SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA, LEGON

ADHERENCE TO DENTAL WASTE MANAGEMENT GUIDELINES
AMONG DENTAL SURGERY STAFF IN FOUR REFERRAL FACILITIES IN
ACCRA

BY
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THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON
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MASTER OF PUBLIC HEALTH DEGREE

JULY, 2018
DECLARATION

I, Alex Ansah Owusu, hereby declare that this dissertation is a result of my independent work. References to other works have been duly acknowledged. I further declare that this dissertation has not been submitted for the award of any degree in this institution and other universities elsewhere.

ALEX ANSAH OWUSU (STUDENT)

DATE

DR. REUBEN ESENA (ACADEMIC SUPERVISOR)

DATE
DEDICATION

This work is dedicated to my parents, Mr and Mrs Osei Tutu as well as Mr and Mrs Mensah for your unceasing prayers, encouragement and support. You have been such a blessing to me.
ACKNOWLEDGEMENT

Indeed my heavenly father knows best and I can always trust in His care. For how far you have brought me, I say thank you God. A special thank you goes to my project supervisor, Dr. Reuben Esena, for all the time he sacrificed to read through this work and guide me every step of the way. A very big thank you also goes to Dr. Abu Manu, Dr. Patricia Akweongo, Prof. Philip Adongo, Prof. Augustine Ankoh, Prof. Richard Adanu, Dr. Reginald Quansah and all the lecturers who equally guided me. I say Ayekoo to all the lecturers of the school of Public of Health, University of Ghana.

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Another thank you goes to the Ghana Health Service Ethical Review Board, 37 Military Hospital Institutional Review Board and The Korle Bu Teaching Hospital Scientific Review Board and Ethical Review Board for the detailed attention they paid to my proposal and the recommendations they made.

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ABSTRACT

**Background:** Increasing access to oral health services comes with increasing levels of generated dental waste. Like any other clinical waste, guidelines exist for management of dental waste. It is the responsibility of the producer of the waste to ensure it is managed according to the guidelines. Improper disposal of this dental waste has harmful effects directly on human health and the environment.

**Objective:** The objective of this research was to determine adherence to dental waste management guidelines among dental surgery staff in four referral facilities in Accra.

**Method:** A descriptive cross-sectional study was done. It was a quantitative study. The study was a census of the dental surgery staff in the four referral facilities in Accra. Data were collected using questionnaires and observation checklists. The outcome variable was Adherence to dental waste management guidelines. It was measured with a composite scale. The collected data were analysed using STATA version 15.0 and results presented in tables and figures.

**Results:** It was found that in the last 12 months, majority of the respondents 109 (87.9%) had not attended any Continuous Professional Development (CPD) programme on clinical waste management. Also less than 10% of the respondents 11 (8.9%) had read the Ministry of Health (MOH) policy on Clinical Waste Management. The study found that most of the dental surgery staff 80 (64.5%) had low level of knowledge on dental waste management guidelines. Although almost all the dental surgery staff 123 (99.2%) had low level of adherence to dental waste management guidelines, they all adhered to guidelines on sharps management.

**Conclusion:** The study concluded that there is a low level of adherence to dental waste management guidelines by dental surgery staff of the four referral facilities studied. It also
found that there is a low level of knowledge on dental waste management guidelines among the dental surgery staff in the 4 referral facilities studied. An enabling environment does not exist to promote adherence to dental waste management guidelines by dental surgery staff in the four referral facilities studied.

**Key words:** Clinic waste, dental surgery waste, adherence, dental surgery staff, oral health.
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<table>
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<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>COHO-</td>
<td>Community Oral Health Officer</td>
</tr>
<tr>
<td>CPD-</td>
<td>Continuous Professional Development</td>
</tr>
<tr>
<td>CSO-</td>
<td>Civil Society Organisation</td>
</tr>
<tr>
<td>DWMG-</td>
<td>Dental Waste Management Guidelines</td>
</tr>
<tr>
<td>GDA-</td>
<td>Ghana Dental Association</td>
</tr>
<tr>
<td>GMA-</td>
<td>Ghana Medical Association</td>
</tr>
<tr>
<td>HIV-</td>
<td>Human Immunodeficiency virus</td>
</tr>
<tr>
<td>KBTH-</td>
<td>Korle Bu Teaching Hospital</td>
</tr>
<tr>
<td>MDC-</td>
<td>Medical and Dental Council</td>
</tr>
<tr>
<td>MOH-</td>
<td>Ministry of Health</td>
</tr>
<tr>
<td>NGO-</td>
<td>Non-Governmental Organization</td>
</tr>
<tr>
<td>RDSA-</td>
<td>Registered Dental Surgery Assistant</td>
</tr>
<tr>
<td>VIP-</td>
<td>Very Important Persons</td>
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</table>
DEFINITION OF SIGNIFICANT TERMS

Amalgam: A mixture of mercury with other metal (silver, copper and zinc) in variable proportions. It is used for dental fillings.

Composite: A tooth-coloured filling material used in dentistry to restore decayed and broken teeth.

Etchants: An acidic chemical that is used for etching (roughening the surface of a tooth to receive an adhesive material)

Disinfectant: A chemical agent that is used to reduce the load of harmful microorganisms (bacteria and fungi) usually on inanimate items.

Fixer: A chemical that is used in processing X- ray films after the film has been developed.

Dental waste: Refers to all waste produced from dental surgeries.

Developer: A chemical solution that changes the invisible image on an X- ray film to a visible one.

Mercury: A heavy metal that is liquid at ordinary temperatures. It is silvery white in colour.

It is a major component of dental amalgam.

Hazardous waste: Refers to infectious, toxic, corrosive and carcinogenic waste that has the potential to have adverse effects on public health and the environment.

Health care waste: Refers to all liquid or solid waste that is not treated, produced in the process of giving medical care, veterinary service or the during medical research that uses humans or animals.

Infectious waste: Waste that contains disease causing organisms such as bacteria, parasites, viruses and fungi in loads that can cause disease in a susceptible individuals.
**Sharps**: Refers to all items that have the ability to cut or puncture and hence carry the risk of injury or infection

**Surgery/ dental surgery**: The area where dental procedure are carried out
CHAPTER ONE

INTRODUCTION

1.1 Background of the study

All over the world today, there are challenges in the management of clinical solid waste. These challenges are particularly more pronounced in developing countries. Improper handling, storage, transportation and ultimate disposal of clinical waste has led to a constant upsurge in health hazards and environmental pollution. Poor handling, starting from collection, through storage to final disposal is evident. This has been attributed to absence of the right legislation, unavailability of specialized health care staff and some level of lack of awareness (Hossain, Santhanam, Nik Norulaini, & Omar, 2011). Additionally, common to all developing countries is poverty which makes it more difficult to manage clinical waste by accepted standards (Hossain et al., 2011).

With increasing access to oral health care services comes increased generation of dental surgery waste. Improper management of dental surgery waste will have both short term and long term health implications. The environment at large is negatively affected by improper disposal of dental waste. Dental surgery staff, the producers of dental waste have the responsibility of ensuring that the waste is managed according to accepted guidelines. This involves proper waste segregation, storage, transportation and final disposal (Ministry of Health, 2006).

Improper disposal of sharps and other dental waste which are contaminated with blood or saliva may put the clinical staff, patients and their families at risk of infections such as hepatitis B, hepatitis C and HIV. Wrong disposal of heavy metal such as, mercury can cause work place exposure to mercury. The effects of mercury on the entire population and the environment is of global concern. The effects of improper disposal of lead is no different. All these metals negatively affect the ecosystem and puts both the current and future generation at risk.
Adherence to dental waste management guidelines by dental surgery staff is key to ensuring a safe environment.

1.2 Problem statement

Wide range of waste is produced in dental surgeries in Accra and Ghana at large. These wastes may be classified as clinical waste, hazardous waste or domestic. Clinical waste refers to waste that contains either partly or entirely of human or animal tissue, blood or any body fluid, excretions, pharmaceutical products, swabs or dressings, syringes, needles or any sharp instruments (Allen, 2014). This type of waste is harmful to individuals who are exposed to it if not made safe. Hazardous waste is one that causes harm to living organisms or the environment, either by itself or via a component it contains (Darwish & Al-Khatib, 2006).

Management of oral health conditions yields a lot of hazardous waste like dental amalgam, etchants, used x-ray developers and fixers, lead foil packets and disinfectants (Isaac, Centre, & Processing, 2016). Amalgam contains mercury which makes it very toxic to both humans and the environment (de Souza, Nozawa, & Honda, 2012).

Utilisation of oral health facilities is on the rise. In the United states of America, 84.7% of the population aged 2-7 years visited the dentist in 2015, 64.0% of those aged 18-64 and 62.8% of those aged 65 years and over visited a dentist in 2015 (National Center for Health Statistics, 2017).

A research done in Urmia, Iran showed that general dental offices produced 58.94 Kg of waste per day, specialist dental offices produced 17.92 Kg of waste per day and dental clinics generated 10.22 Kg of waste per day. Of the generated waste, 35.5% was domestic waste, 34.2% was potentially infectious waste, 11.8% was toxic and chemical waste and 5.56% was pharmaceutical waste (Koolivand, Fathollah, & Nourmoradi, 2014).
The generation of dental waste in itself may not be a problem if the waste is handled the right way.

Acceptable guidelines for managing dental waste, from their generation, treatment, transportation and their final disposal exist. The question is, what proportion of dental surgery staff are aware of the current standards of dental waste management, how many of them adhere to them, are resources necessary for proper dental waste management readily available in Accra and what factors influence adherence to these guidelines?

This research sought to determine the level of adherence to dental waste management guidelines among dental surgery staff in 4 referral facilities in Accra.
1.3 Conceptual framework

Figure 1.1: Conceptual Framework on Adherence to Dental Waste Management Guidelines Among Dental Surgery Staff in 4 Referral Facilities in Accra
1.3.2 Summary of conceptual framework

Adherence to dental waste management guidelines by dental surgery staff is influenced directly by the level of knowledge of dental surgery staff on dental waste management guidelines. As shown in figure 1, dental surgery staff can obtain this knowledge either from the training received while still in school or further training after graduation from school. Sources of this knowledge after graduating from school could be from pre-service training, in-service training, on the job coaching and supervision and personal reading of documents on clinical waste management, such as the MOH Policy on health facility waste management. Very importantly, an enabling environment that supports safe management of dental surgery waste must be available before dental surgery staff can adhere to the dental waste management guidelines. These may include the availability of a digital X-ray machine instead of the conventional X-ray machine, presence of different colour coded bins and puncture proof sharp box in every dental surgery and availability of more environmentally friendly material for use by dental surgery staff.

1.4 Justification of the study

This study determined the level of knowledge of dental surgery staff on dental waste management guidelines. It also examined the proportion of these staff who had read the MOH Policy on Health facility waste management. The study describes dental waste management practices among dental surgery staff in the selected four referral facilities.

It was important to carry out this study because the findings of this study would help policy makers to assess the efficiency of their policy dissemination methods and make the necessary changes if need be. This will help the Medical and Dental Council as well as other health facilities to consider the need to include education and training on clinical waste management in their continuous professional development programmes and pre-service and in-service
trainings. The findings from this steady will also be a good guide for health facilities and the Ministry of Health in creating an environment that will make safe handling of health facility waste the default.

