

**KWAME NKRUMAH UNIVERSITY OF SCIENCE AND
TECHNOLOGY**

INSTITUTE OF DISTANCE LEARNING

DEPARTMENT OF ENVIRONMENTAL SCIENCE

Solid Medical Waste Management Practices:

A Case Study at TheSefwi – Wiawso Government Hospital

Master of Science in Environmental Science

BY

Anna ArabaMensahBEd (Chemistry)

December 2012



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Solid Medical Waste Management Practices:

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A thesis submitted to theDepartment of Environmental Science,

Kwame Nkrumah University of Science and Technology

in Partial Fulfilment of the Requirements for the Degree of

Master of Science in Environmental Science

BY

Anna ArabaMensahBEd (Chemistry)

December 2012

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DECLARATION

I declare that this thesis is my own work towards the MSc. and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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(Supervisor)Signature Date

Certified by:

Rev. Stephen Akyeampong.....
(Head of Department) Signature Date

DEDICATION

I dedicate this work to my dear parents, Mr. and Mrs. Mensah and my two siblings

Ato and Baaba Mensah.

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ABSTRACT

The management of solid medical wastes poses a number of environmental and health challenges in most developing countries including Ghana. Limited consideration has been given to this issue in spite of the possible health problem medical wastes cause. This study looks at the solid medical waste management practices in the Sefwi Wiawso Government Hospital. Structured and unstructured questionnaires were used to collect data while the total waste generated was determined using a weighing scale before segregation. The mean sharps (hypodermic needles, intravenous needles, scalpels, lancets, saws, blades, broken glasses etc.) and hazardous waste generated per month were found to be 30.43 ± 5.3 kg and 96.94 ± 24.5 kg respectively.

The analysis of the results showed that the differences between means of waste generated in different months of the study period were significant ($p = 0.0001$).

The study revealed that except for sharps, segregation of solid medical wastes was not done. The main treatment method adopted in the final disposal of infectious waste is incineration. The study showed that inadequate training for medical waste staff, lack of supervision, insufficient protective equipment and lack of medical waste management policies are the major setbacks militating against waste management in Hospital. This study recommends sustainable management of medical wastes in the hospital to avert or reduce its negative impact on health and the environment.

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LIST OF ABBREVIATIONS AND ACRONYMS

<u>AIDS</u>	-	<u>Acquired Immune Deficiency Syndrome</u>
<u>EPA</u>	-	<u>Environmental Protection Agency</u>
<u>GHS</u>	-	<u>Ghana Health Service</u>
<u>HBV</u>	-	<u>Hepatitis 'B' Virus</u>
<u>HIV</u>	-	<u>Human Immunodeficiency Virus</u>
<u>MOFA</u>	-	<u>Ministry of Food and Agriculture</u>
<u>MSLC</u>	-	<u>Middle School Living Certificate</u>
<u>MWTA</u>	-	<u>Medical Waste Tracking Acts</u>
<u>OPD</u>	-	<u>Out- Patients Department</u>
<u>PCB</u>	-	<u>Polychlorinated biphenyl</u>
<u>RCRA</u>	-	<u>Resource conservation and Recovery Acts</u>

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<u>SPSS</u>	-	<u>Statistical package for Social Science</u>
<u>SWHAT</u>	-	<u>SefwiWiawso Health Assistants Training School</u>
<u>UNCED</u>	-	<u>United Nations Conference on Environment and Development</u>
<u>USEPA</u>	-	<u>United State Environmental Protection Agency</u>
<u>WHO</u>	-	<u>World Health Organisation</u>

