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Medical Waste Management at Private Dental Clinics in the Gaza Strip: Status and Policy Implication

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With respect,
Rola Samir Qeshta

Declaration

I certify that this entire thesis submitted for the Degree of Master, is the result of my own work, except where otherwise acknowledged, and that this study (or any part of the same) has not been submitted for a higher degree or qualification to any other university or institution.

Signed

Rola Samir Qeshta

/ /

Abstract

Medical wastes are generated in hospitals, clinics and places where diagnosis and treatment are conducted. The management of these wastes is an issue of great concern and importance in view of potential public health risks associated with such wastes. This study aims to ascertain the status of medical waste management in private dental clinics in Gaza Governorates, an important segment of dental health care providers.

This study is a quantitative, descriptive, analytical, cross-sectional one. The target population was the dental staff working at private dental clinics in the Gaza Governorates. The researcher used a self-constructed, self-administered questionnaire. In total, 276 respondents completed the questionnaire with a response rate of 98.5%. Statistical Package for the Social Sciences Program (SPSS) has been used for data analysis including cross tabulation, percentages, mean, t test and ANOVA.

Finding revealed that 61.2% of participants were males and 42.8% were aged 30 to less than 40 years. The majority of respondents (88%) were dentists and holding bachelor degree (85.5%). Of respondents, 61% have less than 10 years of experience, and only 1.8% were having more than 30 years of experience. The majority of respondents (89.5%) not received any training about dental waste management. With regard to policy and guidelines, more than two thirds of respondents (87.3%) were aware of presence of waste management policy and guidelines, but the majority of them (88.8%) informed unavailability of manual guidelines for dental waste management in their clinics. Concerning management of dental waste, the majority of respondents (79.3%) reported absence of supervision on waste management process, and almost all (94.6%) reported the availability of personal protective equipment in their clinics. Nearly half of the participants (44.6%) evaluated their dealing with hazardous waste in their clinics as excellent and 65.2% of the participants have licensed their clinics.

Most of participants (90.6%) were personally familiar with dental wastes, also the majority of them (87.6%) had correct knowledge about the definition of dental waste. (98.5%) of respondents knew that they should be wearing personnel protective equipment when handling a dental product. Regarding practice, the majority of the respondents (86%) reported performing separation of the dental waste before disposal, and 88.4 of them reported that they disposed the dental waste after separation. Moreover, the majority of respondents (84.0%) reported disposing cotton, gauze and other items contaminated with blood by thrown it into the general garbage and only 8.3% of them used correct methods. Nearly one third of participants are not satisfied about current dental waste management. Approximately (80%) of the participants had positive attitudes toward the importance of existence of a manual guidelines for dental waste management.

The study concluded that majority of dental staff workers working in private clinics are knowledgeable about dental waste management. The practices towards dental waste require further improvement. There is a need for training and monitoring programs accompanied by supervision and learning.

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List of Abbreviations

ADA	American Dentist Association
ANOVA	One way Analysis of Variance
BMS	Bio-Medical Waste
GGs	Gaza Governorates
GS	Gaza Strip
HIV	Human Immuno-deficiency Virus
MOH	Ministry of Health
MWM	Medical Waste Management
NGOs	Non-Governmental Organizations
PCBs	Palestinian Central Bureau of Statistics
PHC	Primary Health Care
SD	Standard Deviation
SPSS	Statistical Package for Social Sciences
UNRWA	United Nations Relief and Works Agency For Palestine Refugees in The Near East
WB	West Bank
WHMIS	Workplace Hazardous Materials Information System
WHO	World Health Organization

Chapter (1) Introduction

1.1 Research background

Medical Waste Management (MWM) has become a serious problem as it poses possible health hazards and damage to the environment (Adnane et al., 2013). Furthermore, it is a greater importance due to its possible environmental hazards and public health risks with high propensity to result into epidemics (Dehghani et al., 2008).

Medical waste is any waste arising from medical, nursing, dental, veterinary, pharmaceutical or similar practice, investigation, treatment, care, teaching or research, or the collection of blood for transfusion (World Health Organization-WHO, 2014). It remains to be a major challenge, mostly, in most healthcare services of the developing countries where it is hampered by technological, economic, social difficulties and inadequate training of staff responsible for management of the waste (Alagoz and Kocasoy, 2008). WHO reported that approximately 10–25% of the total wastes produced from health care services are hazardous, posing a highly risk against patients, health practitioners, population and environment (Ustun et al., 2013). Poor management of waste potentially exposes health practitioners, handlers waste, patients and the population to infection, toxic effect, injuries, and risks polluting the environment, so it is essential to the medical waste materials to segregate at the point of generation, probably treated and safely disposed (WHO, 2014).

Today, with the increase in demand for dental care, there has been a rapid growth of the dental clinic in recent years, which in turn led to an increase in the amount of biomedical waste generated in the clinics. Dentistry is a profession that provides services for the oral health and well-being, in order to achieve their goals it used different type of materials which present potential challenges to the environment

(Morgat, 2007). Most of these waste materials which generated routinely during the oral healthcare services are nonhazardous and can be managed as household waste (Eve and Cuny, 2012). Even though, the proportion of hazardous wastes from dental services is a small in comparison with other types of health care facilities, there is a risk to cross infection and potential danger for environment associated with mismanaged wastes (Ozbek, 2004). However, the hazardous nature of these waste materials requires policy makers to enforce established waste regulations for dental related medical wastes (Danaei et al., 2014).

Because some products used in dental practices could expose patients and dental practitioners to health problems as cross-transmission of blood-borne pathogens, including hepatitis B, hepatitis C and Human Immunodeficiency Virus (HIV) or the environment if discarded into landfills or poured down drains or if improperly managed (Askarian, 2010). So these types of waste must be regulated and managed separately (Eve and Cuny, 2012). The management of these wastes is an issue of great concern and importance in view of potential public health risks associated with such wastes.

This across sectional study assessed the medical waste management in private dental clinics in Gaza Governorates (GG).

1.2 Research Problem

Medical care is vital for our life, health and well-being and with the advancement in the science field. The quantity of bio hazardous waste product being produced is also increasing at an alarming rate which create serious health problems to the population and present challenges to the environment. So it makes the world need of the day is to create a pollution free environment to keep the earth safe and disease free for a healthy living.

Today, medical waste is considered one of the growing concern in the Gaza Strip (GS) (Ministry of Health-MOH, 2014). Some studies showed significant gaps in certain services in Gaza. Massrouje, (2001) show that there are some gaps in knowledge and practices of health care workers in certain services and there is no system for medical waste management in Gaza. Unfortunately, waste management at dentistry wasn't specifically studied in Gaza especially in private sector which is regarded as crucial provider of dental services. There are gaps in information in reference to what dental health team know and do at their private clinics. In addition, it is not precisely known to what extent practices at private clinics comply with appropriate waste management practices.

1.3 Justifications

The management of medical waste in many developing countries is often poor due to lack of awareness about; segregation of infectious waste from general waste, reuse of disposable syringes and other untreated equipment. In addition to that there are poor training for healthcare professionals, and inadequate storage facilities, transportation and disposal equipment. So WHO has advocated that medical waste should be treated as special waste and should put into a systematic framework (Tiong, 2012).

There is a particular concern in the GS, as in Gaza many of the environmental problems are caused by the small size of the area with high population density (Abu El Qomboz and Busch 2001). The generation of dental waste in the GS is increasing due to the increasing number of graduate dentists and population density. The impact of such hazardous waste pose a large public health problems. In the absence of laws and regulations, urgent efforts are needed to address the issue of dental health waste disposal.

As dental practitioners, we must know that some of materials and procedures that we used to provide dental health services may present hazardous impact to the environment. From dental practices can be divided into two main areas. First, there is environmental burden of the hazardous products and second, the more immediate risks of potentially infectious materials. The inappropriate disposal of dental waste, lack of information about the risk they pose, inadequate training about its management and lack of financial can lead to contamination and being danger to public health and environment. So, In order to minimize the risk to public health it's necessary to evaluate the medical waste management.

To the researcher best knowledge, this study will be the first to handle the topic of assessment of medical waste management at private dental clinics in GGs and so, it focuses the light on how private dental practitioners in GS manage dental waste generated in their dental clinics; and explore their awareness on safe disposal of dental waste. The result of this research would enhance more understanding the enforcement of all relevant health legislators because it would take more interest in precautionary measure against those health threatening. In addition, the results of this study could be a factor to rectify the situation of medical waste management in dental private clinics, especially after the presentation of its results to stakeholders.

1.4 Research aim and objectives

1.4.1 Aim

This study aims to ascertain the status of medical waste management in private dental clinics in GGs, in order to promote waste management practices and subsequently reduce the risks associated with waste management.

1.4.2 Objectives

1. To assess the medical waste management at private dental clinics.

2. To appraise knowledge, attitudes and practices of dental health team at the private dental clinics.

3. To recognize areas of strength and areas of weaknesses at private dental health clinics.

4. To examine variations in waste management in relation to characteristics variables.

5. To provide recommendations that might improve waste management at private dental clinics.

1.5 Research questions

1. What is the status of dental wastes at private dental clinics regarding to their production, attention and management?

2. What is the level of knowledge of the dental team who deal with dental wastes?

3. How do dental team manage their dental waste?

4. Do dental team practices the management of dental wastes according to the policy?

5. Do dental team face problems during dispose their dental waste?

6. What are the factors might limit dental team to manage their dental waste probably?

7. What are the most important factors that influence the dental waste management?

8. Are there any variations between Gaza areas, Private dental clinics or private dental centers and female dental team or male dental team?

9. What are the areas of strengths and weaknesses in dental waste management in the GS?

10. What are the conclusions and recommendations drawn from the study that could positively influence dental waste management?

1.6 Study context

1.6.1 Geographical context

Palestine lies on the western edge of the Asian continent and the eastern extremity of the Mediterranean Sea (The Palestinian Academic Society for the Study of International Affairs- PASSIA, 2009). It is bounded to the north by Lebanon and Syria, to the west by the Mediterranean Sea, to the south by the Gulf of Aqaba and the Egyptian Sinai Peninsula, and to the east by Jordan (annex 1). The land area of Palestine is 26,323 Km^2. Now, Palestinian Territory land comprises two areas separated geographically: the West Bank (WB) and GS with total area 6,020 Km^2 (PCBS, 2013).

The GS is a small piece of land located in the south of Palestine. Its position on the crossroad from Africa to Asia made it a target for occupiers and conquerors over the centuries (Annex 1). The total estimated population in 2012 is about 1,700,000 million with a population density 4,429 person/Km2 (Palestinian Central Bureau of Statistics-PCBs, 2013). This high population density and narrow area of land create high demands for healthcare services and increase work overload on healthcare providers. GS compromises the following main five Governorates: North of Gaza, Gaza City, Mid-zone, Khan-Younis, and Rafah (PCBS, 2013).

1.6.2 Demographic context

GS is highly crowded area, where approximately 1.64 million live in 365 km^2. The total number of Palestinian people according to the estimation 2011 was 4,168,858 of which 50.8% are males and 49.2% are females. The age and sex distribution of population in Palestine shows that 40.8 % is less than 15 years old. The age group (0-4 years) is 14.7%, while for the ages over 65 years constitutes only 2.9 %, so Palestinian society is described as a young population (PCBS, 2013).

The natural increase of population was 2.9% (2.6 % in WB and 3.3 % in GS) in 2012. Despite progressive decline over the years, the number of live births per 1,000 of population per year is still high in comparison to other countries. The Crude birth rate in 2011 was 29.1\1,000 capita (25 in WB and 35.8 in GS). Estimated density in GS is 4,505 people per square kilometer; the population of GS is concentrated in seven town, 10 villages and 8 camps. The crude death rate declines progressively over the years. The crude death rate for Palestine declined from 3.0 per 1,000 of population in 2000 to 2.7 per 1,000 of population in 2011 (2.7 in WB and 2.6 in GS) (MOH, 2012).

1.6.3 Socio-economic context

Within the last years, economic situation continued to decline severely due to the strict siege imposed on Gaza after the Palestinian Legislative Council election. The occupation, conflict, siege, closures and frequent wars have left the high densely populated GS in a state of severe vulnerability (MOH, 2014). The siege that Israel has intensified on the GS since June 2007 has greatly harmed the health system at two levels; the provision of health services inside Gaza and access to treatment outside Gaza (MOH, 2014). The intense isolation has taken the humanitarian situation to an unprecedented level, with coping mechanisms exhausted, widespread absolute poverty and an inability of civil society organizations and formal authorities to meet even the basic needs of the population (MOH, 2014). There has been growing decrease in the ability of local communities to purchase required medicaments, contribute to medical fees and pay for transport to reach health facilities (Palestinian Non-Governmental Organizations-PNGOs, 2009).

The Gross Domestic Product in the GS could not be traced reliably from local sources because of the chaos political situation. However, it was estimated at $ of United State of America 1.3 billion in 2003, and declined to $1.1 billion in 2008 although the

population has increased by around 30% during that period (PCBS, 2010). The annual GDP for Gaza per capita in 2008 was $774.5 (PCBS, 2010). The main sources of livelihood in the GS are employment at the services sector (mainly at government, United Nations Relief and Works Agency For Palestine Refugees in The Near East (UNRWA) and Non-Governmental Organizations-(NGOs)), rain-fed agriculture, livestock rearing and fishing (PCBS, 2013). According to the PCBS Report (2013), the percentage of those who are older than 15 years in labor force is 40.2% and 59.8% are outside the labor force. The same source indicates that among those in labor force, only 56.3% are employed.

1.6.4 Health care system context

1.6.4.1 Health care system:

At present, all four major providers of health care services in Palestine: the MOH, UNRWA, NGOs, and the private sector contribute to all areas of health care. MOH is the main health care provider; it provides primary, secondary services for the whole population. It also purchases advanced medical services from the neighboring countries and other private and NGO healthcare facilities (MOH, 2014). The health system in GS is made up by fragmented services. However, because of various factors, including little health-service development, and poor governance and mismanagement of the Palestinian Authority, current services are not enough adequately for people's needs, especially in tertiary health care. Therefore, the Palestinian Ministry of Health continues to refer patients elsewhere (Israel, Egypt, and Jordan), to obtain needed treatment (WHO, 2013).

UNRWA is the second main health care providers in GS, it operates 21 primary healthcare centers in Gaza; however, the number of Palestine refugees turning to UNRWA for assistance in meeting their healthcare needs continues to rise. From 2009

to 2011, there was 11% increase in the number of consultations provided at UNRWA health centers, with over 4.4 million patient visits in 2012. It also provides a portion of the costs of secondary and tertiary healthcare for vulnerable groups (UNRWA Report, 2013). In addition to MOH and UNRWA, the NGOs also play important role in providing health services, including providing tertiary services-sometimes expensive services- that are usually not provided by the MOH (Abu Hamad, 2009), NGOs play a vital role in promoting accessibility to vulnerable and marginalized people and contribute to bridging the gaps and the perceived inequalities in the health system (Abu Hamad, 2009).

1.6.4.2 Health condition:

Gaza Strip was locked down and isolated by Israel, so its health system was gravely harmed, many services and life-saving treatments aren't available and conditions are getting worse, not better (Lendman, 2011). The main challenge to the health sector was the availability of drugs and medical supplies; severe shortages of essential drugs and medical supplies, insecure power supply and lack of fuel for generators beside to inadequate maintenance capacity and spare parts for medical equipment, have contributed to decline the quality of care (WHO, 2012). Reduced access to medical services outside the Gaza Strip and closing of Rafah crossing, which lead to worsen of the health situation and that increase day after day and placed all the responsibility on Israel (B'Tselem, 2014).

1.6.4.3 Dental services:

All four main health-care providers (Palestinian MOH, the UNRWA and, NGOs, and the private dental sector) contribute to provide dental treatment to all patients. In Gaza, private dental clinics sector consider the main provider to the oral health services since

it provide services of endodontic treatment, surgery, scaling, pedodontics treatment and orthodontic treatment which are not provide by the other health providers. In 2000, the primary health care centers in the governmental sector were reached to 43 centers which provide dental services into 22 centers of them, However by 2010 the centers were reached to 59 and the dental services provided in 24 centers (MOH, 2010).

1.7 Definition of terms

Assessment; - the method involve the evaluation of both quality and quantity of waste**.**

Medical waste: World Health Organization (WHO, 2014) defines medical waste as Waste produced by health care activities including a wide range of materials, from used syringes and needles to soiled dressings, diagnostic samples, body parts, pharmaceuticals, chemicals, blood, medical devices and radioactive materials; and any other waste arising from medical, nursing, dental, veterinary, pharmaceutical or similar practice, investigation, treatment, care, teaching or research, or the collection of blood for transfusion (WHO. 2014).

Bio-dental waste: Biomedical/dental waste" means any waste, which is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities pertaining thereto or in the production or testing of biological. In a dental clinic, any material in contact with patient's blood or saliva (potentially Infectious) which is thrown into the dust bin for disposal by municipal authorities or by any other means is considered Biomedical/Dental Waste.

Clinical waste: Clinical waste is defined as waste which is made up wholly or partly of human or animal tissue including blood, body fluids, excretion; drugs or other pharmaceutical products; swabs, dressings syringes and needles or other sharp instruments which have been used in a clinical environment. In the case of dentistry this

extends to fixer & developer, amalgam, lead foils, anesthetics capsules and feminine hygiene containers (National Health Service, 2012).

Bio-hazardous waste: Bio hazardous waste includes waste which contains recognizable fluid blood, containers or equipment containing blood that is fluid and several other categories of waste, such as chemotherapeutic waste (trace amounts) and bacterial cultures that are not normally generated in a general dental practice (Fred Hutchinson Cancer Research Center, 2016).

Chapter (2) Literature review

This chapter discusses different previous studies which have been done on waste management systems in different Palestine and also in other countries as presented in scholars, reports, and studies. The literature review explains the research topic and provides the information and proper guidelines to the researcher and the reader about the same research topic through previous research (Mertens, 2010). The literature review will be described after introducing the conceptual framework of this study.

2.1 Conceptual framework

The researcher draws the conceptual framework based on literature review and personal experience in dental field. The frame helped for assessment dental waste management which included five domains as shown in Figure 2.1

2.1.1 Dental care providers characteristics

Providers characteristic: it includes age, gender, qualification, specialization and years of experience.

2.1.2 Dental care provider

Knowledge and training: the dentals staff should have adequate knowledge and training about proper dental waste management. Dentists should have the information about properly dispose of mercury and amalgam waste, and how to managing the other wastes. Adequate knowledge about the hazardous medical waste, proper technique and methods of handling the waste, and practice of safety measures can go a long way toward the safe disposal of hazardous waste and protect the community from various adverse effects of the hazardous waste (Vanesh, 2011).

Practice: Dental care providers shows aware and oriented about proper practice of dental waste. This domain aimed to know if dentists practicing a proper methods to managing the dental waste. The dental practice has a statutory duty of care. This means everyone in the waste management chain from producer to disposer. Dental practices are to take all reasonable measures to ensure that waste is dealt with appropriately from the point of production to the point of final disposal. The dental practices responsibility does not end when your waste collector removes your waste.

