kill most organisms of concern. Systems using steam under

pressure are called autoclaves, and are among the most common alternatives to incineration for medical waste treatment (Konnoth, 1994).

Another thermal treatment system that takes advantage of the properties of water uses microwaves as the energy source. In a microwave system, the waste is subjected to high intensity radio waves, tuned to a frequency that is readily absorbed by water molecules. It is an efficient way to deliver the energy where it is most needed for sterilization purposes. The other side of that coin is that microwave heating will be inefficient if the waste is too dry. Microwaves will penetrate bulk materials to some extent, but the heating will proceed more efficiently if the waste is shredded and mixed in the chamber during the process An advantage to both autoclaves and microwave systems is the fact that air does not have to move through the systems while they operate. Emission of volatiles only occurs during loading and unloading, and can be minimized with proper design and operation (Kanitz and Poli, 1995)

Autoclaves and microwave systems are effective, but the necessary equipment is somewhat expensive. In contrast, dry heat systems use less demanding equipment, but typically require higher temperatures and longer exposure times to ensure that the heat supplied by the system penetrates to the center of the waste. Rather than directing the heat into the mass of the waste, evaporating water carries a substantial quantity of the heat away. On the other hand, the drying of the waste has some advantages, including substantial weight and volume reduction and easier handling of the residue (Coad and Christen, 1999).

Since dry heat systems do not involve combustion, unwanted reactions such as dioxin formation are not an issue. But if air moves through the system, it can carry volatiles and pathogens. The exhaust stream is typically filtered before release, but the potential for release always exists.

One disadvantage with all of these systems, stemming from the fact that they operate at substantially lower temperatures than incinerators, is that they require a certain minimum contact time to ensure that all pathogens have been destroyed. Higher temperatures are required to process large quantities of waste in a shorter time.

All waste disposal methods have their advantages and disadvantages. No matter what waste disposal method is used incineration or autoclaving .Society cannot deny the fact that both pose negative effects biologically to both man and his environment. The best method of

reducing waste disposals' negative effect on society is perhaps simply to prevent garbage generation (Battastone et al, 1989).

2.5 Occupational health risk

Hazards associated with laboratory medical wastes according to EHSC,USA (Environment, Health and Safety Committee, 2005). Hazards from infectious wastes and sharps

Infectious wastes may contain a great variety of pathogenic microorganisms. These pathogens may enter the human body by a number of routes, such as:

- Through a puncture, abrasion, or cut in the skin
- Through the mucous membrane
- By inhalation
- By ingestion

There is a particular concern about infections due to HIV, HBV, and hepatitis C virus (HCV), which are generally transmitted through injuries from syringe needles contaminated by infected human blood. The existence in healthcare establishments of bacteria, resistant to antibiotics and chemical disinfectants may also contribute to the hazards created by poorly-managed wastes (Corrao et al, 1995). It has been demonstrated that plasmids from laboratory strains contained in healthcare wastes are transferred to indigenous bacteria via the waste-disposal system.

Concentrated cultures of pathogens and contaminated sharps, particularly hypodermic needles, are probably the waste items that represent the most acute potential hazards to health Sharps may not only cause cuts or punctures but may also infect these wounds if they are contaminated with pathogens. Because of this, double risk of injury and transmission of disease exists. The principal concern is that infections may be transmitted by subcutaneous introduction of the causative agents,e.g. viral blood infections.

Hypodermic needles constitute an important part of the sharps waste category and are particularly hazardous, because they are often contaminated with patient's blood.

2.6 Public Health Impact of Healthcare Wastes (Allen et at ,1989)

Strong epidemiological evidence suggests that HIV/AIDS virus is transmitted through infectious healthcare wastes, and more often, HBV and HCV through injuries caused by syringes, needles contaminated by human blood.

The annual rate of injuries among healthcare and sanitary service personnel from sharps in medical wastes, within and outside hospitals, was estimated by the U.S. Agency for Toxic Substances and Diseases Register (ATSDR, 2002). The annual rate in the USA is 180 per 1,000. Although most work-related injuries among healthcare workers and refuse collectors are sprains and strains caused by over-exertion, a significant percentage is cuts and punctures from discarded sharps.

The Centers for Disease Control and Prevention (CDC, 2000) estimates that 5,100 healthcare workers with frequent occupational blood contact are infected each year with HBV (Miriam Altar, unpublished data). Occupational exposure from needles or other sharp objects remains an issue of great concern to healthcare workers. The risk of hepatitis B or HIV transmission from such exposure has added to this concern. The CDC reported that 37 healthcare workers were infected with HIV through occupational exposure.

The majority of the exposure was due to sharp objects. It has been reported that 7-31% of sharp injuries are related to the disposal of needles, excluding recapping (37-40). Needle-stick injuries (NSIs) are among the greatest occupational hazards of hospital personnel posing a risk for transmission of hepatitis B, hepatitis C, and HIV. It has also been reported that, in the USA, by June 1994, 39 cases of HIV infection were recognized by the CDC as occupational infections. By June 1996, the cumulative recognized cases of occupational HIV infection had risen to 51. All cases were nurses, medical doctors, and laboratory assistants. HIV has extremely limited viability outside a living host, although the live virus-survival time may depend upon the environment and the concentration of the virus.

The main health risks of medical wastes are summarized below (modified from WHO, 1999).

- Contamination of drinking water. Possibility of leachate entering an aquifer, surface water or drinking water system.

- Burning of waste at low temperatures or in open container results in release of toxic pollutants (e.g. dioxin) into the air.
- Carcinogenic waste such as heavy metals, chemical solvents and preservatives pose serious human health risks not only to workers but to the general public as well.
- Unprotected and insecure landfill may pose health hazard to the scavengers and inhabitants at the vicinity.

2.7 Environmental hazards related to medical waste according to (Park, 1994)

The following are environmental impacts associated with the improper disposal of medical wastes:

- Pollutants from medical waste (e.g. heavy metals and PCBs) are persistent in the environment.
- accumulation of toxic chemicals within soil (proximity to agricultural fields, humans, soil organisms, wildlife, cattle).
- ground water contamination, decrease in water quality
- bio-accumulation in organism's fat tissues, and biomagnify through the food chain.
- repeated and indiscriminate application of chemicals over a long period of time has serious adverse effects on soil microbial population - reducing the rate of decomposition, and generally lowering the soil fertility.
- pathogens leads to long term accumulation of toxic substances in the soil
- specimens collected for analysis have the potential to cause disease and illness in man, either through direct contact or indirectly by contamination of soil, groundwater, surface water, and air.
- wind blown dusts from indiscriminately dumping also have the potential to carry hazardous particulates.
- With domestic animals being allowed to graze in open dumps, there is the added risk of reintroducing pathogenic micro-organisms into the food chain.
- Public nuisance (e.g. odors, scenic view, block the walkway, aesthetics, etc.)
- improper sterilization of instruments used in labour room may cause infection to mother and child.

- □ combination of both degradable and non-degradable waste increase the rate of habitat destruction due to the increasing number of sites necessary for disposal of wastes (degradation of habitat).
- □ plastic-bags, plastic containers, if not properly destroyed may contaminate the soil and also reduces the chance for water percolation into the soil during precipitation.
- □ Open air burning does not guarantee properincineration, and releases toxic fumes (dioxin) into the atmosphere from the burning of plastics i.e., PCB's.

2.8 CONSEQUENCES OF IMPROPER DISPOSAL OR NON-DISPOSAL OF MEDICAL WASTE (Mose and Reintbaler,1985)

Medical wastes are a source of contamination and pollution to both humans and the natural environment. Improper disposal may be hazardous if it leads to contamination of water supplies or local sources used by nearby communities or wildlife. Sometimes exposed waste may become accessible to scavengers and children if a landfill is insecure. Medical wastes are potentially capable of causing disease and illness in man, either through direct contact or indirectly by contamination of soil, groundwater, surface water and air.

Wind blown dusts from these dumps also have the potential to carry pathogens and hazardous materials.

2.9 Medical waste legislation

2.9.1 Legislation regarding medical waste management (Peretz et al,1997))

- Because of the potentially dangerous characteristics of medical wastes there is an employed legal control over the process of wastes handling and its disposal by safest means. This legislation and administrative guidelines would be appropriate on the following cases;
- Prevention of occupational, public and environmental hazards.
- The recovery and recycling of materials should be encouraged provided that safety, health and environmental risks can be safely controlled
- Existing external wastes disposal system should be used whenever they are acceptable with regard to health and environmental considerations

- Wastes contaminated with pathogens of diseases notifiable under epidemic control regulations

These legislations vary from country to country, so basic guidelines should be set out so that health care establishments should be held legally accountable for their wastes management practices and the following principal requirements (Johannessen,1997).

- A staff member should be designated as the waste management officer,
- All waste categories should be properly identified
- Waste should be properly segregated and disposed of safely and hygienically; and Health care establishment or their controlling organization should bear all the necessary costs associated with waste management programs.

2.9.2 International agreements for management of wastes (Pruss,et al,1999)

The United Nations Conference on the Environment and Development (UNCED), in 1992, had adopted the Agenda 21, which recommends a set of measures for waste management. The set of recommendations includes:

- Prevention and minimization of production of wastes.
- Reuse or recycling of wastes to the extent possible.
- Treatment of wastes by safe and environmentally-sound methods.
- Disposal of final residues by landfill in confined and carefully-designed sites.

The Agenda 21 also stresses that waste producers should be made responsible for the treatment and final disposal of its own wastes; where possible, each community should dispose of its wastes within its own boundaries.

The Basel convection, signed by more than 100 countries, concerns trasboundary movement of hazardous wastes. So it is applicable to health care wastes. Countries that signed the convection accepted the principle that the only legitimate transboundary shipments of hazardous wastes are exports, from countries that lack the facilities. So, UN recommended standards that regulate the process of wastes disposal. The polluter pay principle implies that all producers of wastes are legally and financially responsible for the safe and environmentally sound disposal of the wastes they produce. This principle attempts to assign liability to the party that causes the damage. The precautionary principle

is a key principle governing health and safety protection. When the magnitude of a particular risk is uncertain, it should be assumed that this risk is significant and measures to protect health and safety should be designed accordingly.

The duty of care principle proposes that any person who is handling and managing hazardous substances or related equipment is ethically responsible for using the utmost care in that task. The proximity principle recommends that treatment and disposal of hazardous wastes take place at the closest possible location to its source in order to minimize the risk involved in its transport.

2.9.3 Legal provision (Pruss et al,1999)

National legislation is the bases for improving health care wastes in any county .It establishes legal controls and permits the national agency responsible for the disposal of health care wastes, usually the ministry of health, to apply pressures for their implementation. The ministry of environment or national environmental protection agency may also involve.