1.5 Research questions

- What proportion of dental staff in referral facilities in Accra adhere to dental waste management guidelines?
- What knowledge do dental surgery staff in referral facilities in Accra have on dental waste management?
- How is dental surgery waste managed by dental surgery staff in referral facilities in Accra?

1.6 Objectives of the study

1.6.1 General objective:
To determine adherence to dental waste management guidelines among dental surgery staff in 4 referral facilities in Accra

1.6.2 Specific objectives:

1. To determine the proportion of dental surgery staff in the selected referral facilities in Accra adhering to dental waste management guidelines.
2. To determine the level of knowledge of dental surgery staff in referral facilities in Accra on dental waste management.
3. To describe methods of dental waste management by dental surgery staff in referral facilities in Accra.
CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This section reviews existing literature relevant to the topic, adherence to dental waste management guidelines. The literature is reviewed under the following headings: Knowledge on clinical waste management; this part will look at the health care waste management policies by the Ministry of Health (MOH), Ghana. It also looks at the best management practices for hazardous dental waste disposal. Published articles on knowledge of dental surgery staff on dental waste management forms the last aspect of this section. The second heading is on methods of clinical waste management. The third heading is on adherence to clinical waste management guidelines.

2.2 Knowledge on clinical waste management

2.2.1 Health care waste management policies by the Ministry of Health (MOH), Ghana

Provision of oral health care services produces waste just like other human activities. This health care waste if not managed as per accepted guidelines puts health professionals, patients and the entire public at risk. Very importantly, the environment is put at risk as well.

About 75% to 90% of health care waste produced in Ghana is non-hazardous and can be treated like regular waste. The remaining 10% to 25% is hazardous and must be managed according to the accepted standards.

Waste is managed in Ghana via a multi-sectorial approach. The Ministry of Local Government implements policies on waste management while the Environmental protection Agency regulates the policies. The producer of the waste is the primary person responsible for its
management. It is therefore the responsibility of all health facilities to ensure proper segregation, storage, treatment and safe disposal of the waste they produced. They are however to do this with the help of stakeholder agencies and ministries (Ministry of Health, 2006).

The policy statement

All hazardous waste must be treated as per this policy.

i. All health care centres are responsible for the separation, storage, labelling, treatment, transportation and disposal of their waste by this policy and other regulations and laws on Health Care Waste Management. This must be done to ensure that health workers, clients and the environment are safe.

ii. Every health care centre and its staff have a responsibility to:

   a. Appropriately store waste and avoid its spillage or loss.
   b. Separate waste that need diverse ways of disposal.
   c. Label waste to show where it is coming from and what it contains.
   d. Give waste solely to individuals approved to receive it.
   e. Accept waste only when instructed to do so and waste must be received by authorised people only.
   f. Give a thorough description of the waste on right forms such that other handlers of the waste can manage it safely. Non-compliant institutions and staff will be liable to negligence.
   g. Keep correct records of waste management activities. Waste management companies also share this responsibility.
   h. Identify and obtain sites for final disposal of treated waste.

iii. When possible, approved waste disposal sites will have a portion set aside for disposal of treated health care waste.
iv. Waste disposal sites will be centralised for health institutions within the same area. This will be the case provided the disposal site is as close as possible to the health facilities.

v. The waste treatment methods associated with the least risk to the environment will be selected, taking into account the available financial, human and technical resources.

vi. The MOH will work together with other appropriate ministries, stakeholders and individuals to promote effective management of health care waste.

vii. For an efficient system and inter-sectoral collaboration health institutions will permanently employ environmental health officers.

viii. Health care facilities shall have back up plans on the protocol to be used in cases of unexpected incidents such as spillages, fire, flooding etc.

ix. Frequent medical monitoring and immunization in addition to education and training of health care waste management staff will be done to promote safety of these staff.

x. The public will be educated on the relevance of health care waste management and their responsibility in pushing for its effective implementation. This will be done by information, education and communication strategies.

**Colour coding of health care waste**

Appropriate separation of health care waste should be done by colour coding of waste containers and plastic bags. In Ghana, the accepted coding scheme is as follows:

Black: General waste such as kitchen waste and paper.

Yellow: Infectious waste as such sharps, patient waste and animal or human tissue. This also includes radioactive waste.
Brown: Hazardous waste such as out of date drugs, vaccines and other chemicals. In situations where limited amounts of this waste is produced, it may be added to infectious waste (Ministry of Health, 2006).

2.2.2 Best management practices for hazardous dental waste disposal

A vast range of waste is produced in dental surgeries as dental surgeons together with their auxiliaries provide oral health services. Dental surgery waste when not handled as per the appropriate guidelines will have grave repercussions on humans and the environment at large.

At the core of dental surgery waste management is the minimization of waste produced in dental surgeries to the barest minimum. This involves the use of efficient equipment and well trained dental surgery staff. Pollution prevention is the education and training of staff to reduce waste production and recognise the socioeconomic importance of waste avoidance.

Unlike minimisation of dental waste which is optional, proper disposal of the waste produced is the responsibility of the facility from which it is produced. Dental surgeries generate a lot of hazardous waste which demand the best management to reduce the environmental effect. Management of dental surgery waste must be in line with legal requirements. Not adhering to these guidelines may lead to legal penalties. Dental surgeons and their auxiliaries must know how hazardous their waste is and be responsible if such waste is not handled based on accepted protocol.

1. Management of mercury containing waste; unused mercury should be kept in well enclosed, fracture-resistant and accurately-labelled containers. An approved waste transporter should then be called to send the waste for recycling. Mercury must never be added to other waste or washed into a drain. Waste amalgam (a tooth filling material) must be stored in a mercontainer (a mercury waste container with an agent for mercury vapour suppression). Dental surgeries must use amalgam separators and suction traps
to prevent amalgam from going down the drain. Dentist must always mix as much amalgam as immediately required to minimise amalgam waste. Failed amalgam restorations should as much as possible be removed manually and placed in an amalgam container. Dentists should use alternate restorative materials other than amalgam whenever economically and ethically applicable. When temporary amalgam storage materials are full, registered amalgam waste transporters should be called to send the waste amalgam for recycling or disposal.

Waste amalgam should not be put in the garbage, washed into the drain or put in the container for sharps.

2. Management of silver containing waste; Used X-ray fixers contain high levels of silver which is hazardous to the environment. When in small quantities, used fixers are best managed by the use of chemical recovery cartridges. These cartridges usually contain steel which reacts with the silver in the fixer to chelate it out. The silver can then be saved in a recommended container and labelled appropriately. An accredited waste transporter should be called to send the waste for recycling or disposal. The fixer with its silver removed can then be mixed with the developer and washed down the drain with a lot of water. When available, dentists should use digital X-rays to reduce the use of fixers. Expired fixers should be returned to manufacturers.

Undeveloped X-ray films are rich in silver and must be managed as hazardous waste. When buried in landfill, silver can concentrate in the soil and ground water and have toxic effects. Undeveloped X-ray films should be stored in appropriate containers and returned to manufacturers for recycling. Developed X-ray films due to their low silver content can be discarded with the regular solid waste.
3. Management of Lead foil packet and lead aprons; the lead can easily leach into the soil and ground if disposed into landfills causing environmental pollution. Lead foil packets should as a result be never added to regular waste. Lead waste should be returned to manufacturers for recycling or disposal.

4. Management of blood soaked material; these materials are infectious and must be kept in colour coded containers (yellow) which are marked with the biohazard symbol. This waste should be double bagged and refrigerated if it will not be disposed in less than five days. When this waste accumulates, a certified biomedical waste carrier should be called to dispose of the waste.

5. Management of Sharps; Sharp waste such as surgical blades, needles, burs, files and orthodontic wires must be well managed to prevent puncture wounds on dental staff and others involved in handling such waste. Such waste should be stored in yellow puncture resistant containers, well labelled and with fixed lid. This container must be labelled with the biohazard symbol. Registered biomedical waste carrier should be called to dispose of the waste when two thirds full. Sharps should never be mixed with other waste.

6. Management of chemicals and disinfectants; to avoid cross infection, a vast range of disinfectants and sterilizing chemicals are used in dental surgeries. The agents can be hazardous to the environment if not well managed. When feasible, dentists should choose other methods of sterilization such as autoclaving or dry heat sterilization over the use of chemicals. Manufacturer’s instructions should be read and followed in disposing of disinfectants and sterilizing agents. Empty disinfectant containers should be rinsed with water and the container added to the regular solid waste. Dental surgeries should avoid halogenated chemicals as much as possible as they cause a lot of environmental pollution.
These chemicals, disinfectants and sterilizations agents should not be poured into drain or septic system.

7. Non-hazardous waste management; waste such as paper, cardboard and plastic should be reduced by using reusable products when possible. This kind of waste should be recycled (Naik, Hegde, Damda, & Malik, 2014).

The Vermont State Dental Society gives similar guidelines for management of dental surgery waste (DeSnyder, Ferraris, & Moreau, 1999).

2.2.3 Knowledge of dental waste management among dental surgery staff in developing countries

A descriptive cross-sectional study was done in Nairobi, Kenya to determine the knowledge, attitudes and practices on dental waste management. About 45% of the respondents had received training on dental waste management although 89.5% of them had been frequently attending continuous dental education programmes. About 58% of the respondents worked in private clinics and 42% in public clinics. About 48.7% of the practitioners knew about waste management guidelines. Of this group only 64% saw the need to go by these guidelines, 5% felt it was tedious and 2% thought the guidelines were impracticable, the rest were apathetic. About 10.7% of the respondents knew dental amalgam had toxic effects on the environment if not properly managed. About 77% had no knowledge on the hazardous effects of poor amalgam waste management. 50% of the respondents stored amalgam waste under water while 25% were ignorant of how to manage amalgam waste. Everyone was aware of cross infection associated with improper management of bloody waste, yet only 56.1% isolated this waste and incinerated it. Additionally, 24.4% disposed bloody waste together with general non-infectious waste, 35.7% of the respondents said improper disposal of sharps had hazardous effects, 52.4%
incinerated pathological waste and 7.3% managed expired drugs together with regular waste. The study recommended that dentists in Kenya enrolled in continuous professional development on waste management (Osamong, Gathece, Kisumbi, & Mutave, 2010).

A study in Amritsar, India, compared the level of awareness of biomedical waste management among dentists and auxiliary dental staff. The results indicated that dentists were more informed when it came to the management of biomedical waste. It concluded that some dentists had no knowledge on some aspects of biomedical waste management. Dental auxiliaries had no knowledge on most aspects of biomedical waste management (Narang, Manchanda, Singh, Verma, & Padda, 2012).

### 2.3 Methods of clinical waste management

A research was done in the Brong-Ahafo Regional capital, Sunyani on Assessing Clinical Solid Waste Management Strategies in the Sunyani Municipality. The management of clinical waste by three health care facilities was investigated. They looked in detail at the various solid waste produced by these facilities and their proportions, the methods used by these health facilities to manage their solid waste and suggested possible reformation to be implemented. Data was obtained from field data, observation and the use of structured interviews. The results showed that diverse types and amount of clinical waste was produced by these facilities. Best practices and standard clinical waste management protocols in transportation, treatment, storage and disposal and the waste were not properly adhered to in two of the three facilities studied. There was no recycling strategy in any of the facilities. The unacceptable level of adherence to clinical waste management guideline was attributed to the indifference of hospital administrators and waste collectors. The research advised that recycling strategies be considered in clinical waste management. It added that staff awareness and training should be regularly organized on the health effects of poor clinical waste management (Isaac et al., 2016).
A cross sectional study was done in India to investigate the Management of Dental Waste in Private Clinics in Chhattisgarh State. The knowledge, attitudes and practices of 100 private practitioners with regards to dental surgery waste management was studied. Attendance to programs on clinical waste management had a significant impact on the level of knowledge of dentists in waste management guidelines; use of colour codes and disposal dental of amalgam. This knowledge had substantial influence on the application of colour coding in waste management. The study concluded that the hazardous effect of improper disposal of dental waste was known to most of the dentists yet most of them did not follow the accepted guidelines. The research recommended that dentists should be trained on the benefits of keeping to the set guidelines on dental waste management. It also mentioned the need to introduce dentists to modern technology in dental waste disposal (Arora, Agrawal, Singh, & Reddy, 2014).