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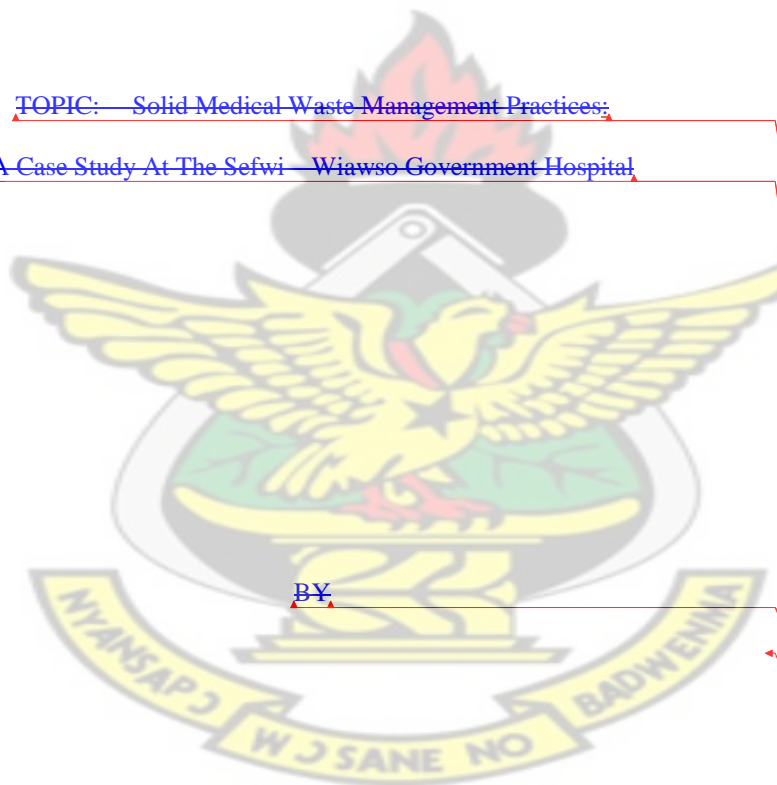
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Anna Araba Mensah

Abstract

The management of solid medical wastes poses a number of both environmental and health challenges in most developing countries including Ghana. Much consideration has not been given to this issue in spite of the disquiet medical wastes cause. This study looks at the solid medical waste management practices in the Sefwi Wiawso Government Hospital. Structure and unstructured questionnaires were used to collect data while weighing scale was use to estimate the total waste generated was determined using a weighing scale.

The study revealed except for sharps, segregation of solid medical wastes was not carrydone, that medical waste workers at the Hospital were not adequately trained. The main treatment method adopted in the final disposal of infectious waste is incineration.

It came out that the segregation of solid medical wastes was not carry out for all medical waste except sharps.

The main treatment method adopted in the final disposal of infectious waste is incineration.

The study revealed that inadequate training for medical waste staff, lack of supervision, insufficient protective equipment and lack of medical wastes management policies are the major setbacks militating against waste management in Hospital.

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Finally, this study recommends sustainable management of medical wastes in the hospital to avert or reduce its negative impact on health and the environment.

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CHAPTER ONE

INTRODUCTION

1.1 Background

In the last few decades, human activities and changes associated with lifestyles and consumption patterns have resulted in the generation of huge volumes of different types of waste. The wastes have threatened the survival of humans and other living things, as well as some natural resources that are necessary to human existence (Oweis, *et al*, 2005).

The concept of waste management in the world is one of the primary aims of humanity. In recent times, management of solid waste has become an issue of increasing concern (Rahman, *et al* 2007).

One estimate shows that about one billion people die each year from waste-related diseases (WHO, 2009). Globally, the amount of municipal waste generated will double by the year 2000 and quadruple by year 2025⁵² (Akter *et. al.* 1999).

The public outcry that followed led to formulation of the US Medical Waste Tracking Act (MWTA) which finally came into force on November 1, 1988. Medical waste management presents a number of environmental challenges in both developed and developing countries (Taru & Kuvarega, 2005). According to Von Schirnding (1999) hazardous wastes are widely dispersed in the environment and have accumulated over the decades. Medical waste is potentially hazardous and infectious if handled carelessly (Mangizvo & Chinamasa, 2008).

