JORDANIAN DENTISTS' KNOWLEDGE AND IMPLEMENTATION OF ECO-FRIENDLY DENTAL OFFICE STRATEGIES

by

Sabha Mahmoud AL Shatrat
B.S. July 2005, Jordan University of Science and Technology

A Thesis Submitted to the Faculty of
Old Dominion University in Partial Fulfillment of the
Requirements for the Degree of

MASTER OF SCIENCE
(DENTAL HYGIENE)

OLD DOMINION UNIVERSITY

May 2011

Approved by:

Deanne Shuman (Director)

Michele Darby (Member)

Ahna Jeng (Member)

ABSTRACT

JORDANIAN DENTISTS' KNOWLEDGE AND IMPLEMENTATION OF ECO-FRIENDLY DENTAL OFFICE STRATEGIES

Sabha Mahmoud AL Shatrat
Old Dominion University, 2010
Director: Deanne Shuman

The purpose of this study was to determine if Jordanian dentists have knowledge about eco-friendly dental offices strategies and were employing these in their dental practices. Male and female dentists between the ages of 23-65, who work in private dental practices in the city of Amman, the capital of Jordan, were included in this study. Dentists' names and addresses were obtained from the Jordanian Dental Association. Data for this study was gathered via a researcher-designed questionnaire distributed to a convenience sample of 150 dentists. Dentists were selected according to their dental practice locality until the required number was completed. The questionnaire consists of three sections: information on subjects' age, gender, income, education level, and time of practice were obtained from the first section; information about Jordanian dentists' knowledge and implementation of eco-friendly strategies; and information about Jordanian dentists' perceived barriers to implementation of eco-friendly strategies. Data were processed using SPSS computer program. Frequencies and percentages were used to summarize categorical data and chi-square was used to analyze nominal data. Sample profile included 73% were between 23-40 years of age; 67% were males, and 33% were females; 54% earned between $500-$1000 a month; 81% had university degree; 82% reported 1-19 years in practice. In terms of knowledge and implementation, the majority of Jordanian dentists have high knowledge and low implementation about eco-friendly dental office strategies. Cost and no advantages from the government were the most

identifiable barriers to implement these strategies. The chi-square analysis revealed statistically significant relationships between the knowledge about eco-friendly dental office strategies and Jordanian demographic characteristics. Limited association was found between the implementation of eco-friendly dental office strategies and Jordanian demographic characteristics. No research could be found related to Jordanian dentists' knowledge and implementation of eco-friendly strategies. This research provides the decision maker with-evidence based information about this topic.

To the man whom I love

To the man who supported and encouraged me during these years

To the man whom I love from the bottom of my heart, my appreciation and love

To my wonderful husband Mohammad Tayyem, I love you…

To my children Sara, Khalil, &Aida

You put the smile on my face

I love you ….

To my brother Ayman Abu-Nabhan and his lovely wife Almaza and their daughter Sarah

For their continuous support and encouragement

I appreciate your help

Thank you …

In the memory of my mother-in-law Aida Qandeel, who died in 2009, for her love, patience, and support...I missed you so much. May Allah accept her and place her in heaven

AKNOWLEDGEMENTS

The researcher wishes to acknowledge the following individuals for their contributions and support in this study:

Professor Deanne Shuman, Interim Dean and thesis director, College of Health Sciences, Old Dominion University, Norfolk, VA for her time, support, continual encouragement friendship, tireless efforts in guidance, expertise, constructive criticism, and love.

Professor Michele Darby, Eminent Scholar, Chair of School of Dental Hygiene, and thesis member, for her time, support, expert, knowledge, encouragement, guidance, and advice.

Dr. Ann Jeng, Associate Professor, School of Community and Environmental Health, thesis member for her time, support, and encouragement.

The researcher wishes to express great appreciation to the overseas individuals from Jordan, who supported the author during this study.

For the researcher's family:

My mother for her love, patience, and support during this study. I love you Mom from the bottom of my heart.

My father in-law for his love, encouragement, and support. I appreciate your help; you deserve all the love in the world.

My brothers and my sisters Nayef, Nawaf, Naser, Mohammad, Nayefa, Nazeeha, and Sa'adeha for their continuous support and encouragement and to their family and children.

My family–in-law, Suhair, Ibraheem, Nabeel, Osama, Sua'ad, and Yahia Tayyem and their families, for their love and support.

My brother-in-law Ahmad Tayyem for everything he did for us.

My friend Michelle Sirois for her friendship.

AL-Hawamdeh Family for being such a good friends all these years.

Dr. Ahed AL-Wahadneh for his continuous support and encouragement.

Dr. Arwa Owais for her continuous support and encouragement.

TABLE OF CONTENTS

Page

LIST OF TABLES....x

Chapter

I. INTRODUCTION....1

PROBLEM STATEMENT....2

RESEARCH QUESTIONS....3

DEFINITION OF TERMS....4

ASSUMPTIONS....7

LIMITATIONS....8

II. REVIEW OF THE LITERATURE....10

AMALGAM MANAGEMENT....11

RADIOGRAPHIC MANAGEMENT....14

PAPER WASTE MANAGEMENT....15

INFECTION CONTROL MANAGEMENT....16

ENERGY MANAGEMENT....17

WATER CONSERVATION....19

III. MATERIALS AND METHODS....22

SAMPLE DESCRIPTION AND SELECTION....22

RESEARCH DESIGN, PROCEDURES AND MATERIALS....23

DATA COLLECTION....24

STATISTICAL TREATMENT....25

IV. RESULTS AND DISCUSSION....27
RESULTS....27
DISCUSSION....45

V. SUMMARY AND CONCLUSIONS....52

REFERENCES....60

APPENDICES....64

A. STANDARD DIALOG....66
B. COVER LETTER....68
C. KNOWLEDGE AND IMPLEMENTATION OF ECO-FRIENDLY DENTAL OFFICE STRATEGIES QUESTIONNAIRE....70
D. ARABIC TRANSLATION OF THE COVER LETTER....75
E. ARABIC TRANSLATION OF THE "JORDAN DENTISTS' KNOWLEDGE AND IMPLEMENTATION OF ECO-FRIENDLY DENTAL OFFICE STRATEGIES QUESTIONNAIRE"....77
F. APPROVAL LETTER OF HUMAN SUBJECT REVIEW COMMITTE....83
G. COMMENTS BY HE QUESTIONNAIR RESPONDENT ABOUT THE BARRIERS OF IMPLEMENTATION....85
H. CHI-SQUARE WITH SIGINIFIVANT ASSOCIATION OF DEMOGRAPHIC CHARACTERISTICS WITH THE KNOWLEDGE OF ECO-FRIENDLY STRATEGIES....88
I. CHI-SQUARE FOR DEMOGRAPHIC CHARACTERISTICS WITH KNOWLEDGE OF ECO-FRIENDLY STRATEGIES....91
J. CHI-SQUARE WITH SIGINIFICANT ASSOCIATION OF DEMOGRAPHIC CHARACTERISTICS WITH THE IMPLEMENTATION OF ECO-FRIENDLY STRATEGIES....94
K. CHI-SQUARE FOR DEMOGRAPHIC CHARACTERISTICS WITH IMPLEMENTATION OF ECO-FRIENDLY STRATEGIES....97

VITA....99

LIST OF TABLES

Table Page

1. Ages of Jordanian dentists....28
2. Monthly income for Jordanian dentists....28
3. Practice years for Jordanian dentists....29
4. Knowledge of Amalgam Management....30
5. Knowledge of Radiographic Management....31
6. Knowledge of Paper Waste Management....32
7. Knowledge of Infection Control Management....33
8. Knowledge of Energy Management....34
9. Knowledge of Water Conservation....35
10. Implementation of Amalgam Management....36
11. Implementation of Radiographic Management....37
12. Implementation of Paper Waste Management....38
13. Implementation of Infection Control Management....39
14. Implementation of Energy Management....40
15. Implementation Water Conservation....41
16. Barriers for implementing eco-friendly strategies....42
17. Significant Values (p-value $\leq .05$) for Comparison Between Demographic and the Knowledge of Eco-friendly Strategies....43
18. Significant Values (p-value $\leq .05$) for Comparison Between Demographic and the Implementation of Eco-friendly Strategies....44

CHAPTER I

INTRODUCTION

Dental professionals have a responsibility to conserve natural resources and reduce environmental impact. Awareness of conserving natural resources has increased since global warming became a certainty. Going green, eco-friendly or environmentally friendly are synonyms used to refer to materials considered to have minimum effect or no harm on the environment (Higgins, 2009). Eco-friendly dentistry is defined by Farahani and Suchak (2007) as:

> an approach to dentistry that implements sustainable practices by keeping resource consumption in line with nature's economy, by safeguarding the external environment by virtue of eliminating or reducing outgoing wastes and by promoting the well-being of all those in the clinical environment by conscious reduction of the chemicals in the breathable air (p. 6).

Conservation programs are starting to take place in dental practice settings to reduce the impact on personal health and the natural environment (Adams, 2007).

Dental professionals share responsibility with other healthcare professionals for managing and controlling waste. Other shared responsibilities include control or reduction of toxic materials and chemicals that end up in county landfills and water supplies. Common wastes in dental settings are amalgam restoration materials containing mercury, plastic barrier covers, radiographic fixer, lead foils, and disinfectant solutions. Going green in dental offices can begin with a large scale decision, such as the building design or with small decisions, such as using biodegradable gauze. The green building, natural building, sustainable design, and green architecture are synonyms which represent techniques used to reduce environmental impact through enhancement in building design,

using energy and water resources wisely, improving public health, and lessening waste and pollution (Henry, 2009). Besides green architecture, there are many ways to "go green" in dental care settings, from converting usage of conventional radiography to digital radiography or implementing paperless techniques and recycling paper waste or using reusable materials (Dalin, 2009; Pockrass, F. & Pockrass, I., 2009).

Problem Statement

According to the Intergovernmental Panel on Climate Change (a group of scientists formed by the United Nations to report every few years about global warming), greenhouse gases (GHGs) are responsible for climate change (IPCC, 2007). Greenhouse gases come from the burning of fossil fuels, i.e., coals, oil, and natural gas. The gas most responsible for climate change is carbon dioxide which causes higher concentrations of GHG to be released three times faster than they are reabsorbed back into the atmosphere (Bommhardt, 2008). According to the Energy Information Administration in 2006, carbon dioxide represented 82% of total US GHG emissions (EIA, 2008). Methane and nitrous oxide also play roles in global warming. Acting as GHGs, methane and nitrous oxide permit sunlight to enter the atmosphere freely; some of the reradiated sun light is reflected back as infrared radiation, i.e., heat. GHGs absorb and trap the infrared radiation, trapping heat in the atmosphere. Methane and nitrous oxide represent 9% and 5%, respectively, of 2006 US GHG emissions according to the Energy Information Administration (EIA, 2008).

In the United States, the primary energy sources are fossil fuels, which are responsible for 98% of carbon dioxide emission. Industrial and transportation sectors are major energy consumers and have higher emission levels of carbon dioxide compared to

residential and commercial sectors (EIA, 2008). In Jordan, local resources of energy are limited. Jordan mainly depends on imported oil (Abdulla et al., 2004). The primary energy source in Jordan is fossil fuels which are responsible for 85 % of GHG emissions (Jaber, 2002). The transportation sector is considered a major energy consumer (41%) followed by the industrial sector (21%), while the residential sector (20%) represents the third energy consumer (Abdulla et al., 2004). Energy sectors produce about 13.4 million tons of carbon dioxide, while landfills emit about 400,000 tons of methane gas. In addition, the agriculture and fertilizer industries emit about 40,000 tons of nitrous oxide (Namrouqa, 2007). The healthcare sector is also an energy consumer which contributes in generating greenhouse gases and consequently, shares responsibility in climate change. Dental offices, as part of the healthcare sector, generate waste which increase environmental pollution and GHG emissions. The improper disposal of mercury filings and toxic materials are examples of polluting dental waste. Annually, one hygienist is responsible for disposing of about 2,000 prophy cups into landfills. About 28 million tons of radiographic fixer, 4.8 million tons of lead foils and 680 million tons of plastic and paper patient barriers are dumped into landfills yearly (Eco Dentistry Association, 2010a). Going green in dental offices provides a way to minimize toxic waste and environmental pollution to protect the patient and the environment. According to the Eco Dentistry Association, implementing eco-friendly innovations can save a dental office about $50,000 (2010b).

Research Questions

This study surveyed Jordanian dentists to answer the following questions:

1. What do Jordanian dentists know about eco-friendly management strategies in the areas of amalgam, radiography, paper, infection control, energy, and water?

2. To what extent do Jordanian dentists' implement eco-friendly management strategies in the areas of amalgam, radiography, paper, infection control, energy, and water?

3. What do Jordanian dentists' perceive as barriers to implementation of eco-friendly management strategies in the areas of amalgam, radiography, paper, infection control, energy, and water?

4. Is there a relationship between Jordanian dentists' demographic characteristics, such as age, gender, monthly income, level of education, length of time in practice, and knowledge of eco-friendly management strategies?

5. Is there a relationship between Jordanian dentists' demographic characteristics, such as age, gender, monthly income, level of education, length of time in practice, and implementation of eco-friendly management strategies?

Definition of Terms

For the purpose of this study, the following key terms are defined:

Amalgam: Restoration material composed of metal alloy and mercury. Use of amalgam will be measured by specific questions in the *Jordanian Dentists' Knowledge and Implementation of Eco-Friendly Dental Office Strategies Questionnaire.*

Climate change: Extremes in climate attributed directly or indirectly to human activity that alters the composition of the global atmosphere in addition to natural climate variability observed over comparable time periods (Intergovernmental Panel on Climate Change, 2007).

Dental office "green" strategies: Techniques used in the dental office include conservation of amalgam, digital radiograph, paper, infection control, energy, and water.

Digital Radiography: Technique that uses a sensor instead of film to acquire the radiographic image. Use of digital radiograph will be measured by specific questions in the *Jordanian Dentists' Knowledge and Implementation of Eco-Friendly Dental Office Strategies Questionnaire.*

Energy waste management: Conservation in energy use in a dental setting for reducing electricity and utilizing renewable energy. Energy will be measured by specific questions in the *Jordanian Dentists' Knowledge and Implementation of Eco-Friendly Dental Office Strategies Questionnaire.*

Environment: All external factors influencing the life and activities of people, plants, and animals ("Environment," 2009).

Environmentally friendly: (Also eco-friendly, nature friendly and green) refers to goods and services considered to inflict minimal or no harm on the environment; materials or innovations used in dental offices which minimize harm to the environment.

Global warming: The gradual increase, observed or projected, in global surface temperature, as one of the consequences of radioactive forcing caused by anthropogenic emissions (Intergovernmental Panel on Climate Change, 2007).

Greenhouse gas: A gas that absorbs radiation at specific wavelengths within the spectrum of radiation (infrared radiation) emitted by the earth's surface and by clouds. The gas in turn emits infrared radiation from a level where the temperature is colder than surface. The net effect is a local trapping of part of absorbed energy and tendency to warm the planetary surface. Water vapor, carbon dioxide, nitrous oxide, methane and ozone are the primary greenhouse gases in the earth's atmosphere (Intergovernmental Panel on Climate Change, 2007).