Attitude: the dental staff attitude effect on how the staff managed dental wastes.

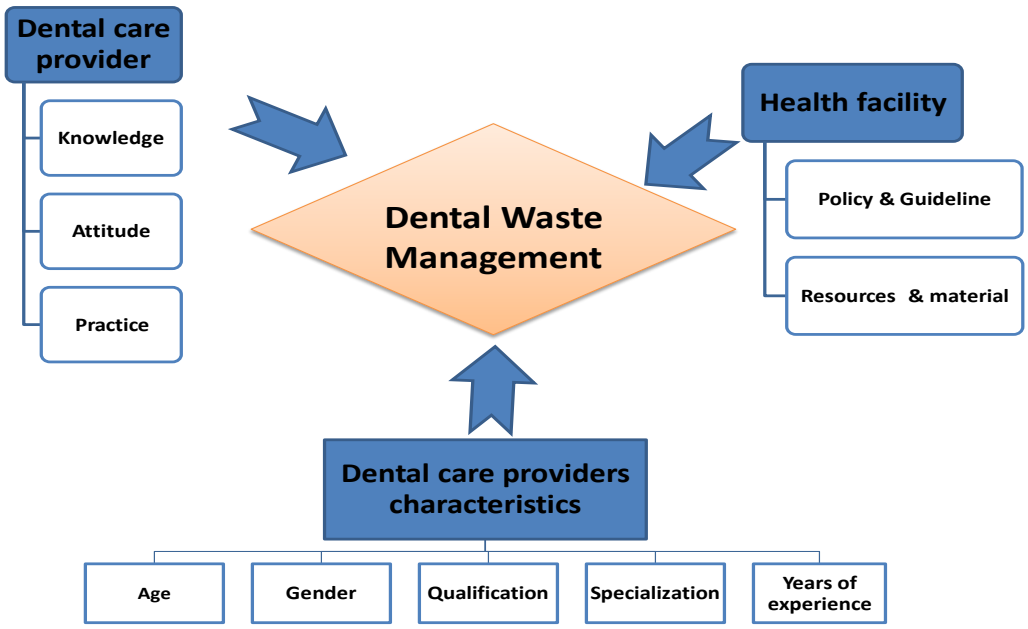


Figure (2.1) Self-developed conceptual framework

2.1.3 Health facility

Policy and guidelines: Dental waste management is established effectively and efficiently in the presence of policies and guidelines. Dental waste management require active participation and co-ordination between governmental and non-governmental

sectors, and the health care workers. Governmental agencies should have a monitoring program to evaluate the dental waste management and the dentists methods of disposing. In addition, To ensure improvement and continuity in management practices, it is of utmost importance that healthcare institutions develop clear plans and policies for the proper management and disposal of medical waste. These policies need to be integrated into routine employee training, continuing education, and management evaluation processes for systems and personnel.

Availability of resources and materials: the management of dental services needs adequate and qualified team in addition to available of resources and material to managed it according to slandered process which is considered another variables which affect on dental waste management. For example, in-available of bags, gloves and sharp boxes, intend the dental workers to disposal it or generation it without separation.

2.2 Literature review

2.2.1 Defining medical wastes

There are different concepts of waste management. WHO (2014) defines medical waste as waste produced by health care activities including a wide range of materials, from used syringes and needles to soiled dressings, diagnostic samples, body parts, pharmaceuticals, chemicals, blood, medical devices and radioactive materials. Moreover, Medical waste tracking act of 1988 defined it as any solid waste that is generated in the diagnosis treatment or immunization of humans or animals in research pertaining there to, or in the production or testing of biological agents (Ferraz and Afonso, 2003). Furthermore, it defined as the disposal of any human infectious agent or equipment that is capable of spreading that disease to humans (Al-Khatib, 2007).

Medical waste is composed of waste that is produced because of any of the following actions: diagnosis, production or testing of biological, accumulation of properly contained home-generated sharps waste, and removal of a regulated waste from a trauma scene by a trauma waste management practitioner (Matin, 2006). Likewise, medical wastes comprise those wastes from animals intentionally exposed to pathogens; bulk human blood and blood products (Duan et al., 2008).

Regulated medical waste shall mean any of the following waste which is produced in the diagnosis, treatment or immunization of human beings or animals, or in production and testing of biological, provided though, that regulated medical waste shall not include hazardous waste identified or listed pursuant to Section of the Environmental Conservation Law, or any household waste promulgated under this section (Felicia et al., 2008).

2.2.2 Types of medical waste

2.2.2.1 Clinical Waste:

Clinical waste is defined under the Controlled Waste Regulations (1992) as: *"Any waste which consists wholly or partly of human tissue, blood or other bodily fluids, excretion, drugs or other medicine products, swabs or dressings or syringes, needles or other sharp instruments being waste which unless rendered safe may prove hazardous to any person coming into contact with it" and; "Any other waste arising from medical, nursing, dental, medicine or similar practice, investigation, treatment, care, teaching or research, or the collection of blood for transfusion being waste which may cause infection to any person coming into contact with it"* (Kettering Borough Council, 2015).

Clinical waste also defines as any waste that contains wholly or partly of human or animal tissue, blood or other body fluids, excretions, drugs or other pharmaceutical products, swab or dressings, syringes, needles or other sharp instruments. Clinical waste means any waste arising from medical, nursing, dental, veterinary, pharmaceutical or similar practice, investigation, treatment, care, teaching or research, or the collection of blood for transfusion, being waste which may cause infection to any subject coming into contact with it (National Health Service, 2012).

Clinical waste is further categorized into: (1) Animal waste: waste arising from the whole or any part of an animal, or excreta. (2) Sharps waste: objects or devices having sharp points or protuberances or cutting edges capable of causing a penetrating injury to humans. (3) Human tissue waste: body tissue, organs, limbs and any free-flowing liquid body substance e.g. blood; Excludes teeth, hair and nails. (4) Laboratory waste: a specimen or culture discarded in the course of medical, dental or veterinary practice or

research, including genetically manipulated material and imported biological material or any material grossly contaminated thereby (Australian / New Zealand Standard, 1998).

2.2.2.2 Related waste

Other wastes produced within health care sites which are contaminated with cytotoxic drugs or other pharmaceuticals, chemicals and radioactive materials and can be further categorized into: (1) Chemical waste: waste material generated from the use of chemicals in medical, dental, veterinary, laboratory, ancillary and disposal procedures. (2) Cytotoxic waste: waste material, including sharps, contaminated with a cytotoxic drug. (3) Radioactive waste: Waste material, including sharps, contaminated with a radioisotope which arises from the medical or research use of radionuclide, e.g. during nuclear medicine, radioimmunoassay and bacteriological procedures, which may be of solid, liquid or gaseous form, and which emit a level of radiation above the level set by regulatory authorities as exempt (WHO, 2015; Department of Environment and Heritage Protection, 2015).

2.2.2.3 Recyclable Waste

Are those products, packages or element thereof that can be diverted from the waste stream and through existing processes, be collected, processed and returned to use in the form of raw materials or products.

2.2.3 Sources of medical wastes

It is well recognized, that hospitals, clinics, laboratories, veterinary clinics and many more establishments have to dispose waste materials that have been produced in the process of medical care and treatment (Abdulla et al., 2008). With the proliferation of blood borne diseases, more care being focused on the issue of infectious medical waste and its disposal, health care organizations must be conscious of the possible risk in

handling infectious waste, and adhere to the uppermost standards of disposal and transport. Education of the teams, clients and community about the management of the infectious waste is a vital in today's health care arena. With increasing awareness in general population about hazards of waste, public interest, litigations was filed against erring officials. Some landmark decisions to streamline clinics waste management have been made in the recent past (Mani, 2006). Different types of health-care facilities can also be viewed as major or minor sources of health-care waste, according to the quantities produced. The major sources are listed below:

2.2.3.1 Major sources of health-care waste

The major source of health care waste is a hospitals including university hospital, general hospital, and district hospital. The other health care facilities that included emergency medical care services, health-care centers and dispensaries, obstetric and maternity clinics, outpatient clinics dialysis centers, long-term health-care establishments and hospices, transfusion centers, military medical services, and prison hospitals or clinics. In addition, related laboratories and research centers is another major source of health care waste that included: Medical and biomedical laboratories, Biotechnology laboratories and institutions, and Medical research centers. Other major sources of health care waste are mortuary and autopsy centers, animal research and testing, blood banks and blood collection services, and nursing homes for the elderly.

2.2.3.2 Minor sources of health-care waste

Minor and scattered sources produce some health-care waste, but their quantities and composition will vary. These sources typically have some common features: they rarely produce radioactive or cytostatic waste, human body parts are not normally produced, and sharps consist mainly of hypodermic needles. The minor sources are

included (1) Small health-care establishments, including: first-aid posts and sick bays physicians' offices, dental clinics, acupuncturists, and chiropractors. (2) Specialized health-care establishments and institutions with low waste generation, including: convalescent nursing homes, and psychiatric hospitals disabled persons' institutions. (3) Activities involving intravenous or subcutaneous interventions that including: Cosmetic ear-piercing and tattoo parlours, and Illicit drug users and needle exchanges. (4) Funeral services, Ambulance services, and Home treatment is also a minor source of health care waste.

2.2.4 Wastes associated with dental clinics

There is a two forms of dental waste, liquid waste and solid waste (Darwish and Al-Khatib, 2006). They are additional categorized into two main groups: Non-risk waste and risk waste. Risk waste is infectious waste and hazardous waste (Iliyas, 2001). The waste supposed to hold the pathogen in sufficient concentration producing disease in susceptible hosts is considered as infectious waste (Vieira et al., 2011). Hazardous waste comprises metals that are toxic and never degrade once they reach the environment. It consists of silver, lead, mercury, X-rays and cleaning solutions (Taiwo and Aderinokun, 2002).

Improper disposal of dental waste can cause harm to the dentist, to the people in the immediate vicinity of the dentist who handle the materials, to the waste handlers or the general public at large through production of toxins through incineration. But most chemical waste streams generated in dental clinics can be managed as nonhazardous waste, if proper disposal guidelines are followed (Agarwalet al., 2012).

2.2.4.1. Risk waste (Infectious waste and hazardous waste)

The infectious waste consider the most important dental solid wastes as include sharps, amalgams, and other contaminated materials with blood and other infectious body liquids such as saliva, urine and excrement (Farmer, 1997). The infectious wastes or the potentially infectious wastes are the sharp objects like dentistry probes and drills, needle tips, needles, surgery blades and scalpels (Komilis, 2009).

Amalgam:

Dental amalgam, sometimes referred to as "silver filling," is a preparation of mercury, silver and tin with small amounts of copper and zinc and is well known in dentistry since the early 1800s (Mackey et al., 2014). It is made of two nearly equal parts: liquid mercury and a powder containing silver, tin, copper, zinc and other metals. Amalgam is one of the most commonly used tooth fillings, and is considered to be a safe, sound, and effective treatment for tooth decay. Amalgam elements are a source of mercury, that is recognized to be a neurotoxic, nephrotoxic, and bio-accumulative element. It can get into the environment over waste water, scrap amalgam or vapors . The mercury in amalgam can be released in the air, in water and as a solid. Mercury is identified to be neurotoxic and nephrotoxic (Clifton, 2007).

Dental amalgam particles used throughout placement or removal of amalgam fillings are often disposed of in sewers or with municipal waste, and pollute water and soil (Mackey et al., 2014). After incineration, mercury may be emitted to the air from the incinerator stacks. And finally, if mercury-contaminated sludge is used as an agricultural fertilizer, some of the mercury used as fertilizer may also evaporate to the atmosphere. Through precipitation, this airborne mercury eventually gets deposited onto water bodies, land and vegetation. Some dentists throw their excess amalgam into

special medical waste (“red bag”) containers, believing this to be an environmentally safe disposal practice. If waste amalgam solids are improperly disposed in medical red bags, however, the amalgam waste may be incinerated and mercury may be emitted to the air from the incinerator stacks. This airborne mercury is eventually deposited into water bodies and onto land (Environmental Protection Agency, 2016). Elementary mercury which ends up in the wastewater is converted by natural process to methyl-mercury which is the most toxic form of mercury.

Dental professionals are exposed to mercury vapour, and studies in this population have shown the presence of elevated levels of mercury in the urine as well as occurrence of neurological symptoms, respiratory disorders and other symptoms of intoxication (Natasha et al., 2016). WHO identified mercury as one of the top ten chemicals that can be harmful to the health (WHO, 2013). Concern about the effects of mercury in the environment has increased over the years, Mercury in the environment is bio accumulative, which means that it released into the air and collects in the waterways, where it enters the food chain and can build up in fish and cause health problems in humans and other animals that eat fish (American Dental Association-ADA, 2010). WHO also estimated that mercury from amalgam and laboratory devices accounts for 53% of total mercury emissions (WHO, 2014), Mercury is a highly toxic substances, if inhaled may be fatal and if absorbed through the skin may be harmful, around 80% of the inhaled mercury vapor is absorbed in the blood through the lungs which lead to harmful effects to the nervous, digestive, respiratory, immune systems and to the kidneys, besides causing lung damage. Adverse health effects from mercury exposure can be: tremors, impaired vision and hearing, paralysis, insomnia, emotional instability, developmental.

The guide line of “Best Management Practices for Amalgam Waste” has published a special guide to manage amalgam waste which reported that: Although mercury from dental amalgam is stable, it should not be disposed of in the garbage, infectious waste “red bag,” or sharps container, also it should not be rinsed down the drain. And it considered that these cautions are important due to some communities incinerate municipal garbage, medical waste, and sludge from wastewater treatment plants as mercury can be released to the environment due to the high temperatures used in the incineration process. The good news is when amalgam waste, kept free from other waste, can be safely recycled (ADA, 2010).

Silver:

Silver is another heavy metal that can enter our water system via improper disposal of dental office waste. Although silver is a component of dental amalgam, the silver thiosulfate in radiographic fixer (a solution normally used in the processing of dental radiographs) presents a greater environmental concern.

Unused films (Unused film should also not be placed in the general waste) contain un reacted silver that can be toxic in the environment. With recent advances in radiographic technology, digital imaging is becoming a popular means of obtaining dental radiographs. Among its advantages are reduced radiation exposure and the absence of chemical image processing. Therefore, incorporation of digital imaging within the dental office can greatly reduce the amount of silver waste generated. It is advisable to collect any unused film that needs disposing in a recommended container for recycling by the disposal company. Using a digital X-ray unit minimizes purchase of new X-ray films (Clifton, 2007).

Lead:

Lead, like mercury and silver, is toxic and persists in the environment. Even at low levels of exposure, lead exerts adverse health effects on both children and adults. The lead foil inside X-ray packets and lead aprons comprise leachable toxin which can pollute soil and groundwater in landfill locations after disposal. These should only be handed over to CWC. High doses of lead intake lead to reproductive toxicity, neurotoxicity, carcinogenicity, hypertension, renal function, immunology, toxic kinetics (Gidlow, 2004). Reducing environmental lead contamination by dental practitioners is an inexpensive and easy task.

Also from the hazardous waste X-ray fixer used in the dental clinics to develop X-rays, it is a hazardous material that should not be simply rinsed down the drain (Hörsted, 2004). After de-silvering the fixer, it can be mixed with developer and water and disposed down the sewer or septic system, spent developer is permitted to be discharged in the above systems after dilution with water. Using a digital X-ray unit and an X-ray cleaner without chromium are other suggested safety measures (Clifton, 2007).

Undeveloped X-ray films contain a high level of silver and must be treated as hazardous waste. It is advisable to collect any unused film that needs disposing in a recommended container for recycling by the disposal company. Using a digital X-ray unit minimizes purchase of new X-ray films (Clifton, 2007).

The lead foil inside X-ray packets and lead aprons contain leachable toxin which can contaminate soil and groundwater in landfill sites after disposal, therefore it should be only handed over to certified biomedical waste carrier (Gidlow, 2004). High doses of lead intake lead to reproductive toxicity, neurotoxicity, carcinogenicity, hypertension, renal function, immunology, toxic kinetics, etc.

Blood-soaked/dripping gauze:

Is a biomedical hazardous waste. It should be enclosed in a yellow biomedical waste bag covered with a double bag, labeled with a biohazard symbol and refrigerated, if onsite for more than 4 days. Once accumulated, certified biomedical waste carrier should be contacted for disposal (Pasupathi et al., 2011).

Sharps:

(Needles, glass carpules, burs, acid etch tips, files, blades and other sharp objects): Their waste management includes collection in a red or yellow puncture resistant container with a lid that cannot be removed. The container should be properly labeled with biohazard symbol and once full, the certified biomedical waste carrier should be contacted for disposal (Blenkharn, 2006). Since needles and sharp instruments are an essential part to provide today's health care, injuries from these objects are a major concern to the dental workers because of possibility transmission of blood-borne viruses (Ali, Fathollah and Heshmatollah, 2014).

All sharps must be disposed using the appropriate guidelines. Proper disposal will minimize possible puncture wounds on other workers handling these wastes such as cleaners and waste carriers. Its management can be done by collecting sharps in a red or yellow puncture resistant container with a lid that cannot be removed, the sharps container should be properly labeled with biohazard sign (Bhaskar et al., 2011), once container is full, contact a certified biomedical waste carrier for disposal, don't throw sharps in a regular garbage bag, do not place other biomedical wastes materials in this container (Gordon et al., 2004).

Chemicals, disinfectants, and sterilizing agents:

Staff handling these materials should be trained in Workplace Hazardous Materials Information System (WHMIS). Whenever possible, use steam or dry heat to sterilize dental instruments. No chlorinated plastic containers (not PVC) should be preferred to minimize environmental impacts and placed in the solid waste stream. Halogenated sterilants have a detrimental effect on environment. Ignitable sterilants should not be poured down the drain as they have potency to explode. HCHO sterilants should also not be disposed down a drain. One should not pour sterilants into a septic system as this may significantly disrupt the bacteria which normally breakdown wastes (Agarwal et al., 2012).

2.2.4.2 Non-hazardous wastes:

According to Mushtaq et al. (2008) and AL-khatib and Sato (2009) opined that non-risk waste are not infectious and non-hazardous, and it comprises mainly office solid waste that originates from Dental clinics and do not contain any substance that would pose a hazard to mankind/animal health or to the environment, the typical components of non-risk waste are paper, cardboard, plastics, wood, food waste, glass and metal, these types of waste can be recycled or put into the trash and disposed of as regular non-risk waste.

Non-dripping gauze and extracted teeth are not considered biomedical waste and can be dispose of directly into the garbage (Bhaskar et al., 2011**)**, when gauze is blood soaked and dripping blood, it become a biomedical hazardous waste. Its management can be done by using a yellow biomedical waste bag, by applying double bag for the waste, by labeling the bag with a biohazard sign.