A study was done to evaluate dental waste management in two cities in Palestine. This study involved 37 randomly selected dental clinics, 31 private and the rest public/NGO. It found that all the dentists disposed of used X-ray fixers and developers by pouring them down the drain. Several other studies in developing countries showed a similar trend in disposal of used X-ray fixers (Jumau-as & Kristopher, 2017). Only 13.5% of the dentists used puncture resistant containers for disposal of sharps, all of whom were public/ NGO practitioners, 45.9% of the dentists disposed of needles with regular waste after capping them, 40.5% put the used sharps in plastic bottles and then placed the bottles in the regular waste. Blood soaked dressings were disposed of with the regular waste. As bad as this practice is, the same was reported in almost all the studies on dental waste management that were reviewed (Adil, Ahmed, Awooda, &
Elbeshir, 2014); (Arora et al., 2014). Dental amalgam was also put in the regular waste (Darwish & Al-Khatib, 2006).

2.4 Adherence to clinical waste management guidelines.

A research was done to assess the compliance of the Greater Accra Regional Hospital to the Ministry of Health (MOH) policies and guidelines for management of clinical waste. The study was a descriptive cross sectional study which employed observation of all the departments and wards and their clinical waste management practices recorded. Questionnaires on the MOH clinical waste management guidelines were administered to the staff in charge of management of the hospital’s solid waste. 59% of the respondents were aware of the existence of the MOH guidelines on clinical waste management. 61% of the respondents had been trained on accurate management of clinical waste and the remaining 39% had received no such training. Colour coding of waste was only adhered to on the very important persons (VIP) ward. The people who handled the clinical waste were not in the accepted personal protective equipment. The study reported poor adherence to the clinical waste management guideline. It found that there was however awareness and preparedness to change from the bad practices. Although most of the staff had knowledge on clinical waste management guidelines, adherence was non-existent due to the absence of the requisite materials and equipment for proper clinical waste management. The poor compliance was also attributed to lack of enforcement by hospital authorities. The study recommended continuous education of clinical staff, especially those who were directly involved in handling and segregation of the clinical waste, on clinical waste management. The education was to focus on understanding the relevance of healthy and safe measures when handling clinical waste (Acheampong et al., 2015).

Another study was conducted in the Greater Accra Region by Asante et al. (2014). It involved 120 healthcare facilities. The data was collected using visit to site, interviews and
questionnaires. The data covered aspects of clinical waste management such as clinical waste generation, its separation, collection, storage, transportation and disposal. The research showed that 8221.2 kg of waste was produced per bed in a day. The study concluded that health facilities in the Greater Accra Region of Ghana did not adhere to the laid down policies on clinical waste management Ghana. The study advised that laws on the accepted guidelines of clinical waste management be passed and enforced by the Ministry of Local Government. This it said, would salvage the current state and secure the environment and human health (Asante, Yanful, & Yaokumah, 2014).

A systematic review carried out to assess the knowledge and awareness of staff and students in a dentistry teaching school in India on biomedical waste handling showed inadequate level of knowledge, as well as awareness among the respondents. The study showed substantial differences in how dental surgery staff managed biomedical waste. This study recommended that continuous education, training, and occasional brief courses on acceptable ways of handling biomedical waste be organized for dental surgery staff. This systematic review showed that adhering to the prescribed dental waste management guideline was both a legal requirement and a social role of dental surgery staff. The review also stated that guidelines on biomedical waste management be enforced by authorities in India and all developing nations with the deserved seriousness (Kapoor, Nirola, Kapoor, Gambhir, & Sagar, 2014).

Multiple studies in different countries showed poor adherence to segregation and storage of blood stained gauze, waste amalgam, used X-ray fixer and lead film packets. Although different percentages of adherence to proper management of the listed dental surgery waste was reported by the studies, most of them were less than 50%. Most of these studies also
showed that waste minimization, waste recycling and waste reuse were non-existent in most developing countries (Koolivand et al., 2014; Arora et al., 2014; Osamong et al., 2010).

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presents the methods used for the collection and analysis of data in this study. They include the study design, study area, study population, sampling, data collection technique, data collection tools, variables, ethical consideration and pretesting.
3.2 Study design

A descriptive cross-sectional study was done among dental surgery staff in 4 referral facilities in Accra. Both the exposure and outcome were measured at the same time. Data collection was done over a two week period. Data was collected using self-administered questionnaires and an observation check list. This study was a quantitative study.

3.3 Study area

The study was conducted in four referral health facilities in the Greater Accra Region of Ghana. These are Korle Bu Teaching Hospital, Greater Accra Regional Hospital, 37 Military Hospital and the Ghana Police Hospital. These facilities provide health care services to patients from all over the Greater Accra Region and beyond. These facilities have been described below.

3.3.1 Korle Bu Teaching Hospital

This hospital was set up on the 9th of October, 1923. It is the largest hospital in Ghana and the third largest in Africa. It is the main referral centre in southern Ghana. It gained the status of a teaching hospital in 1962. Korle Bu is affiliated with the University of Ghana Medical and Dental School.

It has a bed capacity of about 2000. On the average about 1,500 patients visit the hospital in a day. The departments available in this hospital include: Medicine, Child Health, Obstetrics and Gynaecology, Dental, Pathology, Laboratories, Radiology, Anaesthesia, Surgery, Polyclinic, Accident Centre and the Surgical/Medical Emergency as well as Pharmacy (Obaka, 2015). KBTH has the largest dental unit in the Greater Accra Region of Ghana. It has a dental school which trains new dentists as well as specialists in the various specialties of dentistry. KBTH has about 38 surgeries.
3.3.2 Greater Accra Regional Hospital

The Greater Accra Regional Hospital also called the Ridge Hospital was established in 1928. It became a regional hospital in 1997. It provided health care to people from all over the Greater Accra Region of Ghana. It has a 420 bed capacity. This Hospital provides the following services: Internal Medicine, Surgery, Paediatrics, Obstetrics and Gynaecology, Dental, Clinical Psychology, Ophthalmology, Neurosurgery, Dermatology, Anaesthesia Clinic, Diabetic Clinic, Urology, Orthopaedics, Spinal Clinic, CT Scan, and Mammography (GNA, 2017). The dental unit has 4 surgeries.

3.3.3 37 Military Hospital

This Hospital was established in 1941 to provide health care for military officers. It was later expanded and made open to the general public. It is staffed by mainly military officers. It has a 400 bed capacity. It has the following departments: Accident & Emergency, Dental Division, Public Health Division, Medical Division, Medical Reception Stations, Obstetrics & Gynaecology, Paediatric Division, Pathology Division, Pharmacy Division, Radio Diagnosis & X-Ray, Surgical Division and Veterinary Division (37 Military Hospital, 2016).

The dental unit has 7 surgeries.

3.3.4 Ghana Police Hospital

This hospital was set up in 1976 to provide health care for the Ghana Police Service and their dependants. It currently serves the general public as well. The Ghana Police Hospital has the following departments: Internal Medicine, Surgery, Paediatrics, Obstetrics and Gynaecology, Dental, Public health, Clinical Psychology, Urology, Orthopaedics, Pathology, Pharmacy X-ray, ultrasound, and Mammography, Laboratory (Ghana police Hospital, 2017).

The dental unit has 2 surgeries.
3.4 Study variables

The dependent variable was:

- Adherence to dental waste management guidelines

The independent variables were:

- CPD programs attended
- Knowledge of dental surgery staff on clinical waste management
- Availability of equipment for clinical waste management
- Socio demographic factors (age, sex, qualification and place of training)

3.4.1 Derive Variables

1. Adherence

A proposed 12 item composite scale called adherence was formed to measure adherence of the dental surgery staff in this study. Instead, an 8 item scale was formed because 4 of the items on the proposed scale were not applicable to all the respondents; one of the 4 facilities did not use amalgam so items on disposal of amalgam were dropped from the scale. Items on management of X-ray waste were also dropped because one of the facilities did not have an X-ray machine. Adherence to each item was assigned a score of 1 and non-adherence given a score of 0 as shown in table 1. The scores were summed up to attain a theoretical adherence scale ranged from 0-8. After data collection, the lowest score was 1 and the highest score 4. Adherence score was categorized as: 0-2= low adherence, 3-5= moderate adherence and 6-8= high adherence. This was used as the operational definition of adherence.
<table>
<thead>
<tr>
<th>Item</th>
<th>Appropriate practice (score 1)</th>
<th>Inappropriate practice (score 0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is your surgery waste segregated into colour coded bins</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>2. How do you dispose of sharps in your surgery</td>
<td>Stored in a puncture proof container</td>
<td>With other clinic waste</td>
</tr>
<tr>
<td>3. How do you dispose of blood soaked gauze in your surgery</td>
<td>Autoclaved before disposal or isolated and incinerated</td>
<td>With other clinic waste</td>
</tr>
<tr>
<td>4. Do you label your clinic waste</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>5. How is your stored dental waste finally transported out of your facility</td>
<td>By approved clinical waste transporters</td>
<td>By regular waste transporters</td>
</tr>
<tr>
<td>6. Do you have the contact of any of the manufacturers of the materials and chemical you use, such that you can send used or expired products back for recycling</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>7. Do you keep records of waste management activities</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
8. Do you give detailed information on your clinical waste to the waste carriers

Yes  No

2. Knowledge

The researcher developed a knowledge scale with six items, each item scored a 1. Theoretically the scale ranged from 0 to 6. A correct answer was given a score of 1 and a wrong answer 0 as shown in table 3.2. The scores for individual respondents were then summed up. After data collection, the scores of the respondents ranged from 0 to 5. Knowledge score was categorized on an ordinal scale as: 0-2= low knowledge, 3-4= moderate knowledge and 5-6= high knowledge.

**Table 3.2: Algorithm used for measuring knowledge of respondents**

<table>
<thead>
<tr>
<th>Item</th>
<th>Correct response (score 1)</th>
<th>Incorrect answer score 0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What colour code should be used for radioactive waste?</td>
<td>Yellow</td>
<td>-Black</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-No idea</td>
</tr>
<tr>
<td>2. Used X-ray fixers have high concentration of......</td>
<td>Silver</td>
<td>-Iron</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-No idea</td>
</tr>
<tr>
<td>3. How should amalgam waste be disposed of?</td>
<td>Returned to manufacturers for recycling</td>
<td>-Buried in a land fill</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Incinerated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-No idea</td>
</tr>
</tbody>
</table>
3. Categorized age

Although age was collected as a continuous variable, it was categorised as 20-29, 30-39, 40-49 and 50-59.

4. Categorized number of years of practice

Just like age, number of years of practice was collected as a continuous variable but was categorized as 0-5, 6-10, 11-15, 16-20, 21-25 and 26 – the maximum.