Hashemite Kingdom of Jordan: A country in Western Asia (Middle East) spanning the southern part of the Syrian Desert down to the Gulf of Aqaba. Jordan shares borders with Syria to the north, Iraq to the northeast, Saudi Arabia to the east and south, the Gulf of Aqaba to the southwest, and Israel and the West Bank to the west. The Hashemite Kingdom of Jordan is a constitutional monarchy with representative government. The reigning monarch is the head of state, the chief executive, and the commander-in-chief of the armed forces.

Implementation of Eco-friendly Dental Office Strategies: The extent to which Jordanian dentists employ dental office "green" strategies. Implementation will be measured by specific questions in the *Jordanian Dentists' Knowledge and Implementation of Eco-Friendly Dental Office Strategies Questionnaire.*

Infection Control: Application of environmentally-friendly methods and techniques, using of biodegradable chemicals, and using reusable materials in patient care

to prevent the spread of infectious diseases. Infection control will be measured by specific questions in the *Jordanian Dentists' Knowledge and Implementation of Eco-Friendly Dental Office Strategies Questionnaire*.

***Jordanian Dentists' Knowledge and Implementation of Eco-Friendly Dental Office Strategies Questionnaire*:** A researcher-designed questionnaire addressing Jordanian Dentists' knowledge and implementation of eco-friendly dental office strategies. The closed-ended questionnaire includes three sections: Section I: Demographics; Section II: Knowledge and Implementation; and Section III: Barriers. Knowledge of Eco-friendly Dental Office Strategies: Extent of Jordanian dentists' familiarity with dental office "green" strategies. Knowledge will be measured by specific questions in the *Jordanian Dentists' Knowledge and Implementation of Eco-Friendly Dental Office Strategies Questionnaire*.

Paper waste management: Recycling paper waste used in the dental setting, using computer-based records, implementing electronic messaging services, and using educational videos. Use of paper will be measured using specific questions in the *Jordanian Dentists' Knowledge and Implementation of Eco-Friendly Dental Office Strategies Questionnaire*.

Water: Conservation in water use in dental setting, for example converting to dual-flush toilet and using hand sanitizer. Water conservation will be measured by specific questions in the *Jordanian Dentists' Knowledge and Implementation of Eco-Friendly Dental Office Strategies Questionnaire*.

Assumptions

This study is based on the following assumptions:

1. A significant amount of material exists in the literature review regarding green dentistry.

2. The researcher-designed *Jordanian Dentists' Knowledge and Implementation of Eco-Friendly Dental Office Strategies Questionnaire* is a reliable and valid measure of dentists' knowledge and implementation about eco-friendly practice.

3. Jordanian dentists are able to self-report their knowledge and implementation of eco-friendly practices by responding to the *Jordanian Dentists' Knowledge and Implementation of Eco-Friendly Dental Office Strategies Questionnaire.*

4. Jordanian dentists from Amman will be honest and truthful in answering the researcher-designed questionnaire.

5. All eco-friendly strategies identifiable in the study are available for Jordanian dentists.

Limitations

The validity and reliability of this study might have been affected by the following:

1. The sample is a convenience sample; therefore, findings may be generalized only to similar populations.

2. The study results will be self-reported responses and may have participant bias. A cover letter will be used to encourage participation. The questionnaire will not collect sensitive information, the forms will not contain the names of the respondents, and the information will be confidential.

3. The response rate may not be high enough to make a valid interpretation; to encourage responses, multiple attempts will be made to encourage participation.

4. The study will be conducted overseas which makes it difficult to directly supervise data collection. The person who will administer the questionnaire in Jordan will use a standard dialog when addressing the dentists (see Appendix A).

5. Questionnaire will be duplicated and then packaged for two separate mailings to minimize potential for loss. Returned questionnaire will be sent to the USA by UPS.

CHAPTER II

REVIEW OF THE LITERATURE

Climate change has a negative impact on the health of humans, animals, and plants. Increase in GHG concentrations in the atmosphere result in difficulty for some living things to adapt to unpredictable weather. Polar ice sheets are starting to melt, sea levels are rising significantly, and weather can be more extreme: more intense storms, more rain followed by longer and drier droughts (National Geographic, 2011). The relationship between climate and disease is not new. Exposing living things to extreme heat or cold may contribute to the global burden of disease. In the fifth century, Roman aristocrats were relocated to hilly areas in the summer time to avoid malaria. Terms in ancient times were used to state the effect of the climate on disease like "cold" for rhinovirus infections (Relman, Hamburg, Choffnes, & Mock, 2008). Dental offices are one of the sectors that are implementing "going green". Green design or sustainable design is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Higgins, 2009). Dental offices generate a significant amount of waste on a regular basis. Amalgam fillings, lead foils, and radiographic development chemicals are common sources of hazardous waste in dental offices. Plastic and paper chair barriers and sterilization chemicals are also toxic waste from dental offices. Dental office waste, as other wastes, participates negatively in human health as well as increasing environmental pollution (University of Minnesota, 2008). Eco-friendly dental offices utilize effective, evidence-based strategies to reduce toxic waste and minimize the negative effect on human health and environment.

Climate change is a global phenomenon and all citizens need to become aware of the importance of protecting the environment internationally. Health care professionals may play significant roles in decreasing the negative effects of global warming by adapting new choices in their homes and workplaces. Also, they can join communities and organizations that have the same goals or they may work with legislators to create policies that help reduce the global warming (Afzal, 2007).

This study will determine the knowledge and implementation of eco-friendly dental office strategies among Jordanian dental professionals, and promote environmental awareness among Jordanian dentists. Documenting dentists' self-reported knowledge and implementation of eco-friendly dental office strategies will help decision makers plan and implement educational programs for Jordanian dentists.

Amalgam Management

Amalgam, a material used to restore teeth, is composed of 50% metal alloy and 50% mercury (Environmental Protection Agency, 2011). Mercury is stable in the form of amalgam restorations; however, high-levels of mercury in industrial or work exposure causes symptoms which include irritability, memory loss, tremors, poor physical coordination, insomnia, kidney failure, and anorexia (Yang et al, 1994; Bluhm, 1992; Center for Disease Control and Prevention, 2010). Absorption of the mercury through the gastrointestinal tract is minimal; however, mercury can enter the body through breathing or swallowing (Dodes, 2001; Bjorkman, Sandborgh-Englund & Ekstrand, 1997). Mercury vapors released over time can be detrimental to human health (Lorscheider & Vimy, 1993). Mercury in fish is a health risk to humans. The dental team should not dispose amalgam in regular trash or down drains. Instead, amalgam

containing mercury should be collected in well- sealed containers for recycling to protect the environment. The American Dental Association (2007) recommends using pre-capsulated alloys and recycling extracted teeth that contain amalgam fillings to reduce the amount of disposed mercury. In Jordan, it is not mandated that amalgam be handled and disposed of this manner.

Sawair, Hassoneh, Jamleh, and Al-rabab'ah (2010) conducted a study in Jordan in 4 districts including Amman, to investigate the awareness of Jordanian general dental practitioners (GDPs) about mercury hygiene protocols. Dentists aged 23-63 years old were asked to complete a questionnaire consist of 24 questions about their personal information, total amalgam content per week, principles and measures applied to lessen the mercury release in their dental practice, and safety measures used when handling dental amalgam. Results revealed about 77% of the participants were males. The majority (41%) of the respondents aged 30-39 years. Also, the majority of the GDPs worked more than 8 hours daily and 6 or 7 days weekly. The mean of total amalgam contact was 3.2±3.6 hour per week (range: 0.09-23.8 hours). Also, about 8% of GDPs use the alternative fillings in their clinics instead of amalgam. The results suggested a higher percentage (22.6%) of GDPs with no undergraduate training in amalgam safety measures where Jordan is the country of graduation compared with percentage 13.2% of GDPs who graduated from different countries. Also, about 48.2% of GDPs did not train their dental assistants for proper mercury hygiene. About 76.8% of GDPs used different sizes of amalgam capsules. About 25% of GDPs did not have proper ventilation in their practice. The majority (84.2%) of the GDPs disposed of excess of unused amalgam through the drain or in the trash. About 70 % of GDPs were aware that amalgam could

be toxic to the environment, 61.8% to the dentists, and 37.7% to the patient. According to this study, there are no agencies for recycling amalgam waste in Jordan. Sawair et al. concluded that most general dentists do not follow the American Dental Association guidelines regarding amalgam waste management protocols.

Going green in the dental office includes use of an amalgam separator, a solution to reduce the mercury waste. Amalgam separators work based on sedimentation, filtration, centrifugation, chemical removal by ion exchange or using a combination of two techniques. An amalgam separator traps the amalgam particles prior to discharge, which are generated during preparation, mixing, administration, and removal of the filling from a patient's mouth (University of Minnesota, 2008). Amalgam separators efficiently remove 95% of amalgam particles (EPA, 2011). Based on a laboratory study, available amalgam separators in the market exceeded the 95% of amalgam removal efficiency which is the requirement of the International Organization of Standardization (Fan et al, 2002). According to the Eco Dentistry Association (2010a), the use of an amalgam separator in every dental office can reduce 3.7 tons of mercury-containing waste yearly. Based on how the amalgam separators work different types can be found. Many factors should be considered when an amalgam separator is selected for use; for example, cost, regulatory issues, maintenance requirements, size of amalgam separator, and office configuration. Amalgam separators can be installed in different locations in the dental office: within the vacuum system lines or close to dental chairs; in-line at central location before the separator; or the exit side of air/water separator (McManus & Fan 2003). Also, amalgam traps and vacuum filters catch coarse amalgam particles. Using dental chairs for placement and removal of the amalgam filling only equipped with a

vacuum system, directs the amalgam particles to amalgam waste water containers, is considered a third way to reduce the poisoning of mercury in waterways. The fourth way to reduce amalgam toxicity and waste in dental offices is to substitute amalgam with composite, ceramic, gold, porcelain, and glass ionomers (University of Minnesota, 2008; Mercola & Klinghardt, 2001).

Radiographic Management

A digital radiograph, another approach to eco-friendly dentistry, is a technique that uses a sensor instead of film to acquire the radiographic image. Digital images require 50% to 80% less radiation than conventional images, which will reduce the radiation exposure to the patient. Using a digital radiograph instead of conventional techniques will eliminate the paper, plastic, and lead waste generated from discarding the empty film packets. In addition, digital radiographs eliminate the use of developer and fixer chemicals which are toxic wastes (Johnson & Thomson, 2007). According to Eco Dentistry Association (2010a), a dental practice could prevent generating 200 liters of toxic x-ray fixer and 17,200 lead foils in five years by converting to digital radiographs. Converting to digital radiography supports human health by reducing the patient and staff exposure to radiation and toxic materials, but also helps to save about $8,769 annually per office (EDA, 2010b). The oral healthcare provider can transmit the digital radiographs electronically via the Internet, which also reduces paper and plastic waste (Johnson & Thomson, 2007).

Paper Waste Management

More than 100 million tons of paper is thrown away by Americans yearly (Henry, 2009). In Jordan, the major component of municipal solid wastes is the kitchen garbage (55-70%). Paper and cardboard waste are estimated to be 11-17 % of solid waste. The other components are plastic (5-17%), glass (2-2.5%), metals (2-2.5%), and other (4-7%). Solid waste management is not governed by specific legal frame work in Jordan. In Jordan, trash containers contain a mix of waste without separation on site between different sources. Recycling in Jordan is considered at primary stage. Marketing of the recycled products is considered a problem in recycling sector in Jordan. The Jordanian awareness about recycling is increasing through governmental (Ministry of Environment) and non-governmental agencies (Alfayez, 2003).

Paper waste is significant in the dental office. A study to compare five dental offices found 12.3 is the average number of papers in a typical chart used in conventional dental offices, while half of this number of papers used in a dental chart in eco-friendly dental offices which save about 12,600 papers for using a 2,000 charts (Farahani & Suchak 2007). Eco-friendly strategies will save 17 trees when one ton of paper is reduced (Nair, 2009).

To reduce the amount of generated paper, the dental team should recycle paper waste. Some dental offices shred paper waste and donate the shredded papers to the animal shelters to be used in pens (Dalin, 2009). Converting the dental office from a paper-based records system to computer-based records system is another eco-friendly approach. Practice-management software protects the environment by reducing the paper waste, organizes patient records efficiently, and eliminates the risks of losing patient

records during emergencies like fires and floods. In addition, it saves time by updating the patient records and displays the changes using simple easily understood graphs (Berghoff, 2009; Zadeh, 2004). Pulling and filing charts accounts for 25% of the administrative employee's work day. By going green and converting to a paperless office, the labor and space cost for patient records is reduced (Zadeh, 2004). Implementing patient electronic messaging services in the dental office instead of traditional forms of print communication would save about $17,000 annually (McManus, 2009). For example, electronic messaging services used in the dental office for patient's appointment reminders, recall notices, educational newsletter, patient surveys, and referral requests. Also, using educational videos that explain the benefits and the recommendation of different dental procedures, viewed in the waiting room or during the dental procedures is another paperless strategy.

Infection Control Management

A priority for all health care workers is to prevent the spread of infectious diseases. However, using disposable products as a solution to avoid spreading infectious disease increases the amount of generated waste. According to the Eco Dentistry Association, about 680 million plastic and paper chair barriers and 1.7 billion instrument and sterilization bags are dumped into landfills yearly (2010b). Environmentally conscious dental practices are switching from using disposable items to reusable materials to reduce the amount of waste deposited in landfills. About 80% of medical waste can be placed into general trash containers because it is not capable of causing infectious disease. Only 3% of dental office waste is considered infectious waste which requires special disposal (Molinari, 2009).

More environmentally-friendly practices include using reusable cloth fabric, instead of single use paper/plastic barriers in dental offices (Dalin, 2009). Annually, dental teams could save about $2,337 by using cloth operatory and sterilization methods (EDA, 2010b). Buying prophy paste in large containers instead of using single-use plastic cups is another way to go green in the dental office (Pockrass, F. & Pockrass I., 2009). Ceramic or glass reusable drinking cups rather than using disposable styrofoam cups is yet another way to have environmentally conscious dental practices. By switching to reusable cups, dental offices can save $178 yearly (EDA, 2010b). Also, reusable metal suction tips instead of using disposable plastic suction tips decreases the generated waste in the dental office. Using enzyme-based cleaners, which are biodegradable, non- toxic and non-chlorinated, instead of using chemicals also will reduce waste, e.g., Sani-Treet Green™ (Blaes, 2009; Elliott-Smith, 2008) and Enzymax Earth™ that provide effective cleaning without causing harm to environment (Enzymax Earth™, 2010). Using a spray bottle filled with disinfectant chemicals, especially if it is not environmentally friendly; increases chemicals inside the office air. Delivering the product to cloth or gauze protects the staff, patients, and planet (Elliott-Smith, 2008). Steam sterilization is considered eco-friendly because it does not contain toxic chemicals, especially when the instrument is wrapped by cloth instead of paper/plastic autoclave bags (Dalin, 2009).

Energy Management

Overuse of energy has a negative impact on the environment. It can result in acid pollution, acid rain and global warming, oil spills and water pollution, loss of wildness areas, construction of new power plants, foreign energy dependence and the risk of

international conflict over energy supplies (The Pennsylvania State University, 2005). Electricity plays a significant role in air pollution. According to the Environmental Protection Agency (2010a), the single largest contributor to greenhouse gases emission is electricity, generated from coal-burning which releases pollutants into the atmosphere.