2.2.5 Classification of hazardous dental waste

Different fractions of dental waste found in dental clinics, such fraction are domestic type (general waste), potentially infectious, toxic and chemical and pharmaceutical wastes (Kooliv et al., 2014). Fractions are included: Potentially infectious wastes: the component of this fraction are blood-contaminated paper towel, saliva-contaminated paper towel, blood-contaminated gauze, saliva contaminated gauze, blood-contaminated cotton, saliva-contaminated cotton, blood contaminated dental roll, saliva-contaminated dental roll, nylon glove, latex glove, syringe, saliva ejector, sharps and needles, extracted teeth, dental mirror, surgical blades, tongue blade, inseparable components. Also, Chemical & pharmaceutical wastes: the component of this fraction are using medicine ampoules, wax, dental impression material, calcium hydroxide. Additionally, Toxic wastes*:* the component of this fraction are amalgam-contaminated paper towel, amalgam-contaminated gauze, amalgam contaminated cotton, amalgam contaminated dental rolls, film packet's lead foil, amalgam particles, radiography film, inseparable components. Furthermore, Sharp wastes: it included syringe and needles, saliva ejector, extracted teeth, dental mirror, surgical blade, tongue blade. And Domestic/general wastes: it consisted paper, cardboard, plastics, wood, food waste, glass and metals, these types of waste can be recycle or put unto the trash and disposed of as regular non-risk waste (Kooliv et al., 2014).

2.2.6 Dental waste management control plan

Waste management must be a part of all practice's written exposure control plan. Components of the plan would include assignment of risk, types of regulated waste, isolation schemes, handling and storage, neutralization, contingency planning, and community relations (Palenik, 2016).

Assignment of risk. Infectious waste is defined as waste capable of producing an infectious disease. It is also known as regulated waste (regulated by a governmental agency). Regulated waste needs that special disposal actions be used. Except for a relatively limited number of items, dental waste can be disposed of using regular waste storage, removal, and disposal schemes.

Types of regulated waste. For dental offices, there are five types of regulated waste. These include: 1) Bulk (in liquid or semi-liquid form) blood or blood products and other potentially infectious materials, including saliva; 2) Items soaked or caked with blood/saliva; 3) Pathologic waste including exfoliated or extracted teeth; 4). Used sharps, such as injection needles and scalpel blades; and 5) Potential sharps, including used anesthetic carpules that could contain aspirated blood and possibly break.

Isolation schemes. Regulated waste should be isolated. Regulations need that properly designed sharps containers or biohazard bags be employed (Palenik, 2016).

Handling and storage. Dental offices should have written policies and should properly train all affected employees. Regulated waste should be stored in a secure area, and should not be kept for more than 30 days. In almost all locations, liquid or semi-liquid blood can be evacuated into the practice's waste water system. Sink traps and evacuation lines should be rinsed daily. Using an environmentally compatible disinfectant would also be helpful (Palenik, 2016).

Neutralization. Many areas allow for in-house treatment of regulated dental waste. Moist heat must be used, and sterilizers must be biologically monitored regularly. Sharps containers should be left open, no more 3/4 filled, and then processed in an upright position through two consecutive sterilization cycles. Containers are then labeled as "treated" and can be placed with the non-regulated waste. Unless quite large,

biohazard bags can be treated in a single sterilization cycle. Teeth without amalgam restorations can be put into sharps containers or small biohazard bags and processed. If amalgam is present, the teeth should be immersed in a fresh tuberculocidal disinfectant solution for 30 minutes, rinsed well, and disposed of or returned to the patient (Palenik, 2016).

Contingency planning. Offices should anticipate interruptions in their waste management program. It is always best if contingency plans are written and utilize those personnel trained to respond to these situations. Offices should also be ready to deal with spills, sterilizer breakdowns, and waste haulers who fail to appear.

Community relations. Many people are averse to the sight of blood and sharps. Properly treated regulated waste should be placed into some type of container, like a cardboard box. The actual contents would then be concealed (Palenik, 2016).

2.2.7 Public health risks associated with dental waste

The proportion of dental waste can meaningfully contribute to the amount of pollutants produced in an environment if its discarding is not well managed. Furthermore, there is cross- infection risks connected with mismanaged waste. Such cross infection may be from human scavengers who are stated to visit waste dunghills to pick victuals (Coker et al., 2009).

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

Hazardous wastes such as chromium, cadmium and amalgam have been identified to have adverse effects on persons. Chromium is recognized to have a potential to cause liver, kidney and respiratory damage while cadmium may cause kidney disorders and lung cancer (Michael et al., 2010).

Amalgam is not only one of the major hazardous wastes generated at dental clinics, it also acts as a neurotoxin and is considered to be the most toxic non-radioactive element and the most volatile heavy metal known in nature (Al-Khatib and Darwish 2004). Other possible harmful effects of dental amalgam include oral galvanism, soft tissue toxicity, allergen city and ecological grievances (Rao, 2008).

Mercury is highly toxic to human and wildlife. In humans, mercury is toxic to the nervous system (brain and spinal cord), mostly the developing nervous system of a fetus or young child. Effect seen in children with elevated mercury exposure include lowering cognitive abilities, impaired hearing, Poor coordination. Chronic, elevated exposure to mercury also affects the kidney, liver and immune system. Routinely used consumables such as gloves, rubber dams and other chlorine-containing materials are usually disposed of by means of incineration. This process isknown to release vapors containing dioxin, which has been associated with cancer, defects in reproductive and foetal development, neurotoxicity, hormonal and immune disorders (Floret et al., 2003). Mercury also has adverse effects on gastrointestinal, respiratory, immune and renal systems and pregnant and lactating women and children are more susceptible to mercury exposure. Silver used in radiographic fixer solutions can negatively affect the environment. Lead also can have adverse effects, especially on water ecosystem (Danaei, 2014).

Lead, another heavy metal commonly used in dental clinics has been implicated in causing neurological disorders in children and reproductive problems among women following either acute or chronic exposure (Danaei, 2014).

2.2.8 Environmental risks associated with dental waste

Discarded waste that finds itself in landfills can lead to soil and underground water pollution. Darwish and Al-Khatib (2006) supported that mercury is an important constituent of amalgam filling material and is one of the main concern because of the many ways (like the un-used filling material or incinerated amalgam waste or an extracted amalgam filling which has been removed from the tooth) the chemical can come into contact with soil, water, surface water, and air as a result of improper disposal. When mercury waste is incinerated, the volatilized mercury precipitates to the environment and will arrive the soil, surface water and food chain. When mercury waste is disposed of down the drain, there is potential for pollution of water and/or sludge at the wastewater treatment plant or septic system. Mercury can furthermore lead to accumulation in both aquatic and terrestrial food webs when released to the environment and the amount will depend on the size and age of the organism (Babanyara, et al., 2013).

For these reasons, knowledge of waste disposal mechanisms, proper management alternatives and environmental impact assessments are necessary for proper waste management. In most technologically advanced countries of the world, the management of dental waste is a well-established, controlled and monitored process (Michael et al., 2010).

2.2.9 Steps in waste management

Park (2009) identified a seven step for treatment bio-medical waste as following: (1) Waste survey: Quantification and differentiation of waste. (2) Waste segregation: Placing different wastes in different containers. (3) Waste accumulation and storage: Accumulation temporary holding and storage longer holding. (4) Waste transportation: Wastes are carried in special containers in vehicles. (5) Waste treatment: A process that modified the waste to disinfect or decontaminate the waste so that they are no longer a source of pathogens and can be handled, transported and stored safely. (6) Waste disposal: Incineration, microwave irradiation, chemical disinfects, wet and dry thermal treatment, inertization and land disposal. (7) Waste minimization: Following reduce, reuse and recycle methods.

2.2.10 Global perspective of dental waste management practice

In a recent study conducted in Iran by (Ali et al., 2014) they stated that the total dental waste production in dental offices is 87.09%. Where, general dental offices, specialist dental offices and dental clinics are responsible for 67.68%, 20.58%, and 11.74% of this amount respectively. Furthermore, the percentages of different fraction of waste in dental clinics such as domestic-type, potentially infectious, toxic, and chemical and pharmaceutical waste represented 40.72%, 39.32%, 13.58%, and 6.38% of the total waste production (Ali et al., 2014) . This shows that the generation rate of dental waste in Iran is very low. While the amount of dental waste is small in comparison with municipal waste, the treatment and disposal management of dental waste due to it hazardous characteristics is essential. Findings indicate that there was no effective activity for waste minimization, separation, reuse and recycling in the dental centers in Iran. Management of sharps, potentially infectious and other hazardous waste was also not proper and these items were collected and disposed along with domestic waste.

Other findings indicate that improper disposal of sharps and amalgam was widespread among the clinics as these items were discarded with general garbage. Due to the absence of silver recycling companies or silver recovery unit in Iran, x-ray fixer solution was disposed in the drain.

In Nigeria, study conducted by Michael et al, (2010) they recognized that 78.6% of the respondents claimed that no provision had been made for dumping the waste in an environmentally friendly manner. The waste disposal knowledge of the cleaners on the associated danger of operating open disposal site was remarkable, 78.6% knew that there was a high possibility of contacting infections from such site. Likewise 42.9% had on some occasion stated seeing scavengers picking victuals from the disposal site. This shows that there are no proper minimization, reuse, segregation and recycling program for the proper management of dental waste in Osun state.

2.2.11 Domains assessment dental waste management

Based in the literature review, the researcher included five domains may be influencing on dental waste management which included; availability of resources and material, training of dental teams, policy of dental waste management, knowledge about proper dental waste management procedure, and practice of dental team.

2.2.11.1 Knowledge of dental practitioners:

Dentists should have the information about properly dispose of mercury and amalgam waste, and how to managing the other wastes that result from the day-to-day activities of a dental office such as: X-ray fixers and developers; lead foils, shields and aprons; chemical sterility solutions; disinfectants cleaners, and other chemicals; and, general office waste. WHO estimated that 75%-90% of wastes that generated from the health care services are general wastes, and the remaining 10%-25% are classified as

hazardous wastes which may risky to the population (WHO, 2013). A large amount of wastes are produced from the daily activities in dental clinics most of these wastes are nonhazardous which can be managed easily, but the other are risky to humans and the environment (Eve and Cuny, 2012).

As dentists are educated a lot they have some responsibility toward their surroundings, The way they dispose of waste affects the quality of the environment that convey to our children and their children (Baghele, 2013). Adequate knowledge about the hazardous medical waste, proper technique and methods of handling the waste, and practice of safety measures can go a long way toward the safe disposal of hazardous waste and protect the community from various adverse effects of the hazardous waste (Vanesh, 2011).

In India, a large proportion of the dentists are not practicing a proper methods of dental waste management, It found that some of problems that faced a good health waste management was due to lack of concern, motivation, awareness of practitioners and the cost factor (Khandelwal, et al., 2013). However, by another study was also made in India showed that majority of dentist are practicing improper methods of waste disposal while they were aware about hazardous effect of improper dental waste management (Arora et al., 2014), which noted that there is need to training the dental team about proper methods of dental waste management and the hazardous effect of improper waste disposal. Likewise, In India especially Bangalore city, study conducted to assess the attitude of waste management among staff of dental hospitals in Bangalore city. Finding shows, 82.6% of attenders said that it is necessary to segregate waste into different categories at the point of origin, 61.5% of auxiliaries strongly disagreed that segregation of waste at source increases the risk of injury to waste handlers. As many as 33.5% of dentists strongly disagreed that segregation of waste at source increases the

risk of injury to waste handlers and 53.6% agreed that segregation of waste at source does not increase the risk of injury to waste handlers (Rudraswamy, Sampath and Doggalli, 2012).

Inadequate and inappropriate handling of dental health-care waste may have serious public health problems and in addition it has a significant impact on the environment causing pollution of water, air, and soil (Baghele, 2013). The increasing number of dentists in urban areas and increased awareness amongst the public about the dental treatment, so the need today is to educate the dentists to the various types of waste, their generation, segregation, collection, transportation, and final disposal.

Minimizing the effect of dental waste is strongly related to the behavior of the dental team that practicing to manage this waste. In Palestine, dental waste with other medical waste are often disposed as a part of solid waste management system which collected and dumped into uncontrolled landfill (Darwish and Al-Khatib, 2006).

2.2.11.2 Practicing of dental teams

Dental practices must ensure that the full range of waste generated is properly, legally, safely and effectively disposed of, ensuring that risks or potential risks of contamination or infection both within and external to the practice are minimized.

The dental practice has a statutory duty of care. This means everyone in the waste management chain from producer to disposer. Dental practices are to take all reasonable measures to ensure that waste is dealt with appropriately from the point of production to the point of final disposal. The dental practices responsibility does not end when your waste collector removes your waste.

In Poland, Bansal, Vashisth and Gupta researcher conducted study in (2013) to assess the awareness and practices of dental care waste management among private dental practitioners, showed that nearly 14% of the dental practitioners were not aware of the different categories of the waste generated in their clinics and 12% of the practitioners were not aware of the color coding used to dispose the waste. About 26% of them practiced wrong measures to dispose sharps and extracted tooth respectively. A majority 32% of Dentists did not disposed outdated and expired medicines properly. The study concluded that majority of the dental practitioners was aware of categories and color coding used for disposal of different types of wastes yet they do not follow the same in their practice. Hence, strict prosecution laws should also be imposed under biomedical waste management act for the Dentists so that it should be implemented in daily practice.

2.2.11.3 Policy of dental waste management

As clinical waste comes from different types of health care services and it is dangerous therefore it is important to practice special caution when handling and managing of clinical waste to minimize its potential danger to public health or pollution to the environment (Khanehzaei and Ishak, 2014). Health care waste management require active participation and co-ordination between governmental and non-governmental sectors, and the health care workers (Baghele, 2013). To ensure improvement and continuity in management practices, it is of utmost importance that healthcare institutions develop clear plans and policies for the proper management and disposal of medical waste. These policies need to be integrated into routine employee training, continuing education, and management evaluation processes for systems and personnel. All national policies and strategies aim to implement the waste management prioritizes. This prioritizes waste options in terms of environmental impact. These policies

priorities waste management options in terms of environmental impact. The first step in good waste management practice is to prevent or minimize the waste we produce. If waste production cannot be prevented then reuse and recycling are the next preferable options. Generating energy from waste is the next option, while the least flavored option is disposal.

Countries without a national policy show lack of a systematic medical waste management plan and tend to deviate from medical waste management principles on the segregation, collection and disposal of medical waste because of the lack of a national policy (Hassan et al., 2008). Without a national policy, there is the danger of differences within countries on how medical waste is defined, classified, segregated, collected, treated and disposed of. The absence or presence of a national policy is evidence of the lack of attention given to medical waste within a particular country

Dental waste management policy was formulated in order to effectively manage waste generated as a result of clinical and non-clinical activities within the Trust. The aims of this policy are to allow the Trust, to comply with the Environmental Protection Act 1990 and other associated legislation, to comply with Health Technical Memorandum: Safe management of healthcare waste, to confirm compliance of segregation in both local and centralised management processes, offer all staff with explicit direction in the safe handling and disposal of all wastes in line with health and safety and infection control requirements and fully aware of their responsibilities, to ensure that appropriate governance arrangements are in place, to reduce the impact that the Trust's business has on the environment by managing the volume of waste requiring disposal and facilitate the hierarchy of waste management, and to ensure that, where practicable and cost effective, waste is segregated to facilitate recycling (National Health Service, 2012).

In Libya a study shown that surveyed hospitals all lacked regulations regarding the disposal of medical waste. The dumping sites lacked fences to prevent access by stray animals and waste reclaimers. These medical waste dumping sites were located near agricultural areas and occasionally near residential areas (Sawalem et al., 2009). Managing of hazardous waste costs time and money, one of the most effective and economical means of managing hazardous waste is through implementation of hazardous waste reduction strategies (Eve and Cuny, 2012). It is important to know that if dentist practices gain short term benefits from cheap disposal of wastes in the air, land, fresh water, seas or even outer space, it may pass on staggering costs on to future generations, which must either try to cleanse the disposal sites or abandon them altogether (Baghele, 2013).

2.2.11.4 Training of dental teams

Training and capacity building of health-care staff are vital in the efforts to minimize the transmission of secondary infections. Staff training hints to a more informed workforce, which is the foundation for achieving higher standards of infection control. Knowledgeable staff can also help patients and visitors to understand their role in maintaining good hygiene, and to become more responsible for the wastes they produce. Training and continuing education are integral parts of the medical waste-management system. When staffs are properly sensitized to the importance of waste management, they become advocates for best practices, and help to improve and sustain a good waste-management system. Significantly, training should be established and become part of the standard functions of the health-care facility. Training is thus linked to health-care quality improvements, institutional policies and procedures, human resource development including staff performance evaluations, and facility organization

to ensure that someone takes responsibility for the training programme (Chartier et al., 2014).

Staffs who handle medical waste are at a much more risk of exposure to possibly infectious waste. Poor medical waste management practices start with the clinical staffs who produce the waste without proper knowledge of the potential risks or access to necessary protective gear, comprising the workers who collect and transport the wastes through the hospital, the staff who operate a hospital incinerator or who take the waste to municipal bins, the municipal workers who collect waste at the municipal bins and transport it to various dumping sites, and the waste pickers who represent the informal waste management sector, nevertheless play an important role in reducing the amount of waste disposed of. All these persons, whether they are formally or informally part of the health care waste system, are involved in the waste management system and their personal safety and health must be considered. Proper education and training on handling medical waste and the risks involved should be provided.

Medical waste handling is a hazardous waste activity which needs a high standard of training. It calls for specific training that depends on the nature of the work in the institution, the hazards and possibility of worker exposure, and the responsibilities of individual workers (Manyele and Anicetus, 2006). The training must not only be continuous, but also comprehensive, integrated and structured with the necessary elements.

A study conducted in GS revealed that there are a problem in training of health care teams about handling the medical waste, also showed that there is deficiency in implementing training courses about healthcare waste management as 23% only of all study subjects had been provided with training on how to deal with medical waste. (Sarsour et al., 2014).

The results of a study conducted by Dehghani et al. (2008) in Iran presented that none of the interviewed health facility supervisors had been trained on medical waste management. If the supervisors lack knowledge and training on medical waste management, this in turn leads to a lack of training of staff members in junior positions, as well as lack of good monitoring and enforcement of medical waste management procedures and guidelines.

A study conducted in Nigeria shown that the staff handling infectious medical waste in some of the health care facilities opted to carry the waste themselves without any protective gear (Coker et al., 2009). This in itself shows the lack of awareness and knowledge about the potential risks involved in handling medical waste and indicates lack of training of staff handling waste in healthcare facilities. In Tanzania some of the health care facilities had the resources and equipment but, because of lack of awareness and poor management, they unsuccessful to segregate the waste appropriately (Manyele, 2010). A similar study in Bangladesh found that poorly trained waste handlers such as cleaners were subjected to occupational health risks because they were responsible for disposing amputated body parts from operation theatres collected in municipal general waste bins without any formal training (Harhay et al., 2009).