The legal package should specify regulations on treatment for different wastes categories, segregation, collection, storage, handling, disposal, and transport of wastes responsibilities and training requirements. It should take into account the resources and facilities available in the county.

National law on health care wastes management may stand alone or may be a part of more comprehensive legislation such as the following:

Law on management of hazardous wastes: application to health care waste should be explicitly stated. Law on hospital hygiene and infection control: specific article should be devoted to health care wastes.

2.9.4 The law should include the following according to Mato and Kassenga,1997:

1. A clear definition of hazardous health care waste and its various categories.
2. Precise indication of the legal obligations of the health-care waste producer regarding safe handling and disposal.
3. Specifications for record keeping and reporting.
4. Specifications for an inspection system to ensure enforcement of the law, and for penalties to be imposed for contravention.

5. Designation of courts responsible for handling disputes arising from enforcement of or noncompliance with law.
6. Policy document and technical guidelines.
7. The policy document should outline the rationale for legislation, plus national goals and the steps essential to the achievement of these goals. It may contain the following.
    a. Description of the health and safety risks resulting from mismanagement of health care wastes.
    b. Reasons for sound and safe health care wastes management practices in health care establishments.
    c. Listing of approved methods of treatment and disposal for each wastes category.
    d. Warning against unsafe practices, such as disposing of hazardous health care wastes in municipal landfills.

2.9.5 Management responsibilities within and outside health care establishment (WHO, 1999)

1. Assessment of the costs of health care wastes management
2. Key steps of health care wastes management, minimization, separation, identification, handling treatment, and final disposal of wastes, technical specifications for the implementation of each step should be described in separate technical guidelines.
3. Record keeping and documentation, training requirements, rules governing the protection of workers health and safety.

2.10 Medical Waste Plans

2.10.1 National plans for management of healthcare wastes (Akter , 2000)

Purpose of a management plan:

A national management plan will permit healthcare waste-management options to be optimized on a national scale. A national survey relating to disposal of healthcare waste-management system will provide the relevant agency with a basis for identifying actions on a district and national basis, taking into account conditions, needs, and possibilities at each level. An appropriate, safe, and cost-effective strategy should concern principally with treatment, recycling, transport, and disposal options.

2.10.2 Action plan for development of a national program.(WHO,2000)

A national program of healthcare waste management can be developed through a seven-step action plan.

1. Establishment of policy commitment and responsibility: Before an action plan is implemented, there must be commitment to develop a national policy, and the responsibility must be delegated to the appropriate government authority. The Ministry of Health will usually serve as the principal authority. The designated authority will cooperate with other ministries, the private sector, NGOs, and professional organizations, as necessary, to ensure implementation of the action plan. Policy commitment should be reflected in appropriate budgetary allocations at different government levels. Guidance from the central government should lead to maximum efficiency in the use of available resources of healthcare establishments.

2. Conducting a national survey: The national agency responsible for the disposal of healthcare wastes should be fully aware of the current level of waste production and of national waste-management practices. A comprehensive survey is essential for planning an effective waste-management program.

3. Development of national guidelines: The foundation for a national program for healthcare waste management is the technical guidelines and the legal framework that support them. This step, thus, includes the formulation of a national policy document and technical guidelines based on the results of the national survey; the two may be brought together in one comprehensive document.

4. Development of a policy on regional and cooperative methods: The designated government agency should identify resources to ensure a national network of disposal facilities for healthcare wastes, accessible by hospitals, and other healthcare facilities. The national policy should also include technical specifications for the processes and equipment involved in acceptable treatment options. There are three basic options for managing the treatment of healthcare wastes, **which are as follows:**

Option 1. On-site treatment facilities in each healthcare establishment.

Option 2. Regional or cooperative healthcare waste-treatment facilities supplemented by individual facilities for outlying hospitals.

Option 3. Treatment of healthcare wastes in existing industrial or municipal treatment facilities, where these exist.

5. Legislations, regulations and standards: Once developed, the policy and guidelines should be supported by legislation that regulates their application. This law is usually based on international agreement and underlying principles of waste management.
6. Institution of a national training program: To achieve acceptable practices in healthcare waste management and compliance with regulations, it is essential for all managers and other personnel involved receiving appropriate training. To this end, the central government should assist in the preparation of "train the trainer" activities, and competent institutions for the trainers' program should be identified.
7. Review of the national program after implementation: The national program for management of healthcare wastes should be viewed as a continuous process with provision for periodic monitoring and assessment by the responsible national government agency. In addition, the recommendations on waste-treatment methods should be regularly updated to keep pace with new developments. The national agency will base its assessment primarily on reports from healthcare establishments on their success in implementing the waste management plans. It should review annual reports submitted by heads of establishments, and make random visits to carry out audits of the waste management systems.

Any deficiencies in the waste-management systems should be pointed out to the head of the establishment in writing, together with recommendations for remedial measures. The time limit for implementing the remedial measures should be specified, and the head of the establishment should be informed of the follow-up date. In the case of off-site waste-treatment facilities, incinerator operators, road haulage contractors, and landfill operators should also be audited. Periodic reviews of waste-management practices by both national government agency and healthcare establishments should result in both improved protection of occupational and public health and enhanced cost effectiveness of waste disposal.

Chapter (3)

Methodology

This chapter includes the methodology used in this research. The chapter provides information on study design, method of study, study area, preparation of the instrument and ethical matter.

The instrument validity, piloting, study population, eligibility criteria, data collection, and response rate will be addressed in this chapter, in addition to limitation of the study and data management and analysis.

3.1 Study design

The type of study is a descriptive analytic study. This kind of design is suitable because it enables the researcher to describe, explore and analyze the status of a phenomenon being studied (Polit and Hingler, 1999)

3.2 Method of study

Interview questionnaire for lab managers is selected because it allows for a high response rate. Respondents have more time to speak and understand any vague points and it produces additional information through observation (Polit and Hingler, 1997). Self administered questionnaire was selected for many reasons: it helps to have no interviewer

bias, easier questioning of larger numbers of people, as it is perceived as more anonymous and may therefore yield more accurate data on topic being researched– more leisurely, which may permit more careful responding and less time spent on administration.(Waltz and Bausell,1981)

3.4 Study area

The study area is MOH laboratories, including laboratories of primary health care clinics and laboratories of hospitals.

3.4 Preparation of the instrument

3.4.1 Instrument1: Interview questionnaire for lab managers. (See Annex 3 and Annex4)

This questionnaire was constructed in order, demographic data, general data about the lab itself, lab managerial work, and the available facilities in the lab.

3.4.2 Instrument2: self administered questionnaire (See Annex 5 and Annex 6)

This questionnaire was prepared in Arabic and arranged in the order beginning in data about the lab itself, demographic data, the process lab medical wastes management segregation, collection, transport, storage and disposal and it ends with suggestions and recommendation.

3.4.3 Instrument validity

It is used to determine to which extent the instrument can reflect the examined abstract construct. So two types of validity were utilized in this study first; face validity, which is related to the questionnaire appropriateness, layout, appearance and arrangement and these elements were modified by the experts in the field who helped to produce the questionnaire in that manner. Second content related validity which examines the extent to which the designed questionnaires include all major elements related to the construct being measured. This was obtained by reviewing literature and, choosing the relevant

3.5 Ethical matter

Firstly, an explanatory letter from the general directorate of hospitals was obtained for facilitating the study in the ministry hospital lab and the other letter from general directorate of primary health care clinics to facilitate study in clinics labs.

Each subject participated in the study had received explanatory form before taking the questionnaire. This form includes the purpose of the study, keeping of confidentiality of the

information without mentioning the name, and free choice to participate in the study. (See Annex 7)

3.6 Piloting

Before conducting filling questionnaire, piloting was done to assure suitability of the instrument, if they meet the objectives of the study and if there is defect in the questionnaire layout. Fifteen questionnaires were filled on non random bases on 5 primary health clinics. Response rate was 90% and after piloting some modifications for the questionnaire design had been done.

3.7 Study population

The target population in the study was all lab managers and technicians in MOH (237 people).

3.8 Eligibility criteria

Inclusion and exclusion criteria

3.8.1 Inclusion criteria

MOH lab managers and technicians in all Gaza strip hospitals and primary health care clinics.

3.8.2 Exclusion criteria

Any other worker at lab who is either not a manager or lab technician

3.9 Response rate

The response rate for all study population was 94% among the lab mangers, while it was 81% among the lab technicians**.**

3.10 Data collection

The data collected by the researcher herself, interview questionnaire was conducted for the lab managers during their working hours and the self administered questionnaire explained to the lab manager and the technicians before they administer them.

3.11 Limitation of the study

- Stoppage of some lab managers and technicians on work.
- Lack of previous research on lab medical wastes management
- Political condition. (frequent invasion of Israeli occupation forces)
- Abstention of a lot of employees from their jobs.
- Poor cooperativeness of some respondents.

3.12 Data management and analysis

The Statistical Package of Social Sciences (SPSS) was used for analysis, so descriptive statistical analyses such as frequency distribution and other statistical tests. P-value of less than 0.05 was considered statically significant. The statistical analysis was done as the following:

- Over viewing the filled questionnaire.
- Coding the questions
- Designing data entry model.
- Defining and coding variables.
- Data cleaning
- Frequency and cross tabulation tables of study variables.

Chapter (4)

Results

This chapter clarifies the results of study questionnaire with descriptive analysis for data like describing socio-demographic data of the study population and characteristics of MoH laboratories .chi square used to study the relation ship between the study variables.