Electricity is an unsustainable way to make power; therefore, reducing electricity is a way of going green in the dental office. By converting to compact fluorescent light (CFL) bulbs instead of incandescent lights, the user will increase the lifetime up to 12 times longer than traditional incandescent lights. Using CFL reduces heat production by 70% compared to traditional incandescent lights, which releases 90% heat for every watt of energy consumed while illuminated. According to the nonprofit group, Environmental Defense Fund (2009),

> If every household replaces just three 60-watt incandescent bulbs with compact fluorescent bulbs, the pollution savings would be equal to taking 3.5 million cars off the road.

Burned bulbs are considered a hazardous waste regardless of the bulb type. Mercury found in CFL bulbs and lead found in candescent bulbs and light emitting diodes (LEDs) are toxic substances that should not be placed into regular trash, but instead be recycled or disposed in hazardous waste (Henry, 2009).

Green power, another option to reduce energy waste, uses renewable energy such as wind or solar power, keeps the environment clean and reduces the power waste. In Jordan, about 2% of the total energy consumption is renewable energy. The Jordanian government established the National Energy Research Center in 1998 to lessen the burden of imported energy by improving renewable energy and encouraging activities that conserve energy. Small projects related to renewable energy in Jordan are

implemented. Wind as a renewable energy is available resource for energy in Jordan. In cooperation with the Danish and German governments, Jordan has two operating wind farm. Also, solar energy is mainly used in homes and small businesses for water heaters (Abdulla et al., 2004).

Adapting automated thermostats to control heating/cooling systems, unplugging electronic equipment after work hours, putting computers in "sleep mode," using motion detectors for room lighting, and using laptops whenever possible will reduce the emission of greenhouse gases (Dalin, 2009; Henry, 2009).

Water Conservation

The water issue has posed a difficult challenge for Jordan. Jordan is considered one of the driest countries in the world, and has limited water resources. A large area of desert, rapid population growth, a high number of refugees, industrialization, and contamination of water supplies are some reasons for water shortage in Jordan. Eco-friendly strategies are considered initiatives strategies for water conservation (Hadadin & Tarawneh, 2007).

Another way of going green in the dental office is by conserving water. Sinks and toilets waste a significant amount of water daily in homes and in dental offices. Standard toilets use several gallons of water per flush representing a large amount of water waste in the dental office. Converting to a dual-flush toilet at the dental office is a way to conserve water. Dual-flush toilets use up to 1.28 gallons of water per flush as opposed to standard toilets which is considered a good way to save water. Placing bricks or other heavy materials inside the standard toilet tanks will reduce the space needed to

fill the tank with water after the flush which is a cost-effective substitute for a dual-flush toilet to save water (Henry, 2009).

Implementing water faucet motion sensors in all sinks and low-flow water fixtures will eliminate excess of water use (Dalin, 2009). Using hand sanitizer and turning off water faucets during teeth brushing reduces the amount of waste water as well as paper towel waste for hand washing. Proper turning off water faucets during brushing will save up to 90 glasses of water daily (Pockrass, F. & Pockrass I., 2008).

Economic Consideration

In the United States, overhead count costs toward a significant amount of operating a dental practice. Some eco-friendly changes have huge startup costs. It may take years to see a financial benefit from changes such as implementing a computer system and digital radiography. The estimated cost of converting to digital radiography is about $6,000 to $16,000. This cost does not include the cost of the x-ray machine (Johnson &Thomson, 2007). The estimated cost for a wireless digital radiograph system is about $22,000. Additionally, some of the sensors can be damaged easily because they are fragile and small. Also, the estimated cost to replace a sensor varies from $6,000 to $12,000 depending on the system used. In addition, the estimated cost for utilizing practice- management software in the dental office is about $500 to $2242 for a single user. While for networkers the cost is estimated from $1799 to $3944 ("DentiMax'08", 2007). The initial cost and upfront expenses are considered limiting factors of implementing eco-friendly strategies in dental practice.

Summary

As a part of the health care team, dental professionals share responsibility for elimination or reduction of wastes that could cause harm to the natural environment and personal health. Wastes in dental settings are amalgam restoration materials containing mercury, plastic covers, radiographic chemicals, lead foils, and disinfectant solutions that end up in county landfills and water supplies. "Going green" model or using eco-friendly strategies in dental offices can be implemented through paperless techniques and recycling paper waste. Also, converting usage of conventional radiography to digital radiograph, using reusable materials and using energy and water recourses wisely are considered an eco-friendly strategies that could be applied in dental practice and improve public health and lessen waste and pollution.

CHAPTER III

MATERIALS AND METHODS

This chapter describes the sample selection, and methods and materials used in the study to answer the posed research questions.

Sample Description and Selection

According to the Jordanian Dental Association (2011), the number of registered dentists in Jordan is 6854; 4472 dentists are males; and 2382 dentists are females. In The United States, formal accredited dental education is different than in Jordan. In the USA, the minimum requirement for admission to dental school is 90 semester hours of academic work that has been pursued at an accredited four-year college or university. While in Jordan, a dental student does not need any specific requirements for admission except a high grade point average in high school and a high score on the Tawjehee examination, a standard exam for college admission. In Jordan, the length of dental curriculum is 5 years to obtain the Bachelor of Dental Surgery degree. A list of dentists' names was obtained from Jordanian Dental Association. Participants' selection was based on certain inclusion/exclusion criteria as well as accessibility. Participants in this study comprised a convenience sample of 150 male and female dentists, ages 23-65 years who work at private dental offices in the city of Amman.

Willingness of the office manager in the private dental offices to distribute the questionnaire to the dentist was the reason for selecting these settings. From August 1-September 15, 2010, during normal working hours, dentists were personally visited and

asked to read the cover letter that explained the purpose of the survey (see Appendix B). Respondents were informed that they would not be personally identified on the questionnaire, and will be anonymous to the principle investigator.

For inclusion in the survey, dentists will be:

- Between 23-65 years of age
- Working in private dental offices
- Willing to complete the questionnaire

Dental students and dentists who work in public clinic were excluded from the study. An equal number of male and female dentists was a goal in subject participation.

Research Design, Procedure and Materials

A researcher-designed, 55-item questionnaire was developed for use in this study. The *Jordanian Dentists' Knowledge and Implementation of Eco-Friendly Dental Office Strategies Questionnaire* (see Appendix C) was voluntarily completed by each dentist to determine his or her knowledge and implementation of eco-friendly dental office strategies. The questionnaire consists of three sections. Information on subjects' age, gender, income, education level, and time of practice are obtained from the first section. The second section contains information about Jordanian dentists' knowledge and implementation of eco-friendly strategies. This section employs a 4-point Likert scale, the participants were asked to select one answer that applies to his/her dental office management strategies in amalgam, digital radiograph, paper, infection control, energy, and water. The third section contains information about Jordanian dentists' perceived

barriers to implementation of eco-friendly strategies. This section contains four close-ended questions and one open-ended question.

To establish content validity, the questionnaire content was evaluated by a group of faculty experts in health sciences at Old Dominion University and Jordanian dentists at Jordan University of Science and Technology. The cover letter and the questionnaire were translated by the principal investigator into Arabic, the Jordanian official language (see Appendix D) and (see Appendix E). Completion time was approximately 10 minutes. The questionnaire was pilot tested using 10 Jordanian dentists who voluntarily agreed to participate in a pilot. They were asked to answer the questionnaire and provide feedback on content and format. A $10.00 gift card was provided to all pilot study volunteers in appreciation of their participation.

Data Collection

A designated research assistant distributed the questionnaires to dentists in Amman whose names and addresses were obtained from Jordanian Dental Association, since the study will be conducted from the U.S. Data collection arrangements were made with the manager of the private dental clinic of the dentist to obtain permission for delivering the questionnaire until the required number is completed. The person who administered the questionnaire in Jordan used a standard dialog (see Appendix A). Subjects were asked to read the cover letter (see Appendix B) and were able to see the questionnaire before they decided to participate. If the dentist voluntarily agreed to complete it, the questionnaire administrator waited and collected the completed questionnaire. The respondents were directed to place the completed questionnaire in a sealed envelope to protect anonymity and confidentiality. If the dentist voluntarily

agreed to complete the questionnaire and he/she was busy at that time, the questionnaire administrator left the questionnaire and returned to collect at date and time indicated by the dentist. Once 150 questionnaires were completed, the questionnaires were returned by the questionnaire administrator in the sealed envelopes to the principal investigator at Old Dominion University in the U. S. via UPS.

Statistical Treatment

The questionnaire data is nominal and ordinal and was analyzed using frequency distributions, cross tabulation, and Chi-square analysis. The software package, SPSS, was employed with a 0.05 level of significance.

Protection of Human Subjects

1. In August 2010, The College of Health Sciences Human Subjects Review Committee approved the *Jordanian Dentists' Knowledge and Implementation of Eco-Friendly Dental Office Strategies* protocol (see Appendix F)
2. Potential Risks: The information gathered in this study is to measure the knowledge and implementation of eco-friendly dental offices strategies. This study contains no risk to the subjects who will participate in the survey. The questionnaire questions will not contain any sensitive information related to the participants or their names.
3. Potential Benefits: This study will be a benefit to dentists and other dental health professionals about eco-friendly Jordanian dental office strategies. By completing the questionnaire, awareness of eco-friendly strategies will be increased for the Jordanian dentists/participants.

4. Consent Procedure: The participants in this study will be told the reason, purpose, procedure, and nature of the survey by the questionnaire administrator. In addition, the participants will be informed that the person who will lead the study, Sabha M. AL Shatrat, is a dental hygienist working toward her master's degree at Old Dominion University in the U.S. Potential participants will be informed that they have the choice to refuse to participate or to withdraw from the study any time without penalty.
5. Protection of Subjects' Rights: Participants' information will remain confidential in this study. Names of participants will not be used or published in this study; all data will be reported in group form.
6. Risk- Benefit Ratio: This study will contain no risks to subjects who will agree to participate in the survey. This knowledge- based study will be used to develop and improve eco-friendly strategies at Jordanian dental offices.

CHAPTER IV

RESULTS AND DISCUSSION

A study was conducted to determine Jordanian dentists' knowledge about eco-friendly dental offices strategies and if they are employing these in their dental practices. A convenience sample of 150 dentists who work in private dental practices in the city of Amman-Jordan participated in this study. The survey instrument, Jordanian Dentists' Knowledge and Implementation of Eco-friendly Dental Office Strategies, was distributed to practicing dentists to gather information on their knowledge, implementation, and barriers to implementation of eco-friendly dental practices related to waste management strategies of materials used in the dental office: amalgam, radiographic materials, paper, infection control practices, and energy management. The following results are discussed in relationship to the original research questions and hypotheses.

Results

As the sample was a convenience sample, dentists were approached to participate in the study until 150 participants agreed to participate and completed the survey gathering tool. Where respondents left a questionnaire item blank, data are reported as "missing".

Demographics.

Section 1 of the questionnaire solicited demographic information about the participants including: age, gender, monthly income, education level, and years in practice. The largest number of respondents were ages 31-40 (50%) (see Table 1).

Table 1

Ages of Jordanian Dentists

Age	Frequency	Percentage
23-30	34	22.7
31-40	75	50
41-50	32	21.3
51-60	7	4.7
61-65	2	1.3
TOTAL	150	100

Results indicated that 67.3% (101) of the questionnaire respondents were male and 32.7% (49) were female. Table 2 demonstrates the reported monthly income with the largest percentage (54%) being $500-$1,000.

Table 2

Monthly Income for Jordanian Dentists

Monthly Income	Frequency	Percentage
<$500	19	12.7
$500-$1000	81	54.0
>$1000-$1500	41	27.3
>$1500	9	6
TOTAL	150	100

Respondents (n=150) reported the following for educational levels: university degree 80.7% (121), master's degree 11.3% (17), specialty degrees 5.3% (8), and doctoral degrees 2.7% (4). Table 3 displays the information obtained from respondents regarding number of years in dental practice with the majority (82%) being 1 year-19 years.

Table 3

Practice Years for Jordanian Dentists

Practice Years	Frequency	Percentage
1-9	61	40.7
10-19	62	41.3
20-29	21	14
30-39	4	2.7
40-49	2	1.3
TOTAL	150	100

Research Question One.

What do Jordanian dentists know about eco-friendly dental office management strategies in the areas of amalgam, radiography, paper, infection control, energy, and water? Knowledge of management strategies was assessed by the survey, and using the responses noted as: "Fully in Place", "In Progress", and "Aware of Strategy-But not Implemented". "Not Aware of Strategy" contributed to the differences from the 100%. An assumption of this study regarding the respondent's knowledge about eco-friendly dental office management strategies was made. Using and implementing these strategies by the respondents indicate their knowledge about these strategies. The three responses together have a 70% or higher indicate a high level of knowledge about eco-friendly management strategies among the respondents. Responses noted as "Fully in Place", and

"In Progress" were used to assess the dentists' implementation of strategies which is research question two.

The section on amalgam management contains six questions regarding amalgam use and disposal. Based on the knowledge level which is assumed by adding the responses noted as: "Fully in Place", "In Progress", and "Aware of Strategy-But not Implemented", the majority of the respondents reported high knowledge in each strategy with the mean of 94.98% for knowledge in all strategies (see Table 4).

Table 4

Knowledge of Amalgam Management Strategy

Amalgam Management	Fully In Place n (%)	In Progress n (%)	Aware not Implemented n (%)	Total
1. Use pre-capsulated alloys in different size	**88 (58.7%)**	14 (9.3%)	47 (31.3%)	149 (99.3%)
2. Dispose amalgam in means other than regular trash or down drain	26 (17.3%)	29 (19.3%)	**91 (60.7%)**	146 (97.3%)
3. Keep unused amalgam particles in well sealed containers	37 (24.7%)	17 (11.3%)	**90 (60%)**	144 (96%)
4. Use amalgam separators	27 (18%)	11 (7.3%)	**97 (64.7%)**	135 (90%)
5. Use amalgam vacuum filters which directs the amalgam particles to amalgam waste water containers	16 (10.7%)	20 (13.3%)	**95 (63.3%)**	131 (87.3%)
6. Use alternatives to amalgam filling such as composite, ceramic, gold, and porcelain	**1 14 (76%)**	24 (16%)	12 (8%)	150 (100%)
Mean for amalgam waste strategies (Total frequency /6)				142.5 (94.98%)

The section on Radiographic Waste Management contained six questions regarding radiographic use and disposal. Based on the knowledge level responses, the majority of

the respondents have high knowledge in each of the six strategies with the mean of 86.2% for knowledge in all strategies (see Table 5).

Table 5

Knowledge of Radiographic Management Strategy

Radiographic Management	Fully In Place n (%)	In Progress n (%)	Aware not Implemented n (%)	Total
7. Mix and store chemicals according to manufacturer's recommendations to avoid waste	**109 (72.7%)**	18 (12%)	19 (12.7%)	146 (97.4%)
8. Purchase chemicals (developer, fixer) in concentrated form. Prepare chemicals as needed to eliminate excess	**74 (49.3%)**	20 (13.3%)	52 (34.7%)	146 (97.3%)
9. Use waste management program to dispose of lead foils	20 (13.3%)	27 (18%)	**67 (44.7%)**	114 (76%)
10. Use waste management program to dispose fixer	15 (10%)	26 (17.3%)	**66 (44%)**	107 (71.3%)
11. Use digital radiography	**85 (56.7%)**	23 (15.3%)	34 (22.7%)	142 (94.7%)
12. Reuse x-ray mounts for new patients when purging old files	12 (8%)	16 (10.7%)	**93 (62%)**	121 (80.7%)
Mean for the radiographic waste management strategies (Total frequency /6)				129.3 (86.2%)

The section on paper waste management contains eleven questions regarding use of paper waste management strategies. Based on the knowledge level responses, the majority of the respondents have high knowledge in each of the eleven strategies with the mean of 91.9% for all strategies (see Table 6).