2.2.11.5 Availability of resources and material

The availability of proper waste equipment, such as sharps containers and personal protective equipment, goes hand-in-hand with training. Nothing can be more frustrating than to train health-care workers in proper segregation methods when the health-care facility has inadequate or improper containers, thereby hindering the staff from putting their knowledge into practice. Therefore, budgeting and procurement of equipment are also linked to training (Chartier et al., 2014).

2.2.12 Medical waste regulations and management in Palestine

Management of medical waste in Palestine was not given the appropriate concern (Khala, 2009). Most regulations classify solid waste originating from medical clinics into several sub-groups comprising household type waste, infectious waste, sharps, radioactive waste, nonhazardous chemical waste and hazardous chemical waste. Dental waste is often regulated under medical waste regulations (Palestinian Ministry of Environmental Affairs 2000; La Grega, Buckingham, and Evans, 2001). The main basis for dental waste management in the European Union is the Waste Framework Directive that requires Member States to take necessary measures to certify waste is disposed of without endangering human health or the environment.

By the end of 1994, Palestinian authority has focused at the issue of MWM because the donor countries have given Palestinian authority many incinerator to be used in treating medical waste in the WB and GS . Nonetheless the lack of experiences and maintenance in the Palestine territories made the operation of this equipment insufficient and un acceptable because of the emissions of smoke and smells that affect health and the environment of the area (Al-Khatib, 2003)**.**

In many areas of Palestine, the current practice of waste management is to dispose of dental waste along with other healthcare waste as part of the solid waste management system which is collected and dumped in uncontrolled landfills (Al-Khatib et al., 2007). In GS the segregation is done only for sharps and there are no color-coded bags. Medical waste is stored and disposed of with domestic waste in primary health care clinics and is incinerated in hospitals, but there are no emission control or safety measures, also there are some gaps in knowledge of health care workers, and current practices are inadequate (Massrouji, 2001). The operation of incinerators in Palestine

insufficient and un acceptable because of the emissions of smoke and smells that affect health and the environment of the area (AL-khatib and Sato, 2009).

In GS, a study aims to provide information about the management, segregation, storage and disposal of medical wastes in public as well as private hospitals. The results shows, that, healthcare facilities still suffer from inappropriate biomedical wastes management which have not received sufficient concern according to 60% of participants who pointed out that hazardous and medical wastes are still handled and disposed together with domestic wastes and segregation was applied only for sharp waste which is collected in special sharp boxes at the beginning after usage. Furthermore, 42% of respondents don't know if it's there mean for transferring medical waste, and 43% don't know its type or if it's available always. In the surveyed hospitals, there is deficiency in implementing training courses about healthcare waste management as 23% only of all study subjects had been provided with training on how to deal with medical waste. Therefore, the Ministry of Health and healthcare institutions should give more consideration towards policies for the proper management and disposal of health care wastes in order to develop medical waste management practices in Palestine (Sarsour et al. 2014).

In Nablus districts, study conducted by Issam et al (2009) detailed that large majority of dentists showed their incorrect disposal methods of newly placed and old removed amalgam fillings. The study additional highlights the potential threat caused by mercury pollution; 65.6% of the dentists disposed of newly placed amalgam in the trash whilst 23.6% flushed it down the drain. Additionally, 17.3% of the dentists flushed old removed amalgam down the drain through a coarse filter, 21.6% catch in the filter and then throw it in the trash, 52.2% distribute between the filter, drain and trash, and 4.5% throw it in the trash while only 4.4% catch it in a vacuum filter. Used fixer is discarded

down the drain or into the garbage, which is also done by dentists in the Nablus district; this poses a serious threat to the environment and human health. As such, the dental waste should be collected in a clearly marked container and should subsequently be recycled or treated as hazardous waste. The WHO recommendations require a silver recovery unit to be installed at the end of the X-ray processing unit.

Chapter (3) Methodology

This study aims to ascertain the status of medical waste management in private dental clinics in GGs. This chapter will address issues related to methodologies used to answer the research questions. The chapter commences with study design, study population, study setting, period of the study, sample size, and sampling. It presents construction of the questionnaire, piloting, ethical consideration, data collection and data analysis.

3.1 Study design

The design of this study is a quantitative descriptive, analytical cross-sectional. This type of design is useful for describing the study construct.. This design was chosen because it is the useful design and it is less expensive and enables the researcher to meet the study objectives in a short time.

3.2 Study population

The target population consists of all dental staff workers (dentists, dental assistants, nurses and cleaners) who are working in private dental clinics in the GGs at the time of the study.

3.3 Sample size and sampling process

According to the Palestinian Dental Association (2014), there are approximately 300 private dental clinics randomly distributed on the areas of the GS, which contain nearly three workers in every clinic, and so the total study population is estimated to be 900 workers. The researcher used Epi-Info sample size statistical calculator and the sample size equals 269 using the following parameter; Confidence level 95%, Interval 5% population size 900 (annex 2). The researcher increased the sample up to 280 individuals among dental workers to cover for possible non-respondents. The number of

respondents and agree to participate in the study was 276 out of 280 (Response rate was 98.5%).

3.4 Eligibility criteria

3.4.1 Inclusion criteria

The subjects who were included in this study are all dental team who were working in the selected study sites of the private sector and have contact with dental wastes.

3.4.2 Exclusion criteria

The subjects who were excluded in this study are all dental team who were working in Governmental, UNRWA and NGOs dental clinics.

3.5 Study setting

This study was carried out in five Gaza governorates including: North Gaza Governorate, Gaza Governorate, Deir Al-Balah Governorate, Khan-Yunis Governorate and Rafah Governorate.

3.6 Study period

The study is extended for 20 months; it would started in October 2014 and be completed by June 2016. Annex (3) describes the activities of the research and the duration for each activity.

3.7 Ethical and administrative considerations

The study respected the internationally recognized research ethical and administrative principles. The researcher obtained an ethical approval from Helsinki committee (annex 4). In addition, administrative approval was obtained from both Al-Quds University and the target dental clinics. Potential participants were informed about the

aim and procedure of the study, consent form was obtained from each participant in the study.

3.8 Pilot study

After considering the perspectives of the field-related specialists, a pilot study for the questionnaire was conducted before collecting the results of the sample. It provided a trial run for the questionnaire, which involved testing the wordings of the questions, identifying ambiguous questions, testing the techniques used to collect data, and measuring the effectiveness of standard invitation to respondents. The researcher conducted a pilot study on a sample of 30 participants, selected randomly from different clinics. Participants were asked to respond to the questions in the questionnaire and to indicate if there were any difficult confusing and/or ambiguous questions. The pilot participants were not included in the study.

3.9 Data collection methods (Study instruments)

A structured self-administered questionnaire was developed to gain information about the management of dental waste. It was distributed to 280 dental staffs who are currently working in private dental clinics during the time of the study. The data was collected by the researcher himself to avoid any possible bias.

The questionnaire was designed in English language (annex 5). In each questionnaire, an explanatory letter was attached to facilitate questionnaire filling. It consisted of three parts as follows:

1- The first part represented dental teams personal and demographic data
2- The second part concerned about policies and guidelines,

3- The third part represented knowledge, practice, and attitude of dental teams about of waste segregations, collection, transportation, treatment and final disposal practices.

A checklist was included inventory of waste management tools in the dental clinics which filled by researcher.

3.10 Validity and reliability of the instrument:

3.10.1 Validity:

We can term validity of an instrument as a determination of the extent to which the instrument actually reflects the abstract construct being examined. "Validity refers to the degree to which an instrument measures what it is supposed to be measuring". High validity is the absence of systematic errors in the measuring instrument. When an instrument is valid; it truly reflects the concept it is supposed to measure. Achieving good validity requires the care in the research design and sample selection. The questionnaire was reviewed by the supervisor and experts in the field public health, epidemiology, biostatistics, environmental health, and dentist to evaluate the procedure of questions and the method of analyzing the results (annex 6). The experts agreed that the questionnaire was valid and suitable enough to measure the purpose that the questionnaire designed for.

3.10.2 Reliability:

The following steps was done to assure instruments reliability:

♦ Training of data collectors on the dental staff interviewing steps and the way of asking questions. This will assure standardization of questionnaire filling.

♦ Then, the data entry in the same day of data collection would allow possible interventions

to check the data quality or to re-fill the questionnaire when required.

3.11 Data management and statistical analysis

The questionnaires were over viewed at first followed by data entry to the Statistical Package for Social Sciences version 20 (SPSS Inc., Chicago, IL, USA) by the researcher himself. The coded variables entered into the computer. Data cleaning was conducted to check for any missing or error data during entry (through running frequency analysis). All suspected or missed values were checked by revising the available questionnaire.

The collected data were analyzed using SPSS version 20. Many different statistical tests were used, through frequency of the study factors and description of the study population. Analysis included frequency tables, cross tabulations, and coding of data to disseminate the study factors. Advanced statistical analysis were conducted to explore the potential relationships between variables. Therefore, independent sample t-test and one-way ANOVA were used to investigate the relationships between the independent study variables and management of medical waste product from privet dental clinics.

Chapter (4) Results and discussion

This chapter presents the results and analysis of the most important statistical results that describe the characteristics of the study sample and those have been reached about the problem of the study, which aims to measure and determine "Assessment of Medical Waste Management at Private Dental Clinics in the GS".

4.1 Descriptive analysis

4.1.1 Demographic data of the study participants

A sample of 280 participants was included in the study who were different in their personal characteristics including location of the clinics, gender, age, qualifications, specialization, years of experience and if receiving any formal training courses about dental waste management.

As shown in Table 4.1 participants were distributed across GGs as 36.2% from the clinics located in Gaza, 18.5% located in the Middle, 16.7% located in Khan-Yunis, (16.3%) located in North Gaza, and (12.3%) located in Rafah.

With regard to gender, we notice that 61.2% of study population were males, while females represented 38.8%. Regarding the age of the respondents, we notice that, the age of the study population ranged from 20 up to 50 years distributed as 39.1% from the participants are from 20- less than 30 years, (42.8%) are from 30-less than 40years, (13.8%) are from 40-less than 50years, and (4.3%) are 50 years and more. As most of ages are considered in the youth group, this will make it easy to train and educate and to change attitude and improve practice of them on how to deal with dental medical waste. It is known that as the worker get older and exceeds the youth age, it will be more difficult to train him.

Table (4.1): Distribution of responses by demographic characteristics (n=276)

Demographic character	Frequency	Percent
Location-governorate		
North Gaza	45	16.3
Gaza	100	36.2
Middle	51	18.5
Khan Yunis	46	16.7
Rafah	34	12.3
Gender		
Male	169	61.2
Female	107	38.8
Age		
20 – less than 30 years	108	39.1
30 – less than 40 years	118	42.8
40 years and more	50	18.1
Qualification		
Diploma	25	9.1
Bachelor	236	85.5
Higher Education	13	4.7
Other	2	0.7
Specialization		
Dentist	243	88.0
Dental Assistant	4	1.4
Nurse	29	10.6
Experience years		
Less than 10 years	166	60.1
10 – less than 20 years	85	30.8
20 – years and more	25	9.1
Receiving any formal training courses about dental waste management		
Yes	29	10.5
No	247	89.5

According to the qualification and specialization, almost of the respondents (88%) were dentists and has bachelor degree. While (10.5%) was nurses and (1,4%) was dental assistant. the staffs had diploma (9.1%), and (4.7%) had higher education. The researcher attributed high percentage of participants to dentists compared to nurses and dental assistant to the majority of dentists depend on themselves for cleaning and arrangement the clinics not for other staffs to maintain the wage that will paid to

employee. In addition, most of clinics is new and small and have not fund to employee staff and paid for them , as seen by researcher the only big dental centers only employee staffs.

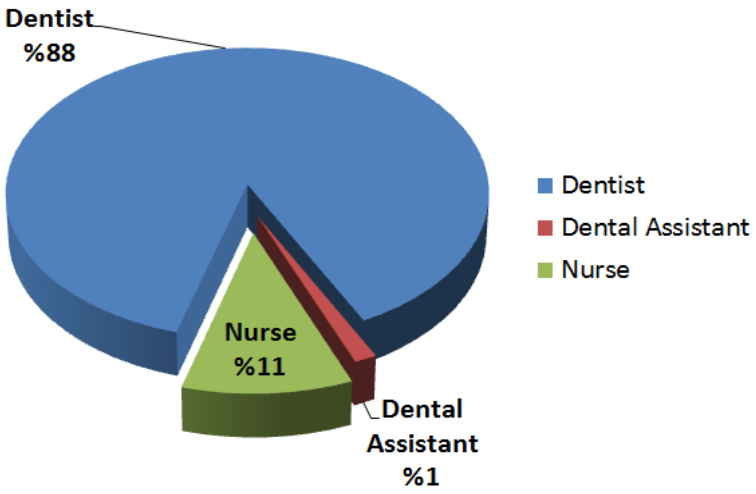


Figure (4.1) Percentage distribution of respondents by specialization

As illustrated in Table (4.1), (60.1%) from respondent has experience years less than 10 years, while (30,8%) ranged from 10 to 20 years of experience, (7.2%) ranged from 20 to 30 years and (1.8%) more than 30 years of experience.

Finally, in regarding the question that if they receive any formal training course about dental waste management the majority of respondents not received any training about dental waste management (89.5%) and only (10.5%) received training. Similar results were obtained from a study conducted in GS revealed that there are a problem in training of health care teams about handling the medical waste, also showed that there is deficiency in implementing training courses about healthcare waste management as 23% only of all study subjects had been provided with training on how to deal with medical waste. (Sarsour et al., 2014), likewise in Emirate of Ajman, study reported that around half (51.1%) of the staff responsible for waste management did not receive any professional training on waste management (Hashim, 2011). Furthermore, In India

study showed that most of the practitioners (89%) depended on clinic assistants for waste management but these assistants have never undergone any formal training courses (Khandelwal et al., 2013). Based in the study finding, the researcher recommended constructing of a training program for the dental staffs and personnel who are in charge of waste management.

In regarding to our study, we notice that most of the dental staffs depending on themselves for waste management and the majority of them have not receive any formal training. Therefore, the researcher indorsed to involved all dental staffs need to be aware of possible health hazards present and must be trained in the appropriate handling, storage and disposal methods, in addition to proper education and training on handling medical waste and the risks involved should be provided. The training must not only be continuous, but also comprehensive, integrated and structured with the necessary elements.

4.1. 2 Policy and guideline related variables:

Table (4.2): Distribution of responses related to the policy and guidelines related variables

Policy and guidelines related variables	Frequency	Percent
Awareness about the presence of special policy for hazardous waste		
Yes, applied	241	87.3
Yes, not applied	21	7.6
No	14	5.1
Having a special policy for hazardous waste management in your clinic		
Yes, applied	200	72.5
Yes, not applied	14	5.1
No	62	22.5
Manual guidelines for dental waste management		
Yes	31	11.2
No	245	88.8

Health care waste management require active participation and co-ordination between governmental and non-governmental sectors, and the health care workers (Baghele,

2013). To ensure improvement and continuity in management practices, it is of utmost importance that healthcare institutions develop clear plans and policies for the proper management and disposal of medical waste. These policies need to be integrated into routine employee training, continuing education, and management evaluation processes for systems and personnel.

In the present study it was found that 87.3% of respondents were aware of presence of waste management policy and guidelines (Table 4.2). Result is higher when compared with other studies. In Libya a study shown that all surveyed hospitals not have regulations regarding the disposal of medical waste (Sawalem et al., 2009). In India, study found that more than half of participants were not aware of waste management guidelines (Arora et al., 2014). Same results were found in study done in Nairobi, Kenya (Osamong et al., 2005). The researcher regardless the high percentage of awareness of dental staffs about waste management policy and guidelines noted that there is need to involve them in developing and reforming policy and guidelines.

Finding also shows, the majority of participants reported that they have not manual guidelines for dental waste management in their clinics. Similar results in Palestine showed no special written policy for hospital waste management (Chartier et al., 2014). In Emirate of Ajman, results showed that 83.7% of the dentists were unaware of any document outlining the policy of waste management (Hashim, 2011). In an Indian city, a large proportion of the dentists are not practicing a proper methods of dental waste management (Khandelwal et al., 2013). Conversely, In India study showed that majority of dentist are practicing improper methods of waste disposal while they were aware about hazardous effect of improper dental waste management (Arora et al., 2014). The researcher based in study finding that shown unavailability manual guidelines for dental waste management in their clinics. Hence, she recommended to provides all dental

clinics with national or international waste management guideline handbook and dental clinics should have written policies and should properly train all affected employees.

4.1. 3 Management related variables:

Table (4.3): Distribution of responses about the management related variables

Management related variables	Frequency	Percent
Having specialized person who supervises the data waste management		
Yes	51	18.5
No	219	79.3
Don't know	6	2.2
Noting any improvement in hazardous waste services in the last years?		
Yes	82	29.7
No	123	44.6
Don't know	71	25.7
Availability of personal protective equipment in your clinic		
Regularly	261	94.6
Sometimes	12	4.3
No	2	0.7
Don't know	1	0.4
Lack of Fund (N=15)		
No	6	40.0
Yes	9	60.0
Lack of workers awareness (N=15)		
No	8	53.3
Yes	7	46.7
Lack of department obligation (N=15)		
No	10	66.7
Yes	5	33.3
If these equipment's are available, do you used them?		
Regularly	261	94.6
Sometimes	15	5.4
Your evaluation of dealing with hazardous waste in your clinic		
Excellent	123	44.6
Very good	132	47.8
Good	14	5.1
Fair	5	1.8
Bad	2	0.7
Having a license in your clinic		
Yes	180	65.2
No	88	31.9
Don't know	8	2.9
MOH have a supervision on waste management at your clinic		
Yes	29	10.5
No	213	77.2
Sometimes	28	10.1
Don't know	6	2.2
Any follow up by municipal to manage your waste		
Yes	14	5.1
No	244	88.4
Don't know	18	6.5

Our study reported that (79.3%) of the respondents agreed on the absence of supervised person on waste management process. Similar finding reported in a study conducted by

Dehghani et al. (2008) in Iran presented that none of the interviewed health facility supervisors had been trained on medical waste management. Study in India reported that safe management of dental health care waste was agreed to be an issue by (80%) of the study participants and (57%) of the respondents were of the view that it is the responsibility of the government. However there was almost total agreement (92%) that it is an issue that require team work (Khandelwal et al., 2013). What's more, a study conducted in Palestine showed that the methods of disposal of dental waste were generally inadequate and exposed dental practitioners to health risks and may contribute to environmental contamination (Darwish, 2006), and due to the increasing number of graduate dentists the generation of dental waste will be increasing which needed urgent efforts to address the issue of dental health waste disposal.

According to our study results revealed that nearly two third of respondents indicated that services were not improved in last years which mean that we need spot the light in this issue. Almost of the respondents indicated that a personal protective equipment are available regularly in their clinics (94.6%). Study results showed that the main reason for inadequate availability of personal protective equipment was lack of funds (60%), the second reason was lack of workers awareness (46.7%) and the third one was lack of department obligation (33.3%) as shown in Table (4.3). The results were in accordance with WHO report that indicated that budgetary restrictions is the main reason for shortage at central level. The political rift between Fatah in the West Bank and Hamas in Gaza has also been reflected in the operations of the Palestinian Authority in terms of disrupted communication, planning and sharing of resources (WHO, 2011).