4.1 Lab Technicians

4.1. Characteristic of Study Population

4.1.1 Table (1) Socio-demographic characteristics of the study population

	Item	N	%
1.	**Sex**		
	Male	83	44.4
	Female	104	55.6
	Total	**187**	**100.0**
2.	**Age**		
	30 Yrs and less	73	39.5
	More than 30 Yrs	112	60.5
	Total	**185**	**100.0**
3.	**Job Title**		
	Lab Technician	179	97.3

	Head of department	5	2.7
	Total	**184**	**100.0**
4.	**Educational Level**		
	Diploma	66	34.7
	BSc	110	57.9
	Master	14	7.4
	Total	**190**	**100.0**
5.	**Years of experience**		
	5 Yrs and less	59	31.1
	From 6 to 10 Yrs	76	40.0
	More than 10 Yrs	55	28.9
	Total	**190**	**100.0**
6.	**Working in other places**		
	Yes	126	66.0
	No	65	34.0
	Total	**191**	**100.0**
7.	**Receiving any training on lab medical wastes**		
	Yes	27	14.1
	No	164	85.9
	Total	**191**	**100.0**

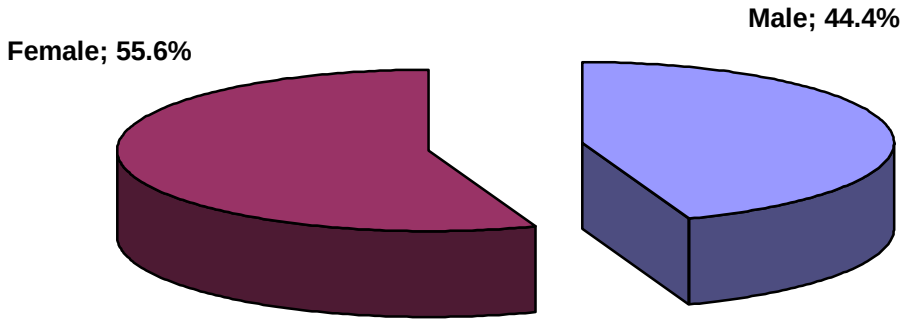
As shown in table 1, females lab technician are more than males. They constitute 55.6% of the total technicians, while males constitute 44.4%. Regarding the age group, 60.5% of the study population is more than 30 years old, while those who are 30 and less constitute 39.5%.

Concerning years of experience among lab technicians, people with 5 years and less constitute 31.1%, 6 to 10 years 40%, and those who are more than 10 years constitute 28.9%.

Regarding previous work, those who worked in other places other than MOH form 66% while those who didn't work represent 34%.

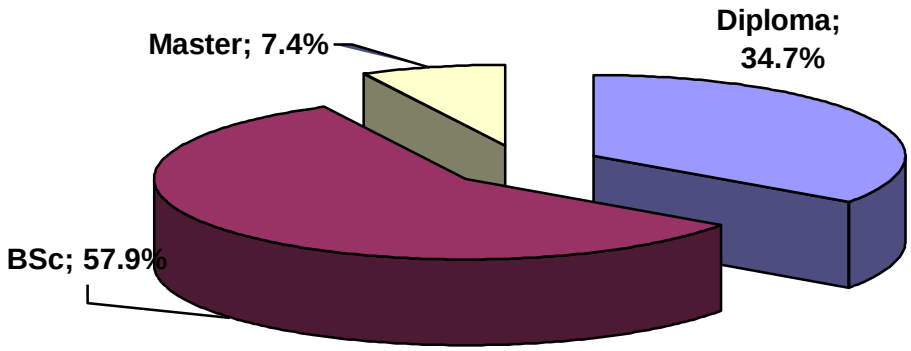
Also the table shows, that most of the lab technicians didn't receive any training 85.9%, while those who received training only represent 14.1%.

4.1.2 Figure (1) Distribution of lab technicians by sex.



4.1.3 Figure 2

Distribution of lab technicians by education



4.2 Characteristic of lab works

4.2.1Table 2 (Characteristics of MoH laboratories. lab technician response).

	Item	N	%
1.	**Kind of laboratory**		
	Intermediate	61.3	117
	Central	21.5	41
	Sub	17.3	33
	Total	**100.0**	**191**
2.	**Responsibility**		
	Hospital	89	46.6
	Primary Health care	102	53.4
	Total	**191**	**100.0**
3.	**No. of employees**		
	10 and less	88	48.9
	From 11 to 20	41	22.8
	More than 21	51	28.3
	Total	**180**	**100.0**
4.	**Working hours**		
	7 Hours and less	171	89.5
	More than 7 Hours	20	10.5
	Total	**191**	**100.0**
5.	**Place of Laboratory**		
	North of Gaza	33	17.3
	Gaza	80	41.9
	Midzone	29	15.2
	Khanyounis	34	17.8
	Rafah	15	7.9
	Total	**191**	**100.0**

In table (2) it's clear that lab technicians working in intermediate labs are more than those who work in the peripheral labs. They constitute 61.3% while lab technicians who are working in the central lab constitute 21.5% and others in the primary care labs are17.3%.Abuot the number of employees, 10 and less constitute 48.95, others from 11 to 20, 22.8% and those with more than 21 are 28.3%.

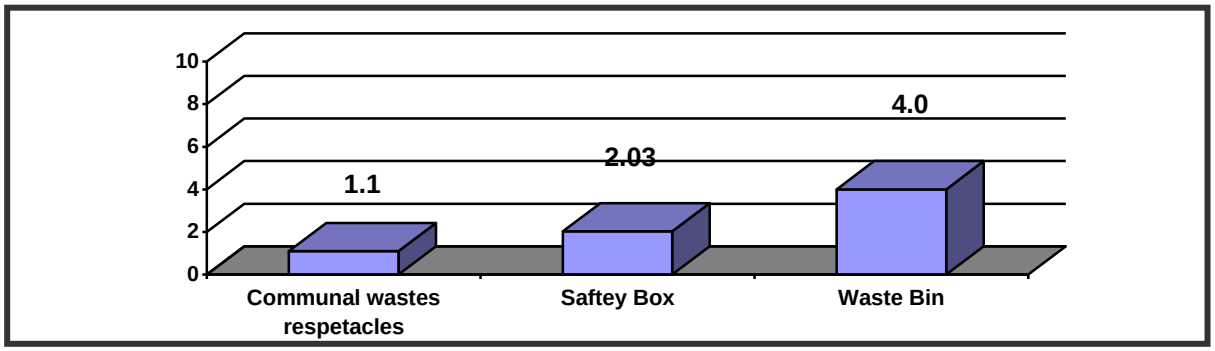
From the table it's shown that the majority of technicians work 7 hours and less (89.5%). Concerning the distribution of laboratories, it seems that Gaza has the largest number of technicians (41.9%) followed by Khanyonis (17.8%), and North of Gaza (17.3%) while Rafah has the lowest (7.9%).

4.2.2 Table (3) Type of Lab Wastes and the Methods of Segregation

Items	Communal wastes receptacles		safety box		Waste bin		Total	
	No.	%	No.	%	No.	%	No.	%
Blood and its Products	30	16.0	46	24.5	112	59.6	189	100.0
Lab culture dishes	19	17.6	46	42.6	43	39.8	108	100.0
Body fluids	32	21.9	19	13.0	95	65.1	146	100.0
Needles and syringes	7	3.8	149	81.9	26	14.3	182	100.0
Chemical substance	31	25.2	27	22.0	65	52.8	123	100.0
radioactive isotopes	6	10.9	26	47.3	23	41.8	55	100.0
Contaminated gloves	26	13.9	14	7.5	147	78.6	187	100.0
Slides	26	14.7	38	21.5	113	63.8	177	100.0
Contaminated Cotton	28	15.0	22	11.8	137	73.3	187	100.0

From table 3, it is clear that waste bin is the most commonly used method of segregation for the different types of wastes; blood and its products 59.6%, sharps like slides63.8% and needles and syringes14.3%. The safety box is the most commonly used method for segregation of needles and syringes (81.9%).

4.2.3 Figure (3) Type of Lab Wastes and the Methods of Segregation by Means



This diagram shows that waste bins are commonly used for wastes segregation.

4.3. Lab wastes collection

4.3.1 Table (4) Type of Lab Wastes and the Methods of Collection

	Puncture and leak proof bags		Defined color coded containers		Safety Box		Domestic Bag		Total	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Blood and its Products	42	22.5	18	9.6	34	18.2	93	49.7	187	100.0
Lab culture dishes	40	37.7	19	17.9	25	23.6	22	20.8	106	100.0
Body fluids	32	21.3	18	12.0	18	12.0	82	54.7	150	100.0
Needles and syringes	21	12.0	11	6.3	126	72.0	17	9.7	175	100.0
Chemical substances	19	14.8	25	19.5	19	14.8	65	50.8	128	100.0
Radioactive isotopes	10	17.2	6	10.3	20	34.5	22	37.9	58	100.0
Contaminated gloves	51	27.1	20	10.6	14	7.4	103	54.8	188	100.0
Slides	30	16.8	19	10.6	41	22.9	89	49.7	179	100.0

Contaminated Cotton	46	24.5	22	11.7	20	10.6	100	53.2	188	100.0

In table(4) it is obvious that about half of lab wastes are collected by domestic bags even needles and syringes with a percent that is not considered simple, about 9.7%. While some results in this table like collection of lab cultures in safety boxes with a percentage of 23.6% contradicts the current collection method in the lab.

4.4 Lab Wastes Transportation and Storage

4.4.1 Table (5) Lab Wastes Transportation and Storage

	Item	N	%
1.	**The person performing the process of lab wastes handling**		
	Lab technician	9	4.7
	Cleaner	179	94.2
	Others	2	1.1
	Total	**190**	**100.0**
2.	**Measuring the weight of lab waste**		
	Yes	0	0.0
	No	190	100.0
	Total	**190**	**100.0**
3.	**Counting the quantities of lab medical waste**		
	Yes	4	2.1
	No	186	97.9
	Total	**190**	**100.0**
4.	**Storing lab waste**		
	Yes	16	8.4
	No	175	91.6
	Total	**191**	**100.0**
4.1	**Storing place**		
	At lab special containers	15	93.8
	Outside the lab	1	6.3

	Total	**16**	**100.0**
5.	**Decontamination and cleaning procedures take place for transport means**		
	Yes	12	6.6
	No	141	77.5
	Don’t know	29	15.9
	Total	**182**	**100.0**
6.	**Consignment note accompanying the waste from the lab to the offsite disposal**		
	Yes	2	1.1
	No	180	98.9
	Total	**182**	**100.0**

From table 5 It is clear that cleaners are the persons responsible for transporting the lab wastes in a percent 94.2% but the process of weighing wastes, counting amount, storing, decontamination and consignment don’t take place.

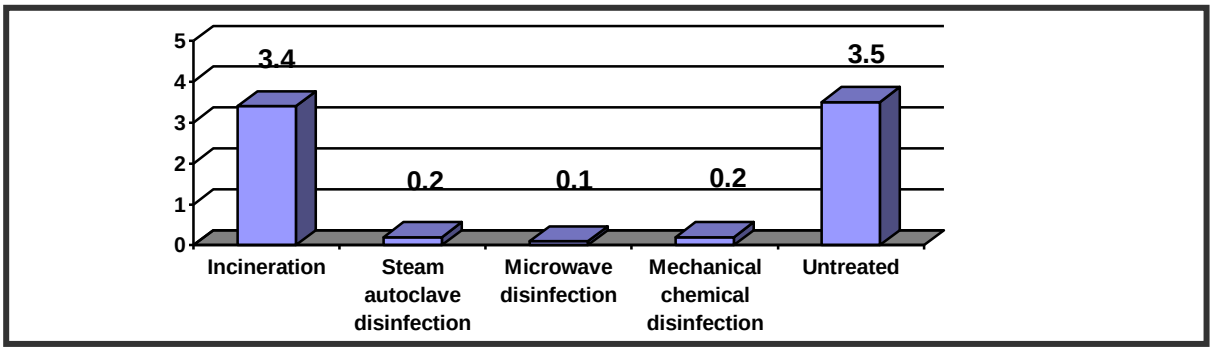
4.5 Methods of waste treatment .