Table 6

Knowledge of Paper Waste Management

Paper Waste Management	Fully In Place n (%)	In Progress n (%)	Aware not Implemented n (%)	Total
13. Recycle dental office paper waste	6 (4%)	6 (4%)	**117 (78%)**	129 (86%)
14. Print on both sides of the paper when possible	49 (32.7%)	12 (8%)	**81 (54%)**	142 (94.7%)
15. Use computer-based records system	**100 (66.7%)**	18 (12%)	29 (19.3%)	147 (98%)
16. Use practice-management software	**60 (40%)**	26 (17.3%)	57 (38%)	143 (95.3%)
17. Implement patient electronic messaging services	10 (6.7%)	17 (11.3%)	**106 (70.7%)**	133 (88.7%)
18. Use educational videos to explain the recommendation of different dental procedure	13 (8.7%)	17 (11.3%)	**109 (72.7%)**	139 (92.7%)
19. Use reusable name badges	10 (6.7%)	16 (10.7%)	**104 (69.3%)**	130 (86.7%)
20. Use recycled paper products	21 (14%)	7 (4.7%)	**107 (71.3%)**	135 (90%)
21. Use scrap office/computer paper for scratch pads and internal notes	**75 (50%)**	5 (3.3%)	58 (38.7%)	138 (92%)
22. Donate old magazines to community centers, public health, and other service centers	49 (32.7%)	19 (12.7%)	**73 (48.7%)**	141(94.1%)
23. Donate old dental books to libraries, schools, or fundraising effort	43 (28.7%)	20 (13.3%)	**77 (51.3%)**	140 (93.3%)
Mean for the paper waste management strategies (Total frequency/11)				137.9 (91.9%)

The section on infection control management contained ten questions regarding infection control handle and use. Based on the knowledge level responses, the majority of the respondents have high knowledge in each of the ten strategies with the mean of 92.34% for knowledge in all strategies (see Table 7).

Table 7

Knowledge of Infection Control Management

Infection Control Management	Fully In Place n (%)	In Progress n (%)	Aware not Implemented n (%)	Total
24. Purchase supplies in bulk packaging	**120 (80%)**	16 (10.7%)	8 (5.3%)	144 (96%)
25. Use reusable glass/ metal cups instead of paper, plastic, or Styrofoam	7 (4.7%)	13 (8.7%)	**109 (72.7%)**	129 (86.1%)
26. Use reusable metal air/water syringes instead of plastic	31 (20.7%)	10 (6.7%)	**98 (65.3%)**	139 (92.7%)
27. Use steam sterilization with cloth instrument wraps vs. paper and plastic autoclave bags	19 (12.7%)	17 (11.3%)	**96 (64%)**	132 (88%)
28. Use metal suction tips instead of disposable plastic suction tips	**13 (8.7%)**	10 (6.7%)	107 (71.3%)	130 (86.7%)
29. Use enzyme –based cleaners that are biodegradable	42 (28%)	18 (12%)	**81** (54%)	141(94%)
30. Use nontoxic, noncorrosive disinfectant wipes instead of pump spray bottles	56 (37.3%)	16 (10.7%)	**71** (47.3%)	143 (95.3%)
31. Use cloth lab coats that can be laundered, rather than disposable ones	44 (29.3%)	11 (7.3%)	**86** (57.3%)	141 (93.9%)
32. Use sterilizable instruments, trays, and film holding devices, rather than disposable products	60 (40%)	21 (14%)	**63** (42%)	144 (96%)
33. Reuse instrument sterilization bags. Secure with autoclave tape	18 (12%)	15 (10%)	**109** (72.7%)	142 (94.7%)
Mean for the infection control management strategies (Total frequency/10)				138.5 (92.34%)

The section on energy management contained six questions regarding energy conservation. Based on the knowledge level responses, the majority of the respondents have high knowledge in each of the six strategies with the mean of 87.2% for knowledge in all strategies (see Table 8).

Table 8

Knowledge of Energy Management

Energy Management	Fully In Place n (%)	In Progress n (%)	Aware not Implemented n (%)	Total
34. Use compact fluorescent light Bulbs	**138 (92%)**	3 (2%)	8 (5.3%)	149 (99.3%)
35. Dispose the burned bulbs into hazardous waste or recycle it	27 (18%)	12 (8%)	**101 (67.3%)**	140 (93.3%)
36. Use renewable energy such as wind or solar power	8 (5.3%)	4 (2.7%)	**109 (72.7%)**	121 (80.7%)
37. Use automated thermostats to control heating /cooling systems	39 (26%)	5 (3.3%)	**77 (51.3%)**	121 (80.6%)
38. Turn off and plug all the electrical appliances at the end of the day, including computers, printers, and copiers	**106 (70.7%)**	7 (4.7%)	34 (22.7%)	147 (98.1%)
39. Use motion detectors for room lighting	4 (2.7%)	9 (6%)	**94 (62.7%)**	107 (71.4%)
Mean for the energy waste management strategies (Total frequency /6)				130.8 (87.2%)

The section on water conservation contains six questions regarding water use and conservation. Based on the knowledge level responses, the majority of the respondents have high knowledge in each of the six strategies with the mean of 91.7% for knowledge in all strategies (see Table 9).

Table 9

Knowledge of Water Conservation

Water Conservation	Fully In Place n (%)	In Progress n (%)	Aware not Implemented n (%)	Total
40.Use water faucet sensors	38 (25.3%)	14 (9.3%)	**77 (51.3%)**	129 (85.9%)
41.Use hand dryers	**75 (50%)**	17 (11.3%)	53 (35.3%)	145 (96.6%)
42.Use hand sanitizer	**131 (87.3%)**	6 (4%)	11 (7.3%)	148 (98.6%)
43.Instruct the patients to turn off water faucet during tooth brushing at home	42 (28%)	11 (7.3%)	**92 (61.3%)**	145 (96.6%)
44.Use dual-flush toilet	**74 (49.3%)**	12 (8%)	47 (31.3%)	133 (88.6%)
45.Put bricks or other heavy materials inside the toilets	47 (31.3%)	15 (10%)	**64 (42.7%)**	126 (84%)
Mean for the energy waste management strategies (Total frequency/6)				137.6 (91.7%)

Research Question Two.

To what extent do Jordanian dentists implement eco-friendly dental office management strategies in the areas of amalgam, radiography, paper, infection control, energy, and water? The first two categories "Fully in Place", and "In Progress" were used to assess the implementation of Jordanian dentists regarding eco-friendly strategies. The two responses together have less than 50% indicate a low level of implementation of eco-friendly management strategies among the respondents. The majority of the responses in amalgam waste management reveal low implementation except in two strategies: 1. Use

pre-capsulated alloys in different size, and 6. Use the alternative to amalgam filling (see Table 10).

Table 10

Implementation of Amalgam Management Strategy

Amalgam Management	Yes	No
	n (%)	n (%)
1. Use pre-capsulated alloys in different size	**102 (68%)**	48 (32%)
2. Dispose amalgam in means other than regular trash or down drain	55 (36.6%)	**95 (63.1%)**
3. Keep unused amalgam particles in well sealed containers	54 (36%)	**96 (64%)**
4. Use amalgam separators	38 (25.3%)	**112 (74.7%)**
5. Use amalgam vacuum filters which directs the amalgam particles to amalgam waste water containers	36 (24%)	**84 (76%)**
6. Use alternatives to amalgam filling such as composite, ceramic, gold, and porcelain	**138 (92%)**	12 (8%)

The responses in the radiographic management reveal low implementation with the mean of 25.6% in three strategies (questions number 9, 10, and 12): use waste management program to dispose of lead foils, use waste management program to dispose fixer, and reuse x-ray mounts for new patients when purging old files. Where the responses reveal high implementation with the mean of 73.1% in the three other strategies (questions number 7, 8, and 11): mix and store chemicals according to manufacturer's recommendations to avoid waste, purchase chemicals (developer, fixer) in concentrated form, and use digital radiography (see Table 11).

Table 11

Implementation of Radiographic Management Strategy

Radiographic Management	Yes	No
	n (%)	n (%)
7. Mix and store chemicals according to manufacturer's recommendations to avoid waste	**127 (84.7%)**	23 (15.4%)
8. Purchase chemicals (developer, fixer) in concentrated form. Prepare chemicals as needed to eliminate excess	**94 (62.6%)**	56 (37.4%)
9. Use waste management program to dispose of lead foils	47 (31.3%)	**103 (68.7%)**
10. Use waste management program to dispose fixer	41 (27%)	**109 (72.7%)**
11. Use digital radiography	**108 (72%)**	42 (28%)
12. Reuse x-ray mounts for new patients when purging old files	28 (18.7%)	**122 (81.3%)**

The majority of the responses for paper waste management reveal low implementation except in three strategies (questions number 15, 16, and 21): use computer-based records system, use practice-management software, and use scrap office/computer paper for scratch pads and internal notes (see Table 12).

Table 12

Implementation of Paper Waste Management

Paper Waste Management	Yes	No
	n (%)	n (%)
13. Recycle dental office paper waste	12 (8%)	**138 (92%)**
14. Print on both sides of the paper when possible	61 (40.7%)	**89 (59.3%)**
15. Use computer-based records system	**118 (78.7%)**	32 (21.3%)
16. Use practice-management software	**86 (57.3%)**	64 (42.7%)
17. Implement patient electronic messaging service	27 (18%)	**123 (82%)**
18. Use educational videos to explain the recommendation of different dental procedure	30 (20%)	**120 (80%)**
19. Use reusable name badges	26 (17.4%)	**124 (82.6%)**
20. Use recycled paper products	28 (18.7%)	**122 (81.3%)**
21. Use scrap office/computer paper for scratch pads and internal notes	**80 (53.3%)**	70 (46.7%)
22. Donate old magazines to community centers, public health, and other service centers	68 (45.4%)	**82 (54.7%)**
23. Donate old dental books to libraries, schools, or fundraising effort	63 (42%)	**87 (58%)**

The majority of the responses in the infection control management reveal low implementation except in two strategies (questions number 24, and 32): purchase supplies in bulk packaging; and use sterilizeable instruments, trays, and film holding devices, rather than disposable products (see Table 13).

Table 13

Implementation of Infection Control Management

Infection Control Management	Yes	No
	n (%)	n (%)
24. Purchase supplies in bulk packaging	**136 (90.7%)**	14 (9.3%)
25. Use reusable glass/ metal cups instead of paper, plastic, or Styrofoam	20 (13.4%)	**130 (86.7%)**
26. Use reusable metal air/water syringes instead of plastic	41 (27.4%)	**109 (72.6%)**
27. Use steam sterilization with cloth instrument wraps vs. paper and plastic autoclave bags	36 (24%)	**114 (76%)**
28. Use metal suction tips instead of disposable plastic suction tips	23 (15.4%)	**127 (84.6%)**
29. Use enzyme –based cleaners that are biodegradable	60 (40%)	**90 (60%)**
30. Use nontoxic, noncorrosive disinfectant wipes instead of pump spray bottles	72 (48%)	**78 (52%)**
31. Use cloth lab coats that can be laundered, rather than disposable ones	55 (36.6%)	**95 (63.3%)**
32. Use sterilizable instruments, trays, and film holding devices, rather than disposable products	**81 (54%)**	69 (46%)
33. Reuse instrument sterilization bags. Secure with autoclave tape	33 (22%)	**117 (78%)**

The majority of the responses for energy management reveal low implementation except in two strategies (questions number 34, and 38): use compact fluorescent light bulbs, and turn off and plug all the electrical appliances at the end of the day (see Table 14).

Table 14

Implementation of Energy Management

Energy Waste Management	Yes	No
	n (%)	n (%)
34. Use compact fluorescent light Bulbs	**141 (94%)**	9 (6%)
35. Dispose the burned bulbs into hazardous waste or recycle it	39 (26%)	**111 (74%)**
36. Use renewable energy such as wind or solar power	12 (8%)	**138 (92%)**
37. Use automated thermostats to control heating /cooling systems	44 (29.3%)	**106 (70.6%)**
38. Turn off and plug all the electrical appliances at the end of the day, including computers, printers, and copiers	**113 (75.4%)**	37 (24.7%)
39. Use motion detectors for room lighting	13 (8.7%)	**137 (91.4%)**

The responses for water conservation reveal low implementation with the mean of 37.1% in three strategies (questions number 40, 43, and 45): use water faucet sensors, instruct the patients to turn off water faucet during tooth brushing at home, and put bricks or other heavy materials inside the toilets. Where the responses reveal high implementation with the mean of 69.9% in other three strategies (questions number 41, 42, and 44): use hand dryers, use hand sanitizer, and use dual-flush toilet (see Table 15).

Table 15

Implementation of Water Conservation

Water Conservation	Yes	No
	n (%)	n (%)
40. Use water faucet sensors	52 (34.6%)	**98 (65.3%)**
41. Use hand dryers	**92 (61.3%)**	58 (38.6%)
42. Use hand sanitizer	**137 (91.3%)**	13 (8.6%)
43. Instruct the patients to turn off water faucet during tooth brushing at home	53 (35.3%)	**97 (64.6%)**
44. Use dual-flush toilet	**86 (57.3%)**	64 (42.6%)
45. Put bricks or other heavy materials inside the toilets	62 (41.3%)	**88 (58.7%)**

Research Question Three.

What do Jordanian dentists perceive as barriers to implementation of eco-friendly management strategies in the areas of amalgam, radiography, paper, infection control, energy, and water? All respondents (n=150) answered the question in Section 3 regarding the barriers to implementation. Some of the respondents chose more than one item from the listed barriers to answer this question. Two barriers to implementation identified by the respondents more frequently were: 1. Cost and 3. No advantages from the government for applying eco-friendly strategies (see Table 16).

Respondents selected the choice of "Other" and provided comments (see Appendix G). Two examples of the participant comments are: " There are no rules or

regulations from the Health Department regarding the waste management of these strategies", and " The patient fee that we charge almost covers our expenses and it will not cover the new technology that you are talking about".

Table 16

Barriers for Implementing Eco-Friendly Strategies

Barriers	Frequency	Percentage
1. Cost	**98**	**33.5**
2. Have no knowledge about eco-friendly strategies	48	16.4
3. No advantages from the government for applying eco-friendly strategies	**80**	**27.3**
4. Makes no difference for the customers	46	15.7
5. Other	21	7.1

Research Question Four.

Is there a relationship between Jordanian dentists' demographic characteristics, such as age, gender, monthly income, level of education, length of time in practice, and knowledge of eco-friendly office strategies? Chi-square results revealed a statistically significant association between Jordanian dentists' demographic characteristics and some of the strategies in the areas of amalgam management, radiographic management, paper waste management, infection control, energy management, and water conservation (see Appendix H). Table 17 demonstrates all of the significant (p-value $\leq .05$) relationships between Jordanian dentists' demographics and the knowledge of eco-friendly strategies. Appendix I contains chi-square results between Jordanian dentists' demographics and the knowledge of eco-friendly strategies.