World Health Organization (1988) argues that proper management of medical waste is a major setback in most developing countries, especially in those countries where regular municipal solid waste is not managed adequately.

Appleton ~~&and~~ Ali (2000) also contended that less developed countries experience more problems in dealing with medical wastes because they do not have clear jurisdiction over special waste management and the resources and technology to manage it are scanty and rare.

The issue of medical wastes management described above is not different in Ghana, even though a lot of resources have been channelled into the sector to remedy the menace, solid medical wastes management remains a major challenge to both public and private health institutions.

1.2 Problem statement

Medical waste management is very important for the protection of the public and the environment from potential infectious exposure to disease causing agents (California ~~M~~medical ~~W~~waste ~~M~~management ~~P~~program, 2011). Healthcare workers and administrators do indicate that the amount of disposable items used in hospitals and other medical facilities have increased dramatically in recent years, although data are not available to document this observation (USEPA, 1988). For sustainable medical wastes management in the health institutions, it is very vital that, the quantity and the types of solid medical waste generated in health institutions are investigated.

SefwiWiawso government hospital is the only government hospital in the municipality, serving a total population of 148,290 (National ~~P~~population ~~C~~ensus, 2010) of which ~~74~~99% are ~~peasant~~ farmers (MOFA, 2010). People from nearby districts such as Akotombra, Juabuso, Bia and Bibiani - Anhwiaso also come to seek medical attention from the hospital. Currently, the hospital does not have adequate medical waste management facility (such as incinerators, autoclaves and microwaves). The waste workers at the hospital are presently co-disposing the hospital waste with domestic wastes from Sefwi-Wiawso Health Assistant Training School (SWHATS) in an open place (30m away from the hospital and 20m to the main lecture hall of SWHATS). Windblown dust and open air burning method of the wastes generated in the hospital have the potential of carrying hazardous particulate into the atmosphere which may affect the health of the people.

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The unfenced nature of the site also gives access to children to scavenge for used items on the site, putting them at risk of getting infected and also allows domestic animals to graze on the dumpsite which may introduce pathogenic micro-organisms into the food chain.

For proper management of medical wastes at the SefwiWiawso hospital the types and quantity of wastes generated must be determined.

1.3 1.4 Scope

The study was carried out at the SefwiWiawso government hospital in the western region of Ghana. Medical waste samples were collected in the hospital by providing the various departments with bins for fourthree months for analysis.

1.4 Objectives

The main objective of the study, was to identify the currentpractices of solid medical waste management in the SefwiWiawso government hospital and the risk associated to them.

Specific objectives:

The Specific objectives were toDetermine the:

- i. Main types of solid medical wastes generated in the hospital.
- ii. Total amount of waste generated in the various units of the hospital.
- iii. Prevailing disposal practices.
- i. Percentage complianceCompliance of the workers to segregation and safety regulations at the hospital. of various units to waste separation after education.

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→ ~~Level of compliance to safety regulations that should be observed by the workers.~~

→ ~~Percentage compliance of the workers of various units to waste separation after education.~~

→ v. Main factors responsible for the poor management of solid medical waste in the SefwiWiawso Hospital.

1.4 Scope

~~The study was carried out at the Sefwi Wiawso government hospital in the western region of Ghana. Medical waste samples were collected in the hospital by providing the various departments with bins for three months for analysis~~

1.5 Organization of report

~~This report is made up of six chapters. Chapter one begins with an introduction which consists of the background, the objectives, the problem statement, and the scope of the study. Chapter two presents a review of available literature. Chapter three describes the study area and the research methodology. Chapter four presents the results. Chapter five discusses the results whiles the six chapter outlines the conclusions and recommendations of the study.~~

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CHAPTER TWO

LITERATURE REVIEW

2.1 Background

Hospital is one of the complex institutions which are visited by people from every walk of life in the society without any distinction between age, sex, race and religion for the health care services.