4.5.1 Table (6) Type of Lab Wastes and the Methods of Treatment Used

	Incineration		Steam autoclave disinfection		Microwave disinfection		Mechanical chemical disinfection		Untreated		Total	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Blood and it's Products	92	50.3	5	2.7	0	0.0	5	2.7	81	44.3	183	100.0
Lab cultures dishes	79	58.5	4	3.0	8	5.9	0	0.0	44	5.9	135	100.0
Body fluids	59	38.1	5	3.2	0	0.0	4	2.6	87	56.1	155	100.0
Needles and syringes	137	74.1	1	0.5	2	1.1	2	1.1	43	23.2	185	100.0
Chemical substance	53	38.7	1	0.7	1	0.7	9	6.6	73	53.3	137	100.0
radioactive isotopes	27	34.6	2	2.6	1	1.3	5	6.4	43	55.1	78	100.0
Contaminated gloves	76	42.0	2	1.1	0	0.0	2	1.1	101	55.8	181	100.0
Slides	79	43.9	2	1.1	0	0.0	0	0.0	99	55.0	180	100.0
Contaminated Cotton	59	32.1	16	8.7	4	2.2	4	2.2	101	54.9	189	100.0

In table (6), the different types of lab wastes remained untreated even needles and syringes in a percent of 23.2%, and radioactive isotopes 55.1%. While the incineration is the most commonly used method of treatment, especially for needles and syringes in a percent of 74.1%. Other methods of treatment rarely take place.

4.5.2 Figure (4) Type of Lab Wastes and the Methods of Treatment by Means



This graph shows that most of lab wastes are disposed of without being treated.

4.6 Lab waste management

4.6.1 Table (7) Relationship between Experience and Training

Item	Yes		No		Total	
	N	%	N	%	N	%
Five years and less	8	29.6	51	31.3	59	31.1
From 6 to 10 Years	5	18.5	71	43.6	76	40.0
More than 10 Years	14	51.9	41	25.2	55	28.9
Total	**27**	**100.0**	**163**	**100.0**	**190**	**100.0**

From the above, it is clear that lab technicians who have 10 years experience and more have received training more than those who have less than 10 years of experience.

4.7 Lab Manager

4.7.1 Table (8) Socio-demographic data of laboratory manager

	Item	N	%
1.	**Sex**		
	Male	16	94.1
	Female	1	5.9
	Total	**17**	**100.0**
2.	**Age**		
	45 Yrs and less	10	58.8
	More than 45 Yrs	7	41.2
	Total	**17**	**100.0**
4.	**Educational Level**		
	BSc	12	70.6
	Master	4	23.5
	PHD	1	5.9
	Total	**17**	**100.0**
7.	**Receiving any training on lab medical wastes**		
	Yes	4	23.5
	No	13	76.5
	Total	**17**	**100.0**

Table (1) shows that 94.1% of the lab mangers were male and 5.9% female. And 58.8% with age 45 years and less; the majority have BS 70.6%and 23.5%. Most of them didn't receive any training 76.5%.

4.7.2 Table (9) characteristics of MoH laboratories, manager response

	Item	N	%
1.	**Lab Kind**		
	Intermediate	9	52.9
	Central	5	29.4
	Sub	3	17.6
	Total	**17**	**100.0**
2.	**Responsibility**		
	Hospital	9	52.9
	PHC	7	41.2
	Other	1	5.9
	Total	**17**	**100.0**
3	**Governorate**		
	North	4	23.5
	Gaza	6	35.3
	Midzone	2	11.8
	Khanyounis	3	17.6
	Rafah	2	11.8
	Total	**17**	**100.0**
4	**Working hours**		
	Six hours	1	5.9
	Seven hours	16	94.1
	Total	**17**	**100.0**
5.	**Number of Employees**		
	10 and less	8	50.0
	More than 10.	8	50.0
	Total	**16**	**100.0**
6.	**Average Number of analyses done every month**		
	10000 Analyses and less	10	66.7
	More than 10000 Analyses	5	33.3

	Total	**15**	**100.0**

From this table it is clear that Gaza has the highest number of lab managers 35.3%,follwed by north 23.5%,Khanyounis 17.6%, mid zone and Rafah 11.8%. Most of the managers work 7 hours, half of them have 10 employees and less and the other half have more than 10 employees. Most of the labs (about 66.7%) perform 10000 analyses and less ,These percentages reflect that most of the lab managers are hospital lab and central lab managers.

4.8 Management

4.8.1Table (10) Laboratory Management Work

	Item	**N**	**%**
1.	**Work protocol to deal with lab medical waste**		
	Yes seen	7	43.8
	Yes not seen	9	56.3
	Total	16	100.0
2.	**If Yes seen is it periodically**		
	Yes	2	28.6
	No	5	71.4
	Total	**7**	**100.0**
3.	**Availability of lab medical wastes management plan**		
	Yes	5	29.4
	No	12	70.6
	Total	**17**	**100.0**
4.	**Availability of persons supervising the process of lab wastes management**		
	Yes	4	23.5
	No	13	76.5
	Total	**17**	**100.0**
5.	**Coordination between lab and municipality**		
	Yes	2	11.8
	No	15	88.2
	Total	**17**	**100.0**

6.	**Frequency of lab wastes disposal**		
	Everyday	12	80.0
	Every other day	3	20.0
	Total	**15**	**100.0**
7.	**Is there a recording system for the process of lab wastes management**		
	Yes	0	0.0
	No	17	100.0
	Total	**17**	**100.0**

In this table it's clear that there is a work protocol in the labs. It is seen by 43.8% of the lab managers and not seen by 56.3%. Those who see this protocol, periodically represent 28.6%. Those who see it but not periodically are 71.4%

Regarding lab medical wastes plan, most of the managers (70.6) responded available.
About the availability of a person supervising the process of lab wastes management, those who responded no 76.5%.
It seems that there is very little coordination with labs and municipality by a percent of 88.2%. It's clear that the labs are disposing of their wastes everyday in a percent 80% but there is no recording system.

4.8.2Table (11) The Degree of Lab's Technicians Manager satisfaction on The Process of Lab Wastes Management

	Item	**N**	**%**
1.	**Are you satisfied with the way of wastes treatment of your lab**		
	Yes to high extent	1	5.9
	To some extent	7	41.2
	Not satisfied	9	52.9
	Total	**17**	**100.0**
2.	**Do you believe there should be legislation that control the process of the lab medical wastes management**		
	Yes	16	94.1

	No	**1**	**5.9**
	Total	**17**	**100.0**

From the above table, it seems that more than half of the lab managers (52.9%) are not satisfied with the process of lab wastes management, and those who are satisfied are very little (5.9%) in comparison to those who are satisfied to some extent (41.2%) and those who are not satisfied.

4.8.3Table (12) Available tools of collection and treatment at the Lab: Manager Response

Item	**Yes**		**No**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**
Safety box containers	17	100.0	0	0.0	**17**	**100.0**
Heavy gloves	1	5.9	16	94.1	**17**	**100.0**
Leak proof bags	3	17.6	14	82.4	**17**	**100.0**
Transport trolley	2	11.8	15	88.2	**17**	**100.0**
Communal wastes receptacles	12	70.6	5	29.4	**17**	**100.0**
Defined coded color containers	2	11.8	15	88.2	**17**	**100.0**
Steam autoclave	8	47.1	9	52.9	**17**	**100.0**
Incinerator	6	35.3	11	64.7	**17**	**100.0**
Disinfectant	12	70.6	5	29.4	**17**	**100.0**

From the above table it is clear that all MOH laboratories have the safety box (100%), this is the only strong point mentioned by lab technicians about their work as a whole. About other facilities like communal wastes receptacles, steam autoclave, disinfectant and incinerators, they are available to some satisfactory extent, but other facilities that are needed for segregation and collection of wastes are unavailable like heavy gloves, leak proof bags, transport trolley and defined color containers.

4.9 regarding the Lab

4.9.1Table (13) Relation between Methods of Segregation and Kind of Laboratory

		Intermediate		Central		Sub		Total		X^2	Sig.
		No.	%	No.	%	No.	%	No.	%		
1.	**Blood and its Products**										
	Communal wastes receptacles	26	22.6	3	7.5	1	3.0	30	16.0	28.7	0.001
	Safety bins	34	29.6	12	30.0	0	0.0	46	24.5		
	Waste bin	55	47.8	25	62.5	32	97.0	112	59.6		
	Total	**115**	**100.0**	**40**	**100.0**	**33**	**100.0**	**188**	**100.0**		
2.	**Lab culture dishes**										
	Communal wastes receptacles	17	17.3	2	22.2	0	0.0	19	17.6	2.90	0.564
	Safety bins	43	43.9	2	22.2	1	100.0	46	42.6		
	Waste bin	38	38.8	5	55.6	0	0.0	43	39.8		
	Total	**98**	**100.0**	**9**	**100.0**	**1**	**100.0**	**108**	**100.0**		
3	**Body fluids**										
	Communal wastes receptacles	28	26.7	3	15.8	1	4.5	32	21.9	14.5	0.006
	Safety bins	18	17.1	1	5.3	0	0.0	19	13.0		
	Waste bin	59	56.2	15	78.9	21	95.5	95	65.1		
	Total	**105**	**100.0**	**19**	**100.0**	**22**	**100.0**	**146**	**100.0**		
4	**Needles and syringes**										
	Communal wastes receptacles	6	5.2	1	3.0	0	0.0	7	3.8	3.41	0.493