Table 17

Significant Values (p-value ≤ .05) for Comparison between Demographic Characteristics and the Knowledge of Eco-Friendly Strategies

Strategy	Age	Gender	Income	Education	Experience
Amalgam Waste Management					
4. Use amalgam separators	-	-	-	.044	.040
5. Use amalgam vacuum filters which directs the amalgam particles to amalgam waste water containers	-	-	.053	-	.046
6. Use alternatives to amalgam filling such as composite, ceramic, gold, and porcelain	-	-	-	.054	-
Radiographic Waste Management					
8. Purchase chemicals (developer, fixer) in concentrated form. Prepare chemicals as needed to eliminate excess	-	-	-	-	.020
10. Use waste management program to dispose fixer	-	-	-	.044	-
12. Reuse x-ray mounts for new patients when purging old files	-	-	.011	.000	.029
Paper Waste Management					
13. Recycle dental office paper waste	.041	-	-	.000	.043
15. Use computer-based records system	-	-	.022	-	-
17. Implement patient electronic messaging service	.033	-	.008	.000	.026
20. Use recycled paper products	.032	-	.001	.022	-
22. Donate old magazines to community centers, public health, and other service centers	-	-	-	-	.012
23. Donate old dental books to libraries, schools, or fundraising effort	-	-	-	-	.004
Infection Control Management					
25. Use reusable glass/ metal cups instead of paper, plastic, or Styrofoam	-	-	-	.021	--
26. Use reusable metal air/water syringes instead of plastic	-	-	-	.044	-
29. Use enzyme –based cleaners that are biodegradable	-	-	.018	-	.051
33. Reuse instrument sterilization bags. Secure with autoclave tape	-	-	.022	-	-
Energy Management					
34. Use compact fluorescent light bulbs	-	-	-	.030	-
35. Dispose the burned bulbs into hazardous waste or recycle it	-	-	-	-	-
37. Use automated thermostats to control heating /cooling systems	-	-	--	-	.044
Water Conservation					
43. Instruct the patients to turn off water faucet during tooth brushing at home	.024	-	-	-	-
45. Put bricks or other heavy materials inside the toilets	-	-	-	.046	-

Research Question Five.

Is there a relationship between Jordanian dentists' demographic characteristics, such as age, gender, monthly income, level of education, length of time in practice, and implementation of eco-friendly office strategies? According to chi-square analysis, there was no significant relationship between Jordanian dentists' demographic characteristics and implementation of amalgam waste management, infection control management, and water conservation. Chi-square results did reveal a limited statistically significant association between Jordanian dentists' demographic characteristics and implementation of eco-friendly office strategies (see Appendix J) in the area of radiographic, paper, and energy management (see Table 18). Appendix K contains chi-square results of Jordanian dentists' demographic characteristics and implementation of eco-friendly office strategies.

Table 18

Significant Values (p-value ≤ .05) for Comparison between Demographic Characteristics and the Implementation of Eco-Friendly Strategies

Strategy	Age	Gender	Income	Education	Experience
Radiographic Waste Management					
8. Purchase chemicals (developer, fixer) in concentrated form. Prepare chemicals as needed to eliminate excess	-	**.054**	-	-	-
Paper Waste Management					
17. Implement patient electronic messaging services	**.020**	-	-	-	-
20. Use recycled paper products	**.046**	-	**.013**	-	-
22. Donate old magazines to community centers, public health, and other service centers	-	-	-	-	**.007**
23. Donate old dental books to libraries, schools, or fundraising effort	-	-	-	-	**.002**
Energy Waste Management					
34. Use compact fluorescent light bulbs	-	-	-	**.0006**	-
38. Turn off and plug all the electrical appliances at the end of the day	-	**.029**	-	-	-

Discussion

Regarding the demographic characteristics of the respondents, the age of the people who participated in this study ranged from (23-65) years with the majority between the ages of 31-40. These finding regarding age are similar to the study by Sawair et al (2010) in which the majority of Jordanian dentists were 30-39 years old. The majority of the participants were males (67%) which correlate with the demographic data provided by the Jordanian Dental Association: 65.2% of registered dentists are males, and 34.8 % are female dentists. The majority of the respondents in this sample, (54 %) earn $500 to $1000 monthly. The income level of Jordan is considered a lower middle income; the average monthly income in Jordan is between $300 and $450. The bachelor's degree is the minimal educational requirement to practice dentistry in Jordan and is reflected in the level of education of the majority of respondents in this survey. The majority of the respondents have practiced between (1-19) years which correlate with the majority of respondent's age in this survey.

Research Question One and Two.

Results reveal that the majority of the respondents have high knowledge about appropriate amalgam management and use other restorative materials such as ceramic, gold, and porcelain. Conversely, results reveal a low implementation of the amalgam management strategies. This result might be due to the high use of alternative restoration materials; and therefore, represent a low need for amalgam waste management. Results reveal that the majority of the respondents use pre-capsulated alloys in different sizes.

This finding is similar to Sawair et al. (2010) who found that about 76% of Jordanian general dental practitioners use amalgam capsules of different sizes.

When respondents were asked about radiographic waste management strategies, the majority of them have high knowledge about the strategies in contrast to low implementation of the strategies. This result might be due to the high use of digital radiography; and therefore, represents a low need to use methods to dispose of chemicals. Because the dental digital images are computerized and stored electronically instead of in a paper chart, x-ray mounts are not needed. The high use of purchasing, mixing, and storing radiographic chemicals might be explained as an alternative plan for the use of digital radiography when needed in such an event as equipment failure. It is possible that respondents misread the questions and are in fact referring to chemicals usage other than radiographic chemicals. Further research investigation is needed to validate the high use of chemicals.

When Jordanian dentists were asked about paper waste management strategies the majority have a high knowledge about these strategies. This result might be explained by the disseminated information through the public media. Awareness about recycling may be heightened on occasions such as Clean Planet Day or Earth Day. Results from this study reveal that these Jordanian dentists have high knowledge about paper waste management compared to low implementation of the strategies. Results reveal that dentists are using computer-based records systems and practice-management software; and therefore, might not be printing documents as frequently as with paper-management systems. High technology use might be affected by the location of the study population who work in the private sector in Amman, the capital of Jordan, where advanced

technology is readily available. The study's results reveal a high implementation of using scrap office/ computer paper for scratch pads and internal notes. This result might be explained by the dentists' responses regarding low use of recycled paper waste of the dental office or printing on both sides. The majority of the respondents (92%) have low implementation in recycling dental office paper waste which could correlate with the circumstances that recycling programs in Jordan are still in an embryonic stage. The present study's results reveal low use of patient electronic messaging services which might be explained by low access to the internet by most Jordanian citizens. The majority of the respondents have low implementation in using reusable name badges and educational videos. This result might be due to not using any name badges or not having educational videos. The results that the Jordanian dentists do not donate their old books and magazines are difficult to explain. A deeper research investigation in recycling is needed to validate all of these findings.

Results reveal that Jordanian dentists have high knowledge about infection control management with a low implementation of the strategies. Using the disposable items might be more preferable by Jordanian dentists for the prevention of disease transmission. Results reveal low use of reusable cups, air/water syringes, suction tips, lab coats, and sterilization bags which might be explained by the great care that is needed to properly clean and sterilize all reusable items. These results also might be due to the need for extra equipment such as a dishwasher with a special sanitizer cycle for reusable cups. The uses of reusable products in dental offices add responsibility for staff to ensure equipment meet all health code requirements and to use universal standards. Results reveal low use of some products like enzyme-based cleaners and disinfectant wipes

which might be due to lack of products availability or lack of product marketing to dentists. These measures might represent a higher cost for infection control measures to the dental practice. Results reveal that the majority of the Jordanian dentists purchase supplies in bulk packaging which might be due to economic choice that reduces the expenses compared with the single-use supplies.

Results reveal that these Jordanian dentists have high knowledge about energy waste management in contrast to low implementation of the strategies. The low use of automated thermostats and motion detectors for lighting might be explained by the need for building renovation and added costs. Results reveal that these Jordanian dentists have a high use of fluorescent light bulbs. The majority of Jordanian dentists turn off all electrical appliances when not in use. These results might be explained by no or low cost is needed to implement these strategies. Results reveal the low use of renewable energy which is similar to the findings by Abdulla et al (2004) in which about 2% of the total energy consumption is renewable energy in Jordan.

The study's results reveal a high use of hand dryers and sanitizer gels; and therefore, represent a low need for water faucet sensors. Results reveal that these Jordanian dentists have a high use of dual-flush toilets which might explain why adjustments do not need to be made to the toilet tank water level. The result that most of the Jordanian dentists do not instruct their patients to turn off water faucets during tooth brushing is difficult to explain. Most Jordanians should be highly aware of the severe water crises in Jordan. Nevertheless, these observations highlight a need for educational programs to familiarize Jordanian dentists for better water conservation and therefore, take any extra steps to conserve water.

Research Question Three.

This question addresses the barriers to implementation of eco-friendly dental strategies for Jordanian dentists. Results reveal the majority of respondents chose "the cost" and " no advantages from the government for applying eco-friendly strategies" most often as barriers to implementation. This finding correlates with the knowledge that the majority of Jordanian dentists earn middle incomes; therefore, may not have the resources to implement what they perceive as costly strategies. The Jordanian government might encourage dentists to implement eco-friendly strategies in their offices by providing tax incentives and free custom duties for purchase and use of the equipment or materials that have minimum effect on the environment. What is not known in this study is if the Jordanian dentists perceive the value of eco-friendly strategies; does the value outweigh the cost. Results reveal a low number of the respondents (16%) chose the "Have no knowledge about eco-friendly strategies" which correlates with the findings of this study in which the majority of respondents have a high knowledge of eco-friendly strategies.

Research Question Four.

Is there a relationship between Jordanian dentists' demographic characteristics and the knowledge of eco-friendly office strategies? An association was found between knowledge of eco-friendly strategies in amalgam waste, radiographic waste, and infection control strategies and Jordanian dentists' income, education, and years of practice. This association without further details is difficult to explain and current literature does not provide evidence to support these findings. Knowledge of eco-friendly strategies of all

areas do not demonstrate a relationship across gender, which might be explained by both males and females dentists having the same educational experiences. Further investigation is needed to provide additional insights into the relationship between the knowledge of eco-friendly office strategies and Jordanian dentists' demographic characteristics.

Research Question Five.

Is there a relationship between Jordanian dentists' demographic characteristics and the implementation of eco-friendly office strategies? Results revealed limited association between the implementation of eco-friendly office strategies and Jordanian dentists' demographic characteristics. No clear pattern emerged from the analysis; and therefore, may exert little influence over Jordanian dentists' decisions to implement these strategies in their dental practices. Further research is needed to examine if there are other influencing variables affecting the Jordanian dentists' implementation of eco-friendly office strategies.

Limitations

Based on this study the following limitations might have influenced the results:

1 The sample was not randomly selected; therefore, findings may only be generalized to Jordanian dentists with the similar characteristics.

2 Questionnaire design might have been a factor influencing results through the following:

a. A lack of clarity in questions which combined two strategies in one question. One question which combined two strategies was item 8 under radiographic management.

b. Inclusion of questions regarding reusable items, such as air/water syringe tips, needs to be reexamined because these items are extremely difficult to clean and disinfect. Uses of disposable syringe tips are recommended for proper prevention of disease transmission.

c. Questionnaire construction disallowed use of parametric statistical tests which might have been achieved with different answer formats.

d. The statistical test used was not capable to predict the direction of the association, between demographic characteristics and eco-friendly strategies. Redesign questionnaire responses would allow for other statistical analyses.

3 A significant amount of material does not exist in the literature review regarding eco-friendly dental strategies which had been assumption of the study.

4 Not all eco-friendly strategies identifiable in the study are available for Jordanian dentists, such as lead foil recycling.

CHAPTER V

SUMMARY AND CONCLUSION

A lack of research exists on Jordanian dentists' knowledge and implementation of eco-friendly strategy in dental practice. The purpose of this descriptive survey was to determine if the Jordanian dentists have the knowledge about eco-friendly dental offices strategies and are employing these strategies in their dental practice. Also, what are the barriers to implement these strategies if they have the knowledge?

About (50%) of the respondents were between 31-40 years of age, and the minority (1.3%) were between 61-65 years of age. More than half of the respondents were male (67%), and (33%) were female. More than half of the respondents 54% earned between $500 and $1000 monthly, 12.7% earned < $500 monthly, 27.3% earned between $1000 and $1500 monthly, and 6% earned more than $1500 monthly. Therefore, the majority of the respondents earn more than the average monthly income. The majority of the respondents 81% held university degree, 11% Master's degrees, 5% held specialty degrees, and 3% doctoral degrees. About 82% of the respondents were practicing for 1 year-19 years.

Knowledge and Implementation

1. The majority of the respondents have a high knowledge about eco-friendly strategies in the area of amalgam waste management. Jordanian dentists are largely using alternative restorative materials and not amalgam. While the majority of the responses reveal low implementation in amalgam waste management, about one fourth of the respondents use the amalgam separators and

amalgam vacuum filters. About one third of the respondents dispose of amalgam in means other than regular trash or down drains and keep unused amalgam particles in well sealed containers.

2. The majority of the respondents have a high knowledge about eco-friendly strategies in the area of radiographic waste management. More than two thirds of the respondents do not use waste management programs to dispose the lead foils, fixer or reuse x-ray mounts. The majority of the respondents do mix and store according to manufacturer's recommendations, purchase chemicals in concentrated form, and use digital radiography strategies.
3. The majority of the respondents have a high knowledge about eco-friendly strategies in the area of paper waste management. Majority of Jordanian dentists use computer-based records system; and therefore, do not generate dental office paper waste. More than half of the respondents did not print on both sides, donate old magazines, and donate old dental books. The majority of the respondents did not recycle dental office paper waste, implement patient electronic messaging service, use educational videos, use reusable name badges, and use recycled paper products.
4. The majority of the respondents have a high knowledge about eco-friendly strategies in the area of infection control management. About two thirds of the respondents do not use reusable cups, air/water syringes, cloth instrument wraps, metal suction tips, and instrument sterilization bags. More than half of the respondents did not use enzyme-based cleaners, nontoxic wipes, and cloth lab coats.

5. The majority of the respondents have a high knowledge about eco-friendly strategies in the area of energy management. Jordanian dentists are largely using compact fluorescent light bulbs. While the majority of the responses reveal low implementation in energy management. More than two third of the respondents do not dispose burned bulbs into hazardous waste, use renewable energy, use automated thermostats, and use motion detectors.
6. The majority of the respondents have a high knowledge about eco-friendly strategies in the area of water conservation. Jordanian dentists are largely using hand sanitizer gels. More than half of the respondents used hand dryers, and dual-flush toilets. Less than two-third of the respondents do not use the water faucet sensors, instruct the patients to turn off water during brushing, and put heavy materials inside the toilets.

Barriers to Implementation

The majority of the respondents identified the cost and no advantages from the government for applying eco-friendly strategies as barriers to implementation.

Relationships of Knowledge and Demographics

1. A significant association was found between the knowledge of amalgam waste, radiographic waste, and infection control strategies with income, education, and experience.
2. A significant association was found between the knowledge of the paper waste management strategies with age, income, education, and experience.

3. A significant association was found between the knowledge of energy management strategies with education, and experience.
4. A significant association was found between the knowledge of water conservation strategies with age, and education.

Relationships of Implementation and Demographics

A limited association was found between the implementation of eco-friendly office strategies and Jordanian dentists' demographic characteristics.