In the provision of health care, waste is generated which includes sharps, human tissues or body parts and other infectious materials (Patil and Pokhrel, 2004).

According to the Ghana Health Service (GHS, 2008), 'ten to twenty-five percent of these wastes are hazardous and requires special arrangements for management due to their potential for creating a variety of health risks' (Ghana health service, 2008).

2.2 Definitions of waste

Waste is an inevitable product of society (White *et al.*, 1995) which according to Basel Convention of 1997 is defined as "substance or objects which are disposed-off or are intended to be disposed-disposed-off or are required to be disposed-disposed-off by the provision of the national law". Waste is also defined in German Waste Act of August 27, 1993 as portable objects that have been abandoned by the owner.

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The World Health Organisation defines medical or healthcare waste as the total waste stream from healthcare establishments, research facilities, laboratories, and emergency relief donations. In addition, it includes the waste originating from "minor" or "scattered" sources - such as that produced in the course of healthcare undertaken in the home (such as dialysis, insulin injections, etc.) (WHO, 1999).

According to Ferraz and Afonso (2003), medical waste is any solid waste that is generated in the diagnosis, treatment or immunisation of human beings or animals, in related research, biological production or testing. This is generated or produced as a result of any of the following actions: diagnosis, production or testing of biological and immunisation (Matin, 2006). In addition, medical wastes include those wastes from animals intentionally exposed to pathogens; bulk human blood and blood products (Duan et al., 2008).

2.3 Sources of Medical Wastes

It is well known that hospitals, clinics, nursing homes, laboratories, veterinary clinics and many health establishments have to dispose waste materials that have been generated in the process of medical care and treatment (Abdulla et al., 2008). In developing countries, medical waste is typically derived from two main sources: emergency relief donations (i.e. leftover from international donor response to either a humanitarian crisis or a natural disaster) and long-term healthcare services (Abor, 2007).

The aim of healthcare services is to reduce health problems as well as prevent potential risk. As a result, waste, which is potentially harmful to public health and the

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environment, are often generated. Leftover emergency relief donations normally create a one off medical care waste issue, and can be dealt with in the same manner as long-term healthcare services waste (Johannessen *et al*, 2000).

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With the proliferation of blood borne diseases, more attention is being focused on the issue of infectious medical waste and its disposal, health care institutions must be aware of the potential risk in handling infectious waste, and adhere to the highest standards of disposal and transport. Education of the staff, patients and community about the management of the infectious waste is crucial in today's health care arena.

2.4 Types of Solid Medical Wastes

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Circumstantial waste characterization is of no great importance, due to the waste stream's heterogeneity. The focus of concern is on infectious wastes and on their proper treatment and disposal. Potential infectious wastes, toxic wastes and potential toxic wastes are classified as wastes that require special handling.

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In an attempt to gain a general appreciation of type of wastes generated in a hospital, Reinhardt *et al*, in 1991 categorized hospital wastes as:

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- Cultures and stocks of infectious agents and associated biologicals
- Human blood and blood products
- Pathological wastes
- Contaminated sharps
- Contaminated animal carcasses, body parts and bedding
- Isolation waste

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- Wastes from surgery and autopsy
- Contaminated laboratory wastes
- Dialysis unit wastes
- Contaminated ~~equipment~~equipment

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Due to the lack of a nationally mandated definition of biohazardous waste, significant definitional changes in the waste stream occur routinely as one crosses borders between countries and local jurisdictions. ~~No matter how it is~~However termed or defined, proper and safe management of medical waste must be an integral part of any healthcare strategy to protect the safety and health of healthcare providers and support staff, patients and their families, waste industry workers, and the general public.