In Palestine, there is a poor coordination between different department and MOH and other related organization which could have a destructive implementation of best waste management (Chartier et al., 2014). Our study showed like results as the majority of

staffs reported no supervision by MOH or follow up by municipal on waste management of their clinics. In a previous study shown the municipality sends a car to transport the containers and it is not suitable for this purpose as it not having their own car details that transfer of medical waste as it's being all the regular waste transport.

Nearly half of the participants (44.6%) evaluated their dealing with hazardous waste in their clinics as excellent despite that they have not training courses about dental waste management or have manual guidelines for managing the waste and nearly (65.2%) of the participants have licensed their clinics. The researcher attributed this finding to the knowledge of staff which received during schools and university about waste management and protective measure. Also, the awareness of them to suspected infection when dealing with infected waste.

4.1.4 knowledge of personnel involved in the study:

Dentists should have the information about properly dispose of dental medical waste, and how to managing the other wastes that result from the day-to-day activities of a dental office. In this study, most of the participants are personally familiar with dental waste (90.6%). Only 8.3% are not familiar with dental waste and the reminder indicated that they don't know and so the majority of the respondents had correct knowledge about dental waste definition (87.6%) as they defined the dental waste management "Any waste which is generated during the diagnosis and treatment, any materials in contact with patients' blood or saliva, any waste consist of human tissues, swabs, sharp needles, hazardous and nonhazardous waste and chemical and infectious waste. Similar results from study conducted in Tricity (Chandigarh, Panchkula and Mohali) stated that nearly 86% of dental teams were aware of the different categories of the waste generated in their clinics (Bansal, Vashisth and Gupta, 2013). Adequate knowledge about the hazardous medical waste, proper technique and methods of handling the waste, and practice of safety measures can go a long way toward the safe disposal of hazardous waste and protect the community from various adverse effects of the hazardous waste (Vanesh, 2011).

Nearly, 98.5% of the respondents knew that they should be wearing personnel protective equipment when handling a dental product, while the rest did not know. Regarding the impact of dental waste on human health, (96.7%) of the participants agree that it was hazardous to health while (2.9%) of them are not agree, whereas (93.1) considered dental waste as hazardous to the environment, (4.7%) saw that it does not hazardous.

Table (4.4): Distribution of responses with regard to the knowledge about waste management (n=276)

Knowledge	Frequency	Percent
You are personally familiar with dental waste		
Yes to high extent	250	90.6
No	23	8.3
Don't know	3	1.1
If the answer is yes, above what does the dental waste means. (n=250)		
Any waste which is generated during the diagnosis and treatment.	3	1.2
Any materials in contact with patients' blood or saliva.	8	3.2
Any waste consist of human tissues, swabs, sharp needles.	14	5.6
Hazardous and nonhazardous waste.	4	1.6
Chemical and infectious waste.	2	0.8
All the above	219	87.6
You should wear personnel protective equipment when handling a dental products		
Yes	272	98.6
No	4	1.4
You know that dental waste may be hazardous to human health		
Yes	267	96.7
No	8	2.9
Don't know	1	0.4
You know that dental waste may be hazardous to environment		
Yes	257	93.1
No	13	4.7
Don't know	6	2.2
You know what is the proper procedures for disposal of the dental waste		
Yes	256	92.8
No	12	4.3
Don't know	8	2.9
Segregations from each other (n=256)		
No	190	74.2
Yes	66	25.8
Packing and labeling (n=256)		
No	236	92.2
Yes	20	7.8
Collecting in special containers (n=256)		
No	224	87.5
Yes	32	12.5
Transported in safe manner (n=256)		
No	235	91.8
Yes	21	8.2
Storage (n=256)		
No	253	98.8
Yes	3	1.2
All of the above (n=256)		
No	87	34.0
Yes	169	66.0
You know that dental waste should be segregated for disposal		
Yes	253	91.7
No	18	6.5
Don't know	5	1.8
If the answer is yes, how does it segregated? (n=253)		
Hazardous and nonhazardous	191	75.5
Chemical waste	8	3.2
Infectious waste	21	8.3
Sharps waste	23	9.1
General waste	10	4.0
Waste segregation process lead to (Apply the policy recommendations)		
No	261	94.6
Yes	15	5.4
Reduce the disposal		
No	264	95.7
Yes	12	4.3
Prevent mixing of dental waste with other waste		
No	120	43.5
Yes	156	56.5
All of the above		
No	159	57.6
Yes	117	42.4
Don't know		
No	270	97.8
Yes	6	2.2

The study result also showed in table 4.4 that 7% from the participants did not know the proper procedures of dental waste management steps. Approximately (66%) of the participants have complete correct knowledge about all steps of the proper procedures from the point of segregation to the waste storage. One quarter of the respondents said that waste should be segregated from each other prior to disposal. Nearly almost of the respondents showed that waste should not be packing and labeling and should not be collecting in special containers or transported in safe manner or even stored.

Among the participants (92%) knew that the dental waste should be segregated for disposal and should be classified into different pattern as (75.5%) hazardous and nonhazardous, (3.2) chemical waste, (8.3) infectious waste, (9.1) sharps waste and (4.0) general waste.

Regarding the aims of dental waste segregation, nearly half of the respondents indicated to prevent mixing of dental waste with other wastes (table 4.4). These results indicated insufficient knowledge about dental waste segregation when compared with other study. Study conducted in Bangalore city shows, 82.6% of attenders said that it is necessary to segregate waste into different categories at the point of origin (Rudraswamy, Sampath and Doggalli, 2012). For that reason, the researcher recommended to educate dental staffs about dental waste segregation and steps of appropriate waste management steps.

Another important issue is the types of plastic bags used for waste disposal. The plastic bags used for waste disposal are special non-chlorinated, which can be incinerated. Normal plastic bags if used, will release dioxins and furans which further pollute the environment (National guidelines on Hospital waste management. Biomedical waste regulations. 1998). As shown in table (4.4) , half of the participants can use any bag for waste disposal.

Table (4.4b): Distribution of responses according to knowledge (n=276)

Knowledge	Frequency	Percent
Can any plastic bag used for waste disposal?		
Yes	142	51.4
No	124	44.9
Don't know	10	3.6
Types of bags (Yellow bag)		
No	218	79.0
Yes	58	21.0
Red bag		
No	198	71.7
Yes	78	28.3
Black bag		
No	182	65.9
Yes	94	34.1
Blue bag		
No	250	90.6
Yes	26	9.4
Safety box		
No	93	33.7
Yes	183	66.3
Don't know		
No	272	98.6
Yes	4	1.4
The collection time of waste done		
Daily	245	88.8
Weekly	21	7.6
Monthly	4	1.4
Don't know	6	2.2
Do you know the ways used to safe elimination the wastes?		
Yes	118	42.8
No	140	50.7
Don't know	18	6.5
Chemical disinfection (n=118)		
No	99	83.9
Yes	19	16.1
Burning in open places (n=118)		
No	90	76.3
Yes	28	23.7
Recycling (n=118)		
No	81	68.6
Yes	37	31.4
By the incineration (n=118)		
No	37	31.4
Yes	81	68.6
All dental waste should be incinerated?		
Yes	40	14.5
No	194	70.3
Don't know	42	15.2

According to the types of plastic bags used, table (4.4b) showed that 66.3% of participants used safety box, (34.1%) used black bags, (28.3%) used red one, (21.0%) used yellow bags and (9.4%) used blue bags. The study results revealed that half of the participants did knew the ways used to safe elimination of waste. Finding shows, 23.7%

showed that it should be burning in open place and (16.1%) reported that it should be eliminated by chemical disinfected. This finding shows that unaware of the dental teams regarding appropriate disposable of the dental waste. Similar finding was observed in Khala study (2009) shows that management of medical waste in Palestine was not given the appropriate concern. Likewise, in GS the segregation is done only for sharps and there are no color-coded bags (Massrouji, 2001). Ideally, dental amalgam particles used throughout placement or removal of amalgam fillings are often disposed of in sewers or with municipal waste, and pollute water and soil (Mackey et al., 2014). Some dentists throw their excess amalgam into special medical waste ("red bag") containers (Pan et al., 2013). All sharps must be disposed using the appropriate guidelines, its management can be done by collecting sharps in a red or yellow puncture resistant container with a lid that cannot be removed, the sharps container should be properly labeled with biohazard sign (Bhaskar et al., 2011).

4.1.5 Dental waste management practice of respondents:

Dental practices must ensure that the full range of waste generated is properly, legally, safely and effectively disposed of, ensuring that risks or potential risks of contamination or infection both within and external to the practice are minimized (Isopharm, 2016). Dental practices are to take all reasonable measures to ensure that waste is dealt with appropriately from the point of production to the point of final disposal. The dental practices responsibility does not end when your waste collector removes your waste.

Table (4.5), also shows that the majority of the respondents are perform separation of the dental waste before disposal (86%), (88.4) of the respondents reported that they disposed the dental waste after separation. The table also shows that (84%) of the participants classify the dental waste to hazardous and not hazardous waste and (87.7) dispose the hazardous waste into special containers.

Finding are in line with Mushtaq et al., (2008) and AL-khatib and Sato (2009) opined that non-risk waste are not infectious and non-hazardous, and it comprises mainly office solid waste that originates from Dental clinics and do not contain any substance that would pose a hazard to mankind/animal health or to the environment, the typical components of non-risk waste can be recycled or put into the trash and disposed of as regular non-risk waste. Non-dripping gauze and extracted teeth are not considered biomedical waste and can be dispose of directly into the garbage (Bhaskar et al., 2011).

Table (4.5): Distribution of responses by practice related variables (n=276)

Practice	Frequency	Percent
Performing separation for dental waste product before disposal		
Yes	237	85.9
No	36	13.0
Don't know	3	1.1
Disposing your dental waste product separated from each other		
Yes	244	88.4
No	30	10.9
Don't know	2	0.7
Disposing the hazardous waste in special container		
Yes	242	87.7
No	34	12.3
Classifying the dental waste product to hazardous and nonhazardous waste?		
Yes	232	84.1
No	35	12.7
Don't know	9	3.3
You dispose excess mercury during amalgam restoration in		
Thrown into drain	146	52.9
Use amalgam separator	28	10.1
Into general garbage	102	37.0
You dispose of the x-rays films, film packet and unused film		
Collecting in a marked container	107	38.8
Throw into the regular garbage	169	61.2
You manage the lead foil that present inside each X ray packet		
Collecting in a specialized container	41	14.9
Throw into the regular garbage	235	85.1
Disposing cotton, gauze and other items contaminated by blood?		
Red bag	21	7.6
Yellow bag covered with double bags	23	8.3
General garbage	232	84.1
Where do you dispose sharps waste?		
Yellow or red puncture resistance container	139	50.4
General garbage	11	4.0
Black bag	126	45.7
How to disposed of the sterilization solutions and hazardous liquid?		
Drain	239	86.6
General garbage	18	6.5
Chemical treatment and discharge into drains	19	6.9
You dispose the general office waste through		
General garbage	255	92.4
Special containers	9	3.3
Special bag for easy recycling	12	4.3
You put a sign as dangerous for hazardous waste		
Yes	97	35.1
No	179	64.9
The bags or containers replaced immediately with new ones of the same type when filled		
Yes	254	92.0
No	19	6.9
Don't know	3	1.1
Generated waste remain in place by more than one day		
Yes	29	10.5
No	231	83.7
Don't know	16	5.8
Hazardous waste are transported by special staff		
Yes, regularly	49	17.8
Yes, not regularly	51	18.5
No	176	63.8

WHO identified mercury as one of the top ten chemicals that can be harmful to the health (WHO, 2013). The guideline of "Best Management Practices for Amalgam Waste" has published a special guide to manage amalgam waste which reported that: Although mercury from dental amalgam is stable, it should not be disposed of in the garbage, infectious waste "red bag," or sharps container, also it should not be rinsed down the drain. But in our study results showed nearly half of the participants reported that they disposing the excess amalgam thrown into drain, (37%) disposed the excess into general garbage and only (10%) of them used amalgam separator. The results of the present study is higher compared with other studies, Sudhakar and Chandrashekar (2008) indicated only 15% of Group IV, and 35% of Group III were disposing of amalgam and metal in the proper method. The Group I (55%) and Group II (65%) technicians followed the better disposal methods. The disinfection of waste prior to disposal was practiced by 20-25% subjects in group IV and Group III.

Another common waste product in the dental office, un-used film should also not be placed in the general waste. Un-used films contain un-reacted silver that can be toxic in the environment. The study showed that more than half of the respondents disposed of unused films by thrown it into the general garbage. Among its advantages are reduced radiation exposure and the absence of chemical image processing. Therefore, incorporation of digital imaging within the dental office can greatly reduce the amount of silver waste generated. It is advisable to collect any unused film that needs disposing in a recommended container for recycling by the disposal company. Using a digital X-ray unit minimizes purchase of new X-ray films (Clifton, 2007).

The lead foil inside each x-ray packet is a leachable toxin and can contaminate the soil and groundwater in landfill sites. Lead foil packets should never be thrown in the regular garbage. This material must be either recycled or treated as a hazardous waste.

Collect lead foil packets in a marked container Once container is full, contact a certified waste carrier for recycling or disposal (Best Management Practices for Hazardous Dental Waste Disposal Updated Fall 2014). The study results revealed in table (4.5b) that the majority of respondents (85.0%) dispose of the lead foil that present inside the x-ray packet by wrong methods as they thrown into the regular garbage and only (15.0%) disposed it by collecting in a special containers. Similar results from study conducted in Southern Iran reported that most of studied centers collected and disposed lead foil pockets waste by wrong methods (Danaei M., et. al 2014).

Bloody/body waste are suspected of causing infection and set guidelines should be followed strictly for this type of waste. Non-dripping gauze and extracted teeth are not considered biomedical waste and can be put directly into the garbage. When gauze is blood soaked and dripping blood, it does become a biomedical hazardous waste. Waste Management Options Best Management Practice (BMP) Use a yellow biomedical waste bag to collect the non-anatomical wastes, Double bag the waste Label the bag with a biohazard symbol. Do not throw blood soaked materials into the regular garbage (Best Management Practices for Hazardous Dental Waste Disposal Updated Fall 2014). The study revealed that the majority of respondents (84.0%) were disposed of cotton, gauze and other items contaminated with blood by thrown it into the general garbage and only (8.3) of them used correct methods' by using a yellow bags covered with double bags. In the study done in India reported that (56%) disposed bloody/body waste as general waste (Arora et al., 2014). Another study done in Nairobi, Kenya (56.1%) respondents dispose the bloody/body waste according to the set guidelines (Osamong et al., 2005).

All sharps must be disposed using the appropriate guidelines. Proper disposal will minimize possible puncture wounds on other workers handling these wastes such as cleaners and waste carriers. Best Management Practice (BMP) collect sharps in a red or

yellow puncture resistant container with a lid that cannot be removed. The sharps container should be properly labeled with biohazard symbol. In the absence of laws and regulations, there is no doubt that responsible disposal of waste within each dental clinic would reduce the heavy impact and would make a difference. For example, the placement of sharps in separate puncture-resistant containers may not entirely eliminate their harmful effect, but it would certainly minimize it considerably and all clinics should have and use such containers. Furthermore, the final disposal of sharps should be by incineration. Thus, awareness should be raised among dental care professionals regarding the proper disposal of dental waste and the health issues involved and they should be encouraged to follow safe procedures (Darwish and Al-Khatib, 2006).

The study revealed that half of the respondents (50%) used the correct methods for disposal of the sharp wastes as they used yellow or red puncture resistance containers. Similar results from study conducted in Kenya (61%) of respondents applied the recommended manner for sharps/needle (Osamong et al., 2005). Another study conducted in India showed that (60%) of the dentists did apply the recommended manner for disposal of sharps (Arora et al., 2014). Also in study done in Ajman, United Arab Emirates (56%) of the dentists knew the recommended manner for disposal of sharps (Hashim, 2011).

The dental office utilizes many chemicals, disinfectants, and sterilizing agents that may be hazardous to the environment if they are not properly disposed. Regarding liquid wastes, the majority of respondents (86.6) disposed of the sterilization solutions and hazardous liquid into the drain. Similar study conducted in India reported that all the dental clinics were found discharging their waste water directly into the sewer system, especially developer and fixers used for development of dental X-ray film (Khandelwal et al., 2013).

Regarding general office waste, our study reported that almost of the respondents (92.4) disposed it into general garbage. Also, the study revealed that (83.7) of the respondents did not retain the generated waste in place more than one day. Similar study result conducted in Ajman, United Arab Emirates reported that more than half the clinics (67.3%) it was kept generated waste for less than 5 days until the municipality collected it (Hashim, 2011).

Regarding bio-hazard symbol, study result was reported to be used for labeling by only (35%) of them. Similar study result conducted in India reported that (15%) of the clinics labeling the hazardous waste as dangerous (Khandelwal et al., 2013).

According to the bags or containers replaced immediately with new ones when filled, (92%) of the participants reported yes and (68.3%) of them reported that the hazardous wastes were not transported by special staff.

4.1.6 Attitude towards dental waste management:

The research results exhibited the good Bio-Medical Waste (BMW) disposal attitude among all participants which represented 93.5%. Similar to the previous study reports, the majority of the respondents (80-85%) across all the groups agreed on the lesser generation, better segregation and disinfection of dental solid waste. Total of 85-95% of the respondents is of the opinion, the continuous update on BMW disposal and treatment plant necessity at an institute (Rudraswamy, Sampath and Doggalli, 2012).

Nearly thirty two percent of participants are not satisfied about current dental waste management. Similar results were conducted in Gaza and showed negative perception of healthcare staff especially of nurses (53.6%) toward current medical waste management (Shushaa and Abu Safiah, 2000).

Approximately (80%) of the participants had positive attitude toward the importance of existence of a manual guidelines for dental waste management. (27%) of respondents were uncertain if Palestine has adequate legislation dealing with the safe treatment and disposal of hazardous dental waste.

Study results showed positive attitude of participant (86%) for including waste management responsibility in job descriptions. In addition, they received positive attitude concerning protection of dental staff against hazardous waste. Similar results were conducted in study in Cape town, South Africa, which showed that (82%) of respondents agree with statement "Waste management responsibilities should be included in job description of the professionals" and (95%) of them had positive attitude towards "Hospital staff should be protected from hazardous waste" (Sattar, 2011).

The majority of respondents have positive attitude about the impact of waste generated by dental clinics on the environment, human health. Similarly (90%) of them had positive

attitude towards improving the awareness of healthcare employees concerning environmental issues. These results were consistent with Sattar (2011) study that indicated 88.3% of physician and nurses had positive attitude towards the same statement. Insufficient awareness of impact of healthcare waste could lead to some sort of weakness in the application of safe management system correctly (Abbasi, 2005).