Conclusions

Based on the results of this study, the following conclusions are made:

1. Jordanian dentists have a high knowledge of eco-friendly dental office management strategies in the areas of amalgam, radiography, paper, infection control, energy, and water.
2. Jordanian dentists have a low implementation of eco-friendly dental office management strategies in the areas of amalgam, radiography, paper, infection control, energy, and water.
3. Cost and no advantages from the government for applying eco-friendly strategies are considered the most identified barriers to implementation by the Jordanian dentists.
4. Association was found between the knowledge of the amalgam waste, radiographic waste, and infection control management strategies and income, education levels, and years of experience

5. Association was found between the knowledge of the paper waste management strategies and age, income, education levels, and years of experience.
6. Association was found between the knowledge of energy management strategies with education levels, and years of experience.
7. Association was found between the knowledge of water conservation strategies with age, education levels.
8. No association was found between the knowledge of eco-friendly strategies with gender.
9. No association was found between the implementation of amalgam waste management strategies and demographic characteristics.
10. No association was found between the implementation of infection control management strategies and demographic characteristics.
11. No association was found between the implementation of water conservation strategies and demographic characteristics.
12. A limited association was found between the implementation of radiographic waste management and gender.
13. A limited association was found between the implementation of paper waste management and age, income, and experience.
14. A limited association was found between the implementation of energy management and gender, and education.

Recommendations

The following recommendation for further study and for improving the Jordanian dentists' knowledge and implementation of eco-friendly strategies are provided:

1. This study should be replicated in a probability sample of Jordanian dentists.
2. Enhance questionnaire design by addressing previously discussed limitations.
3. Establish test-retest reliability by administering the questionnaire twice to the same 10 Jordanian dentists within one week.
4. Dental school faculty should examine the curricula to ensure that the students are graduating with competencies in safe handling of dental amalgam fillings and wastes.
5. Jordanian Dental Association should increase the Jordanian dentists' awareness about environmental problems and solutions that could be related to dentistry during their annual meeting or through educational courses.
6. Dental and dental hygiene schools should be initiative in environmental protection program such as recycling.
7. Implementing eco-friendly strategies in dental school serve as a good example of how oral health professionals can be part of protecting the environment.
8. A report based on the outcomes of this survey, with the recommendation, will be sent to relevant departments at the Jordanian Ministries of Environment and Education to encourage implement new regulations and dental curriculum that enhance the application of these strategies.
9. Dental and dental hygiene professional associations are encouraged to take a leader role in increase public awareness about environmental problems.
10. Organizing workshops that emphasis and encourage using recyclable materials.
11. Media awareness about the value and cost effectiveness of using eco-friendly strategies should be used.

Future Studies

Considering the results and limitation of this study, future studies should focus on answering the following research questions:

1. What is the attitude of Jordanian dentists toward environmental problems?
2. Do Jordanian dentists value eco-friendly dental office strategies?
3. What is the knowledge of Jordanian dentists who work in the public sector about eco-friendly strategies?
4. What is the implementation by Jordanian dentists who work in public sector of eco-friendly strategies?
5. What is the cost effectiveness of using eco-friendly strategies in Jordanian dental practice?
6. Is the knowledge of Jordanian dentists who work in cities other than Amman different?
7. Is the implementation of Jordanian dentists who work in cities other than Amman different?

This study represents the first known attempt to document the knowledge and implementation of eco-friendly dental office strategies among Jordanian dentists who work in the private sector. The study examines the role of dentists, yet to be explained is the role of dental hygienists and dental assistants in implementation of eco-friendly dental strategies.

REFERENCES

Abdulla, F.,Widyan, M., AL-Ghazawi, Z., Kiwan, S., Abu-Qdais, H., Hayajneh, M., & AL-Nimar, M. (2004). *Status of Jordan renewable energy sector: problems, needs and challenges*. School of Engineering, Jordan University of Science and Technology, Irbid 22110, Jordan. Retrieved from http://webfea.fea.aub.edu.lb/fea/research/erg/RCW/Status%20of%20Jordan%20Renewable%20Energy%20Sector.pdf.

Adams, E. (2007). Eco-friendly dentistry: Not a matter of choice. *Journal of the Canadian Dental Association, 73*(7), 581-584. Retrieved from http://www.cda-adc.ca/jcda.

Afzal, B. M. (2007). Global warming: a public health concern. *Online Journal of Issues in Nursing, 12(*2).

Alfayez, K. (2003). *Biological treatment of municipal solid waste composting. Training –Biogas Project*. Ministry of Environment, Solid Waste Management Division, Jordan. Retrieved from http://jes.org.jo/biogas/pdfs/k/english.pdf.

American Dental Association. (2007) *Best management practices for amalgam waste*. Chicago, Illinois: American Dental Association, October. Retrieved from http://www.ada.org/prof/resources/topics/topics_amalgamwaste.pdf.

Berghoff, J. (2009). Paperless office. *Dental Economics. 99*(2). Retrieved from http://www.dentaleconomics.com/display_article/368382/56/none/none/Feat/Paperless-Office-.

Bjorkman, L., Sandborgh-Englund, G., & Ekstrand, J. (2007). Mercury in saliva and feces after removal of amalgam fillings. *Toxicology and Applied Pharmacology, 144*, 156-162.

Blaes, J. (2009). Green, clean, and keen. *Dental Economics*, *99*(2), 112-113. Retrieved from http://www.dentaleconomics.com/display_article/354490/54/none/none/Dept/Green,-clean,-and-keen.

Bluhm, R., Bobbitt, R., Welch, A., Wood, A., Bonfiglio, J., Sarzen,C., Health, A., and Branch, R. (1992). Elemental mercury vapour toxicity treatment and prognosis after acute intensive exposure in chloralkali plant workers part 1: History, neuropsychological findings and chelator effects. *Human and Experimental Toxicology, 11*(3), 201-210. doi: 10.1177/096032719201100308

Bommhardt, C. (2008). It's easy being green. *Academy of General Dentistry, 36*(8). Retrieved from http://www.agd.org/support/articles/?ArtID=3792.

Dalin, J. (2009). Going "Green". *Dental Economics*, *99*(3), 60. Retrieved from http://www.dentaleconomics.com/display_article/357556/54/none/none/Colum/Going-%E2%80%9Cgreen%E2%80%9D.

DentiMax'08. Pricing (2007). Retrieved from http://www.dentimax.com/pricing.html.

Center for Disease Control and Prevention, Department of Health and Human Services (2010). *Dental amalgam use and benefits*. Atlanta, GA. Retrieved from http://www.cdc.gov/OralHealth/publications/factsheets/amalgam.htm.

Dodes, J. (2001).The amalgam controversy: An evidence-based analysis. The *Journal of the American Dental Association*, *132*(5), 348-356.

Eco Dentistry Association (2010).Reduces waste and pollution: The environmental impacts of dentistry. Retrieved from http://www.ecodentistry.org/displaycommon.cfm?an=1&subarticlenbr=71.

Eco Dentistry Association (2010). Save water, energy, and money: Go green, save green. Retrieved from http://www.ecodentistry.org/displaycommon.cfm?an=1&subarticlenbr=49.

Elliott-Smith, S. (2008). Green dental hygiene: Eco-friendly practices that anyone can adopt. *Access*, *22*(1), 23-26.

Energy Information Administration (2008). Official energy statistics from the U.S. Government. *Greenhouse Gases*. Retrieved from http://www.eia.doe.gov/bookshelf/brochures/greenhouse/Chapter1.htm.

Environment (2009). In Encarta online dictionary Retrieved from http://encarta.msn.com/dictionary_1861608713/environment.html.

Environmental Defense Fund (2009). Make the switch to energy-saving bulbs. Retrieved from http: http://www.edf.org/page.cfm?tagid=608.

Environmental Protection Agency (2011). Mercury in dental amalgam. Retrieved from http://www.epa.gov/mercury/dentalamalgam.html.

Environmental Protection Agency (2010). Human-related sources and sinks of carbon dioxide. Retrieved from http:// http://www.epa.gov/climatechange/emissions/co2_human.html.

Enzymax Earth™ (2010). A higher standard of clean. [Supplemental material]. Retrieved from: http://www.friendsofhufriedy.com/userfiles/file/Brochures/9437_Enzymax_Brochure.pdf.

Fan, P.L., Batchu, H., Chou, H., Gasparac, W., Sandrik, J., & Meyer. D. (2002). Laboratory evaluation of amalgam separators. The *Journal of the American Dental Association, 133*(5), 577-589.

Farahani, A., & Suchak, M. (2007). Eco-friendly dentistry: The environmentally-responsible dental practice. University of Waterloo, Canada. April 3.

Henry, K. (2009). Go green dentistry. *RDH, 29*(3), 52-56. Retrieved from http://www.rdhmag.com/display_article/356443/56/none/none/Feat/Go-Green-Dentistry.

Hadadin, N., & Tarawneh, Z. (2007). Environmental issues in Jordan, solutions and recommendations. *American Journal of Environmental Sciences, 3*(1), 30-36.

Higgins, N. (2009). Going "Green" in your dental office. *Sidekick.* Retrieved from http://sidekickmag.com/office_design/articles-office-design/goinggreen-in your-dental office.

Intergovernmental Panel on Climate Change. (2007). *Climate change 2007: climate change impacts, adaptation, and vulnerability. Contribution of working group II to the Intergovernmental Panel on Climate Change Fourth Assessment Report.* Cambridge, UK: Cambridge University Press.

Jaber, J. (2002). Greenhouse gas emissions and barriers to implementation in the Jordanian energy sector [Abstract]. *Energy policy, 30*(5), 385-395. doi:10.1016/S0301-4215(01)00105-7

Johnson, O., & Thomson, E. (2007). *Essentials of Dental Radiography for Dental Assistants and Hygienists.* New Jersey: Pearson/Prentice Hall.

Jordanian Dental Association (2011). Retrieved from http://www.jda.org.jo/.

Lorscheider F., & Vimy M. J. (1993). Evaluation of the safety issue of mercury release from dental fillings. *The FASEB Journal, 7*, 1432-1433.

McManus, V. (2009). Embracing the electronic revolution. *Dental Economics, 99*(3), 60. Retrieved from http://www.dentaleconomics.com/display_article/357570/54/none/none/Feat/Embracing-the-electronic-revolution.

McManus, K.R., & Fan, P.L. (2003). Purchasing, installing and operating dental amalgam separators. *Journal of American Dental Association, 134*, 1054-1065.

Mercola, J.M., Klinghardt, D. (2001). Mercury toxicity and systemic elimination agents. *Journal of Nutritional Medicine, 11*, 53-62. doi:10.1080/13590840020030267

Molinari, J. (2009). Infection control going green: on coming reality-part1. *Dental Economics, 99*(3), 66. Retrieved from http://www.dentaleconomics.com/display_article/357559/54/none/none/Colum/Infection-control-going-green:-oncoming-reality-%C3%A2??-Part-1-.

Nair, S. (2009). Let us go for gmail, go green. Retrieved from http: http://www.peerpower.com/public/article/6109/1139.

Namrouqa, H. (2007, February17). Jordan aiming to reduce greenhouse gas emissions. *Jordan Times.* Retrieved from http://www.arabenvironment.net/archive/2007/2/159511.html.

National Geographic (2011). Global warming. Retrieved from http://environment.nationalgeographic.com/environment/global-warming/.

Pockrass, F., & Pockrass, I. (2008). The four"Rs" of eco-friendly dentistry. *Access, 22*(8), 18-21.

Pockrass, F., & Pockrass, I. (2009). Reducing waste and pollution. *Access, 23*(5), 14-16.

Relman, D., Hamburg, M., Choffnes, E., & Mack, A. (2008).Summary and assessment. *Global climate change and extreme weather events: Understanding the contributions to infectious disease emergence.* Washington, DC: The National Academies Press (pp.1-50).

Sawair, F., Hassoneh, Y., Jamileh, A., & Al-rababah, M. (2010). Observance of proper mercury hygiene practices by Jordanian general dental practitioners. *International Journal of Occupational Medicine and Environmental Health, 23*(1) 47-54. doi:10.2478/v10001-010-0012-9

The Pennsylvania State University, Office of Physical Plant. (2005). Awareness & conservation. *Why conserve energy.* Retrieved from http://energy.opp.psu.edu/awareness-conservation/why-conserve-energy.

University of Minnesota, Minnesota Technical Assistance Program. (2008). *Dental office hazardous waste.* Retrieved from http://mntap.umn.edu/health/81FS.DentalWaste.pdf.

Yang, Y. J., Huang, C. C., Shih, T. S., et al. (1994). Chronic elemental mercury intoxication: Clinical and field studies in lampsocket manufactures. *Occupational and Environmental Medicine, 51*(4), 267-270. doi:10.1136/oem.51.4.267

Zadeh, P. (2004). The paperless dental office. *Dental Economics*. *94*(3).page numbers Retrieved from http://www.dentaleconomics.com/display_article/201185/54/none/none/Feat/The-Paperless-Dental-Office.

APPENDICES

APPENDIX A

Standard Dialog

"Hello, I would like to introduce myself. My name is .....

I am helping a graduate student who is working toward her master's degree in dental hygiene in the United States. I want to ask your cooperation in answering this questionnaire which asses the knowledge of Jordanian dentists about eco-friendly dental office strategies. Here is the cove letter that explains the purpose of the survey and the questionnaire.

Please read the cover letter to decide if you want to participate.

Thank You

APPENDIX B

Cover Letter

School of Dental Hygiene
4608 Hampton Blvd, Rm 2011
Old Dominion University
Norfolk, VA 23529-0499
USA
August/2010

Dear Dentist:

I am a graduate student pursing a master's degree in dental hygiene at Old Dominion University, in Norfolk, Virginia, and I am conducting a survey as part of my degree requirements. The survey is to assess the knowledge of Jordanian dentists' about eco-friendly dental offices strategies. Your participation in the survey is very valuable as you will provide information that is not available at this time to dental professionals.

The enclosed questionnaire will take about 10 minutes to complete. Your identity and responses will be confidential and anonymous. Responses will be reported in group-form only.

Your completion and submission of the questionnaire implies your consent. Please answer each question completely and honestly. Return the questionnaire sealed in the provided envelope to the person who administered the questionnaire to you. If you are interested in survey results, leave your name and contact information with the questionnaire administrator or send it to me at (salxs001@odu.edu). Thank you for your time, patience, and support in the conduct of this study.

Sincerely,

Sabha M. AL Shatrat

Sabha M. AL Shatrat
Masters Degree Candidate

APPENDIX C

Jordan Dentists' Knowledge and Implementation of

Eco-Friendly Dental Office Strategies

Questionnaire

Jordan Dentists' Knowledge and Implementation of

Eco-Friendly Dental Office Strategies

DIRECTIONS: Please answer each question by checking (x) the answer that BEST reflects your knowledge or by writing in a short response. After completing the questionnaire, please seal it the envelope. This will insure that your responses are preserved anonymous and confidential. Please return the completed questionnaire in the sealed envelope to the person who distributed it to you. The questionnaire takes about 10 minutes to complete. Thank you.

SECTION 1: Demographics

Age (years): ☐ 23-30 ☐ 31-40 ☐ 41-50 ☐ 51-60 ☐ 61-65

Gender: ☐ Male ☐ Female

Monthly Income: ☐ <$500 ☐ $500-1000 ☐ > $1000- 1500 ☐ >$1500

Education Level (check your highest): ☐ University Degree ☐ Master's Degree

☐ Specialty ☐ PhD

Years in Practice (years): ☐ 1-9 ☐ 10-19 ☐ 20-29 ☐ 30-39 ☐ 40-49

SECTION 2: Knowledge & Implementation of Eco-friendly Strategies

Select one answer for each eco-friendly strategy listed below.