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Medical waste is generated primarily in the course of healthcare or research by both medical institutions and home healthcare activities and to a lesser extent by illegal drug users. The primary medical institutions generating bio-hazardous waste include hospitals, laboratories, physicians, dentists, veterinarians, long-term healthcare facilities, clinics, blood establishments, and funeral homes. The WHO, (2005); Kasevaand Mato, (1999) and Khalaf-Felicia, et al. et al.(20098) also classified waste as follows;

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Pathological wastes

These are body tissues that are removed during surgery or autopsy. This category includes tissue samples removed during biopsy, body tissues and organs, amputated limbs, and body fluids. Special handling of pathological wastes is warranted for two

reasons: the infectious potential of the body tissues and aesthetic considerations. Even if pathological waste may contain healthy body parts, it has to be considered as infectious waste for precautionary reasons.

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Non-hazardous waste

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Non-hazardous waste does not pose special handling problems to human health or environment. They are generated in the patients' ward areas, out-patient-department (OPD), kitchens, offices, etc.

It includes general waste such as food waste, paper waste, non-infectious materials, waste originated from catering services and administrative establishment. Others are empty syrup bottles, barrel, wool, unused needle, empty saline bags and set without needles and nozzles that is not contaminated with blood or body fluid etc.

Hazardous waste:

Hazardous waste is responsible for spreading of infectious and epidemic diseases and should be given special care in handling. These are mostly clinical waste which includes blood bag, bloods contaminated saline/ set, blood and body fluid contaminated materials, body parts/organs, clothes used by AIDS and carrier's patients, drainage tube, gauze, bandage and cotton, surgical sponge etc. (Md. Shahjahan *et al*, 2006).

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Hazardous wastes are normally produced in labour wards, operation theatres, laboratories, etc. (Kaseva *and* Mato, 1999).

Infectious wastes

Infectious waste is defined as waste that contains pathogens in sufficient concentration or quantity that, when exposed to it, can result in diseases, e.g. waste

from surgeries with infectious diseases, contaminated plastic items, etc (Kaseva~~&and~~Mato, 1999).

Infectious waste contains a great variety of pathogenic micro-organisms. Pathogens in infectious waste may enter a human body through a number of routes such as:

▲Puncture, abrasion, or cut in the skin.

▲Through mucus membrane.

▲By inhalation and

▲By ingestion.

Th~~ese~~es pathogenic micro-organisms can cause respiratory infections, genital infections, anthrax, meningitis and many more (WHO, 2009).

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Sharps:

Sharps are defined as things that could cause a cut or puncture leading to wound.

Items like needles, syringes, knives, broken glass, cover slip, infusion set, nozzle of syringe, scalpels blades etc. form part of sharp wastes (Khalaf~~Felicia~~, ~~et al.~~Aet al. 20098).

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Pressurized containers:

These consist of full or emptied containers or aerosol cans with pressurized liquids, gas or powdered materials.

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Pharmaceutical waste:

Many chemicals and pharmaceutical waste in Healthcare establishments are hazardous.

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These may cause intoxication, either by acute or chronic exposure, and injuries which may include burning. Chemicals residues discharged into the sewerage system poses adverse effects on operation of the biological sewage system plants or toxic effects on the natural ecosystems of receiving waters (WHO, 2009).

Pharmaceutical waste includes expired, unused, spilt and contaminated pharmaceutical products, drugs and vaccines. In this category are also included discarded items used in the handling of pharmaceuticals like bottles, vials, connecting tubing.

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Highly infectious waste:

It includes microbial cultures and stocks of highly infectious agents from Medical Analysis Laboratories. They also include body fluids of patients with highly infectious diseases.

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The GHS (2008) classified the ten to twenty five percent hazardous as:

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Pathological waste: ~~This include~~ These include tissue samples, organs and body fluid.

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Pharmaceuticals waste: Consist of expired or unused drugs, split and contaminated pharmaceutical products, drugs and vaccines.

Sharps: These are waste entailing the risk of injury. Examples are needlessyringes, disposable scalpels, lancets and blades.

Non sharps: These are infectious waste such as swabs, bandages, disposable medical devices, etc. (GHS, 2008).