Regarding he importance of receiving training, highly positive attitude was reported by the majority of respondents who reported that all employee contacting with the waste should be trained enough. Similarly, result of a study conducted in Sudan revealed that majority of respondents (85%) agreed with the attitude statement "training program on healthcare waste is important" (El Khalifa, 2014). In addition, study conducted at primary health care centers in Nablus and Salfit governorates in the West Bank, Palestine revealed that the vast majority of the staff interviewed agreed that training was important (Al-Khatib, 2013).

Regarding incinerators, (80%) of participants agreed on the necessity of getting operational certificates for incinerator. About one third of respondents were not satisfied with incinerators. The same results were reported by (Sattar, 2011) who reported that (92%) of participants agreed with the statement "Incinerators should be certified".

Finally, the study results showed that the majority of respondents had a positive attitude towards their cooperation with specialized committees for the disposal of hazardous waste. This was in agreement with the study results conducted in Gaza which revealed that the majority of respondents indicated their willingness to participate in future specialized training programs in medical waste management (Sarsour et al., 2014).

Table (4.6): Distribution of responses by attitudes towards sold waste management (n=276)

Attitude	Dis-agree		Neutral		Agree	
	N	%	N	%	N	%
Dental waste management is an important issue.	4	1.4	14	5.1	258	93.5
You are satisfied about current dental waste management.	87	31.5	100	36.2	89	32.2
Presence of manual guidelines for dental waste management is important.	15	5.4	34	12.3	227	82.2
Palestine has adequate legislation dealing with the safe treatment and disposal of hazardous dental	112	40.6	89	32.2	75	27.2
Responsible person should be supervise the process of dental waste management	12	4.3	25	9.1	239	86.6
Waste management responsibility should be included in the job descriptions of all related	7	2.5	31	11.2	238	86.2
Dental staff should be protected against hazardous waste.	5	1.8	15	5.4	256	92.8
All waste generated by dental clinics has negative impact on the environment.	11	4.0	36	13.0	229	83.0
Dental waste has negative impact on human health.	5	1.8	26	9.4	245	88.8
Healthcare professionals should be more aware of environmental issues.	6	2.2	22	8.0	248	89.9
Presence of special tools is essential for dealing with hazardous waste	4	1.4	22	8.0	250	90.6
All employee contacting with the waste should be training enough	6	2.2	14	5.1	256	92.8
Incinerators must be certified to dispose of medical waste.	11	4.0	49	17.8	216	78.3
You are satisfied with incinerator system.	40	14.5	142	51.4	94	34.1
You are ready to cooperate with the specialized committees for the disposal of hazardous waste.	11	4.0	29	10.5	236	85.5
Total (mean)	3.6		72%			

4.2 Observational checklist

Table (4.7): Observational checklist of the availability of waste management items.

Items	Yes	No	Not applicable
Written plan for hazardous waste management are available	75(27.4)	199 (72.6)	2 (0.7)
Written guideline for hazardous waste management are available	79 (28.9)	194 (70.1)	3 (1.1)
All dental product that identified as hazardous waste are labeling .	95 (34.9)	177 (65.1)	4 (1.4)
There is recording system for the process of dental waste	65 (24.5)	200 (75.5)	11 (4.0)
There is posters, flyers and labeling to remind employees about waste reduction.	81 (30.2)	187 (69.8)	8 (2.9)
There is separation for hazardous waste type.	236 (88.1)	32 (11.9)	8 (2.9)
Color-coded plastic bags or containers are used	136 (50.2)	135 (49.8)	5 (1.8)
Personal protective equipment are available	253 (92.0)	22 (8.0)	1 (0.4)
Empty stock containers/ bags are available in or near the soiled utility rooms at all times	249 (91.9)	22 (8.1)	5 (1.8)
Liquid medical waste is poured down into drain.	220 (80.3)	54 (19.7)	2 (0.7)
Chemical waste are packed in chemical resistant containers	196 (72.3)	75 (27.7)	5 (1.8)
General waste and dental waste bags are separated.	201 (75.0)	67 (25.0)	8 (2.9)
Container is sufficiently strong	216 (80.3)	53 (19.7)	7 (2.5)
Hazardous waste containers are kept closed	219 (80.5)	53 (19.5)	4 (1.4)
Containers are fill to ¾ full.	122 (45.9)	144 (52.2)	10 (3.6)
There is no leakage or spill from container	232 (86.6)	36 (13.4)	8 (2.9)
All hazardous waste containers are maintained in good condition	237 (88.4)	31 (11.6)	8 (2.9)
Controlled substances waste are stored in tight, secure and control	227 (84.7)	41 (15.3)	8 (2.9)
Chemotherapy wastes are collected separately	172 (65.2)	92 (34.8)	12 (4.3)
Universal waste and dental waste bags are separated.	206 (75.5)	67 (24.5)	3 (1.1)
All containers that hold or use dental materials are labeled properly.	78 (29.0)	191 (71.0)	7 (2.5)
Off-site Collection and transportation vehicle are suitable size commensurate with the design of the vehicle	47 (20.3)	184 (79.7)	45 (16.3)
There is suitable system for securing the load during transport.	41 (17.0)	200 (83.0)	35 (12.7)
The vehicle should be marked with the name and address of the waste carrier.	41 (17.5)	193 (82.5)	42 (15.2)
Autoclave uses steam sterilization are used	220 (83.0)	45 (17.0)	11 (4.0)
Chemical Disinfection are used	222 (84.1)	42 (15.9)	12 (4.3)
Worker are used personal protective equipment's	231 (88.2)	31 (11.2)	14 (5.1)
Waste are kept labeled	83 (31.8)	178 (68.2)	15 (5.4)
Dental waste are disposed to sanitary landfill without treatment	179 (72.8)	67 (27.2)	30 (10.9)

The researcher observed that unavailability of written plan for hazardous waste management in 72.2% of clinics. Also, written guideline for hazardous waste

management are not available in 70.1% of clinics. In addition, 65.1% of clinics not used labeling in all dental product that identified as hazardous waste. Furthermore, there is unavailability of a recording system for the process of dental waste management in 75.5% of observed clinics. The researcher also observed that 71% of clinics not used labeled properly in all containers that hold or use dental materials.

4.3 Inferential statistic

To explore differences in perceptions about dental waste management in reference to selected variables, the researcher conducted inferential analysis as illustrated below.

4.3.1 Differences in the perception about dental waste management according to gender

Table 4.8 illustrates differences in perception about dental waste management in reference to gender. t-test results show that there were no statistical significant differences between dental waste management according to gender in practice, knowledge and check-list domains (P= 0.577, 0.060, 0.547 respectively), despite the fact that female ones had slightly higher scores in practice and check-list domains. However, in policy and guidelines domain, male had higher mean score than female and the variations among the two groups were statistically significant (P= 0.030). In contrary, Female had reported higher score than male one in the management and attitude domains and the variations among the two groups were statistically significant (p=0.004, 0.018 respectively).

Table (4.8): Differences in the perception about dental waste management according to gender

Variable	Gender	N	Mean	SD	Test value	Sig.
Policy & guidelines	Male	169	0.59	0.20	-2.19	0.030
	Female	107	0.64	0.20		
Management	Male	169	0.46	0.14	-2.92	0.004
	Female	107	0.52	0.20		
Knowledge	Male	169	0.76	0.13	1.89	0.060
	Female	107	0.73	0.13		
Practice	Male	169	0.65	0.15	-0.56	0.577
	Female	107	0.66	0.20		
Attitude	Male	169	3.56	0.43	-2.39	0.018
	Female	107	3.67	0.29		
Check-list	Male	169	0.58	0.14	-0.60	0.547
	Female	107	0.59	0.16		

4.3.2 Differences in the perception about dental waste management according to specialist

Using one-way ANOVA test, there were not statistical significant differences in the following domains (management, practice, attitude, and check-list) according to specialist as shown in the table 4. 9., despite the fact that dental assistant had slightly higher scores in domains in comparison with dentist and nurse. However, in policy and guidelines domain, dentist had higher mean score followed by dental assistant and nurse and the variations among the two groups were statistically significant (P= 0.008). In contrary, nurse had reported slightly higher score in the knowledge domain and the variations among the two groups were statistically significant (p=0.002).

Table (4.9): Differences in the perception about dental waste management according to specialization

Variable	Specialization	N	Mean	SD	Test value	Sig.
Policy and guidelines	Dentist	243	0.62	0.19	F=4.89	0.008
	Dental assistant	4	0.67	0.27		
	Nurse	29	0.51	0.23		
Management	Dentist	243	0.48	0.17	F=0.60	0.547
	Dental assistant	4	0.57	0.20		
	Nurse	29	0.47	0.16		
Knowledge	Dentist	243	0.74	0.13	F=6.22	0.002
	Dental assistant	4	0.81	0.06		
	Nurse	29	0.82	0.09		
Practice	Dentist	243	0.65	0.18	F=0.99	0.375
	Dental assistant	4	0.75	0.10		
	Nurse	29	0.67	0.10		
Attitude	Dentist	243	3.60	0.37	F=0.64	0.529
	Dental assistant	4	3.78	0.16		
	Nurse	29	3.56	0.55		
Check-list	Dentist	243	0.58	0.15	F=1.36	0.258
	Dental assistant	4	0.69	0.10		
	Nurse	29	0.60	0.10		

4.3.3 Differences in the perception about dental waste management according to location

Using one-way ANOVA test, the results in the table below demonstrates that there is a statistically significant differences in (policy and guidelines, management, knowledge, practice, and attitude) due to location, where all their significant levels were less than 0.05. Whereas for "Check-List" we notice that its significant level is greater than 0.05 (Sig. = 0.175) this indicates that there is no significant difference in checklist due to location.

Concerning policy and guidelines and management domains, there were statistical significant differences between dental staffs (F=19.72; p=0.000, F=0.801; p=0.000 respectively) due to location, these differences were toward staffs whose clinic in Gaza, which means that those dental staffs follow and adopt policy and guidelines than other staffs in other location.

Regarding knowledge and attitude domains, there were statistical significant differences between dental staffs (F=27.86; p=0.000, F=2.65; p=0.035 respectively) due to location, these differences were toward staffs whose clinic in Middle area, which means that those staffs have more knowledge and attitude toward dental waste management in comparison with other location.

Concerning practice domain, there were also statistical significant differences between dental staffs (F=3,45; p=0.009) due to location, these differences were toward staffs whose clinic in Rafah.

Table (4.10): Differences in the perception about dental waste management according to location

Variable	Location	N	Mean	SD	Test value	Sig.
Policy and guidelines	North Gaza	45	0.68	0.12	F=19.72	0.000
	Gaza	100	0.71	0.19		
	Middle	51	0.51	0.17		
	Khan Yunis	46	0.49	0.18		
	Rafah	34	0.57	0.19		
Management	North Gaza	45	0.40	0.14	F=8.01	0.000
	Gaza	100	0.55	0.20		
	Middle	51	0.47	0.12		
	Khan Yunis	46	0.46	0.14		
	Rafah	34	0.47	0.14		
Knowledge	North Gaza	45	0.69	0.09	F=27.68	0.000
	Gaza	100	0.68	0.16		
	Middle	51	0.84	0.07		
	Khan Yunis	46	0.77	0.07		
	Rafah	34	0.84	0.08		
Practice	North Gaza	45	0.69	0.15	F=3.45	0.009
	Gaza	100	0.63	0.25		
	Middle	51	0.62	0.05		
	Khan Yunis	46	0.63	0.04		
	Rafah	34	0.73	0.11		
Attitude	North Gaza	45	3.64	0.63	F=2.56	0.039
	Gaza	100	3.56	0.43		
	Middle	51	3.70	0.17		
	Khan Yunis	46	3.65	0.16		
	Rafah	34	3.46	0.17		
Check-list	North Gaza	45	0.62	0.14	F=1.60	0.175
	Gaza	100	0.56	0.21		
	Middle	51	0.59	0.01		
	Khan Yunis	46	0.60	0.02		
	Rafah	34	0.58	0.11		

4.3.4 Differences in the perception about dental waste management according to receiving training courses

Table 4.11 illustrates differences in perception about dental waste management in reference to receiving training. t-test results show that there were no statistical significant differences between dental waste management according to receiving training in practice, attitude and check-list domains, despite the fact that staffs who receiving training had slightly higher scores in practice and check-list domains. However, in policy and guidelines, management and knowledge domains, staffs receiving training had higher mean score than staffs not receiving training and the variations among the two groups were statistically significant (P= 0.0004; 0.000; 0.013 respectively).

Table (4.11): Differences in the perception about dental waste management according to receiving training

Variable	Receiving training	N	Mean	SD	Test value	Sig.
Policy and guidelines	No	274	0.60	0.19	T= -2.91	0.004
	Yes	29	0.71	0.23		
Management	No	274	0.47	0.16	T= -4.48	0.000
	Yes	29	0.61	0.16		
Knowledge	No	274	0.74	0.13	T= -2.51	0.013
	Yes	29	0.80	0.12		
Practice	No	274	0.64	0.17	T= -1.59	0.113
	Yes	29	0.70	0.17		
Attitude	No	274	3.61	0.38	T= 0.91	0.361
	Yes	29	3.54	0.46		
Check-list	No	274	0.58	0.14	T= -1.83	0.076
	Yes	29	0.64	0.19		

Chapter (5) Conclusion and recommendations

This chapter provides the main conclusion and also the recommendations for the key persons and decision makers in GS to enhance and improve dental waste management.

5.1 Conclusion

The study built its conclusion and suggestions to be presented in this chapter on the findings and results of assessing the status of medical waste management in private dental clinics in GGs, in order to enable all health workers seeks to the protection of their work force from the risk or foreseeable injury to their health and also enhance more understanding the enforcement of all relevant health legislators, and provide policy makers with recommendations that might enhance and improve dental waste management. Five domains tool used to obtain quantitative results including; availability of resources and material, training of dental teams, policy of dental waste management, knowledge about proper dental waste management procedure, and practice of dental team.

Main results indicated that nearly sixty percent of dental staffs was males, and the majority of them are from age 30-less 40 years. Approximately one third of dental clinics located in Gaza and the lowest percentage was located in Rafah. Almost of the respondents were dentists and has bachelor degree, while nurses represent ten percent. Nearly sixty percent of dental staffs has experience less than 10 years while one third ranged from 10 to 20 years of experience. The majority of staffs not received any formal training course about dental waste management whereas only ten in a hundred received training course.

As regards policy and guideline, result revealed closely eighty seven percentage of respondents were aware of presence of waste management policy and guidelines, but

majority of them stated that they have not manual guidelines for dental waste management in their clinics.

In relation to management of medical waste, approximately eight percent of staffs stated the absence of supervised person on waste management process. Likewise, nearly two third of respondents indicated that services were not improved in last years. In addition, almost of the staffs showed the availability of a personal protective equipment in their clinics. Furthermore, nearly half of the participants evaluated their dealing with hazardous waste in their clinics as excellent despite that they have not training courses about dental waste management or have manual guidelines for managing the waste. As well as nearly sixty five percent of the staffs have licensed their clinics.

On the subject of knowledge of staffs regarding dental waste management, most of the staffs are personally familiar with dental waste, only eight percent are not familiar with dental waste and the reminder indicated that they don't know and so the majority of the respondents had correct knowledge about dental waste definition. Nearly all of the respondents knew that they should be wearing personnel protective equipment when handling a dental product, while the rest did not know. Finding moreover shown that only seven percent of participants did not know the proper procedures of dental waste management steps. Approximately sixty six percent of them have complete correct knowledge about all steps of the proper procedures from the point of segregation to the waste storage. One quarter of the respondents said that waste should be segregated from each other prior to disposal. Nearly almost of the respondents showed that waste should not be packing and labeling and should not be collecting in special containers or transported in safe manner or even stored. Too, half of the participants can use any bag for waste disposal, two third of them used safety box for disposal and one third used black bags. Also, half of the participants did knew the ways used to safe elimination of waste,

nearly sixty-eight percent of them informed that the waste should be incinerated, one third reported that it should be recycling, and one quarter showed that it should be burning in open place.

With reference to dental waste management practice of respondents, majority of the respondents are perform separation of the dental waste before disposal. Nearly eight percent of the participants classify the dental waste to hazardous and not hazardous waste and eighty seven percent are dispose the hazardous waste into special containers. Also, results presented nearly half of the participants reported that they disposing the excess amalgam thrown into drain. More than half of the them disposed of unused films by thrown it into the general garbage. Finding also revealed that eighty five percent of respondents dispose of the lead foil that present inside the x-ray packet by wrong methods as they thrown into the regular garbage. Additionally, half of the respondents used correct methods for disposal of the sharp wastes as they used yellow or red puncture resistance containers.

Regarding liquid wastes, the majority of respondents (86.6) disposed of the sterilization solutions and hazardous liquid into the drain. Regarding general office waste, our study reported that almost of the respondents disposed it into general garbage. Similarly, the study revealed that eighty three percent of the respondents did not remain the generated waste in place more than one day. While, concerning bio-hazard symbol, study result was reported that one third of staffs used labeling.

On behalf of attitude towards dental waste management, the results exhibited the good BMW disposal attitude among all participants, and nearly thirty two percent of participants are not satisfied about current dental waste management. Approximately eighty two percent of the participants had positive attitude toward the importance of

existence of a manual guidelines for dental waste management, and nearly quarter of respondents were uncertain if Palestine has adequate legislation dealing with the safe treatment and disposal of hazardous dental waste. The majority of respondents have positive attitude about the impact of waste generated by dental clinics on the environment, human health. Similarly nine percent of them had positive attitude towards improving the awareness of healthcare employees concerning environmental issues. Regarding he importance of receiving training, highly positive attitude was reported by the majority of respondents who reported that all employee contacting with the waste should be trained enough. The study results showed that the majority of respondents had a positive attitude towards their cooperation with specialized committees for the disposal of hazardous waste.

Finally, statistically significant differences was shown in in policy and guidelines domain, the favor was for male (P= 0.030). In contrary, Female had reported higher score in the management and attitude domains and the variations among the two groups were statistically significant. Furthermore, dentist had higher mean score in policy and guidelines domain and the variations among the two groups were statistically significant. In opposing, nurse had reported slightly higher score in the knowledge domain and the variations among the two groups were statistically significant. Moreover, statistically significant differences in policy and guidelines, management, knowledge, practice, and attitude due to location. Also, statistical significant differences between dental waste management according to receiving training in in policy and guidelines, management and knowledge domains, the significant was favor for staffs receiving training course.

5.2 Recommendations

This study reveals all the salient fact needed starting from the source of the dental waste to the process of final disposition without causing a prejudicial effect, nevertheless in order to prolong the managerial process of this waste, it is now recommended that:

1- A national collaborative effort should be made to promote the appropriate management of solid wastes.

2- Establishment of monitoring programs in all dental care clinics to identify noncompliant practices and to better enforce approparite regulations.

3- Construction of a training program for the dental staff and personnel who are in charge of waste management.

4- Establishment of education program to all staff in dental clinics, in order to adopt an effective waste management practices. The education program can adopt the IPC protocol as a training frame.