	Fully In Place	In Progress	Aware of Strategy-But not Implemented	Not aware of Strategy-Need More Information to Evaluate
Amalgam Management				
1. Use pre-capsulated alloys in different size	☐	☐	☐	☐
2. Dispose amalgam in means other than regular trash or down drain	☐	☐	☐	☐
3. Keep unused amalgam particles in well sealed containers	☐	☐	☐	☐
4. Use amalgam separators	☐	☐	☐	☐
5. Use amalgam vacuum filters which directs the amalgam particles to amalgam waste water containers	☐	☐	☐	☐
6. Use alternatives to amalgam filling such as composite, ceramic, gold, and porcelain	☐	☐	☐	☐
Radiographic Management				
7. Mix and store chemicals according to manufacturer's recommendations to avoid waste	☐	☐	☐	☐
8. Purchase chemicals (developer, fixer) in concentrated form. Prepare chemicals as needed to eliminate excess	☐	☐	☐	☐
9. Use waste management program to dispose of lead foils	☐	☐	☐	☐
10. Use waste management program to dispose fixer	☐	☐	☐	☐
11. Use digital radiography	☐	☐	☐	☐
12. Reuse x-ray mounts for new patients when purging old files	☐	☐	☐	☐
Paper Waste Management				
13. Recycle dental office paper waste	☐	☐	☐	☐
14. Print on both sides of the paper when possible	☐	☐	☐	☐
15. Use computer-based records system	☐	☐	☐	☐
16. Use practice-management software	☐	☐	☐	☐
17. Implement patient electronic messaging services	☐	☐	☐	☐
18. Use educational videos to explain the recommendation of different dental procedure	☐	☐	☐	☐
19. Use reusable name badges	☐	☐	☐	☐

	Fully In Place	In Progress	Aware of Strategy-But not Implemented	Not aware of Strategy-Need More Information to Evaluate
20. Use recycled paper products	☐	☐	☐	☐
21. Use scrap office/computer paper for scratch pads and internal notes	☐	☐	☐	☐
22. Donate old magazines to community centers, public health, and other service centers	☐	☐	☐	☐
23. Donate old dental books to libraries, schools, or fundraising effort	☐	☐	☐	☐
Infection Control Management				
24. Purchase supplies in bulk packaging	☐	☐	☐	☐
25. Use reusable glass/ metal cups instead of paper, plastic, or Styrofoam	☐	☐	☐	☐
26. Use reusable metal air/water syringes instead of plastic	☐	☐	☐	☐
27. Use steam sterilization with cloth instrument wraps vs. paper and plastic autoclave bags	☐	☐	☐	☐
28. Use metal suction tips instead of disposable plastic suction tips	☐	☐	☐	☐
29. Use enzyme –based cleaners that are biodegradable	☐	☐	☐	☐
30. Use nontoxic, noncorrosive disinfectant wipes instead of pump spray bottles	☐	☐	☐	☐
31. Use cloth lab coats that can be laundered, rather than disposable ones	☐	☐	☐	☐
32. Use sterilizable instruments, trays, and film holding devices, rather than disposable products	☐	☐	☐	☐
33. Reuse instrument sterilization bags. Secure with autoclave tape	☐	☐	☐	☐
Energy Management				
34. Use compact fluorescent light bulbs	☐	☐	☐	☐
35. Dispose the burned bulbs into hazardous waste or recycle it	☐	☐	☐	☐
36. Use renewable energy such as wind or solar power	☐	☐	☐	☐
37. Use automated thermostats to control heating /cooling systems	☐	☐	☐	☐
38. Turn off and plug all the electrical appliances at the end of the day, including computers, printers, and copiers	☐	☐	☐	☐

	Fully In Place	In Progress	Aware of Strategy-But not Implemented	Not aware of Strategy-Need More Information to Evaluate
39. Use motion detectors for room lighting	☐	☐	☐	☐
Water Conservation				
40. Use water faucet sensors	☐	☐	☐	☐
41. Use hand dryers	☐	☐	☐	☐
42. Use hand sanitizer	☐	☐	☐	☐
43. Instruct the patients to turn off water faucet during tooth brushing at home	☐	☐	☐	☐
44. Use dual-flush toilet	☐	☐	☐	☐
45. Put bricks or other heavy materials inside the toilets	☐	☐	☐	☐

SECTION 3: Barriers to Implementation

What are the barriers for implementing eco-friendly strategies in your dental office?

1☐ Cost

2☐ Have no knowledge about eco-friendly strategies

3☐ No advantages from the government for applying eco-friendly strategies

4.☐ Makes no difference for the customers

5.☐ Other.....

Thank you for your participation in this survey. Please place your questionnaire in the envelope, seal it, and return it to the person who gave it you.

APPENDIX D

Cover letter in Arabic

حضرة الدكتور/الدكتورة المحترم/ه :

أنا طالبة في مرحلة الماجستير تخصص صحة الفم والأسنان في جامعة اولد دومينيون –ولاية فيرجينيا – الولايات المتحدة الأمريكية .

أقوم بهذا البحث الميداني الذي يعتبر من متطلبات الحصول على درجة الماجستير ، ويبحث الإستبيان في مدى معرفة وتطبيق اطباء الأسنان الأردنيين بالإستراتيجيات المستخدمة في عيادة الأسنان والتي تتعلق بالحفاظ على البيئة.

إن إكمالك للإستبيان سوف يزود الباحثة والمهتمين بصحة الفم والأسنان بمعلومات غير متوفرة لدينا حاليا.

الرجاء إكمال الإستبيان الاتي بحل جميع اسئلته التي لن تأخذ أكثر من عشر دقائق من وقتك .

الرجاء إكمال الأسئلة بصدق وأمانة ثم إعادتها الى الشخص الذي سلمك إياها، مع العلم بأن إسمك سوف لايظهر على الإستبيان حفاظا على خصوصيتك .

أذا كنت من المهتمين لمعرفة نتائج هذا البحث فإنه لمن دواعي سروري اشراكك بنتائج البحث التي سترسل بالبريد على العنوان الذي تتركه للشخص الذي سلمك هذا الإستبيان ، او بالتخاطب على البريد الالكتروني :

salxs001@odu.edu

شكرا للوقت الذي قضيته في الإجابة على الأسئلة ولدعمك للبحث والمشاركة .

مع تحيات الباحثه : صبحه محمود الشطرات

طالبة دراسات عليا – قسم صحة الفم والاسنان

جامعة اولد دومينيون – فيرجينيا – الولايات المتحدة الامريكية .

APPENDIX E

Arabic Translation of *Jordan Dentists' Knowledge and Implementation of Eco-Friendly Dental Office Strategies Questionnaire*

مدى معرفة وتطبيق أطباء الأسنان الأردنيين بالإستراتيجيات

المستخدمة في عيادات الأسنان والتي تتعلق بالحفاظ على البيئة

إرشادات : أرجو الإجابة على الأسئلة التالية بوضع إشارة X داخل المربع أو إكمال الفراغ .

بعد الانتهاء من الاجابة على الاستبيان الرجاء اعادته الى الشخص الذي سلمك اياه في المغلف الخاص بها وذلك للحفاظ على خصوصيتك .

إكمال الاستبيان سوف لن يأخذ أكثر من عشر دقائق :

القسم الاول : معلومات عامة :.

العمر :

☐ 30-23 ☐ 40-31 ☐ 50-41 ☐ 60-51

☐ 65-61 .

الجنس :

☐ ذكر ☐ انثى

الدخل الشهري :

☐ أقل من 500 دينار ☐ بين 500 – 1000 دينار ☐ بين 1000-1500 دينار

☐ أكثر من 1500 دينار .

أعلى تحصيل علمي :

☐ بكالوريوس ☐ ماجستير

☐ إختصاص ☐ دكتوراه

الخبره :

☐ من 1 الى 9 سنوات ☐ من 10 الى 19 سنه ☐ 29-20 سنه

☐ 39-30 سنه ☐ 49-40 سنه .

القسم الثاني : المعرفة والسلوك المرتبط بالاستراتيجيات المتعلقة بالحفاظ على البيئة

إختر إجابة واحدة فقط لكل من الإستراتيجيات التالية :

الرقم					
	تدبير ما تبقى من (مخلفات) الأملغم				
-1	استخدام أحجام مختلفة من كبسولة الأملغم	☐	☐	☐	☐
-2	التخلص من الأملغم بطرق أخرى غير النفايات أو مصرف المياه	☐	☐	☐	☐
-3	الحفاظ على أجزاء الأملغم غير المستخدمة في وعاء مغلق	☐	☐	☐	☐
-4	استخدام ما يسمى بفاصل الأملغم(Amalgam Separators)	☐	☐	☐	☐
-5	إستخدام مرشح هوائي للأملغم والذي يوجه جزيئات الأملغم الى اوعية خاصة بمصارف المياه.	☐	☐	☐	☐
-6	إستخدام حشوات بديلة للأملغم مثل سيراميك ، ذهب، بورسلين كمبوزيت	☐	☐	☐	☐
	تدبير وتصريف مخلفات الأشعة				
-7	خلط وتخزين المواد الكيميائية حسب إرشادات المنتج	☐	☐	☐	☐
-8	شراء المواد الكيميائية (المظهر والمثبت للأفلام) بشكل مركز وتحضيرها عند الضرورة لتفادي التبذير.	☐	☐	☐	☐
-9	إستخدام برنامج خاص للتخلص من الرقاقة الرصاصية (الرقاقة المعدنية الرصاصية)	☐	☐	☐	☐
-10	إستخدام برنامج التدبير الخاص للتخلص من المثبت FIXER	☐	☐	☐	☐
-11	إستخدام الاشعة الرقمية (Digital Radiology)	☐	☐	☐	☐
-12	إعادة إستخدام بطاقات العرض (X-Ray Mounts) للأشعة للمرضى الجدد بعد الحصول عليها من ملفات متلفة لمرضى قدامى	☐	☐	☐	☐
	تدبير مخلفات الورق				
-13	إعادة تدوير أوراق العيادة	☐	☐	☐	☐

-14	الطباعة على الوجهين للورق إن أمكن	☐	☐	☐	☐
-15	إستخدام الكمبيوتر لحفظ المعلومات	☐	☐	☐	☐
-16	إستخدام Practice-Management Software قاعدة بيانات	☐	☐	☐	☐
-17	إستخدام رسائل الكترونية لخدمة المرضى وتذكيرهم بمواعيدهم	☐	☐	☐	☐
-18	استخدام افلام فيديو لتوضيح الإجراءات السنية المختلفة	☐	☐	☐	☐
-19	إستخدام Name badge والتي يمكن استخدامها اكثر من مرة	☐	☐	☐	☐
-20	إستخدام الورق المدور Recycable	☐	☐	☐	☐
-21	إستخدام مخلفات إوراق الكمبيوتر والمكتب من أجل كتابة الملاحظات	☐	☐	☐	☐
-22	التبرع بالمجلات للمراكز الإجتماعية ومراكز الخدمات والصحة العامة	☐	☐	☐	☐
-23	التبرع بكتب الإسنان القديمة الى المكتبات والمدارس او جهات التبرع	☐	☐	☐	☐
	إدارة العدوى Infection Control				
-24	شراء المواد المستخدمة بعبوات كبيرة بدل العبوات الصغيرة	☐	☐	☐	☐
-25	إستخدام كاسات من الزجاج أو المعدن بدلا من الورق او البلاستيكStyrofoam	☐	☐	☐	☐
-26	إستخدام Reusable Air – Water Syringe بدلا من البلاستيك	☐	☐	☐	☐
-27	إستخدام قطعة قماش لتغطية الأدوات بدلا من أكياس الورق أو البلاستيك في جهاز البخار للتعقيم	☐	☐	☐	☐
-28	إستخدام Suction tips معدنية بدلا من البلاستيكية	☐	☐	☐	☐
-29	إستخدام مواد تنظيف خاصة بحماية البيئة	☐	☐	☐	☐
-30	إستخدام مناديل مطهرة وغير سامة بدلا من زجاجات الرش Spry botles	☐	☐	☐	☐
-31	إستخدام مرابيل من القماش والتي يمكن غسلها بدلا من استخدام المرابيل المستخدمة لمرة واحدة فقط Disposable	☐	☐	☐	☐

-32	إستخدام الادوات –الصواني –حاملة الافلام التي يمكن تعقيمها بدل من Disposable Products	☐	☐	☐	☐
-33	إعادة استخدام اكياس التعقيم مع إحكامها بشرائط التعقيم	☐	☐	☐	☐
	تدبير الطاقة				
-34	إستخدام Fluorescent Light	☐	☐	☐	☐
-35	التخلص من اللمبة المحروقة مع المخلفات الخطرة أو إعادة تصنيعها	☐	☐	☐	☐
-36	إستخدام الطاقة المتجددة مثل الرياح أو الطاقة الشمسية	☐	☐	☐	☐
-37	إستخدام منظم الحرارة الاوتوماتيكي لضبط نظام الحرارة والبرودة	☐	☐	☐	☐
-38	إطفاء جميع الاجهزة الكهربائية وسحب الفيش عند نهاية اليوم بما فيها الكمبيوتر والطابعة والناسخة	☐	☐	☐	☐
-39	إستخدام منظم الإضاءة عن طريق الحركة	☐	☐	☐	☐
	تدبير المياه				
-40	إستخدام منظمات حنفيات الماء Water faucet Sensor	☐	☐	☐	☐
-41	إستخدام مجففات الأيدي Hand Dryer	☐	☐	☐	☐
-42	إستخدام معقمات الأيدي Hand Sanitizer	☐	☐	☐	☐
-43	إعطاء تعليمات للمريض بإغلاق حنفية المياه أثناء تفريش الإسنان	☐	☐	☐	☐
-44	أستخدام Dual-Flush toliet	☐	☐	☐	☐
-45	وضع طوب أو مواد ثقيلة داخل التواليت لتخفيف سعة التواليت من المياه وذلك لتقليل كمية المياه المستهلكة	☐	☐	☐	☐

القسم الثالث : الحواجز والعوائق للتنفيذ أو التطبيق

ما المانع من إستخدام الإستراتيجيات المتعلقة بحماية البيئة في عيادتك ؟

- ☐ التكلفة
- ☐ عدم المعرفة بالإستراتيجيات المتعلقة بحماية البيئة
- ☐ عدم وجود مميزات تعطيها الحكومة لمطبقي النظام
- ☐ لا يوجد اي فرق بين تطبيقها أو عدم تطبيقها لدى المرضى
- ☐ أخـــــرى : .....

.....

.....

شكرا لك لمشاركتك في هذه الدراسة .

من فضلك سلم الاستبيان الى الشخص الذي سلمك اياه

مع تحيات الباحثة : صبحة محمود الشطرات

طالبة دراسات عليا – قسم صحة الفم والإسنان

جامعة اولد دومينيون- فيرجينيا

الولايات المتحدة الامريكية

APPENDIX F

Approval letter of Human Subjects Review Committee

11th August 2010

Deanne Shuman, BSDH, MS, PhD
Professor & Acting Chair
School of Dental Hygiene
College of Health Sciences
Old Dominion University
Health Sciences Building, Room 3104
Norfolk, VA 23529-049

Dear Professor Shuman;

The College of Health Sciences Human Subjects Review Committee has reviewed your application for exempt status titled: *'JORDANIAN DENTISTS' KNOWLEDGE AND IMPLEMENTATION OF ECO-FRIENDLY DENTAL OFFICES STRATEGIES'*. Your protocol is now approved as Exempt by the College of Health Sciences Human Subjects committee as of today's date. You will not need to submit further reports on the project unless there is a significant change in methods that would impact human subjects.