5. Categorized CPDs attended

Number of CPDs attended was collected as a continuous variable was categorized a 0, 1-5, 6-10 and 11- the maximum.

3.5 Study population

The study population comprised of the dental surgery staff from the selected four referral facilities in Accra. The dental surgery staff consisted of dental surgeons, community oral health officers, registered dental surgery assistants, diploma nurses, and on the job trained personnel.
3.6 Sampling.

3.6.1 Sample Size

The study was a census of all the dental surgery staff in the four referral health facilities in Accra stated earlier. The 37 Military Hospital had about 22 dentists and 20 dental surgery auxiliaries; the Ghana Police Hospital had about 4 dentists and 5 auxiliaries; the Greater Accra Regional Hospital had about 13 dentists and 8 auxiliaries; the Korle Bu teaching Hospital had about 40 dentists and 41 dental surgery auxiliaries. This made a total of 155 dental surgery staff.

3.6.2 Sampling Method

All dental surgeons and dental surgery auxiliaries in the four referral health facilities who consented were recruited for the study.

3.6.3 Inclusion criteria

Dental surgery staff who work in the four referral facilities were included in this study.

3.6.4 Exclusion criteria

Dental surgery staff of the four referral facilities who were on leave were not included in this study.

3.7 Data collection method

The questionnaires were Self- administered by the dental surgery staff at the close of their day and during their lunch break. The questionnaires collected information on socio-demographic characteristics, the dental surgery, knowledge of dental surgery staff and waste management practices in the dental surgery. The questionnaire was designed by the researcher. The design of the questionnaires was guided by existing literature on dental waste management and the
specific objectives of this study. On the average, it took 15 minutes to completer the questionnaire. (See appendix C)

The researcher visited all the 38 surgeries in KBTH, the 7 in 37 Military Hospital, the 4 in the Greater Accra Regional Hospital and the 2 in the Ghana Police Hospital at the close of their clinics to observe how the generated dental surgery waste for the day was managed. The researcher looked out for the presence of colour coded bins and the number of different colours available. The researcher also observed the content of the bins to ascertain if it matched the colour code of the bin. The researcher looked out for whether or not the waste bins were labelled and labels if present contained all the required information. The researcher also checked for the presence of a puncture proof sharps container and finally observed to see if there was an installed amalgam separator. The observation was done with the aid of an observation check list (See appendix D). It took an average of 7 minutes to complete the observation check list.

In of the facilities selected for this study, two dentists were recruited at research assistants to help with data collections in their respective hospitals.

The period for data collection spanned from the first to the last week of June.

3.8 Data collection tool

The data collection tools were a questionnaire and an observation check list.

3.9 Data processing and analysis

Data was entered into Microsoft Excel using a laptop. This was done by the lead investigator. The entered data was reviewed by two other people.
Data was analyzed using STATA version 15. Descriptive statistics was employed to describe the factors that influence adherence to dental waste management by summarizing them into percentages. Median, 25th percentile and 75th percentile were determined for age because age was not normally distributed. Frequencies and percentages were presented with the aid of tables and graphs. Mean adherence score and standard deviation were determined. Chi-square test was used to determine association between the dependent and independent variables. A P-value of less than or equal to 0.05 was considered statistically significant. There was no significant variation in the outcome variable. This did not allow for a significant grouping that would allow for any meaningful chi square and logistic regressions analysis as was stated in the proposal.

3.10 Quality Assurance

Research assistants were trained to aid in data collection. Pretesting of questionnaire and observation check list were done to assess the clarity of the questions. This was done in a dental facility that was not included in the final research. Returned questionnaires were scrutinized for mistakes and completeness. Questionnaires with unclear responses or a lot of missing information were not included in the analysis. Entered data were cross checked to reduce entry errors and to make the data, more reliable.

Training of research assistants: Three house officers were recruited from each of the selected facilities as research assistants to help collect the data in their respective facilities. They were trained for a day on the questionnaire and observation check list. They were also taught how to obtain consent, as well as how to handle the information collected. The researcher supervised and reviewed their work. A total of eight research assistants were involved.

3.11 Ethical considerations

A detailed proposal of the study was submitted to the University of Ghana, specifically, the School of Public Health for review. An oral presentation and defense of the proposal was done.
The necessary corrections were made and the protocol submitted to the Ghana Health Service Ethics Review Committee for review. The proposal was also submitted to the 37 Military Hospital Institutional Review Board, Korle Bu Teaching Hospital Scientific and Technical Committee and Korle Bu Teaching Hospital Institutional Review Board review. The corrections to comments from the review boards were incorporated and approval received from all the review boards. The reference numbers for the various ethical approval documents are GHS- ERC: 133/12/17, 37MH-IRB IPN 211/2018, KBTH-STC 00045/2018 and KBTH-IRB 00045/2018 respectively for the earlier mentioned review boards.

A letter was also sent to the Regional health directorate asking for permission to carry out the research. Approval was also sought from every dental facility whose staff were included in the study.

3.11 Participant’s consent

Informed consent was sought from study participants. The aim of the research was first explained clearly to them and then consent sought. (See appendix A and B)

3.11.2 Voluntary consent

Participants were told they could opt out from the research whenever they wanted to and that, there were be no penalties for voluntary withdrawal. (See appendix A and B)

3.11.3 Privacy and confidentiality

Participant privacy and confidentiality was assured. The collected data will be destroyed after a period of at most 5 years. (See appendix A and B)

3.11.4 Compensation

There was no financial or material incentives for the study participants.
3.11.5 Potential risks/ benefits

There was no harm in this study. The findings will be used to help protect clinic staff, their patients and the environment. (See appendix A and B)

3.11.6 Conflict of interest

I hereby declare that there was no conflict of interest. This research was only on account of academic and public health relevance.

3.12 Pretesting

The data collection tools were first pretested among dental surgery staff in Achimota Hospital Dental unit and the necessary modifications made.

CHAPTER FOUR

RESULTS

This current study assessed adherence to dental waste management guidelines by dental surgery staff in 4 referral facilities in Accra. In all 124 dental surgery staff completed the questionnaire. A total of 51 surgeries (the room in which dentists work) were observed using an observation check list.

4.1 Socio-demographic features of participants

A greater fraction of the respondents 79 (63.7%) were females. Their median age was 29 years, with a 25th percentile of 27 and 75 percentile of 35. Majority of the respondents 63 (50.8%)
were within the age range of 20-29 years. Most of the participants 69 (55.7%) had a qualification of Bachelor of Dental Surgery and above. Of the 124 respondents, 114 (91.9%) trained in Ghana and the rest outside Ghana.

This study showed that most of the dental surgery staff had practiced for 0-5 years. The minimum number of years of practice was 1 year and maximum was 37 years. The median number of years of practice was 3 years, with a 25\textsuperscript{th} percentile of 1 year and 75\textsuperscript{th} percentile of 8.5 years. Details of the socio-demographic features of the respondents is shown in table 3.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Frequency (n=124)</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex of respondent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>45</td>
<td>36.29</td>
</tr>
<tr>
<td>female</td>
<td>79</td>
<td>63.71</td>
</tr>
<tr>
<td>Age of Respondent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-29</td>
<td>63</td>
<td>50.81</td>
</tr>
<tr>
<td>30-39</td>
<td>40</td>
<td>32.26</td>
</tr>
<tr>
<td>40-49</td>
<td>13</td>
<td>10.48</td>
</tr>
<tr>
<td>50-59</td>
<td>8</td>
<td>6.45</td>
</tr>
<tr>
<td>Qualification of Respondent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BDS and above</td>
<td>69</td>
<td>55.65</td>
</tr>
<tr>
<td>COHO</td>
<td>5</td>
<td>4.03</td>
</tr>
<tr>
<td>RDSA</td>
<td>35</td>
<td>28.23</td>
</tr>
<tr>
<td>Diploma in nursing</td>
<td>5</td>
<td>4.03</td>
</tr>
<tr>
<td>Trained on the job</td>
<td>10</td>
<td>8.06</td>
</tr>
</tbody>
</table>
4.2 Surgery characteristics

4.2.1 Type of X-ray used by respondents

An investigation to find out the type of X-ray machine used by the dental surgery staff showed most of them 67 (54.0) used both a conventional and a digital X-ray machine as shown in table 4.

Table 3.2 type of X-ray machine used by respondents

<table>
<thead>
<tr>
<th>Type of X-ray machine used</th>
<th>Frequency (n=124)</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional X-ray machine only</td>
<td>49</td>
<td>39.52</td>
</tr>
<tr>
<td>Both conventional X-ray machine and digital X-ray machine</td>
<td>67</td>
<td>54.03</td>
</tr>
<tr>
<td>No X-ray machine</td>
<td>8</td>
<td>6.45</td>
</tr>
</tbody>
</table>
4.2.2 Frequency of amalgam use by respondents

From this study, a large proportion of the dental surgery staff, 51 (41.1%) had not used dental amalgam for a period of about one month. The highest frequency of amalgam use in a month was 19 times and this was the case for 3 of the respondents. Details are shown in figure 4.1.
Figure 4.1: Frequency of amalgam use by respondents
4.2.3 Use of dental chair with an installed amalgam separator

Of the 124 participants, none of them used a dental chair that had an installed amalgam separator.

4.3 Education and training in dental waste management guidelines

4.3.1 Training in dental waste management in school

As shown in table 4.3, a little over half of the respondents, 70 (56.5%) indicated that they received training on dental waste management when they were in school.

<table>
<thead>
<tr>
<th>Training in dental waste management in school</th>
<th>Frequency (n= 124)</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>70</td>
<td>56.45</td>
</tr>
<tr>
<td>No</td>
<td>54</td>
<td>43.55</td>
</tr>
</tbody>
</table>

4.3.2 Continuous Professional Development programmes attended in the last 12 months

Of the 124 respondents, 37 (29.8%) had not attended any CPD programme in the last 12 months. More than half of the respondents, 71 (57.3%) had attended 1-5 CPD programmes. The details are shown table 4.4.

<table>
<thead>
<tr>
<th>Number of CPDs attended by respondent</th>
<th>Frequency (n= 124)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>37</td>
<td>29.84</td>
</tr>
<tr>
<td>1-5</td>
<td>71</td>
<td>57.26</td>
</tr>
<tr>
<td>6-10</td>
<td>13</td>
<td>10.48</td>
</tr>
<tr>
<td>11-22</td>
<td>3</td>
<td>2.42</td>
</tr>
</tbody>
</table>
4.3.3 CPD attended by role of respondents

It was found that, 12 (17%) of the dentists involved in this study had not attended any CPD programme in the last 12 months. On the other hand, 25 (45%) of the assistants had not attended any CPD in the past 12 months. This was significant (P= 0.001). The results are shown in table 4.5.

<table>
<thead>
<tr>
<th>Role of respondent in surgery</th>
<th>Number of CPDs attended in last 12 months n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dentist</td>
<td>12 (17.39) 43 (62.32) 13 (18.84) 1 (1.45)</td>
</tr>
<tr>
<td>Assistant</td>
<td>25 (45.45) 28 (50.91) 0 (0.00) 2 (2.42)</td>
</tr>
<tr>
<td>Person chi² (3) = 19.74</td>
<td>P value = 0.001</td>
</tr>
</tbody>
</table>

4.3.4 Continuous Professional Development programmes on clinical waste management attended in the last 12 months

A search to know the number of CPDs on clinical waste management in the last 12 months showed that, 109 (87.9%) of the respondents had not attended any CPD programme on clinical waste management. Details are shown in table 4.6.