	Safety bins	91	78.4	29	87.9	29	87.9	149	81.9		
	Waste bin	19	16.4	3	9.1	4	12.1	26	14.3		
	Total	**116**	**100.0**	**33**	**100.0**	**33**	**100.0**	**182**	**100.0**		
5	**Chemical substances**										
	Communal wastes receptacles	28	29.5	2	7.4	1	100.0	31	25.2	14.2	0.007
	Safety bins	24	25.3	3	11.1	0	0.0	27	22.0		
	Waste bin	43	45.3	22	81.5	0	0.0	65	52.8		
	Total	**95**	**100.0**	**27**	**100.0**	**1**	**100.0**	**123**	**100.0**		
6	**Radioactive isotopes**										
	Communal wastes receptacles	6	12.5	0	0.0	0	0.0	6	10.9	3.075	0.545
	Safety bins	23	47.9	2	33.3	1	100.0	26	47.3		
	Waste bin	19	39.6	4	66.7	0	0.0	23	41.8		
	Total	**48**	**100.0**	**6**	**100.0**	**1**	**100.0**	**55**	**100.0**		
7	**Contaminated gloves**										
	Communal wastes receptacles	22	19.3	3	7.5	1	3.0	26	13.9	13.4	0.009
	Safety bins	12	10.5	2.0	5.0	0	0.0	14.0	7.5		
	Waste bin	80	70.2	35.0	87.5	32	97.0	147.0	78.6		
	Total	**114**	**100.0**	**40**	**100.0**	**33**	**100.0**	**187**	**100.0**		
8	**Slides**										
	Communal wastes receptacles	23	20.0	2	6.9	1	3.0	26	14.7	17.157	0.002
	Safety bins	30	26.1	6	20.7	2	6.1	38	21.5		
	Waste bin	62	53.9	21	72.4	30	90.9	113	63.8		

	Total	115	100.0	29	100.0	33	100.0	177	100.0		
9	**Contaminated Cotton**										
	Communal wastes receptacles	25	21.4	2	5.4	1	3.0	28	15.0	17.32	0.002
	Safety bins	16	13.7	6	16.2	0	0.0	22	11.8		
	Waste bin	76	65.0	29	78.4	32	97.0	137	73.3		
	Total	117	100.0	37	100.0	33	100.0	187	100.0		

The above table shows that the segregation of blood and its products in the intermediate central and peripheral labs take place in the wastes bins in these percentages respectively 47.8%,62.5%,97%, and a P-value = 0.001. So there is a very significant relationship between the lab kind and the process of blood products segregation.

Segregation of lab culture dishes.

It's clear that intermediate labs segregate the culture dishes in the safety box (43.9%), central lab in the wastes bin and the peripheral labs segregate in the safety box (42.6%), P-value = 0.564. So there is no relationship between the kind of lab and the process of lab cultures segregation.

Segregation of radioactive isotopes:

In intermediate labs radioactive isotopes are segregated in the safety box in a percent of 47.9%, in the central labs segregation takes place in wastes bin (66,7%), and at peripheral labs they are segregated in safety box (47.3%), P-value = 0.545

There is no relationship between the lab kind and the process of radioactive isotopes segregation.

4.9.2 Table (14) Relation between Methods of Collection and Kind of Laboratory

		Intermediate		Central		Sub		Total		X^2	Sig.
		No.	%	No.	%	No.	%	No.	%		
1.	**Blood and its Products**										
	Puncture and leak proof bags	38	33.0	2	5.1	2	6.1	42	22.5	45.94	0.001
	Defined color coded containers	14	12.2	4	10.3	0	0.0	18	9.6		
	safety Box	24	20.9	10	25.6	0	0.0	34	18.2		
	Domestic Bag	39	33.9	23	59.0	31	93.9	93	49.7		
	Total	**115**	**100.0**	**39**	**100.0**	**33**	**100.0**	**187**	**100.0**		
	Lab culture, dishes										
	Puncture and leak proof bags	38	40.0	2	25.0	0	0.0	40	37.7	12.363	0.05
	Defined color coded containers	15	15.8	4	50.0	0	0.0	19	17.9		
	safety Box	24	25.3	0	0.0	1	33.3	25	23.6		
	Domestic Bag	18	18.9	2	25.0	2	66.7	22	20.8		
	Total	95	100.0	8	100.0	3	100.0	106	100.0		
	Body fluids										
	Puncture and leak proof bags	28	27.2	2	12.5	2	6.5	32	21.3	28.13	0.001
	Defined color coded	15	14.6	3	18.8	0	0.0	18	12.0		

	containers										
	safety Box	17	16.5	1	6.3	0	0.0	18	12.0		
	Domestic Bag	43	41.7	10	62.5	29	93.5	82	54.7		
	Total	103	100.0	16	100.0	31	100.0	150	100.0		
	Needles and syringes										
	Puncture and leak proof bags	14	12.2	7.0	23.3	0	0.0	21.0	12.0		
	Defined color coded containers	10	8.7	1.0	3.3	0	0.0	11.0	6.3	11.94	0.063
	safety Box	80	69.6	19	63.3	27	90.0	126	72.0		
	Domestic Bag	11	9.6	3	10.0	3	10.0	17	9.7		
	Total	115	100.0	30	100.0	30	100.0	175	100.0		
	Chemical substances										
	Puncture and leak proof bags	17	17.3	1	3.7	1	33.3	19	14.8		
	Defined color coded containers	16	16.3	9	33.3	0	0.0	25	19.5	11.304	0.079
	safety Box	18	18.4	1	3.7	0	0.0	19	14.8		
	Domestic Bag	47	48.0	16	59.3	2	66.7	65	50.8		
	Total	98	100.0	27	100.0	3	100.0	128	100.0		
	Radioactive isotopes										
	Puncture and leak proof bags	9	18.4	1	16.7	0	0.0	10	17.2		
	Defined color coded containers	5	10.2	1	16.7	0	0.0	6	10.3	2.7	0.840
	safety Box	18	36.7	1	16.7	1	33.3	20	34.5		
	Domestic Bag	17	34.7	3	50.0	2	66.7	22	37.9		

	Total	49	100.0	6	100.0	3	100.0	58	100.0		
	Contaminated gloves										
	Puncture and leak proof bags	47	40.5	2	5.0	2	6.3	51	27.1		
	Defined color coded containers	16	13.8	4	10.0	0	0.0	20	10.6	46.00	0.001
	safety Box	8	6.9	6	15.0	0	0.0	14	7.4		
	Domestic Bag	45	38.8	28	70.0	30	93.8	103	54.8		
	Total	116	100.0	40	100.0	32	100.0	188	100.0		
	Slides										
	Puncture and leak proof bags	27	23.3	1	3.3	2	6.1	30	16.8		
	Defined color coded containers	15	12.9	4.0	13.3	0	0.0	19.0	10.6	38.39	0.001
	safety Box	34	29.3	6.0	20.0	1	3.0	41.0	22.9		
	Domestic Bag	40	34.5	19	63.3	30	90.9	89	49.7		
	Total	116	100.0	30	100.0	33	100.0	179	100.0		
	Contaminated Cotton										
	Puncture and leak proof bags	42	35.9	2	5.3	2	6.1	46	24.5		
	Defined color coded containers	18	15.4	4.0	10.5	0	0.0	22.0	11.7	44.28	0.001
	safety Box	13	11.1	7.0	18.4	0	0.0	20.0	10.6		
	Domestic Bag	44	37.6	25	65.8	31	93.9	100	53.2		
	Total	117	100.0	38	100.0	33	100.0	188	100.0		

In this table its clear that blood and its products collected mostly in domestic bags, at intermediate lab in a percent 33.9%,at central lab 59% and at peripheral labs 93.9%

P-value = 0.001. So there is a very significant relationship between the kind of lab and the process of blood and its products collection.

Needles and syringes collection:

Safety box is most commonly used collection method in all kinds of labs

P-value = 0.063. So there is a relationship, but not significant between lab kinds and the process of needles and syringes collection

Chemical wastes collection:

Domestic bags are the most common method of collection of chemical wastes in all labs in the following percents respectively 48%,59,3%,66.7%, P-value = 0.079. So there is relationship, but not significant, between the lab kind and the process of chemical wastes collection.

4.9.3 Table (15) Transportation of Laboratory Medical Waste

		Intermediate		Central		Sub		Total		X^2	Sig.
		No.	%	No.	%	No.	%	No.	%		
	Counting the quantities of lab medical waste										
	Yes	4	3.4	0	0.0	0	0.0	4	2.1	2.549	0.280
	No	113	96.6	41	100.0	32	100.0	186	97.9		
	Total	117	100.0	41	100.0	32	100.0	190	100.0		
	Storing lab waste										
	Yes	10	8.5	6	14.6	0	0.0	16	8.4	5.118	0.078
	No	107	91.5	35	85.4	33	100.0	175	91.6		
	Total	117	100.0	41	100.0	33	100.0	191	100.0		
	Decontamination and cleaning procedures take place for transport mean										
	Yes	12	10.7	0	0.0	0	0.0	12	6.6	15.680	0.003
	No	77	68.8	32	86.5	32	97.0	141	77.5		

	DK	23	20.5	5	13.5	1	3.0	29	15.9		
	Total	112	100.0	37	100.0	33	100.0	182	100.0		
	Consignment note accompanying the waste from the lab to the offsite disposal										
	Yes	2	1.8	0	0.0	0	0.0	2	1.1		
	No	110	98.2	38	100.0	32	100.0	180	98.9	1.264	0.532
	Total	112	100.0	38	100.0	32	100.0	182	100.0		

From the table it is clear that most of the labs don't perform counting for the lab medical wastes. Those in the intermediate labs who respond no 96.6%, in central and peripheral labs don't do this process totally, P-value = 0.280, which means that there is no relationship between the lab kind and the process of counting wastes.

Regarding wastes storing ,it doesn't take place as described and arranged in the table, 91.5%,85.4%,100%, which means that all kinds of labs don't do this process P-value = 0.078. That means there is a relationship but insignificant between lab kind and the process of storage of medical wastes.

Concerning decontamination, it also doesn't take place in the different kinds of labs in the following percentages 68.6%, 86.6%, 97%. P-value = 0.003, which means that there is a significant relationship between lab kind and the process of lab wastes decontamination.