Sincerely,

Steven Morrison, PhD
Chair, COHS Human Subjects Committee

cc: COHS IRB Members

APPENDIX G

Respondents Comments

- **Comment #1:**

  I try my best to apply all the strategies and to tell the patients about it.

- **Comment #2:**

  You are talking about unfamiliar thing

- **Comment #3:**

  No recycle containers

- **Comment #4:**

  No money and no rules to force us to do the recycling.

- **Comment #5:**

  No money to cover these expenses and we can't charge these expenses to the customers

- **Comment #6:**

  No rules and regulations.

- **Comment #7:**

  The patients ask for disposable items because they don't trust our sterilization.

- **Comment #8:**

  The patients scared from the dentists and they don't trust him.

- **Comment #9:**

  The area that I work in is a low income area and it is hard to charge the patients any extra money.

- **Comment #10:**

  There are no rules or regulations from the Health Department regarding the waste management of these strategies.

- **Comment #11:**

  The patient fee that we charge almost covers our expenses and it will not cover the new technology that you are talking about.

- **Comment #12:**

  There are no rules and regulations.

  The financial problems with the all patients make us do the basic needs.

- **Comment #13:**

  All what I know about cleaning/sterilization is to clean the ground and my tools and I believe it is my fault because I should know more than that to save my patients.

- **Comment #14:**

  No regulations and rules

- **Comment #15:**

  Some of these strategies we don't know anything about it and others we try to do it but the expenses are the problem that faces us.

- **Comment #16:**

  The patients extract his/her teeth instead of filling because it is cheaper.

- **Comment #17:**

  There are no rules and regulations, cost, regional limitation, and "Patients ask me about x-ray what is this??...it makes no difference for them. There concern more about the cost and if put stone inside the siphon they will ask me to remove it"

APPENDIX H

Chi-square Analysis with Significant Association of Demographic Characteristics with the Knowledge of Eco-friendly Strategies

Table 1

Chi-square Analysis of Age with the Knowledge of Eco-friendly Strategies

Strategy	χ^2	df	Asymp.sig.(2-sided)
13. Recycle dental office paper waste	16.133	8	.041
17. Implement patient electronic messaging service	16.712	8	.033
20. Use recycled paper products	16.820	8	.032
43. Instruct the patients to turn off water faucet during tooth brushing at home	17.642	8	.024

Table 2

Chi-square Analysis of Monthly Income with the Knowledge of Eco-friendly Strategies

Strategy	χ^2	df	Asymp.sig.(2-sided)
5. Use amalgam vacuum filters which directs the amalgam particles to amalgam waste water containers	12.426	6	.053
12. Reuse x-ray mounts for new patients when purging old files	16.588	6	.011
15. Use computer-based records system	14.811	6	.022
17. Implement patient electronic messaging service	17.315	6	.008
20. Use recycled paper products	22.819	6	.001
29. Use enzyme –based cleaners that are biodegradable	15.329	6	.018
33. Reuse instrument sterilization bags. Secure with autoclave tape	14.781	6	.022

Table 3

Chi-square Analysis of Education Level with the Knowledge of Eco-friendly Strategies

Strategy	$\chi 2$	df	Asymp.sig.(2-sided)
4. Use amalgam separators	12.949	6	.044
6. Use alternatives to amalgam filling such as composite, ceramic, gold, and porcelain	12.370	6	.054
10. Use waste management program to dispose fixer	12.910	6	.044
12. Reuse x-ray mounts for new patients when purging old files	26.097	6	.000
13. Recycle dental office paper waste	29.406	6	.00
17. Implement patient electronic messaging service	30.136	6	.000
20. Use recycled paper products	14.777	6	.022
25. Use reusable glass/ metal cups instead of paper, plastic, or Styrofoam	14.916	6	.021
26. Use reusable metal air/water syringes instead of plastic	12.914	6	.044
34. Use compact fluorescent light Bulbs	13.986	6	.030
45. Put bricks or other heavy materials inside the toilets	12.797	6	.046

Table 4

Chi-square Analysis Years of Experience with the Knowledge of Eco-friendly Strategies

Strategy	$\chi 2$	df	Asymp.sig.(2-sided)
4. Use amalgam separators	16.144	8	.040
5. Use amalgam vacuum filters which directs the amalgam particles to amalgam waste water containers	15.771	8	.046
8. Purchase chemicals (developer, fixer) in concentrated form. Prepare chemicals as needed to eliminate excess	18.168	8	.020
12. Reuse x-ray mounts for new patients when purging old files	17,158	8	.029
13. Recycle dental office paper waste	15.929	8	.043
17. Implement patient electronic messaging service	17.415	8	.026
22. Donate old magazines to community centers, public health, and other service centers	19.570	8	.012
23.Donate old dental books to libraries, schools, or fundraising effort	22.766	8	.004
29.Use enzyme –based cleaners that are biodegradable	15.462	8	.051
37. Use automated thermostats to control heating /cooling systems	15.888	8	.044

APPENDIX I

Chi-square Analysis for Demographic Characteristics with the Knowledge of Eco-friendly Strategies

Chi-square for Demographic Characteristics with the Knowledge of Eco-friendly Strategies

Strategy	Age	Gender	Income	Education	Experience
Amalgam Management					
1. Use pre-capsulated alloys in different size	.228	.965	.475	.102	.294
2. Dispose amalgam in means other than regular trash or down drain	.277	.955	.803	.195	.127
3. Keep unused amalgam particles in well sealed containers	.758	.576	.264	.162	.570
4. Use amalgam separators	.550	.555	.236	**.044**	**.040**
5. Use amalgam vacuum filters which directs the amalgam particles to amalgam waste water containers	.515	.874	**.053**	.263	**.046**
6. Use alternatives to amalgam filling such as composite, ceramic, gold, and porcelain	.299	.400	.446	**.054**	.310
Radiographic Management					
7. Mix and store chemicals according to manufacturer's recommendations to avoid waste	.612	.619	.507	.482	.250
8. Purchase chemicals (developer, fixer) in concentrated form. Prepare chemicals as needed to eliminate excess	.702	.155	.248	.513	**.020**
9. Use waste management program to dispose of lead foils	.874	.340	.215	.111	.412
10. Use waste management program to dispose fixer	.637	.815	.225	**.044**	.273
11. Use digital radiography	.603	.303	.574	.842	.130
12. Reuse x-ray mounts for new patients when purging old files	.201	.452	**.011**	**.000**	**.029**
Paper Waste Management					
13. Recycle dental office paper waste	**.041**	.651	.327	**.000**	**.043**
14. Print on both sides of the paper when possible	.230	.502	.723	.274	.431
15. Use computer-based records system	.352	.329	**.022**	.150	.247
16. Use practice-management software	.873	.710	.198	.099	.425
17. Implement patient electronic messaging service	**.033**	.655	**.008**	**.000**	**.026**
18.Use educational videos to explain the recommendation of different dental procedure	.911	.872	.358	.308	.410
19. Use reusable name badges	.436	.731	.309	.115	.119
20. Use recycled paper products	**.032**	.088	**.001**	**.022**	.058
21. Use scrap office/computer paper for scratch pads and internal notes	.361	.634	.637	.288	.689
22. Donate old magazines to community centers, public health, and other service centers	.130	.212	.638	.203	**.012**
23. Donate old dental books to libraries, schools, or fundraising effort	.090	.754	.655	.674	**.004**

Infection Control Management					
24. Purchase supplies in bulk packaging	.125	.857	.355	.123	.306
25. Use reusable glass/ metal cups instead of paper, plastic, or Styrofoam	.731	.961	.891	**.021**	.312
26. Use reusable metal air/water syringes instead of plastic	.239	.154	.151	**.044**	.278
27. Use steam sterilization with cloth instrument wraps vs. paper and plastic autoclave bags	.192	.831	.152	.427	.283
28. Use metal suction tips instead of disposable plastic suction tips	.977	.389	.856	.373	.715
29. Use enzyme –based cleaners that are biodegradable	.872	.538	**.018**	.235	**.051**
30. Use nontoxic, noncorrosive disinfectant wipes instead of pump spray bottles	.863	.205	.252	.812	.082
31. Use cloth lab coats that can be laundered, rather than disposable ones	.446	.142	.284	.922	.169
32. Use sterilizable instruments, trays, and film holding devices, rather than disposable products	.521	.842	.866	.137	.231
33. Reuse instrument sterilization bags. Secure with autoclave tape	.092	.718	**.022**	.552	.175
Energy Management					
34. Use compact fluorescent light Bulbs	.797	.168	.702	**.030**	.369
35. Dispose the burned bulbs into hazardous waste or recycle it	.897	**.056**	.309	.280	.119
36. Use renewable energy such as wind or solar power	.778	.217	.181	.576	.386
37. Use automated thermostats to control heating /cooling systems	.244	.521	099	.100	**.044**
38. Turn off and plug all the electrical appliances at the end of the day, including computers, printers, and copiers	.239	.090	.553	.624	.110
39. Use motion detectors for room lighting	.997	.807	.461	.100	.583
Water Conservation					
40. Use water faucet sensors	.714	.117	.772	.573	.988
41. Use hand dryers	.127	.849	.078	.063	.168
42. Use hand sanitizer	**.024**	.623	.594	.081	.073
43. Instruct the patients to turn off water faucet during tooth brushing at home	.568	.502	.128	.418	.188
44. Use dual-flush toilet	.332	.417	.760	.971	.643
45. Put bricks or other heavy materials inside the toilets	.714	.554	.499	**.046**	.436

APPENDIX J

Chi-square Analysis with Significant Association of Demographic Characteristics with the Implementation of Eco-friendly Strategies

Table 1

Chi-square Analysis of Age with the Implementation of Eco-friendly Strategies

Strategy	$\chi 2$	df	Asymp.sig.(2-sided)
17. Implement patient electronic messaging services	9.856	3	.020
20. Use recycled paper products	8.000	3	.046

Table2

Chi-square Analysis of gender with the Implementation of Eco-friendly Strategies

Strategy	$\chi 2$	df	Asymp.sig.(2-sided)
8. Purchase chemicals (developer, fixer) in concentrated form. Prepare chemicals as needed to eliminate excess	3.715	1	.054
38. Turn off and plug all the electrical appliances at the end of the day	4.777	1	.029

Table 3

Chi-square Analysis of Monthly Income with the Implementation of Eco-friendly Strategies

Strategy	$\chi 2$	df	Asymp.sig.(2-sided)
20. Use recycled paper products	10.756	3	.013

Table 4

Chi-square Analysis of Education Levels with the Implementation of Eco-friendly Strategies

Strategy	$\chi 2$	df	Asymp.sig.(2-sided)
34. Use compact fluorescent light Bulbs	12.363	3	.006

Table 5

Chi-square Analysis of Years of Experience with the Implementation of Eco-friendly Strategies

Strategy	$\chi 2$	df	Asymp.sig.(2-sided)
22. Donate old magazines to community centers	14.027	4	.007
23. Donate old dental books to libraries	17.006	4	.002

APPENDIX K

Chi-square for Demographic Characteristics with the Implementation of Eco-friendly Strategies

Chi-square for Demographic Characteristics with the Implementation of Eco-friendly Strategies

Strategy	Age	Gender	Income	Education	Experience
Amalgam Waste Management					
1. Use pre-capsulated alloys in different size	.147	.839	.298	.433	.231
2. Dispose amalgam in means other than regular trash or down drain	.157	.778	.565	.115	.780
3. Keep unused amalgam particles in well sealed containers	.339	.300	.187	.111	.597
4. Use amalgam separators	.621	.932	.192	.210	.280
5. Use amalgam vacuum filters which directs the amalgam particles to amalgam waste water containers	.177	.877	.118	.409	.549
6. Use alternatives to amalgam filling such as composite, ceramic, gold, and porcelain	.167	.578	.315	.689	.557
Radiographic Waste Management					
7. Mix and store chemicals according to manufacturer's recommendations to avoid waste	.338	.509	.314	.433	**.055**
8. Purchase chemicals (developer, fixer) in concentrated form. Prepare chemicals as needed to eliminate excess	.725	**.054**	.494	.115	.085
9. Use waste management program to dispose of lead foils	.688	.172	.372	.111	.645
10. Use waste management program to dispose fixer	.511	.548	.584	.210	.142
11. Use digital radiography	.633	.259	.290	.409	.182
12. Reuse x-ray mounts for new patients when purging old files	.399	.227	.239	.689	.195
Paper Waste Management					
13. Recycle dental office paper waste	.083	.505	.261	.753	.193
14. Print on both sides of the paper when possible	.141	.805	.462	**.058**	.126
15. Use computer-based records system	.403	.777	.633	.197	.311
16. Use practice-management software	.727	.598	.570	.198	.592
17. Implement patient electronic messaging service	**.020**	.401	.343	.156	.222
18. Use educational videos to explain the recommendation of different dental procedure	.572	.602	.133	.526	.834
19. Use reusable name badges	.223	.780	.386	.836	.355
20. Use recycled paper products	**.046**	.078	**.013**	.234	.305
21. Use scrap office/computer paper for scratch pads and internal notes	.479	.809	.873	.346	.773
22. Donate old magazines to community centers, public health, and other service centers	.170	.208	.363	.107	**.007**
23. Donate old dental books to libraries, schools, or fundraising effort	.065	.564	.256	.270	**.002**

Infection Control Management					
24. Purchase supplies in bulk packaging	.553	.639	.116	.175	.192
25. Use reusable glass/ metal cups instead of paper, plastic, or Styrofoam	.341	.919	.857	.122	.736
26. Use reusable metal air/water syringes instead of plastic	.658	.186	.598	.420	.748
27. Use steam sterilization with cloth instrument wraps vs. paper and plastic autoclave bags	.209	.559	.534	.243	.500
28. Use metal suction tips instead of disposable plastic suction tips	.8111	.179	.823	.257	.631
29. Use enzyme –based cleaners that are biodegradable	.914	.610	.503	.303	.169
30. Use nontoxic, noncorrosive disinfectant wipes instead of pump spray bottles	.568	.075	.931	.636	.628
31. Use cloth lab coats that can be laundered, rather than disposable ones	.574	.751	.626	.718	.774
32. Use sterilizable instruments, trays, and film holding devices, rather than disposable products	.696	.776	.918	.384	.701
33. Reuse instrument sterilization bags. Secure with autoclave tape	.191	.943	.428	.584	.410
Energy Management					
34. Use compact fluorescent light Bulbs	.950	.914	.498	**.0006**	.607
35. Dispose the burned bulbs into hazardous waste or recycle it	.797	.889	.169	.305	.735
36. Use renewable energy such as wind or solar power	.463	.083	.290	.755	.117
37. Use automated thermostats to control heating /cooling systems	.621	.947	.418	.452	.458
38. Turn off and plug all the electrical appliances at the end of the day, including computers, printers, and copiers	.888	**.029**	.478	.546	.687
39. Use motion detectors for room lighting	.923	.913	.563	.277	.713
Water Conservation					
40. Use water faucet sensors	.373	.496	.760	.587	.942
41. Use hand dryers	.617	.836	.440	.097	.186
42. Use hand sanitizer	.580	.384	.378	.071	.853
43. Instruct the patients to turn off water faucet during tooth brushing at home	.166	.942	.060	.321	.508
44. Use dual-flush toilet	.797	.205	.649	.849	.721
45. Put bricks or other heavy materials inside the toilets	.213	.673	.774	.129	.372