<table>
<thead>
<tr>
<th>Number of CPDs on clinical waste management attended</th>
<th>Frequency (n= 124)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>109</td>
<td>87.90</td>
</tr>
<tr>
<td>1</td>
<td>13</td>
<td>10.48</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>0.81</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>0.81</td>
</tr>
</tbody>
</table>
4.3.5 Reading of MOH Policy on Clinical Waste Management

Of the 124 dental surgery staff recruited for this study, less than 10% of them 11 (8.9%) had read the MOH policy on Clinical Waste Management as shown in table 4.7.

<table>
<thead>
<tr>
<th>Has respondent read MOH policy on clinical waste management</th>
<th>Frequency (n= 124)</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>11</td>
<td>8.87</td>
</tr>
<tr>
<td>No</td>
<td>113</td>
<td>91.13</td>
</tr>
</tbody>
</table>

4.4. Knowledge of dental surgery staff on dental waste management guidelines

To assess the knowledge of the respondents on dental waste management guidelines, questions were asked on colour coding of clinic waste, main content of used X-ray fixers, appropriate disposal of amalgam waste, disposal of blood soaked gauze and disposal of developed X-ray films. With each of these questions, less than 35% of the respondents got the right answer. However about 95% of them knew how to dispose of used sharps. Details are shown in table 10.
### Table 4.8: Knowledge of dental surgery staff on dental waste management guidelines

<table>
<thead>
<tr>
<th>Question on knowledge of respondents</th>
<th>Frequency n=124</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What colour code should be used for radioactive waste?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Yellow</em></td>
<td>29</td>
<td>23.39</td>
</tr>
<tr>
<td>Black</td>
<td>21</td>
<td>16.94</td>
</tr>
<tr>
<td>None of the above</td>
<td>21</td>
<td>16.94</td>
</tr>
<tr>
<td>No idea</td>
<td>53</td>
<td>42.74</td>
</tr>
</tbody>
</table>

| **Used X-ray fixers have high concentration of……** | | |
| *Silver* | 41 | 33.06 |
| Iron | 6 | 4.84 |
| None of the above | 8 | 6.45 |
| No idea | 69 | 55.65 |

| **How should amalgam waste be disposed of?** | | |
| *None of the above* | 24 | 19.35 |
| Buried in a land fill | 22 | 17.74 |
| Incinerated | 27 | 21.77 |
| No idea | 51 | 41.13 |

| **How should blood soaked gauze be disposed of** | | |
| *Autoclaved before disposal* | 9 | 7.26 |
| Together with regular waste | 29 | 23.39 |
| None of the above | 72 | 58.06 |
| No idea | 14 | 11.29 |

| **How should sharps be disposed of** | | |
| *Separated in a puncture proof container* | 118 | 95.16 |
| Separated in a puncture proof container | 4 | 3.23 |
| No idea | 2 | 1.61 |

| **Developed X-ray films can be discarded with regular waste** | | |
| *Yes* | 42 | 33.87 |
| No | 62 | 50 |
| No Idea | 20 | 16 |

*correct answer
4.4.1 Knowledge score of respondents

When the knowledge of the individual respondents was summed up, 3 of the respondents scored 0 and 1 respondent had the highest score of 5. Most of the respondents 41 (33.1%) scored 2 as shown in figure 4.2.

![Knowledge score of respondents](image)

Figure 4.2 Knowledge score of respondents

4.4.2 Categorized knowledge score of respondents

Knowledge score was categorized as: 0-2= low knowledge, 3-4= moderate knowledge and 5-6= high knowledge. As shown in table 4.9, it was found that most of the dental surgery staff 80 (64.5%) had low level of knowledge on dental waste management guidelines.
Table 4.9: categorized knowledge score of respondents

<table>
<thead>
<tr>
<th>Level of Knowledge of respondent</th>
<th>Frequency (n=124)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low knowledge</td>
<td>80</td>
<td>64.52</td>
</tr>
<tr>
<td>Moderate knowledge</td>
<td>43</td>
<td>34.68</td>
</tr>
<tr>
<td>High knowledge</td>
<td>1</td>
<td>0.81</td>
</tr>
</tbody>
</table>

4.5 Dental waste management practices of respondents

When respondents were asked about their dental waste management practices, it was found that, of the 124 respondents, none of them segregates their clinic waste in colour coded bins. All the respondents who use dental amalgam 102 (82.3%) store amalgam waste under water in a closed container temporarily. Also, all the respondents store their sharp waste in puncture proof containers. Blood soaked gauze is disposed with other clinic waste by all the dental surgery staff recruited for this study. Almost all the respondents 122 (98.4%) do not label their clinical waste. More than half of the participants 78 (62.9%) dispose of used X-ray fixers by pouring them down the drain. According to 76 (61.3%) of the respondents, regular waste transporters are responsible for the final transportation of dental surgery waste out of their facilities. Almost all the respondents 121 (97.6%) do not have the contact of any of the manufacturers of the materials and chemical they use, such that they can send used or expired products back for recycling. Almost half of the respondents 59 (47.6%) do not know how temporary storage of amalgam is finally disposed of.

None of the users of conventional X-ray machines returns lead foil packets of developed X-rays to manufacturers for recycling. None of the 124 respondents keeps records of clinical waste activities. Almost all the respondents 117 (94.4%) do not give detailed information on their clinical waste to waste carriers. Facility Administrators of most of the respondents 91(73.4%) never visit the surgery to monitor how generated waste is managed. Details are shown in table 4.10.
<table>
<thead>
<tr>
<th>Question on practices of respondents</th>
<th>Frequency (n= 124)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is your surgery waste segregated into colour coded bins</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>124</td>
<td>100.00</td>
</tr>
<tr>
<td>Yes</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>How do you store waste amalgam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stored under water in a closed container</td>
<td>102</td>
<td>82.26</td>
</tr>
<tr>
<td>Not applicable</td>
<td>22</td>
<td>17.74</td>
</tr>
<tr>
<td>How do you dispose of sharps in your surgery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stored in a puncture proof container</td>
<td>124</td>
<td>100.00</td>
</tr>
<tr>
<td>How do you dispose of blood soaked gauze in your surgery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disposed with other clinic waste</td>
<td>124</td>
<td>100.00</td>
</tr>
<tr>
<td>Do you label your clinic waste</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>122</td>
<td>98.39</td>
</tr>
<tr>
<td>Yes</td>
<td>2</td>
<td>1.61</td>
</tr>
<tr>
<td>How do you disposed of used X-ray fixers in your surgery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pour down the drain</td>
<td>78</td>
<td>62.90</td>
</tr>
<tr>
<td>No idea</td>
<td>38</td>
<td>30.65</td>
</tr>
<tr>
<td>Not applicable</td>
<td>8</td>
<td>6.45</td>
</tr>
<tr>
<td>How is your stored dental waste finally transported out of your facility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>By regular waste transporter</td>
<td>76</td>
<td>61.29</td>
</tr>
<tr>
<td>By approved clinical waste transporters</td>
<td>6</td>
<td>4.84</td>
</tr>
<tr>
<td>I have no idea</td>
<td>42</td>
<td>33.87</td>
</tr>
<tr>
<td>Do you have the contact of any of the manufacturers of the materials and chemical you use, such that you can send used or expired products back for recycling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>121</td>
<td>97.58</td>
</tr>
<tr>
<td>Yes</td>
<td>3</td>
<td>2.42</td>
</tr>
<tr>
<td>When temporary storage of amalgam is full, how do you dispose of it</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disposed with other clinical waste</td>
<td>43</td>
<td>34.68</td>
</tr>
<tr>
<td>No idea</td>
<td>59</td>
<td>47.58</td>
</tr>
<tr>
<td>Not applicable</td>
<td>22</td>
<td>17.74</td>
</tr>
</tbody>
</table>
Do you return lead foil packets of developed X-ray films to manufacturers

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>116</td>
<td>93.55</td>
</tr>
<tr>
<td>Not applicable</td>
<td>8</td>
<td>6.45</td>
</tr>
<tr>
<td>Yes</td>
<td>0</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Do you keep records of waste management activities

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>124</td>
<td>100.00</td>
</tr>
<tr>
<td>Yes</td>
<td>0</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Do you give detailed information on your clinical waste to the waste carriers

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>117</td>
<td>94.35</td>
</tr>
<tr>
<td>Yes</td>
<td>7</td>
<td>5.65</td>
</tr>
</tbody>
</table>

Does any of the facility administrators ever visit the surgery to monitor how the generated waste is managed

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>91</td>
<td>73.39</td>
</tr>
<tr>
<td>Yes</td>
<td>33</td>
<td>26.61</td>
</tr>
</tbody>
</table>

4.5.1 Adherence score of respondents

A composite scale for adherence was formed by combining 8 of the questions on adherence. With a possible minimum score of 0 and a maximum score of 8, it was found that most of the participants 110 (88.71%) scored 1 out of 8. The highest score of 4 was scored by only 1 respondent. Details are shown in table 4.11. The mean adherence score was 1.13 with a standard deviation of 0.4

Table 4.11: Adherence score of respondents

<table>
<thead>
<tr>
<th>Adherence score of respondent</th>
<th>Frequency (n=124)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>110</td>
<td>88.71</td>
</tr>
<tr>
<td>2</td>
<td>13</td>
<td>10.48</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>0.81</td>
</tr>
</tbody>
</table>
4.5.2 Categorized adherence score of respondents

Adherence score was categorized as: 0-2 = low Adherence, 3-5 = moderate adherence and 6-8 = high adherence. It was found that almost all the dental surgery staff, 123 (99.2%) had low level of adherence to dental waste management guidelines as shown in table 4.12.

<table>
<thead>
<tr>
<th>Level of Adherence of respondent</th>
<th>Frequency (n=124)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Adherence</td>
<td>123</td>
<td>99.19</td>
</tr>
<tr>
<td>Moderate Adherence</td>
<td>1</td>
<td>0.81</td>
</tr>
<tr>
<td>High Adherence</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

4.6 Observation check list

This study was carried out in four different referral facilities with a total of 51 dental surgeries. The largest facility contributed 38 (74.0%) of the 51 observed surgeries. The smallest number of surgeries from a facility was 2 which formed 3.9% of the total number of observed surgeries. Details are shown in table 4.13.

<table>
<thead>
<tr>
<th>Facility ID</th>
<th>Number of surgeries (n=51)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3.92</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>7.84</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>13.73</td>
</tr>
<tr>
<td>4</td>
<td>38</td>
<td>74.51</td>
</tr>
</tbody>
</table>

Observation of the 51 surgeries in the 4 referral facilities showed that all these surgeries stored their generated waste in colour coded bins. None of the observed surgeries had more than one colour code available. The colour code available in most of the surgeries 47, (92.2%) was black.

It was also found that the content of the bins did not match the colour code of the bins. All the observed bins contained a mixture of domestic and infectious waste. None of the observed bins was labelled. All the observed surgeries had a puncture resistant sharps container most of which
49 (96.1%) were labelled. Only 11 (21.6%) of the sharps containers had labels with all the required information.

None of the 51 surgeries had an installed amalgam separator. Details are shown in table 4.14.