4.9.4 Table (16) Relation between Methods of Treatment and Kind of Laboratory

		Intermediate		**Central**		**Sub**		**Total**		**X^2**	**Sig.**
		No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**		
1.	**Blood and it's Products**										
	Incineration	77	67.5	12	30.8	3	10.0	92	50.3		
	Steam autoclave disinfection	4	3.5	1	2.6	0	0.0	5	2.7	47.1	0.001
	Mechanical	3	2.6	2	5.1	0	0.0	5	2.7		

	chemical disinfection										
	Untreated	30	26.3	24	61.5	27	90.0	81	44.3		
	Total	114	100.0	39	100.0	30	100.0	183	100.0		
	Lab cultures dishes										
	Incineration	74	74.0	4	18.2	1	7.7	79	58.5		
	Steam autoclave disinfection	4	4.0	0	0.0	0	0.0	4	3.0	55.58	0.001
	Microwave disinfection	7	7.0	1	4.5	0	0.0	8	5.9		
	Untreated	15	15.0	17	77.3	12	92.3	44	32.6		
	Total	100	100.0	22	100.0	13	100.0	135	100.0		
	Body fluids										
	Incineration	53	49.5	6	24.0	0	0.0	59	38.1		
	Steam autoclave disinfection	4	3.7	1.0	4.0	0	0.0	5.0	3.2		
	Mechanical chemical disinfection	3	2.8	1.0	4.0	0	0.0	4.0	2.6	26.789	0.001
	Untreated	47	43.9	17	68.0	23	100.0	87	56.1		
	Total	107	100.0	25	100.0	23	100.0	155	100.0		
	Needles and syringes										
	Incineration	99	86.1	19	51.4	19	57.6	137	74.1		
	Steam autoclave disinfection	0	0.0	0	0.0	1	3.0	1	0.5	35.169	0.001
	Microwave disinfection	2	1.7	0	0.0	0	0.0	2	1.1		
	Mechanical	2	1.7	0	0.0	0	0.0	2	1.1		

	chemical disinfection										
	Untreated	12	10.4	18	48.6	13	39.4	43	23.2		
	Total	115	100.0	37	100.0	33	100.0	185	100.0		
	Chemical substances										
	Incineration	43	46.7	10	29.4	0	0.0	53	38.7		
	Steam autoclave disinfection	0	0.0	1	2.9	0	0.0	1	0.7		
	Microwave disinfection	1	1.1	0	0.0	0	0.0	1	0.7	19.104	0.014
	Mechanical chemical disinfection	8	8.7	1	2.9	0	0.0	9	6.6		
	Untreated	40	43.5	22	64.7	11	100.0	73	53.3		
	Total	92	100.0	34	100.0	11	100.0	137	100.0		
	Radioactive isotopes										
	Incineration	24	51.1	3	15.8	0	0.0	27	34.6		
	Steam autoclave disinfection	1	2.1	0	0.0	1	8.3	2	2.6		
	Microwave disinfection	1	2.1	0	0.0	0	0.0	1	1.3	25.4	0.001
	Mechanical chemical disinfection	5	10.6	0	0.0	0	0.0	5	6.4		
	Untreated	16	34.0	16	84.2	11	91.7	43	55.1		
	Total	47	100.0	19	100.0	12	100.0	78	100.0		
	Contaminated gloves										
	Incineration	65	58.0	11	29.7	0	0.0	76	42.0	41.7	0.001

	Steam autoclave disinfection	1	0.9	1	2.7	0	0.0	2	1.1		
	Mechanical chemical disinfection	2	1.8	0	0.0	0	0.0	2	1.1		
	Untreated	44	39.3	25	67.6	32	100.0	101	55.8		
	Total	112	100.0	37	100.0	32	100.0	181	100.0		
	Slides										
	Incineration	68	60.7	11	30.6	0	0.0	79	43.9		
	Steam autoclave disinfection	1	0.9	1.0	2.8	0	0.0	2.0	1.1	42.3	0.001
	Untreated	43	38.4	24.0	66.7	32	100.0	99.0	55.0		
	Total	112	100.0	36	100.0	32	100.0	180	100.0		
	Contaminated Cotton										
	Incineration	49	43.0	10	26.3	0	0.0	59	32.1		
	Steam autoclave disinfection	14	12.3	2	5.3	0	0.0	16	8.7		
	Microwave disinfection	4	3.5	0	0.0	0	0.0	4	2.2	44.308	0.001
	Mechanical chemical disinfection	4	3.5	0	0.0	0	0.0	4	2.2		
	Untreated	43	37.7	26	68.4	32	100.0	101	54.9		
	Total	114	100.0	38	100.0	32	100.0	184	100.0		

In this table, the blood and its products is treated by incineration by 67.5% at the intermediate lab but at the two lab kinds remain untreated, P-value=0.001. So there is a significant relationship between the lab kind and the process of blood treatment.

Treatment of needles and syringes

Incineration is the most commonly used method of treatment in all kinds of lab respectively as in the table, 86.1%, 51.4%, and 57.6%. P-value = 0.001. So there is a very significant relationship between the lab kind and the process of needles and syringes treatment.

Treatment of slides:

Slides in the intermediate labs are treated by incineration 60.7%, but they untreated in the other two labs with P-value = 0.001. So there is a very significant relationship between the lab kind and the process of slides treatment.

Chapter (5)

Discussion

5.1 Characteristics of study population

The number of the study population that responded to the two questionnaires is 208 subjects. Female lab technicians constitute 55.6% while males represent 44.4%. This indicates that more females' lab technicians are employed than males, most of the lab managers were males 94.1%. However more male lab technicians are needed especially in hospitals for night shifts and emergency. This is because MOH doesn't allow female lab technicians to work at night due to societal and cultural issues. In addition to that during the researcher observation, most of the primary health care laboratories were occupied by female lab technicians, but the responsible about work is mainly male. This employment of more females in the labs exposes them to occupational risks and thus exposing their families to that risk.

The level of education of the lab technicians is satisfactory because most of them carry the BS degree (57.9%), which is considered necessary for working effectively in the lab field. About 7.4%have a master degree, while their managers have the BS degrees (70.6%), master degree (23.5%), and PhD (5.9%). This indicates that lab managers and lab technicians have the capacity to develop their education and career. This can be reflected in their work performance and surely affect the process of lab medical wastes management positively.

The majority of the lab technicians have wide experience on lab work, about 68.9%. That means they are familiar with all processes that take place in their labs, the work guidelines and how the processes of lab medical wastes management proceed .This process is considered an integral part of their work because doing this work in a manner that reflect their experience in medical wastes management affect positively their health and the environment as a whole. This corresponds with previous studies which indicated that years of experience increase the level of performance (Coat, 1994, Cointrea, 2000)

5.2 Training

Training and up-to-date information to the people working in any profession is essential to develop that profession, especially at lab work and specifically lab wastes management. Therefore promotion of appropriate handling and disposal of medical wastes through training is very vital and responds to the demand intensified by great increase in the prevalence of HIV and viral hepatitis (Pruss et al, 1999). Unfortunately this doesn't take place in the Palestinian MOH laboratories, where lab technicians haven't ever been trained on the process of lab wastes management and those technicians who said they received training represents 14.1%. They only received courses on infection control which include information on cleaning, decontamination, sepsis, and autoclaving procedures and don't take into consideration the processes of segregation, collection, transport and treatment which collectively represent the core work of labs. Above all, the lab managers who don't receive training on medical wastes management represent 76.5 %.These results are congruent with the findings of Abu Alqomboz, 2002, who indicated that only 17.6% of health workers received training on wastes management.

One great problem that had been highlighted through that study is that training was weak and neglected at MOH regarding labs. This becomes clear through the relationship between the lab technicians experience and the times they received training .It has been neglected by all MOHs of the Palestinian authority so they don't receive training in any period. That finding was clarified by Abu Alqumboz study 2002, which showed that when the training is accompanied by good experience, it affects positively the knowledge and performance of the process of medical wastes management.

Therefore, bodies responsible for training in every health care setting should be activated and monitored regularly to bring training that is effective and influential on the process of lab wastes management.

5.3 Working hours

The study shows that not all lab technicians work the same number of hours especially those working at hospitals, and specifically those working at night shifts who are mainly males. They may experience work burns, which make them, react in a way that affects the process of wastes management. This condition is specific to Gaza Strip where Israeli night attacks are prevalent which necessitate a heavy work from all health and lab team. About 33.3% of the lab managers mention that they do more than 10,000 tests monthly. This

condition is limited to hospital labs. Those technicians may neglect the process of medical wastes management totally due to emergency and workload. The results show that the process of wastes management at primary care facilities is better than that in the hospitals. This result is consistent with the findings of Massroji,(2000), and Abu alqomboz, (2002).

5.4 Method of segregation

Segregation of lab wastes at point of generation, during handling, storing, and lab packing is important for safety reasons, pollution prevention and for ensuring the lowest disposal costs (Phengxay, 2005). During this study the researcher found that, for the majority of lab wastes, the wastes bins are the commonly used method of segregation either for hazardous and non hazardous wastes. Blood and its products, sharps like slides, chemicals, and even in some cases needles and syringes are segregated in the wastes bins to be mixed. with domestic wastes in the following percentages respectively 59.6%, 63.8%, 52.8% and 14.3%.This miserable condition of segregation impose very serious and dangerous effects on lab workers, handlers and those who are scavengers, so deteriorating and communicating the risk to the public and to the whole environment (WHO,2005b). It's interesting to notice that most of the lab managers reported the availability of safety boxes in their labs (100%), but segregation of needles and syringes at these boxes takes place by 81.9% and this isn't satisfactory and unacceptable percentage to eliminate accidents that cause serious damages in terms of health and illness and in terms of money. (Keneedy, 1998)

In Alkhatib study(2006 on the MOH primary health care clinics in west bank and Gaza Strip on medical wastes management, it has been found that 10.8%of primary health care facilities segregate their medical wastes. Sharps are the main wastes that are segregated(40%) and the process of medical wastes segregation in Gaza is better than in WB.But his findings contradict with the researcher findings and with Abu shomar (2007) finding in her study on work load at MOH labs. She found that 18.8% of primary health care labs segregate their lab wastes worldwide; all heath care facilities give great concern to segregate their wastes. William, 2006, in his study on wastes management in 4 governmental hospitals in Nigeria found that 3 out of 4 hospitals give high priority to segregation for every waste generated from the hospital in a special container. Accordingly the researcher recommends wastes segregation at source of generation to establish for good lab medical wastes management.

5.5 Methods of collection

In order to avoid accumulation of the waste, it must be collected on a regular basis and transported to a central storage area within the HCF before being treated or removed. The collection must follow specific routes through the HCF to reduce the passage of loaded carts through wards and other clean areas.(Poulsen and Brum,1995) . According to the WHO, (2004) the carts should be; easy to load and unload; have no sharp edges that could damage waste bags or containers and easy to clean.