5- Awareness of dental staffs regarding the proper disposal of dental wastes and the health issues involved and they should be encouraged to follow safe procedures.

6- Awareness of dental staff about waste management policy and guidelines and involve them in developing and reforming policy and guidelines, and providing them with national or international waste management guideline handbook.

7- Enforcement Legislation to all dental clinics about indiscriminate disposition of waste.

5.3 Recommendations for new area of research

1- Investigate the volume and weight of different types of dental waste in Dental clinics in the GS.

2- Interventional studies for understanding of the current situation of dental waste management in the GS.

3- In-depth investigations regarding dental and medical waste generation, handling and disposal in the dental clinics in the GS.

Referances

Abbasi S. (2005). Solid medical waste management in the hospital of Damascus University. *Damascus University Journal of Science and Engendering*; 2(1):65-84.

Abdulla F, Abu Qdais H, & Rabi A. (2008). Site investigation on medical waste management practices in northern Jordan. *Waste Management*; 28 (2008): 450–458

Abramson JH, & Abramson ZH. (2000). *Survey Methods in Community Medicine*, 5th edition. Edinburgh & London: Livingstone.

Abu El Qomboz Y. & Busch I. (2001). *solid waste management in Gaza Strip problems and solution.*

Abu Hamad B. (2009). *Managerial challenges facing health system: focus on human resources management in Gaza*. Paper presented at the first conference of managerial reforming and development on April, 30. General Personnel Coucil, Gaza: Palestine.

Adnane MI, Belkacem K, Abdelkarim E, & Mohamed B. (2013). Medical waste management: a case study of the Souss-Massa-Drâa region, Morocco. *J Environ Prot*.; 4(9):914-919

Alagoz AZ, & Kocasoy G. (2008). Improvement and modification of the routing system for the health-care waste collection and transportation in Istanbul. *Waste Manag*.; 28(8):1461–1471.

Ali F, Patil A, Prasant MC, Tahasildar S, & Patil K. (2014). Needle stick injuries in dental clinics. *Journal of Evolution of Medical and Dental Sciences;*3(02):374-378.

Ali K, Fathollah B, & Heshmatollah N. (2014). Investigation on the characteristics and management of dental waste in Urmia, Iran 8 June 2014, pp. 1

AL-Khatib I & Sato C (2009). Solid health care waste management status at health care centers in the West Bank-Palestinian Territory. *Waste Manag*.;29(8):2398-403.

Al-Khatib I, & Darwish R. (2004). Assessment of waste amalgam management in dental clinics in Ramallah and al-Bireh cities in Palestine. *International Journal of Environmental Health Research*, 14:179–183.

Al-Khatib I.A. (2007). Medical waste management in healthcare centers in the occupied Palestinian territory. *Eastern Mediterranean Health Journal*; 13(3)" 694-705.

Al-Khatib IA. (2003). *Medical waste management in Palestine*. A study in current situation. Palestine, Birzeit University, Institute of Community and Public health.

Al-Khatib IA. (2013). Problems of management of medical solid waste at primary health care centers in the Palestine Territory and their remedial measures. *Eastern Mediterranean Health Journal*; 19: 152-58.

American Dental Association (2010). *Dental amalgam*. Updated on safety concern.

Arora R, Agrawal A, Singh D, & Reddy J. (2014). Management of dental waste in private clinics in Chhattisgarh State, India – A cross sectional study. *Journal of dental and medical sciences*; 13(1):53-56.

Askarian M, Heidarpoor P, & Assadian O. (2010). A total quality management approach to healthcare waste management in Namazi Hospital, Iran. *Waste Manag*.; 30(11):2321-2326.

Australian / New Zealand Standard (1998). *Management of clinical and related wastes. Homebush: Standards Australia International Limited*.

Babanyara YY, Ibrahim DB, Garba T, Bogoro AG, & Abubakar MY. (2013). Poor Medical Waste Management (MWM) Practices and its Risks to Human Health and the Environment: a literature Review. *World Academy of Science, Engineering and Technology (WASET)*; 83,10-05.

Baghele O, Phadke S, Deshpande A, Deshpande J, & Baghele M. (2013). A simplified model for biomedical waste management in dental practices - A pilot project at Thane, India. *European Journal of General Dentistry*; 2(3): 235-240

Bansal M, Vashisth S, and Gupta N. (2013). Knowledge, awareness and practices of dental care waste management among private dental practitioners in Tricity (Chandigarh, Panchkula and Mohali). *J Int Soc Prev Community Dent*.; 3(2): 72–76.

Bhaskar A, Mohit K, Srishti A, Ajay S, Abhinav S. (2004) Bio medical waste and dentistry. *Journal of Oral Health Community Dentistry*; 5(3): 153-155.

Blenkharn JI.(2006). Standards of clinical waste management in UK hospitals. *J Hosp Infect;*.;62:300–3.

B'Tselem - The Israeli Information Center for Human Rights in the Occupied Territories (2014). *Health situation in the Gaza Strip*.

Chartier Y, Emmanuel J, Pieper U, Prüss A, Rushbrook P, Stringer R, Townend W, Wilburn S, & Zghondi R. (2014). *Safe management of wastes from health-care activities*. 2nd ed. WHO.

Clifton JC 2nd (2007). Mercury exposure and public health. *Pediatr Clin North Am*.;54(2):237-69.

Coker A, Sangodoyin A, Sridhar M, Booth C, Olomolaiye P, & Hammond F (2009). Medical waste management in Ibadan, Nigeria: obstacles and prospects. *Waste Management*; 29 (2): 29(2):804-811.

Coker AO. (2009). Medical waste management in Ibadan, Nigeria: Obstacles and Prospects. February 2009. *Waste Management*; 29(2): 804-811.

Danaei M, Karimzadeh P, Momeni M, Palenik CJ, Nayebi M, Keshavarzi V, & Askarian M. (2014). The management of dental waste in dental offices and clinics in Shiraz, Southern Iran. *Int J Occup Environ Med*.;5(1):18-23.

Danaei M, Karimzadeh P, Momeni M, Palenik CJ, Nayebi M, Keshavarzi V, & Askarian M. (2014). The management of dental waste in dental offices and clinics in Shiraz, Southern Iran. *Int J Occup Environ Med*. ;5(1):18-23.

Darwish RO, & Al-Khatib IA. (2006). Evaluation of dental waste management in two cities in Palestine. E*ast Mediterr Health J*.;12(2): 217-222.

Dehghani MH, Azam K, Changani F, & Dehghani EF. (2008). Assessment of medical waste management in educational hospitals of Tehran University Medical Science. *Iran J Environ Health Sci Eng*.; 5(2):131–136.

Duan H. Huang Q, Wang Q, Zhou B, & Jinhui L. (2008). Hazardous waste generation and management in China. *J. Hazard. Mater*. 01.106

El Khalifa ME. (2014). *Environmental sanitation assessment and development of an integrated plan for healthcare waste management at the main hospitals in white Nile state, Sudan*. Alexandria: Alexandria University.

Environmental Protection Agency (2016). *Mercury in dental amalgam.* https://www.epa.gov/mercury/mercury-dental-amalgam (Accessed 20, May, 2016).

Eve J. &Cuny, MS. (2012). Managing sharps and other hazardous waste in the dental office. *AEGIS Communications* 8(2).

Farmer GM, Stankiewicz N, Michael B, Wojcik A, Lim Y, Ivkovic D, & Rajakulendran J. (1997). Audit of waste collected over one week from ten dental practices. A pilot study. Aust Dent J.;42(2):114-7.

Felicia, N, Sally M, & Luke C. (2008). Hospital solid waste management practices in Limpopo Province. *Waste Management*; 28 (2008) 1236– 1245.

Ferraz A, & Afonso SAV. (2003). Incineration of different types of medical wastes: emission factors for gaseous emissions, Atmospheric Environment 37, 5415-5422

Floret N, Mauny F, Challier B, Arveux P, Cahn JY, & Viel JF. (2003). Dioxin emissions from a solid waste incinerator and risk of non-Hodgkin lymphoma. *Epidemiology*; 14,392–398.

Fred Hutchinson Cancer Research Center (2016). *Biohazardous Waste*. https://extranet.fhcrc.org/EN/sections/ehs/hamm/chap6/section8.html

Gidlow DA. (2004). Lead toxicity. *Occup Med (Lond);*54(2):76–81.

Gordon JG, Rein Hardt PA, & Denys GA. (2004). *Medical waste management*. In: Mayhall CG (ed). Hospital epidemiology and infection control, (3 rd.). Lippincott Williams and Wilkins publication. Pages: 1773-85.

Harhay MO, Halpern SD, Harhay JS, & Olliaro PL. (2009). Health care waste management: a neglected and growing public health problem worldwide. *Trop Med Int Health*.;14(11):1414-7.

Hashim R, Mahrouq R, & Hadi N. (2011). Evaluation of dental waste management in the Emirate of Ajman, United Arab Emirates. *Journal of International Dental and Medical Research*;4(2):65-69.

Hassan AS, Okuofu CA, & Balogun JK. (2008). The use of biological index of pollution (Bip) in assessing quality of rural water sources in Zaria, Nigeria. *Science World Journal*; 3(2):101-105.

Hörsted-Bindslev P. (2004). Amalgam toxicity—environmental and occupational hazards. *J Dent*. ;32(5):359-65.

Iliyas M. (2001). *Community medicine and public health*. 5th ed. Karachi: Time Publisher; p. 62.

Issam A, Al-Khatib, Maria Monou, Salem A. Mosleh, Mohammed M. Al-Subu and Despo Kassinos. (2009). Dental Solid and Hazardous Waste Management and Safety Practices in developing Countries: Nablus district Palestine. 11 September, 2009.

Kettering Borough Council (2015). *Clinical waste*. http://www.kettering.gov.uk/info/200084/recycling_rubbish_and_waste/114/clinical_waste (Accessed 10, Feb., 2016).

Khala A. (2009). *Assessment of medical waste management in Jenin District Hospitals* MSc. Thesis, An-Najah National University, Palestine.

Khandelwal V, Khandelwal S, & Thakur J. (2013). Health care waste disposal among private dentist in an Indian city: it's time to act. *Int J Infect Control*; 9(2):1-5.

Khandelwal V, Khandelwal S, & Thakur J.(2013). Health care waste disposal among private dentist in an Indian city: it's time to act. *Int J Infect Control* 9(2).

Khanehzaei G, and Ishak M. (2014). *Current practices of clinical waste management in private clinics, Selangor, Malaysia.* Chapter From Sources to Solution, pp 279-283

Komilis DP, Voudrias EA, Anthoulakis S, & Iosifidis N. (2009). Composition and production rate of solid waste from dental laboratories in Xanthi, Greece. *Waste Manage*.; 29(3):1208-1212.

La Grega MD, Buckingham PL, & Evans JC. (2001) Hazardous waste management. 2nd edn. McGraw Hill, New York.

Lendman S. (2011). *Critical health issues in Gaza*.

Mackey TK, Contreras JT, Liang BA. (2013). the minamata convention on mercury: attempting to address the global controversy of dental amalgam use and mercury waste disposal. *Sci Total Environ.* 15;472:125-9.

Mani SK. (2006). Biomedical waste generated in Delhi government hospitals in December, Directorate of Health Services, GNCT of Delhi. www.health.delhigovt.nic.in/Health/files/bio.html. (Accessed 15, May, 2016).

Manyele S, & Anicetus H. (2006). Management of medical waste in Tanzanian hospitals. *Tanzania Health Research Bulletin*; 8:177-182.

Manyele SV, & Lyasenga TJ. (2010). Factors affecting medical waste management in low health facilities in Tanzania. *African journal of science and technology*; 4 (5):308-313.

Massrouje HT. (2001). Medical waste and health workers in Gaza governorates. *East Mediterr Health J.*;7(6):1017-1024.

Massrouji M. (2001). Medical waste and health workers in Gaza governorates. *East Mediterr Health J.*, 7: 1017-24.

Matin K. (2006). *University of California, Irvine Medical Waste Management Plan*.pp.1-5

Mertens D M. (2010). *Integrating diversity with quantitative, qualitative, and mixed methods*. Research and Evaluation in Education and Psychology. 3rd Edition.

Michael A A, Solomon ON, Abel A, Albert A A, & Comelius TB (2010). Waste Management and Research 28:769

Ministry of Health (2010). *Health Annual Report Palestine 2010*. Palestinian Health Information Center. Nablus-Palestine

Ministry of Health (2014). *Health sector strategic plan: Gaza Governorates 2014-2018*. Gaza: Palestine.

MOH-PHIC (2006). *Primary health care. Health Status in Palestine 2005*.

Morgat H. (2007). The Environmental Impact of Dentistry. *J Can Dent Assoc*;73(1):59-62

Mushtaq A, Alam M, Shahid I & Sohaila M. (2008). *The management of dental waste in a dental hospital of Lahore, Montmorency* by College of Dentistry and Institute of Public Health, Lahore – Pakistan

Natasha N, Silvana SB, Amy I, Ha H, and Leonard AC (2016). A review of mercury exposure and health of dental personnel. *Safety and Health at Work*; 2(24); 22-29

National Health Service (2012). *Waste Disposal Operational Policy*.

Osamong LA, Gathece LW, Kisumbi BK, & Mutave RJ. (2005). Management of dental waste by practitioners in Nairobi, Kenya. *Afr J Oral Health*;2(1&2):24-9.

Ozbek M, & Sanin FD. (2004). A study of the dental solid waste produced in a school of dentistry in Turkey. Waste Manag.;24(4):339-45.

Palenik C. (2016). *Waste management*. Retrieved from: http://www.dentaleconomics.com/articles/print/volume-93/issue-departments/infection-control/waste-management.html. (Accessed 05, March, 2016).

Palestinian Academic Society for the Study of International Affairs (PASSIA) (2009). *Facts and figures: geography*. Jerusalem, Palestine.

Palestinian Central Bureau of Statistics (2010). *Poverty in Palestinian Territories*. Ramallah: Palestine.

Palestinian Central Bureau of Statistics (2012). *Palestinians at the End of Year, 2012*. Ramallah -Palestine.

Palestinian Central Bureau of Statistics (2013). *Palestine in figures 2012*. Ramallah: Palestine.

Palestinian Ministry of Environmental Affairs (2000). Palestinian environmental strategy. Al-Bireh, Palestine.

Palestinian Non-governmental Organizations Network (2009). Priorities and needs of health sector in Gaza Governorates: consequences of the long siege and the last war on Gaza.

Palestinian Water Authority (2013). *Water quality in the Gaza Strip municipal wells*. Gaza: Palestine.

Park K. (2009). *Hospital waste management*. Park's Textbook of Preventive and Social Medicine. 22nd edition, Jabalpur, India: M/s Banarasidas Bhanot Publishers; 694-9.

Pasupathi P, Sindhu S, Ponnusha BS, & Ambika A. (2011). Biomedical waste management for health care industry. *Int J Biol Med Res*.;2:472–86.

Raghad H, Roaa M, & Neam H.(2011). Evaluation of dental waste management in the Emirate of Ajman, United Arab Emirates. *J Int Dent Med Res*.; 4: 64-9.

Rao HP. (2008). Report: hospital waste management- awareness and practices: a study of three states in India. *Waste Management & Research*;26:297-303.

Rudraswamy S, Sampath N, & Doggalli N. (2012). Staff's attitude regarding hospital waste management in the dental college hospitals of Bangalore city, India Indian. *J Occup Environ Med*.; 16(2): 75-78.

Sarsour A, Ayoub A, Lubbad I, Omran A, & Shahrour I. (2014). Assessment of medical waste management within selected hospitals in Gaza Strip, Palestine: A Pilot study. *International Journal of Scientific Research in Environmental Science*; 2 (5): 164-173.

Sattar S. (2011). *An environmental impact perspective of the management, treatment, and disposal of hazardous pharmaceutical compounds generated as medical waste at selected hospitals in Cape Town, South Africa*. South Africa: The Cape Peninsula University of Technology.

Sawalem M, Selic E, & Herbell JD. (2009). Hospital waste management in Libya: A case study. *Waste Management*; 29 (4):1370-1375.

Shushaa S, & Abu Safiah Y. (2000). *Medical waste management among health workers in Gaza governorates*. Gaza strip: Al-Quds University – Abu Dis.

Sudhakar V, & Chandrashekar J. (2008). Dental health care waste disposal among private dental practices in Bangalore City, India. *Int Dent J*.; 58(1): 51-4.

Taiwo JO, & Aderinokun GA. (2002). Assessing cross infection prevention measures at the Dental Clinic, University College Hospital, Ibadan. *Afr J Med Med Sci*.;31:213–217.

Tiong C, Abd.Latiff P, Subramaniam Al Karuppannan M. (2012). *Medical waste management in private medical clinics Taiping, Perak.* International Conference on Ecological, Environmental and Bio-Sciences April 13-15, 2012 Pattaya

Ustun AP, Jorge E, Philip R, Raki Z, Ruth S, Ute P, William KT, Susan W, & Yves C. (2013). *Safe management of wastes from health-care activities* (second edition).

Vanesh M, Dwivedi S, Hassan MA, & Misra1 RP. (2011). Knowledge, Attitude, and Practices about Biomedical Waste Management among Healthcare Personnel: A Cross-sectional Study. *Indian J Community Med*.; 36(2): 143–145.

Vieira CD, de Carvalho MA, Cussiol NA, *et al.* (2011). Count, identification and antimicrobial susceptibility of bacteria recovered from dental solid waste in Brazil. *Waste Manag*.; 31(6): 1327-32.

WHO (2014). *Medical waste definition*. Available at: http://www.who.int/topics/medical_waste/en/ (Accessed 01, June, 2016).

World Health Organization (2005). *Mercury in health care*.

World Health Organization (2009). Wastes from health-care activities. Fact sheet No.

World Health Organization (2011). *Essential medicine in Palestine: occupied Palestinian territory*.

World Health Organization (2013). *Towards mercury-free health care in Argentina*.