**Table 4.14: Observation findings**

<table>
<thead>
<tr>
<th>Observation</th>
<th>Findings</th>
<th>Frequency (n=51)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is waste stored in colour coded bins</td>
<td>Yes</td>
<td>51</td>
<td>100.00</td>
</tr>
<tr>
<td>How many different colour codes are present</td>
<td>1</td>
<td>51</td>
<td>100.00</td>
</tr>
<tr>
<td>What colour code(s) are available</td>
<td>Black</td>
<td>47</td>
<td>92.16</td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td>4</td>
<td>7.84</td>
</tr>
<tr>
<td>Do the contents of the bins match the colour code</td>
<td>No</td>
<td>51</td>
<td>100.00</td>
</tr>
<tr>
<td>Content of bins</td>
<td>Mixture of domestic and infectious waste</td>
<td>51</td>
<td>100.00</td>
</tr>
<tr>
<td></td>
<td>Infectious waste only</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Domestic waste only</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Are bins labelled</td>
<td>No</td>
<td>51</td>
<td>100.00</td>
</tr>
<tr>
<td>Is a puncture resistant sharps container present</td>
<td>Yes</td>
<td>51</td>
<td>100.00</td>
</tr>
<tr>
<td>Is puncture resistant sharps container labelled</td>
<td>No</td>
<td>2</td>
<td>3.92</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>49</td>
<td>96.08</td>
</tr>
<tr>
<td>Does label contain all the required information</td>
<td>No</td>
<td>38</td>
<td>74.51</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>11</td>
<td>21.57</td>
</tr>
<tr>
<td></td>
<td>Not applicable</td>
<td>2</td>
<td>3.92</td>
</tr>
<tr>
<td>Is there an installed amalgam separator?</td>
<td>No</td>
<td>51</td>
<td>100.00</td>
</tr>
</tbody>
</table>
CHAPTER FIVE

DISCUSSION OF FINDINGS

5.0 Introduction

This chapter discloses adherence to dental waste management guidelines by dental surgery staff in four referral facilities in Accra. It explored the level of knowledge of the respondents on dental waste management guidelines and also described how dental surgery staff manage their generated waste.

5.1 Socio-demographic characteristics of respondents

Most of the respondents in this study (63.7%) were females and the rest males. Of all the literature reviewed, only one study, a study in the Philippines, showed a similar trend in the sex of the respondents (Jumau-as & Kristopher, 2017). All the other studies reviewed reported more male than female dental surgery staff (Singh, Jurel, Tripathi, Agrawal, & Kumari, 2014; Arora et al., 2014; Agrawal, Chand, Kumari, & Singh, 2015). The age of the respondents was not normally distributed. The youngest staff was 23 years old and oldest 59 years old, both of whom were assistants. The median age was 29. Over 80% of the respondents were less than 40 years, indicating a young population of dental surgery staff in the referral facilities that were studied. This age distribution is comparable with what was observed in a similar study in Nairobi, Kenya (Osamong et al., 2010).

More than half of the dental surgery staff studied were dentists and the rest auxiliaries. This finding is similar to a study on dental waste management in India where 76% of the respondents were dentists and the rest auxiliaries (Arora et al., 2014). The auxiliaries comprised of registered dental surgery assistants, community oral health officers, diploma in nurses and on the job trained staff.
This current study showed that over 90% of the dental surgery staff in the selected facilities were trained in Ghana, about 2% were trained in an African country other than Ghana and the remaining about 6% obtained their training from outside Africa. This could be explained by the presence of multiple institutions for training dental surgery staff and other health workers in Ghana.

A little over half of the respondents have been working as dental surgery staff for less than six years. The longest serving group were those who had practiced for between twenty six and thirty seven years. This group only formed about 3% of the 124 respondents that were involved in the study.

5.2 Surgery characteristics

5.2.1 Type of X-ray machine used by respondents

A key investigative tool in the practice of dentistry is radiography. X-rays are not only used to make or confirm diagnosis in dentistry but also used in the course of most dental treatments to guide the procedures. They are also used to monitor the outcome and prognosis of most dental procedures. There are currently two types of X-ray machines in use by dental surgery staff. These are the older conventional X-ray machine which requires the use of an X-ray film which is processed in a fixer and a developer to show the image, and the more modern digital X-ray machine which displays the image on a computer monitor after the X- has been taken. This study showed that with the exception of about 6% of the respondents who did not have an X-ray machine in their facility, the remaining 94% used conventional X-ray machines. About 54% of the respondents also used a digital X-ray machine in addition to the conventional one. Due to the challenges associated with the management of the waste produced from the use of the conventional X-ray machines (lead foil packets, used fixer solutions, waste undeveloped
X-ray films), its use is discouraged. Instead, dental surgery staff are encouraged to use the digital X-ray machine (Naik et al., 2014). The reason for the high patronage of the conventional X-ray machine over the digital type notwithstanding the hazardous waste associated with its use could be due to the fact that the digital X-ray machine is more expensive.

A review of literature shows that dental surgery staff in most developing countries also resort to the use of conventional X-ray machine (Arora et al., 2014; Jumau-as & Kristopher, 2017; Zazouli & Ehsan, 2014; Agrawal et al., 2015).

5.2.2 Frequency of amalgam by respondents

Dental amalgam is one of the oldest filling materials used in dentistry. It’s been in use for over 165 years now. Even though it not as aesthetic as more recent filling material, it remains one of the most widely used materials and the material of choice for restoring posterior teeth. Notwithstanding the fact that amalgam was not expected to be in use by the 20th century, it is still in frequent use (Bharti, Wadhwani, Tikku, & Chandra, 2010). The findings of this current study did not deviate from Bharti’s findings. More than half of the respondents had used dental amalgam at least once in the past month. About 15% used amalgam three times in a month. About 4% used amalgam ten time in a month. Fifty one of the respondents never used amalgam in the past month, of this number, 22 of them worked in a facility that did not use amalgam at all. The remaining 29 could be dental surgery staff who had specialized in or doing rotations that do not use amalgam at all. A similar trend in amalgam use by dental surgery staff was reported in a study on knowledge as well as practices on hazardous waste handling among dental surgery staff in India. That study showed that only 12% of the respondents did not use amalgam at all, which is lower than the 41% reported in this current study (Agrawal et al., 2015).
5.2.3 Use of dental chair with an installed amalgam separator

Amalgam separators play an important role of ensuring that no waste amalgam escapes into the drainage and ultimately into the environment. Guidelines on amalgam waste management requires that an amalgam separator be installed in every dental unit where amalgam is used (Naik et al., 2014; DeSnyder et al., 1999; Agarwal, Singh, Bhansali, & Agarwal, 2012).

This study found that although amalgam is used by about 59% of the dental surgery staff, none of them uses a dental chair with an installed amalgam separator. None of the reviewed documents from developing countries made mention of amalgam separators. In contrast, the documents from developed countries stressed on the need to enforce the installation of amalgam separators in dental surgeries that used amalgam (Naik et al., 2014; DeSnyder et al., 1999; Agarwal et al., 2012).

5.3 Education and training on dental waste management guidelines

5.3.1 Training in dental waste management in school

This study inquired if respondents received some amount of training on dental waste management while in school. It is expected that institutions that train dental surgery staff offer training in dental waste management that meets international standards. The results indicated that a little over half of the respondents got some training on dental waste management in school, while the rest did not.

5.3.2 Continuous Professional Development programmes attended in the last 12 months

Attending continuous professional development programmes frequently keeps dental surgery staff up to date on current standards of offering oral health care. To continuously provide safe and quality oral health that meets global standards, it is recommended that dental surgery staff frequent CPD programmes for their personal upgrade. This study showed that about 70% of
the respondents had attended at least one CPD programme in the last 12 months with the rest attending none. The showed that dentists attended CPD programmes more frequently than the assistants (Pearson’s chi-square (3) = 19.74, P value = 0.001).

When the study probed to find out how many of the respondents had attended CPD programmes on clinical waste management it was found that 88% of the respondents had not been at a CPD on clinical waste management. Only 12% had attended a CPD programmes on clinical waste management. An Indian study reported that 47% of the dental surgery staff studied had been to a CPD programme on dental waste management (Arora et al., 2014). A similar study in the Philippines indicated that 94% of the respondents had received training on how to manage clinic waste (Jumau-as & Kristopher, 2017). The low proportion recorded in this study could be due to low interest of the respondents in CPDs on clinical waste management or limited number of organized CPD programmes on clinical waste management in Accra.

5.3.3 Reading of MOH Policy on Clinical Waste Management

This study investigated the proportion of the respondents who had read the MOH Policy on Clinical Waste Management. It was found that, of the 124 respondents, only 9% had read the policy document. A study done on dental waste management in India showed that 47% of the respondents were aware of the existence of dental waste management guidelines (Arora et al., 2014). A similar study in the Philippines stated that 100% of the respondents knew about the existence of a policy on dental waste guidelines (Jumau-as & Kristopher, 2017). A study in Kenya reported that about 48% of the respondents knew that guidelines on dental waste management existed (Osamong et al., 2010). The low proportion reported in this study compared with the others stated could be explained by the fact that this current study reports the percentage that had read the policy while the other studies reports the percentage that knew such a document existed. It is likely that, a higher percentage of the respondents in this study
simply knew that the policy existed even though they had not read it. It is equally possible that some of the respondents in the other studies mentioned, only knew the guidelines existed but had not read them.

5.4 Knowledge of dental surgery staff on dental waste management guidelines

Unlike the other studies that recorded self-reported knowledge, this current study assessed knowledge of respondents based on the responses the participants gave to questions on the areas investigated. This gave a more objective assessment of the knowledge of respondents.

This study found that only 23% of the respondents had the right knowledge on colour coding of clinic waste. Studies in India and the Philippines reported 48% and 4% respectively as the proportion of respondents with knowledge on colour coding of clinic waste (Arora et al., 2014; Jumau-as & Kristopher, 2017). This shows that dental surgery staff recruited for all these studies had low knowledge on colour coding of clinic waste.

Less than half of the respondents in this study were aware of the high concentration of silver, a heavy metal, in used X-ray fixer solutions. About 80% of the respondents in this study did not know the right way to dispose of waste amalgam although about 59% of the respondents in this study used amalgam.

Only 7% of the respondents in this study knew the recommended way to dispose of blood soaked gauze even though all dental surgery stall produce this infectious waste very frequently. In contrast with the poor knowledge in the right disposal of blood soaked gauze, almost all the respondents knew the right way to dispose of sharps in the clinic.

Developed X-ray films unlike the undeveloped ones are non-hazardous and can be disposed with domestic waste (Naik et al., 2014). Only 34% of the respondents had this knowledge.
A high proportion of respondents had knowledge on the right way to manage sharps but not on how to manage the other items mentioned in this study. This could be due to the fact that of the items respondents were examined on, they only adhered to sharps management guidelines in their various clinics.

When knowledge score of the respondents was categorized into low, moderate and high, only 1 respondent fell in the high knowledge category. Most of the respondents 65% were in the low knowledge category. The rest of the respondents were in the moderate knowledge group. This distribution in level of knowledge among the respondents could be attributed the fact that less than 10% of the respondents had read the MOH Policy on Clinical Waste Management and the fact that the right practices were not carried out in their clinics.