In addition to that WHO, 2004 proposed color coding system to minimize risks. The researcher found that the domestic bags that easily torn, and punctured are used in the collection of all types of lab medical wastes even cultures. Needles and syringes 72% are collected in safety box and the rest of them are collected in domestic bags 9.7%, 9.7% respectively. This is not a simple issue, because it increases the risk of needle stick injury for lab personnel, in- and out-patients receiving treatment in health-care facilities; workers in support services linked to health-care facilities such as laundries, waste handling and transportation services; workers in waste disposal facilities, including scavengers; the general public and more specifically the children playing with the items they can find in the waste outside the health-care facilities when it is directly accessible to them (Mikkel,et al,2000)

In the study of Alkhatib(2007), medical wastes are not collected every day and stay in waste bins till next day, insects come out of it, children play with it, and so it represents a serious source of infections transmission. Similarly the situation in our labs is not different. However the percent of using safety box is 72% and the collection of these containers at the health care settings corners till final disposal is very common .Some clients use them to dispose their own wastes while they are opened and needles come out of them. The situation in most of the developing countries is similar. Rashid (1996) found that most hospitals in Bangladesh collect all wastes in open wastes bins that are accessible to general public and they remain for 2 to 3 days without being eliminated. All these findings are supported by BAN & HCWH (1999) studies, sharps which include syringes and needles, have the highest disease transmission potential amongst all categories of medical waste. Almost 85% of sharp injuries are caused between their usage and subsequent disposal. More than 20% of those who handle them encounter stick injuries, which frequently occur

in developing countries. This poor situation of lab wastes collection push most of lab technicians to speak about their urgent needs for medical supplies that improve the situation and the need for quality control and supervision that ensure safety. Therefore, the researcher calls for uniformity in methods of segregation and collection of lab medical wastes in all health settings. (see Annex 8)

5.6 Storage and transport

HCW are temporarily stored before being treated / disposed of on-site or transported off-site. A maximum storage time should not exceed 24 hours. Non-risk HCW should always be stored in a separate location from the infectious hazardous HCW in order to avoid cross-contamination, (Dasilva, 2004).

A storage facility, sized according to the volume of waste generated as well as the frequency of collection, must be found inside all HCFs. The facility should not be situated near to food stores or food preparation areas and its access should always be limited to authorized personnel. It should also be easy to clean, have good lighting and ventilation, and designed to prevent rodents, insects or birds from entering.(FEPA,1991). The researcher in this study found that there no storing is taking place for lab wastes (91.6% respond no), only needles and syringes are stored in any available area in the health care facility till final disposal which may take several weeks after storage. At this period of storage, some of these cleaners empty some of the safety boxes in domestic bags to be disposed of with the domestic wastes in the health care facility and take these contaminated boxes for their personal use (this situation has been described by some lab managers).

5.7 Off-site transportation

It is known that off-site transportation is required when hazardous HCW is treated outside the HCF. The waste producer is then responsible for the proper packaging and labeling of the containers that are transported. One of the reasons for labeling HCW bags or containers is that in case of an accident, the content can be quickly identified and appropriate measures are taken. The labeling system should comply with the United Nations Recommendations and contain at least: the proper shipping name and the total quantity of waste covered by the description (by mass or volume); and he date of collection. The transportation should always be properly documented and all vehicles should carry a consignment note from the point of collection to the treatment facility (Leonard, 2003).

Furthermore, the vehicles used for the collection of hazardous / infectious HCW should not be used for any other purpose. They shall be free of sharp edges, easy to load and unload by hand, easy to clean / disinfect, and fully enclosed to prevent any spillage in the hospital premises or on the road during transportation. (Agarwal, 1998)

The researcher found out that cleaners lack facilities and supervision. Lab managers reported that they don't have facilities to do all the procedures e.g. they lack transport trolleys in an 88.2%,heavy gloves94.2%and defined colored containers 82.4% .These findings were consistent with the findings of Alkhatib 2007, where none of the previous procedures were done, none of the facilities are available, so exposing wastes handlers to injuries. In a study done in Ramalah 40.5% of hospital cleaners were exposed to needle stick injury, which is congruence with the situation in different areas in Africa, where cleaners are responsible for collection and storage of medical wastes in the different health care settings with increased risk to needle stick injury (NSI) (Kennedy,1989). Again the researcher recommends, good segregation and collection for proper transport and storage minimize occupational hazards among medical labs workers and community.

5.8 Treatment methods

Waste treatment is but one small piece of a much larger system of purchasing and materials management that determines the overall environmental and health impacts of a health care facility (Coad and Christen, 2003). Regarding the study findings, it's clear that most of lab wastes remain untreated in different percentages. Chemical wastes, radioactive isotopes, contaminated gloves, and slides remain untreated as the following53.3%, 55.1%, 55.8%.55%. Other methods of treatment like steam autoclaving; microwave disinfection and mechanical, chemical disinfections are rarely used. Contrary to that incineration is the most commonly used method of treatment in the labs. It's used for treatment of different kinds of lab wastes, mostly for needles and syringes 74.1%, and lab culture dishes 58.5%. These results are congruent with Alkhatib (2007) that the incineration is the most commonly used method of treatment 70.6% in west bank and Gaza strip, followed by chemical disinfection 13.8% which is used only in the WB. Similarly the situation in USA, treatment of most regulated medical wastes is most commonly accomplished by

incineration (64%-93%), and about one third of US hospitals steam sterilizes their microbiological wastes (Rutala, 1998).

The observed untreated lab medical wastes and incinerated wastes are risk to public health .The problem is doubled when the health care facilities are surrounded by densely populated communities as prevalent in Gaza, so easing the transmission of infections and spreading of ashes and other dangerous emissions. (Phillip R.1997, Philip, G 1999).Therefore, the researcher sees that the current medical wastes treatment practices observed within and outsides health care facilities call for a specific wastes management policy for medical wastes in the country, in particular, treatment of infectious wastes and sharp wastes.

5.9 Lab kind and processes of lab wastes management

There are different kinds of labs, intermediate where 61.3% of lab technicians' work, 21.5% at central labs and 17.6% at peripheral labs .The research revealed that there are some similarities and some differences among the MOH labs regarding the process of medical wastes management. Also it shows that all kinds of labs segregate most of their lab wastes in the wastes bins, all kinds of labs collect their needles and syringes in safety boxes. Regarding treatment of lab wastes, it differs from lab to another, some of them leave wastes without treatment and others treat them by incineration. There are many factors that affect this process like generation rate of each lab and availability of supplies and staff. These findings agree with Williams (2006) findings that there is no uniformity among hospitals regarding medical wastes management. The researcher recommends that all health care facilities should work according to a unified national guideline.

5.10 Legislation

Legislation to medical wastes management is very important. It incorporates obligations to wastes generator to conduct monitoring, testing or risk assessment and well put in place policies for safe disposal of medical wastes (Rushbrook, 2000). In this study the researcher found that most of the lab managers aren’t satisfied with the current situation of medical wastes management. Only 5.9% are satisfied, 41.2% satisfied to some limits and 52.9% not satisfied. Most of them 94.1% believe in the presence of legislation that controls the process of medical wastes management. Many studies indicate that there should be a legislation that control the process of medical wastes management due to its

dangerous properties .Each country should have its system of management that ensure handling and disposing of their wastes by the safest means (Reksnohadhy,1994).

Many studies conducted by WHO East Mediterranean Regional Office about medical wastes management studies revealed that none of the institutions and governmental labs, even private labs have codes of rules and regulation that control the process of medical wastes management. In OP, the Environmental Law of 1999 identifies the Ministry of Environmental Affairs in co-ordination with other competent bodies as being responsible for specifying legislation for managing hazardous waste (in the form of orders and directives) and for issuing one or more lists of what constitutes hazardous wastes. The management of the waste includes storing, use, treatment, handling and disposal, therefore relating not only to HCF, but also to those who have responsibility for the collection, transport, treatment and disposal of the HCW. To date, these orders and directives have not yet been elaborated and implemented into law and the lists of hazardous waste still wait to be introduced into the law. A large number of institutions are still concerned with and, in fact are playing a role in HCW with no clear regulations, laws or by-laws. So the researcher recommends that there should be ongoing coordination among the ministries involved in the process like MOH, environmental quality authority, and ministry of local government.

5.11 Medical wastes management plan

To have the process of medical wastes management operates effectively there should be a plan upon which the whole processes proceed. Through this study the researcher found that 70.6% of the labs lack a medical waste plan. These findings supported by Abu Alquboz study (2002) that 55% of institutions that deal with hazardous wastes including health care facilities lack a wastes management plan. He said that there is no comprehensive planning for HWM in most of the organizations and there are only certain steps such as segregation, collection, but without transferring or sanitary disposal. For these reasons the researcher sees that every health care facility should develop a comprehensive waste management plan including legislative context, details of what type of waste bags will be used for collection, labeling specifications, consignment notes, training requirements and schedules, health and safety of workers, cleaning and maintenance requirements.

5.12 The presence of guidelines

Regarding the presence of work protocol in the labs, some (43.8%) of the lab managers said that they have a work protocol and see it and 28.6% of the 43.8% review it periodically. Manyele (2003), proposed that each health care facility should have national guidelines incorporating handling, storage, transportation and disposal of medical wastes. These guidelines should be tracked, inspected and monitored by regulatory bodies for effective management.

In spite of the great deal of WHO publications on the importance of using and reviewing the work guidelines regarding medical wastes management, still people working there do neglect it. Akter(2001) in her study on medical wastes management in Bangladesh hospitals had found out that the health workers themselves aren't interested in reviewing guidelines and little attention is paid to the process of medical wastes management. This situation is agreement with our situation. So the researcher proposes that there should be a tracking program that allows for the understanding of wastes and assists in the evaluation of any potential harm to the environment and human health.

Chapter (6)

Conclusions and recommendations

Conclusion and recommendation

6.1 Conclusion

Medical wastes are produced in all different forms, it is generated from different health care facilities, including medical laboratories and medical research centers It is characteristically heterogeneous, consisting of objects of various sizes and composed of many different materials. Sharps are the most serious and dangerous risk to health. Its worth mentioning that medical wastes management process is an interrelated and multidivisional process .It needs more cooperation and a lot of coordination among all the responsible bodies in the field to bring prominent change on what is running in the field regarding the process of wastes management.

6.2 Recommendations

Therefore the researcher proposes some recommendations that enhance and help to develop the process of medical wastes management as follows.

- Issuing of policies, strategies, and enforcement of legislation for the process of medical wastes management through the cooperation of the main governmental players in the field; First MOH by supervising the regulations and control of health hazards and monitoring wastes treatment; Second, EQA by legislation and monitoring; third, ministry of local governments to regulate authorities for enforcement of wastes management standards and prevailing legislation. Last, the municipalities which are responsible for collection, transport, and disposal and monitoring of HCW deposited in communal system.
- Promotion of monitoring and evaluation programs to help identify gaps and problems and give necessary support as required.

- Each lab manger with his staff should prepare medical wastes management plan taking into consideration the available staff and supplies, and a plan for emergency situations at labs.

- Each lab manger should designate a especial person for supervising the whole process of lab wastes management he should give feedback to the responsible bodies in the field and can in intervene as necessary.

- Segregation at source of generation is the basic step in the whole process of lab medical wastes management. All the efforts should be done to enhance this step by ongoing follow up through out the work and at the end of the work by the lab managers and the designated person of supervision.
- Collection of wastes should be done daily and the collected sharps should be handled carefully in a storage place that should be away from the clients.
- All laboratory wastes should be steam sterilized before disposal. Other contaminated material as glassware, laboratory equipment, and radioactive wastes should be decontaminated by means demonstrated to be effective before washing, reuse, or disposal.