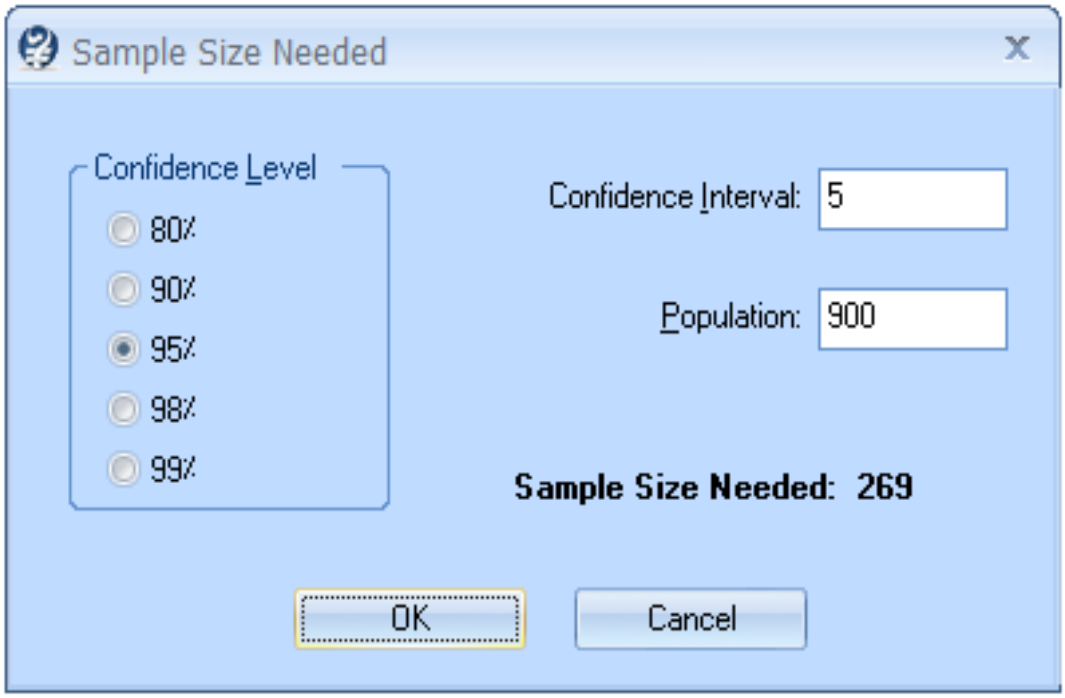
World Health Organization (2014a). *Waste management*. http://www.who.int/topics/medical_waste/en/ (Accessed 12, April, 2016).

Annexes

Annex (1) Map of Palestine

Source: (WHO, 2013)

Annex (2) Sample calculation



Annex (3) Study activates time table

Activity	Duration	10/11	12/1	2/3	4	5-11	12	1-3	4	5/6/7
Proposal writing	2 month									
Proposal defense and approval	1 month									
Expert committee check for validity of instruments	1 month									
Pilot Study	2 month									
Modifications	1month									
Data Collection	6 months									
Data Entry	1 month									
Data Analysis	2 months									
Research writing	2 months									

Annex (4) Ethical approvals from Helsinki Committee

Annex (5) The study instrument (Questionnaire)

Serial No.:
Date:

Demographic characters

1.	**Name of clinic: …….**			
2.	**Location- governorate:**			
	1. North Gaza	2. Gaza	3. Middle	
	4. Khan Yunis	5. Rafah		
3.	**Gender:**			
	1. Male	2. Female		
4.	**Age in year** ……..			
5.	**Qualification**			
	1. Diploma	2. Bachelor	3. Higher education	
	4. Other…….			
6.	**Specialization /profession**			
	1. Dentist	2. Dental assistant		
	3. Nurse	4. Other……		
7.	**Years of experience in the current position**……..			
8.	**Total years of experience** ……...			
9.	**Did you receive any formal training courses about dental waste management?**			
	1. Yes	2. No		
10.	**If yes, when did you receive the last training** ……			
11.	**Is there special policy for hazardous waste management in your town?**			
	1. Yes	2. No	3. Don't know	
12.	**Is there special policy for hazardous waste management in your clinic?**			
	1. Yes	2. No	3. Don't know	

13.	**Are there manual guidelines of dental waste management?**			
	1. Yes	2. No	3. Don't know	
14.	**Is there a special team or committee for hazardous waste management in your clinic?**			
	1. Yes	2. No	3. Don't know	
15.	**Are there legislations and bylaws for controlling hazardous waste management applying in your clinic?**			
	1. Yes	2. No	3. Don't know	
If the answer is yes in Q15				
16.	**Are the accountable people applying these regulations and bylaws?**			
	1. Yes	2. No	3. Don't know	
17.	**Is there a specialized person to supervise the process of dental waste management in your clinic?**			
	1. Yes	2. No	3. Don't know	
18.	**Does your clinic coordinate with other organizations in relation to the waste oncern?**			
	1. Yes	2. No	3. Don't know	
19.	**If yes, indicate these organization**……			
20.	**Have you notice any improvement in hazardous waste services in the last years?**			
	1. Yes	2. No	3. Don't know	
21.	**Did you notice any environmental improvement in hazardous waste field at the last years?**			
	1. Yes	2. No	3. Don't know	
22.	**If yes, what are these improvement?** **Specify**,……..			
23.	**If no, the reasons are** …….....			
24.	**Are there personal protective equipment available in your clinic? (gloves, gown, shoes, mask……etc.**			
	1. Regularly	2. Some times	3. Not absolutely	4. Don't know
25.	**If these equipment's are not available in proper manner, why?**			
	1. Lack of fund		2. Lack of workers awareness	
	3. Lack of department obligation		4. Others, specify …….	

26.	**If these equipment's are available, are you used it?**			
	1. Regularly	2. Some times	3. Not absolutely	
27.	**What is your evaluation about dealing with hazardous waste in your clinic?**			
	1. Excellent	2. Very good	3. Good	
	4. Fair	5. Bad		

Knowledge

28.	**Do you personally familiar with dental waste?**			
	1. Yes	2. No	3. Don't know	
If the answer is yes in Q28				
29.	**What does the dental waste means?**			
	1. Heavy metals as amalgam.	2. Sharps as needles.		
	3. Chemicals solution as sterilizing agents.	4. Cotton, gauze or other contaminated tissues.		
	5. Others like paper.	6. All of the above		
	7. None of the above			
30.	**Do you know that you should wear personnel protective equipment when handling a dental products?**			
	1. Yes	2. No	3. Don't know	
31.	**Do you know that dental waste may be hazardous to human health?**			
	1. Yes	2. No	3. Don't know	
32.	**Could you know that dental waste may be hazardous to environment?**			
	1. Yes	2. No	3. Don't know	
33.	**Do you know what is the proper procedures for safe elimination of the dental waste?**			
	1. Yes	2. No	3. Don't know	
34.	**Do you know that dentalwaste should be segregated for disposal?**			
	1. Yes	2. No	3. Don't know	
35.	**If yes, segregation process are met to ensure**			
	1. Regulations application	2. Reduce costs of disposal		
	3. Others, …….			
36.	**Do you know that a color coded container should be available for different type of dental waste?**			

	1. Yes	2. No	3. Don't know	
37.	**Do you know when is the collection time of dental waste?**			
	1. Yes	2. No	3. Don't know	
38.	**If yes, collection time are done.....**			
39.	**Do you know if there is dental waste storage area in your town?**			
	1. Yes	2. No	3. Don't know	
40.	**If yes, Do you know what is the maximum time for dental waste storage area?**			
	1. Yes	2. No	3. Don't know	
41.	**If yes, the maximum time for waste in storage area are…… day**			
42.	**Do you know what is the feature of dental waste vehicle?**			
	1. Yes	2. No	3. Don't know	
43.	**Do you know what are the treatment methods of dental waste?**			
	1. Yes	2. No	3. Don't know	

Practice

44.	**Do you currently performing a separation for dental waste product before disposal?**			
	1. Yes	2. No	3. Don't know	
45.	**Do you disposed of your dental waste product separated from each other?**			
	1. Yes	2. No	3. Don't know	
46.	**Do you disposed of the hazardous waste in special container?**			
	1. Yes	2. No	3. Don't know	
47.	**Do you classified the dental waste product to hazardous and non-hazardous waste?**			
	1. Yes	2. No	3. Don't know	
48.	**Do you disposed the needles and sharps into special container?**			
	1. Yes	2. No	3. Don't know	
49.	**Do you disposed of the liquid into containers that break resistance?**			
	1. Yes	2. No		
50.	**Do you put a sign as dangerous for hazardous waste?**			
	1. Yes	2. No	3. Don't know	

51.	**Are the hazardous waste are transported by special staff?**			
	1. Yes	2. No	3. Don't know	
52.	**Do you currently use a system for the disposal of dental Waste?**			
	1. Yes	2. No	3. Don't know	
53.	**Do you disposed of the remnants of amalgam into the wastewater?**			
	1. Yes	2. No	3. Don't know	
54.	**Do you use special container to store the waste of amalgam?**			
	1. Yes	2. No	3. Don't know	
55.	**Are generated waste remain in place by more than one day?**			
	1. Yes	2. No	3. Don't know	
56.	**How to disposed of the sterilization solutions?**			
	1. Wastewater	2. Stored		
	3. Don't know			
57.	**Are the bags or containers replaced immediately with new ones of the same type when filled?**			
	1. Yes	2. No	3. Don't know	
58.	**How to dispose of the x-rays films?**			
	1. Regular garbage	2. Special containers		
59.	**Is there a regular collection for hazardous waste in your town?**			
	1. Yes	2. No	3. Don't know	
If the answer is yes in Q59				
60.	**How many times do they usually collect hazardous waste?**.....			
61.	**How to dispose of the x-ray film packet? How to dispose the unused film?**			
	1. Regular garbage	2. Special containers		
62.	**How to dispose of the infectious waste(swab and gauze)?**			
	1. Regular garbage	2. Special containers		
63.	**How to dispose of the drugs and pharmaceutical waste? How to dispose of non hazardous waste?**			
	1. Regular garbage	2. Special containers		
64.	**Are liquid hazardous waste discharge concentrated to the sanitary sewer?**			
	1. Yes	2. No	3. Don't know	

Attitude

		Strongly	Disagree	Neutral	Agree	Strongly agree	
65	Dental waste management is an important issue.	1	2	3	4	5	
66	You are satisfied about current dental waste management policy.	1	2	3	4	5	
67	Current methods of dental waste management are appropriate.	1	2	3	4	5	
68	Formal training in dental waste management should be provided by the specialist for all healthcare professionals.	1	2	3	4	5	
69	Presence of manual for dental waste management is important.	1	2	3	4	5	
70	Palestine has adequate legislation dealing with the safe treatment and disposal of hazardous dental waste.	1	2	3	4	5	
71	Responsible person should be supervise the process of dental waste management.	1	2	3	4	5	
72	Waste management responsibility should be included in the job descriptions of all related healthcare professionals.	1	2	3	4	5	
73	Dental staff should be protected against hazardous waste.	1	2	3	4	5	
74	All waste generated by dental clinics has negative impact on the environment.	1	2	3	4	5	
75	Dental waste has negative impact on human health.	1	2	3	4	5	
76	Mishandling of hazardous waste lead to environmental harm and impacts.	1	2	3	4	5	
77	Healthcare professionals should be more aware of environmental issues.	1	2	3	4	5	
78	Each department or ward should keep records of hazardous waste generated.	1	2	3	4	5	
79	Presence of special tools is essential for dealing with hazardous waste.	1	2	3	4	5	
80	All dental clinics waste should be incinerated?	1	2	3	4	5	
81	Incinerator staff should have certificates of competency or received adequate training.	1	2	3	4	5	
82	Incinerators must be certified to dispose of medical waste.	1	2	3	4	5	
83	You are satisfied with incinerator system.	1	2	3	4	5	

Check list

Serial No.	**Name of clinic:**
Date :	

No.		**Yes**	**No**	**NA**
1.	Written plan for hazardous waste management are available			
2.	Written guideline for hazardous waste management are available			
3.	All dental product that have been identified as hazardous waste are labeling .			
4.	There is recording system for the process of dental waste management.			
5.	There is posters, flyers and labeling to remind employees about waste reduction.			
6.	There is separation for hazardous waste type.			
7.	Color-coded plastic bags or containers are used			
8.	Personal protective equipment are available			
9.	Empty stock containers/ bags are available in or near the soiled utility rooms at all times			
10.	Liquid medical waste is poured down into drain.			
11	Chemical waste are packed inchemical resistant containers			
12	General waste and dental waste bags are separated.			
13	Container is sufficiently strong			
14	Hazardous waste containers are kept closed			
15	Containers are fill to ¾ full.			
16	There is no leakage or spill from container			
17	All hazardous waste containers are maintained in good condition			
18	Controlled substances waste are stored in tight, secure and control place.			

19	Chemotherapy wastes are collected separately			
20	Universal waste and dental waste bags are separated.			
21	All containers that hold or use dental materials are labeled properly.			
22	Off-site Collection and transportation vehicle are suitable size commensurate with the design of the vehicle			
23	There is suitable system for securing the load during transport.			
24	The vehicle should be marked with the name and address of the waste carrier.			
25	Autoclave uses steam sterilization are used			
26	Chemical Disinfection are used			
27	Worker are used personal protective equipment's			
28	Waste are kept labeled			
29	Dental waste are disposed to sanitary landfill without treatment			

Annex (6) Expert of panel

1- **Dr. Yehia Abed:** Doctor of Public Health-Al Quds University

2- **Dr. Lamis Abu-Haloub:** Dentist- PhD Public Health

3- **Dr. Yasir El-Aydi**: Dentist- PhD

4- **Dr. Salwa Mejdalawi:** Dentist- Master Public Health

5- **Dr. Amal Al-Batsh**: Dentist- Master Public Health

6- **Dr. Hanan Diab**: Dentist- Master Public Health

7- **ملخص الدراسة**

تقييم إدارة نفايات عيادات طب الأسنان الخاصة في قطاع غزة

إعداد: رولا سمير قشطة

إشراف: د. بسام أبو حمد

يمكن تعريف النفايات الطبية بأنها مخلفات تتألف من نفايات صلبة، أو سائلة أو كلتيهما، وتأتي من مصادر مختلفة مثل المستشفيات والعيادات وهي تنتخ عادة من خلال المعالجة، الوقاية، والتشخيص أو البحث في أمراض الانسان أو الحيوان. وبشكل عام تعد إدارة النفايات الطبية أهمية كبيرة نظراً لطبيعتها المعدية والخطرة التي يمكن أن تتسبب في أثار غير مرغوب فيها على البشر والبيئة. وبشكل خاص تعد مشكلة إدارة مخلفات عيادات الأسنان أحد أهم أركان التحكم بالعدوى، فإن تنظيم التخلص من هذه النفايات هو تحكم بالعدوى خارج العيادة، بل يتسع ليصبح أكثر شمولية، فيضم الوقاية من المواد السامة للإنسان والبيئة بشكل خاص. وتقع المسئولية بالدرجة الأولى في الحفاظ على البيئة من هذه المخلفات على جميع العاملين بهذه العيادات، ثم على الجهات العامة بالدرجة الثانية، ومن ثم فإن التخلص من نفايات عيادات الأسنان ليس مهماً من الناحية الأخلاقية فحسب بل هي مسئولية بيئية أيضاً ولهذا هدفت هذه الدراسة إلى تقييم إدارة نفايات عيادات طب الأسنان الخاصة في قطاع غزة.

ولتحقيق أهداف الدراسة، اعتمدت الباحثة المنهج الوصفي التحليلي من خلال الاطلاع على ما هو متوافر من الدراسات المتعلقة بإدارة النفايات الطبية بشكل عام ونفايات عيادات طب الأسنان بشكل خاص، ثم انتقلت الباحثة إلى الدراسة الميدانية بالاعتماد على استبانة تم إعدادها لقياس متغيرات الدراسة، وتم توزيع الاستبانة على مجتمع الدراسة من جميع العاملين في عيادات الأسنان الخاصة في قطاع غزة والبالغ عددهم 276 فرداً، وكانت نسبة الاستجابة عالية جداً حيث بلغت 98.5%. وتم استخدام الأساليب الإحصائية لتحليل ردود المستجيبين.

أظهرت نتائج الدراسة أن 61.2% من عينة الدراسة ذكور وأن 42.8% تتراوح أعمارهم بين 30 إلى أقل من 40 سنة. كما أفصحت النتائج أن غالبية أفراد الدراسة (88%) هم أطباء الأسنان وغالبيتهم يحملون شهادة البكالوريوس وبنسبة بلغت 85.5%. وأشارت النتائج أيضاً أن 60.1% من المستجيبين لديهم خبرة في العمل أقل من 10 سنوات، بينما 1.8% لديهم خبرة أكثر من 30 سنة. كما نوهت النتائج أن غالبية المستطلعين (89.5٪) لم يتلقوا أي تدريب حول إدارة نفايات الأسنان وفقط (10.5٪) تلقوا تدريباً.

وفيما يتعلق بالسياسات والمبادئ التوجيهية، فقد أشارت الدراسة أن أكثر من ثلثي المستجيبين (87.3٪) على بينة من وجود سياسة لإدارة النفايات الطبية، في المقابل أشار الغالبية منهم (88.8٪) بعدم توفر كتاب يدوي بهذه السياسات والمبادئ في عياداتهم.

وفيما يتعلق بإدارة نفايات الأسنان، ذكرت غالبية المستطلعين (79.3٪) عدم توفر شخص يشرف على عملية إدارة النفايات، وتقريبا (94.6٪) من المستجيبين أفادوا بتوافر المعدات الشخصية للوقاية في العيادات. كما أشار ما يقرب من نصف المشاركين (44.6٪) بأنهم يتعاملوا بطريقة صحيحة مع النفايات الخطرة في عياداتهم، وأشارا (65.2٪) من المشاركين بأن عياداتهم مرخصة.

وفيما يتعلق بمعرفة المشاركين عن إدارة النفايات الطبية بعيادات الأسنان، فقد أشار معظم عينة الدراسة (90.6٪) بأنهم على دراية شخصية بهذه النفايات، كما كان الغالبية منهم (87.6٪) لديهم معرفة صحيحة حول تعريف النفايات الأسنان. وأن ما يقرب من (98.5٪) من المستطلعين يعرفون أنهم يجب أن يرتدوا المعدات الواقية عند التعامل مع نفايات الأسنان. كما أشارت النتائج بأن فقط (7٪) من المشاركين لا يعرفون الإجراءات المناسبة والخطوات الصحيحة في إدارة نفايات الأسنان.

أما بالنسبة لممارسة المشاركين في إدارة نفايات طب الأسنان، فقد أفصح الغالبية (86٪) بفصل نفايات الأسنان عن بعضها قبل التخلص منها، وأن (88.4) منهم أفادوا بأنهم التخلص من النفايات الأسنان يتم بعد الانفصال. وعلاوة على ذلك، أفصح غالبية المستطلعين (84.0٪) بالتخلص من القطن والشاش وغيرها من المواد الملوثة بالدم بالطرق الصحيحة وميها في سلة القمامة العامة بينما أشار (8.3٪) منهم باستخدام الطرق الصحيحة.

وفيما يتعلق بمواقف المشاركين نحو إدارة نفايات الأسنان، أظهرت النتائج بأن مواقف العامين في عيادات طب الأسنان بالممتازة. كما أفصحت النتائج بأن ما يقرب من (32%) من المشاركين غير راضين عن إدارة النفايات الأسنان الحالية.

وخلصت الدراسة إلى أن غالبية الموظفين العاملين طب الأسنان الذين يعملون في العيادات الخاصة على دراية إدارة النفايات الأسنان. بينما هناك خلل في ممارسة ومواقف العاملين في عيادات الأسنان في إدارة النفايات الأسنان ولهذا تنصح الباحثة بأن العاملين بحاجة إلى برامج تدريبية ومراقبة العاملين في هذه العيادات مع تنفيذ عملية التدقيق سنوية بالإضافة إلى دمج العاملين في رامج تعليمية تخص بإدارة النفايات الطبية عامة والأسنان بشكل خاص.