5.5 Dental waste management practices of respondents

5.5.1 Practice on waste segregation into colour coded bins

The MOH policy on clinical waste management states that, diverse waste categories need diverse ways of handling, diverse methods of treatment, as well as diverse disposal methods. It is therefore very vital that clinical waste is separated into the different categories to ensure the safety of clinic staff and waste handlers. Segregation of clinic waste also facilitate the correct management of the generated waste. Clinical waste segregation also reduces the cost of its disposal due to the variation in the cost of managing different waste categories. Putting all the clinic waste together renders everything infectious and hence a higher cost of appropriate disposal. The policy also states that segregation of waste must take place at the source of waste generation. It states clearly that waste segregation is the responsibility of one who produces the waste. Segregated waste according to the policy, must be kept in the correct colour coded bin as detailed in the literature review section of this work. The policy also requires that an
instruction poster on the procedure involved in waste separation be pasted at every area of waste segregation in addition to other relevant points (Ministry of Health, 2006).

This current study showed that none of the respondents (100%) segregated their dental surgery waste into different colour coded bins. In addition all the respondents (100%) stated that they disposed of blood soaked gauze with other clinical waste. The observation revealed that even though the bins in respondents’ clinics were colour coded, only a single colour code was present in each facility. Of the 51 dental surgeries (room where dentists work) observed 47 (92%) of them had only black colour coded bins. This was in 3 of the 4 referral facilities selected for this study. The fourth facility had 4 dental surgeries which had only yellow coded bins. That is, the dental units of all the 4 referral facilities studied did not practice waste segregation. An Indian study that involved 50 facilities reported that only 4 of them practiced waste segregation (Jumau-as & Kristopher, 2017).

The observation of the content of the bins showed a mixture of domestic and infectious waste in all the 51 dental surgeries observed. The content of the bins included used face masks, food scraps, cotton rolls, used blood stained latex gloves and blood stained gauze. Some of the bins in addition contained excess dental filling materials while others also contained extracted teeth.

The reason for none of the respondents adhering to the segregation of clinical waste into colour coded bins could not be completely attributed to the low level of knowledge on colour coding of waste because even those that demonstrated knowledge on colour coding of clinic waste did not adhere to this guideline. The non-adherence of the respondents to waste separation into colour coded bins could be due to a non-existent enabling environment to comply with this requirement. This was made evident by the observation findings which showed that only one colour code was present in the dental surgeries of the all 4 facilities studied, making it practically impossible for the respondents to segregate waste into different colour codes.
5.5.2 Practices on labelling of clinical waste

Almost all the respondents (98%) admitted to not labelling their clinic waste. The observation showed that all the respondents (100%) put the waste they generated in unlabeled bins. Almost all the sharps containers 96% in the observed dental surgeries were however labelled. Thirty-eight (74%) of the sharps containers although labelled, their labels did not contain all the recommended information a label should have. Only 4% of the sharps containers were not labelled at all. These were white bottles with a large body and narrow openings. All they had written on them was sharps. They did not have the biohazard symbol. The well labelled sharps containers were special preformed boxes manufactured mainly for storage of sharp clinical waste. These boxes contained the required information, which included the biohazard symbol. The MOH policy on clinic waste management requires that all clinical waste be labelled to show where it is coming from and what it contains (Ministry of Health, 2006).

5.5.3 Practices on management of amalgam waste

When the practice of temporary storage of amalgam was probed, this study found that all the respondents from the facilities that used amalgam 82% stated that waste amalgam was stored under water in a closed container. This is an improvised way of going about the ideal, the use of a mercontainer (a mercury waste container with an agent for mercury vapour suppression) (Naik et al., 2014; Agarwal et al., 2012). This shows that dental surgery staff in the 4 referral facilities studied do their best within the means of their available resources to avoid improper disposal of amalgam waste.

Respondents were then asked how they managed temporary storage of amalgam waste when it was full. Forty-three of the respondents (35%) indicated that it was disposed of together with other clinic waste. Fifty nine (48%) said that they had no idea of how this waste was managed. The remaining respondents worked in the facility that did not use amalgam at all.
The MOH Policy on Clinical waste management makes it clear that the producer of the waste must know how his or her generated waste is stored, transported and finally disposed of. It is therefore wrong for respondents to have no idea of how their generated waste was managed (Ministry of Health, 2006). When temporary amalgam storage materials are full, a registered amalgam waste transporters should be called to send the waste amalgam for recycling or disposal.

Waste amalgam should not be put in the garbage, washed into the drain or put in the container for sharps (Naik et al., 2014). A study in India reported that 79% of the respondents disposed of their generated amalgam waste together with general waste, while 13% of them disposed of this waste in other inappropriate ways (Arora et al., 2014). In a facility based study in Iran, it was found that 92% of the facilities disposed of amalgam waste into toilets as well as the sewer system (Zazouli & Ehsan, 2014). A study done in Palestine found that over 80% of generated amalgam waste was disposed of into either the clinic garbage or drain (Darwish & Al-Khatib, 2006).

The poor management practices found in all these studies could be due to poor enforcement of existing policies or guideline on clinical waste management. It could also stem from a lack of an enabling environment that support proper clinical waste management.

Moreover, this study found that almost all the respondents 98% did not have the contact of any of the manufacturers of the materials and chemical they used so that they could send waste or expired materials that need to be recycled back to these manufacturers.

5.5.4 Practices on management of used X-ray fixers

When respondents were asked about how they handled used X-ray fixers, 63% stated that it was poured down the clinic’s drains. Thirty-eight (31%) had no idea and the rest worked in a facility that did not have an X-ray machine. The guideline on management of X-ray fixers
makes it clear that used X-ray fixers contain high levels of silver which is hazardous to the environment (Naik et al., 2014). When in small quantities, used fixers can be managed by the use of chemical recovery cartridges to separate out the silver (Naik et al., 2014). The fixer with its silver removed can then be mixed with the developer and washed down the drain with a lot of water. Used fixers can also be returned to manufacturers via an accredited waste transporter for recycling or disposal (Naik et al., 2014). A study in India showed that only 9% of the respondents disposed of used X-ray fixers the recommended way (Arora et al., 2014). The poor adherence to this guideline could be the same as the reason stated for the non-adherence to the guidelines on amalgam management above.

5.5.5 Practices on disposal of lead foil packets

Lead foil packets are the waste products left behind after conventional X-rays are taken. This study found that they were disposed with the rest of the clinical waste in all the facilities that provided X-ray services. The lead can easily leach into the soil and ground if disposed into landfills causing environmental pollution. Lead foil packets according to the guidelines on dental waste management should never be added to regular waste. Lead waste should be returned to manufacturers for recycling or disposal (Naik et al., 2014). Intake of high levels of lead can predispose one to reproductive defects, nerve defects, cancers, hypertension, impairment in kidney function and immunological impairments (Agarwal et al., 2012). A study in Iran showed that 78% of the facilities studied disposed of lead foil packets with general waste (Zazouli & Ehsan, 2014). The reasons for the low adherence to the guidelines on management of lead foil packets could be similar to the reasons stated for the non-adherence to the guidelines on amalgam management above.
5.5.6 Practices on management of sharps

A lot of sharps are frequently used by dental surgery staff. Some of these include surgical blades, suture materials, needles and orthodontic wires. These sharps are usually contaminated with blood and other body fluids, making them very infectious. The MOH Policy on Clinical waste management instructs that sharps be stored in puncture proof containers that are well labelled and bear the biohazard symbol (Ministry of Health, 2006; Agarwal et al., 2012). Sharps when managed according to recommended standards protects dental surgery staff from puncture wounds that could lead to cross infection (Naik et al., 2014).

This study showed that all the respondents (100%) adhered to this guideline. The observation showed that, all the dental surgeries where the respondents worked had a puncture proof sharps container. A study done in India showed that 60% of the respondents disposed of sharps in the recommended way. In spite of the poor adherence to the other components of the dental waste management guidelines, respondents showed a 100% adherence to the guidelines on sharps management. This could be due to the fact that over 95% of these respondents had knowledge on how to properly dispose of sharps. This could also be attributed to the observation finding that puncture proof sharp containers were present in all the dental surgeries. That is, an environment that makes it possible to adhere to this guideline was present. Finally, improper sharps disposal poses an immediate and direct risk of contracting infectious diseases such as Hepatitis B and HIV on dental surgery staff unlike the other waste which do not directly on these staff.
5.5.7 Other practices on clinical waste management

This study found that most of the respondents (94%) did not give detailed information on their generated waste to waste carriers. Furthermore, none of the respondents (100%) kept records on waste management activities in their clinics.

When the respondents were asked if any of the facility administrators ever visited their surgeries to monitor how the generated waste was managed, 73% of them said no and the rest said yes.

Finally, when the respondents were asked of how stored waste was finally transported out of their respective facilities, 61% of them said it was carried by regular waste transporters, 5% said it was by approved clinical waste transporters and the remaining 34% had no idea.

The MOH Policy on Clinical Waste Management requires that generators of waste give detailed information on the waste to waste carriers before waste is carried out. Health facility waste should be transported by licensed clinic waste transporters and not by regular waste transporters. The policy also states that, it is required of health institutions to keep records of their waste management activities. The records should contain information on the waste type, site of generation, when the waste was segregated and who did the segregation. The records are also expected to have information on the final disposal. In a situation where final disposal takes place outside the health facility, information on the waste disposal company should be document as well. This should include the company name, its license, place of treatment and final disposal. The disposal method by the company should also be documented.

The policy also requires that supervision of waste management activities be carried out by authorities from the facility and occasionally by external supervisors (Ministry of Health, 2006).
Adherence to these requirements of the policy was found to be very low. This could be due to the fact that over 90% of these respondents had not read the MOH Policy on Clinical Waste Management.

5.5.8 Adherence score of respondents

The adherence scale that was formed as detailed in the methods section of this dissertation showed that most of the respondents (89%) scored 1 out of a maximum score of 8. Thirteen (10%) of the respondents scored 2 and one person scored 4. The mean adherence score was 1.13 with a standard deviation of 0.4.

On the ordinal scale described in the methods section, almost all the dental surgery staff recruited (99%) for this study fell in the low adherence category. One person was in the moderate adherence category. None of the respondents was in the high adherence category.

The low adherence observed in this study could be attributed to the low level of knowledge of the respondents on the dental waste management guidelines, which could also be due to inadequate training in management of dental surgery waste in the training institutions.

The low adherence could also be as result of a lack of an enabling environment with the required systems, technology and materials to facilitate adherence to the guidelines.

Lastly, the low adherence could be due to a lack of effective monitoring and supervision by personnel with adequate knowledge on the policy and the guidelines.
CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.0 Introduction

This chapter presents the conclusions, recommendations, limitations to the study and future research.

6.1 Conclusions

Based on the results obtained from this study, the following conclusions can be arrived at:

1. There was a low level of adherence to dental waste management guidelines by dental surgery staff of the four referral facilities studied.

2. There was a low level of knowledge on dental waste management guidelines among the dental surgery staff in the four referral facilities studied.

3. A low proportion of the dental surgery staff in the four referral facilities studied had read the MOH Policy on Health Care Waste management in Ghana.

4. An enabling environment does not exist to promote adherence to dental waste management guidelines by dental surgery staff in the four referral facilities studied.
6.2 Recommendations

From the findings of this study, the following recommendations if treated with the deserved seriousness, will help improve the level adherence to dental waste management guidelines.

6.2.1 Recommendations to the Ministry of Health

1. The MOH should engage all the available television stations, FM stations, social media and the print media in the dissemination of policies.
2. The MOH should carry out research to assess the efficiency of their policy dissemination strategies.
3. The MOH should collaborate with the Ministry of Education to incorporate lessons on waste segregation and its importance in the education curriculum.
4. The MOH should actively involve all stakeholders such as private and public health facilities, non-governmental organizations (NGOs), civil society organizations (CSO) and the health training institutions in its quest to ensure proper hospital waste management.
5. The MOH should carry out frequent monitoring and controlling functions to ensure that policies are implemented as per the core components of the implementation process.
6. The MOH should institute punishments for non-compliant individuals or facilities.