- Design and implement awareness programs for wastes handlers; keep these programs continuous with close monitoring on their real work in the field.
- MOH should promote the activities of quality assurance department in the ministry as it's the figure in the ministry responsible for lab quality of work.
- Training of lab technicians, the new as well as the experienced staff, on each step in the process of lab wastes management and keep them up to date. The training should be scheduled regularly on time frame.

- Review WHO guideline of safe management of wastes from health care activities and review the recent publications regarding the process of all wastes management.

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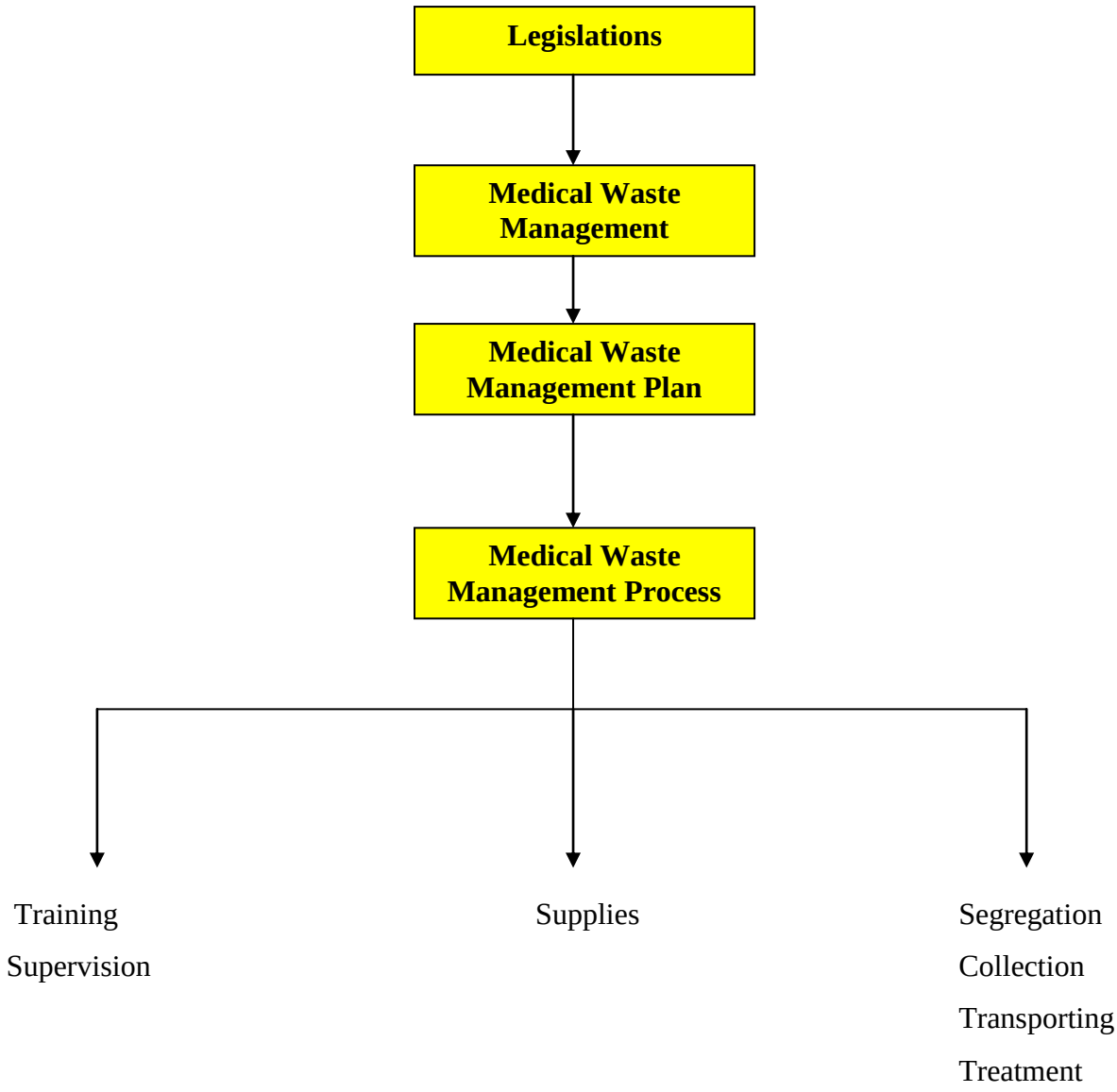
List of Annexes



Conceptual frame work of the study

Collection and handling the lab wastes in MoH's labs/Gaza

At intermediate laboratory.

Different Kinds of Wastes (contaminated gloves, blood and its products and domestic wastes) are collected in open communal wastes receptacles where domestic bags are used for collecting these wastes

At central Laboratory

A contaminated waste bin is used as a method of segregation of different kinds of wastes.

At peripheral laboratory.
Domestic bags are used to collect different kinds of laboratories wastes (blood ,urine containers, tubes) .

At peripheral laboratory.
Full safety boxes at temporary storage site at a corner in the care sitting waiting for final disposal.

At peripheral laboratory.
The safety boxes are waiting for disposal used by the public
for eliminating their wastes .(tissue paper and nylon packets in these boxes)

عزيزي المشارك

انا الباحثة نجاح شعبان اقوم بعمل دراسة حول كيفية التخلص من النفايات الطبية من مختبرات وزارة الصحة الفلسطينية ضمن ماجستير الصحة العامة بجامعة القدس إل\ا نرجو من سيادتكم التكرم بتعبئة هده الاستبيان بهدف البحث العلمي و لكم حرية الاختيار في المشاركة وستكون المعلومات التي تدلون بها في محل السرية التامة وستستخدم في تحسين الوضع السائد في المختبرات ولكم جزيل الشكر

الباحثة نجاح شعبان

للاستفسار يمكن الاتصال عتى تيلفون 2473833

Questionaire1 for lab manager

Name of the lab ……. Governorate……

Personal data

Age …… Sex …… Occupation……

Level of education BS ❑ Master degree ❑ PhD ❑

Work area

.Regular number of working hours ……..

Lab kind ……

Total number of employees at lab ……

Average number of analysis done every month …….

Is there work protocol about how to deal with lab medical wastes?

Yes seen ❑ Yes not seen ❑ Don't know ❑

If yes, is it reviewed periodically?

Yes ❑ No ❑

Is there lab medical wastes management plan at your facility?

Yes ❑ No ❑ Don't know ❑

Is there a person supervise the process of lab medical wastes management?

Yes ❑ No ❑ Don’t know ❑

Is there coordination between your lab and municipality regarding lab wastes management?

Yes ❑ No ❑ Don’t know ❑

How much time it takes you to dispose your lab wastes?

Everyday ❑ Every two days ❑ I don’t know ❑

Is there recording system for the process of lab wastes management?

Yes ❑ No ❑ I don’t know ❑

Had you ever received training courses about lab wastes management for you and your staff?

Yes ❑ No ❑ I don’t know❑

If yes, please fill this table:

Training years	**Training topic**	**Trained employee**

Are you satisfied with your way of wastes treatment in your lab?

Yes to high extent ❑ To some extent ❑ Not satisfied ❑

Do you believe there should be legislation that control the process of lab medical wastes management?

Yes ❑ No ❑ Don't know ❑

- Please put X at the available facility at your lab.

Sharp box containers ❑

Heavy gloves ❑

Leak proof bags ❑

Transport trolley ❑

Communal wastes receptacles ❑

Defined coded color containers ❑

Steam autoclave ❑

Incinerator ❑

Disinfectant material ❑

What suggestions or ideas do you have to improve the process of lab wastes management?.

استبيان 1 لمدراء المختبرات

اسم المختبر ..... المحافظة.....

معلومات شخصية

العمر ..... النوع ..... الوظيفة .....

مستوى التعليم

دبلوم ❑ بكالوريوس ❑ ماجستير ❑ دكتوراة ❑

معلومات عن مكان العمل

عدد ساعات العمل .....

نوع المختبر .....

عدد العاملين في المختبر .....

معدل التحاليل الشهرية في المختبر .....

هل يوجد لديكم دليل خاص بالمختبر لتنظيم عملية التخلص من النفايات الطبية؟

نعم يوجد ❑ لايوجد ❑ لأعرف ❑

اذا كانت الاجابة نعم هل يتم مراجعة هذا الدليل بانتظام؟

نعم ..... لا .....

هل يوجد في المختبر خطة خاصة بادارة النفايات الطبية في المختبر؟

نعم يوجد ❑ لايوجد ❑ لأعرف ❑

هل يوجد شخص يشرف على عملية ادارة النفايات الطبية في المختبر ؟

نعم يوجد ❑ لايوجد ❑ لأعرف ❑

هل يوجد تنسيق بين مختبركم و البلدية للتخلص من النفايات الطبية ؟

نعم يوجد ❑ لايوجد ❑ لاأعرف ❑

اذا كانت الإجابة بنعم فكل كم يوم يحصل

كل يوم ❑ كل يومين ❑ لا أعرف ❑

هل يوجد نظام تسجيل خاص بالنفايات الطبية في مختبركم ؟

نعم يوجد ❑ لايوجد ❑ لاأعرف ❑

هل سبق و أن تلقيت تدريبا عن كيفية التخلص من النفايات في المختبرات؟

نعم ❑ لا ❑

إذا كانت الاجابة بنعم املا الجدول من فضلك.

سنة التدريب	موضع التدريب	عدد المو ظفين المتدريبين

هل سبق و أن أحد فني المختبر لديك تلقى تدريبا عن كيفية التخلص من النفايات الطبية من مختبرك؟

نعم ❑ لا ❑ لا أعرف ❑

اذا كانت الاجابة نعم املا الجدول.

سنة التدريب	موضع التدريب	عدد المو ظفين المتدريبين

هل أنت راضٍ عن عملية التخلص من النفايات الطبية في مختبرك.

نعم ❑ لا ❑ لا أعرف ❑

هل تؤمن بوجود تشريعات و قوانين تنظم عمل المختبرات ؟

نعم ❑ لا ❑ لا أعرف ❑

من فضلك ضع علامة(✓)امام الموارد المتاحة لديك في المختبر

- ❑ صندوق النفايات الخطرة
- ❑ قفازات سميكة
- ❑ أكياس غير قابلة للتمزق
- ❑ عربات نقل
- ❑ مجمع النفايات العام
- ❑ حاويات ملونة خاصة
- ❑ جهاز تعقيم
- ❑ محرقة
- ❑ مواد معقمة