6.2.2 Recommendations to health worker training institutions

1. Health worker training institutions should incorporate training on health care waste management in their curricula.
2. They must ensure their students pass a standard examination on this subject before the students graduate.

### 6.2.3 Recommendations to Ghana Medical and Dental Council (MDC)

1. The MDC must make it a policy that health workers go for at least one CPD on clinical waste management a year before their license is renewed. Just as is done for ethics.

### 6.2.4 Recommendations to the Ghana Medical Association (GMA) and Ghana Dental Association (GDA)

1. GMA and GDA should organize CPD programmes on clinical waste management more frequently.

### 6.2.5 Recommendations to health facilities

1. Facilities must ensure that multiple colour coded bins are made available at all areas in the facilities. The colour coded bins place at an area should be based on the kind of waste generated at that area.
2. Health facilities must recycle their waste whenever possible.
3. Facilities must ensure that old stocks of medications, chemicals and other materials are used before new ones to keep them from expiring and adding up to clinic waste. Facilities can exchange these materials with other health facilities when the materials are nearing their expiry dates.
4. Facilities should organize frequent pre-service training as well as in-service training in clinical waste management for their staff.
5. Facilities should develop their own waste management protocols based on the guidelines of the national policy document. These protocols should be disseminated to
everyone involved in clinical waste segregation, storage, transportation and disposal including their supervisors.

6. Facilities should provide digital X-ray machines and do away with conventional X-ray machines

6.2.6 Recommendations to dental surgery staff

1. Dental surgery staff should put in conscious efforts to seek new information on modern and safer ways of providing quality oral health care.

2. Dental surgery staff should choose composite filling material over amalgam in situations where both can be used.

3. Dental surgery staff should mix the right amount of material they need for procedures, to reduce the amount that goes waste.

6.2.7 Recommendations to the University of Ghana and other tertiary institutions

1. Tertiary institutions should collaborate with MOH and health facilities to carry out research on developing technologies for safe and efficient disposal of clinical waste.

6.3 Limitation to the Study

Even though this study was carefully done, there was a limitation.

The limitation of this research is that it only looked at dental surgery staff in four facilities, all of which were in Accra.

6.4 Future Research

This study should be repeated among a larger number of facilities and also involve facilities in multiple cities.
REFERENCES


APPENDICES

Appendix A – Respondent Information Sheet

General information

Project Title: Adherence to dental waste management guidelines among dental surgery staff in 4 referral facilities in Accra

I am……………………………………………………………………………………………..(interviewer), a student of the Department of Health Policy Planning and Management in the School of Public Health, University of Ghana Legon pursuing a Master of Public Health Degree Programme. I am here with my research assistants to carry out a survey to find out the adherence to dental waste management guidelines among dental surgery staff in 4 referral facilities in Accra. This is purely for academic purposes and forms part of the requirement for the award of Master of Public Health Degree.

Procedure

The study will involve answering questions from a questionnaire about adherence to dental waste management guidelines among dental surgery staff in Accra. The information you provide will add to knowledge and inform policy about adherence to dental waste
management guidelines among dental surgery staff in Accra and propose some interventions needed.

Benefits and Risks

The study will have no immediate benefit to you directly but the findings from this study will inform policies that will protect dental surgery staff, their patients and the environment at large.

There will be no monetary or material compensation for the study. There are also no known risks associated with this study and I am always available to answer any questions if you have any.

Confidentiality

No name will be recorded. Your name and identity are not needed in the study. However the information you are going to provide will be coded and will be treated strictly confidential.

You are assured of total confidentiality to the information you will give. Apart from the researcher and supervisor of this research, no one else will have access to information provided whether in part or whole. Data collected will be stored under lock and key then destroyed after a minimum of three years as per research protocol after the study is completed.

Right to refuse
Participation in this study is voluntary. You are free to answer part or the entire questionnaire. You can choose to withdraw from the study or stop the interview at any time you want. You can also choose not to answer any question(s) you find uncomfortable about. Should you choose not to participate, it will not affect you or your clinic in any way. However you are encouraged to participate fully in this study to help Adherence to dental waste management guidelines among dental surgery staff in Accra, Ghana and beyond. Completing this questionnaire will take about 10 to 15 minutes.

**Dissemination of results**

Findings and recommendations would be available at the School of Public Health and it will also be disseminated through a meeting with different stakeholders at the end of the study.

**Before Taking Consent**

Do you have any questions you wish to ask about the study? Yes/No

If yes, please indicate the questions below

...................................................................................................................................................................
...................................................................................................................................................................
...................................................................................................................................................................

If you have any question(s) or further clarification concerning this study and/or the conduct of the researcher and research assistants, please do not hesitate to contact the following; Dr. Alex Ansah Owusu, School of Public Health, University of Ghana, Legon owusu.alex28@gmail.com. Tel: 0501367126/0546560880; Dr. Reuben Esena, School of Public Health, University of Ghana, Legon, rkesena@outlook.com Tel: 0277220276 and; Mrs. Hannah Frimpong (Administrator), Ghana Health Service Ethical Review Committee Secretariat, Accra. Tel: 0507041223/0243235225; Mr. Prince Yaw Ashitey, 37 Military
Hospital Institutional Review Board (IRB) Administrator, Tel: 0243004247, email: irb37milhosp@hotmail.com; Institutional Review Board (KBTH-IRB), Scientific and Technical Committee (KBTH- STC), Korle Bu Teaching Hospital, Tel 0302667759, email: Info@kbth.gov.gh, pr@kbth.gov.gh
Appendix B: Informed Consent

I have read the information given above, and I understand. I have been given a chance to ask questions concerning this study and questions have been answered to my satisfaction. I now voluntarily agree to participate in this study knowing that I have the right to withdraw at any time without it affecting my current or future use of health care services.

Signature/Thumb print: ............................ Date: ............................

Contact detail: ............................

I, the undersigned, have explained this consent to the respondent in English and that she/he understands the purpose of the study, procedures to be followed as well as the risks and benefits of the study. The participant has fully agreed to participate in the study.

Signature of interviewer ............................ Date: ............................

Contact detail: ............................
Appendix C: Questionnaire on adherence to dental waste management guidelines among dental surgery staff in 4 referral facilities in Accra

Department Of Health Policy, Planning And Management

This is a study on adherence to dental waste management guidelines among dental surgery staff in 4 referral facilities in Accra. The results of this research will help put measures in place to protect dental surgery staff, their patients and the environment at large.

Thank you for taking part in this study. The aim of this research is to investigate the adherence to dental waste management guidelines among dental surgery staff in 4 referral facilities in Accra. Confidentiality of the answers given is assured. Thank you very much for your participation.

Instruction

Please answer by circling your response or filling the space provided. Thank you.

Part 1 : Demographics

1. Gender 0- male 1- Female
2. Age………………
3. Role 0- Dentist 1- Assistant
4. What is your level of qualification? 0- BDS and above 1 – COHO 2- RDSA 3- Diploma in nursing 4- Trained on the job
5. Number of years of practice………………
6. Where did you train 0- Ghana 1- African country other than Ghana 2- outside Africa
Part 2: Your Clinic

1. What type of X-ray machine do you use in this clinic?
   0- Conventional X-ray machine  1- Digital X-ray machine  2- Both  3- None

2. About how many times do you use amalgam in a month? .......................

3. Do you have an amalgam separator installed in your dental chair?  0- No  1- Yes

4. Do you sometimes work at a private dental clinic?  0- No  1- Yes

Part 3: Knowledge

1. Did you have training on dental surgery waste management in school?  0- No  1- Yes

2. How many CPD programs have you attended in the last 12 months? ...........

3. How many of the CPDs were on clinical waste management? ......

4. Have you read the MOH Policy on clinical waste management? 0- No  1- Yes

5. What colour code should be used for radioactive waste?  0- Yellow  1- Black  2- None of the above  3- No idea

6. Used X-ray fixers have high concentrations of...  0- iron  1- silver  2- none of the above  3- No idea

7. How should amalgam waste be disposed of?  0- Buried in a land fill  1- incinerated  2- None of the above  3- No idea

8. How should blood soaked gauze be disposed of?  0- Together with regular waste  1- Autoclave before disposal  2- none of the above  3- No idea

9. How should used sharps be disposed of?  0- Covered and disposed with other clinic waste  1- Separated in a puncture proof container  2- No idea  3- Other, Specify............................

10. Developed X-ray films can be discarded with regular waste. 0- No  1- Yes  2- No idea
Part 4: Practices in your dental surgery

1. Is your clinic waste segregated into colour coded bins? 0- No 1- Yes

2. How do you store amalgam waste in your surgery? 0- Stored under water in a closed container 1- Disposed with other clinic waste 2- No idea 3- Not applicable 4- Other, specify ………

3. How do you dispose of sharps in your surgery? 0- Put in a puncture proof container with a lid 1- with other clinic waste 2- Other, Specify ………

4. How do you dispose of blood soaked gauze in your surgery? 0- Disposed with other clinic waste 1- Autoclaved and disposed with other clinic waste 2- Isolated and incinerated 3- Other, specify ………

5. Do you label your clinic waste? 0- No 1- Yes

6. How do you dispose of used X-ray fixers in your surgery? 0- Pour down the drain 1- Return to manufacturers 2- No idea 3- Not applicable 4- Others, Specify ………

7. How is your stored dental waste finally transported out of your facility? 0- By regular waste transporters 1- By approved clinical waste transporters 2- I have no idea

8. Do you have the contact of any of the manufacturers of the materials and chemicals you use, such that you can send used or expired ones for recycling? 0- No 1- Yes

9. Does any of the facility administrators ever visit the surgery to monitor how the generated waste is managed? 0- No 1- Yes 2- No idea

10. When temporary storage of amalgam is full, how do you dispose of it? 0- Disposed with other clinical waste 1- Handed to licensed amalgam waste carrier 2- No idea 3- Not applicable 4- Others, Specify ………

11. Do you return lead foil packets of developed X-ray films to manufacturers? 0- No 1- Yes 2- Not applicable
12. Do you keep records of waste management activities? 0- No 1- Yes

13. Do you give detailed information on your clinical waste to the waste carriers? 0- No 1- Yes

Thank you for your time.

The end.

Appendix D: Observation check list (for investigator only)

1. Is waste stored in colour coded bins? 0- No 1- Yes

2. How many different colour codes are present ..........

3. What colour code(s) are available? 0- black 1- yellow 2-brown 3- Others, specify............

4. Do the contents of the bins match the colour code? 0- NO 1- Yes
5. Content of bin  
   0- mixture of domestic and infectious waste  
   1- clinic waste only  
   2- domestic waste only

6. Are bins labelled?  
   0- No  
   1- Yes

7. Does label contain all the required information?  
   0- No  
   1- Yes  
   2- Not applicable

8. Is a puncture resistant sharps container present?  
   0- No  
   1- Yes

9. Is puncture resistant sharps container labelled?  
   0- No  
   1- Yes  
   2- Not applicable

10. Does label contain all the required information?  
    0- No  
    1- Yes  
    2- Not applicable

11. Is there an installed amalgam separator?  
    0- No  
    1- Yes