Chemicals: These are made up of mostly solvents, disinfectants, etc.

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2.5 Impacts of medical waste on environment

According to Akter, (2000) the following are environmental impacts associated with improper disposal of medical wastes:

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- ❖ ~~Pollutants from medical waste (e.g. heavy metals and PCBs) are~~ Persistent ~~of p~~ Pollutants from medical waste (e.g. heavy metals and PCBs) are in the environment

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- ❖ Accumulation of toxic chemicals within soil (proximity to agricultural fields, humans, soil organisms, wildlife, cattle)
- ❖ Ground water contamination
- ❖ Bio-accumulation in organism's fat tissues, and biomagnify through the food chain.
- ❖ Repeated and indiscriminate application of chemicals over a long period of time has serious adverse effects on soil microbial population - reducing the rate of decomposition, and generally lowering the soil fertility.
- ❖ Pathogens lead to long term accumulation of toxic substances in the soil
- ❖ Specimens collected for analysis have the potential to cause disease and illness in man, either through direct contact or indirectly, by contamination of soil, groundwater, surface water, and air.
- ❖ Windblown dusts from indiscriminately dumping also have the potential to carry hazardous particulates
- ❖ With domestic animals being allowed to graze in open dumps, there is the added risk of reintroducing pathogenic micro-organisms into the food chain.
- ❖ Public nuisance, (e.g. odours, scenic view, block the walkway, aesthetics, etc.).
- ❖ Combination of both degradable and non-degradable waste increase the rate of habitat destruction due to the increasing number of sites necessary for disposal of wastes (degradation of habitat).
- ❖ Plastic-bags and ~~plastic~~ containers, if not properly destroyed may contaminate the soil and also reduces the chance for water percolation into the soil during precipitation.

- ❖ Open air burning does not guarantee proper incineration, and releases toxic fumes (dioxin) into the atmosphere from the burning of plastics i.e., PCB's.

2.6 Impacts of medical waste on human health

Medical wastes constitute a larger portion of infectious wastes, which are potentially dangerous since they may contain pathogenic agents and may be resistant to treatment and possess high ability to cause disease (Abdulla *et al.*, 2008). Improper medical waste management causes unpleasant smell, growth and multiplication of insects, rodents and worms, and may lead to transmission of diseases like typhoid, cholera, and hepatitis through injuries from sharps contaminated with human blood. (Khalaf, Felicia *et al.*, 2009).

Health impacts originating from exposure to hazardous hospital wastes include mutagenic, teratogenic and carcinogenic effects, respiratory damage, central nervous system effects, reproductive system damage and others (Khalaf, Felicia *et al.*, 2009).

Exposure to medical waste can result in disease or injury. According to WHO (1999), all individuals specifically health care staff (e.g., doctors, nurses, laboratory technicians, and waste handlers), exposed to medical waste, are potentially at risk. Waste care workers handling waste containing blood-soaked objects from patients in different units in the hospitals must be protected from the transmission of hepatitis B (WHO, 1985). Hospital staff is reported to frequently have an infection rate of hepatitis B three to six times higher than normal risks; (Qusus, 1988).

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hospitals waste is the transmission of AIDS\HIV viruses and, more often, of hepatitis B virus (HBV) through the injuries caused by syringe needles contaminated by human blood, (WHO, 1999).

adversely impact human health by contaminating water bodies during waste treatment and by polluting the air through emissions of highly toxic gases during incineration.

the water bodies may become contaminated.

(which is the case with the majority of incinerators in developing countries), dioxins and furans and other toxic air pollutants may be produced. This would cause serious illness in people who inhale this air (WHO, 2000).

handling as follows:

- Possibility of leachate entering an aquifer, surface water or drinking water system which may contaminate it.

- Non-antibiotics. biodegradable

eoplastics and disinfectants disposed of into the sewage system may kill

bacteria necessary for the treatment of sewage. Antineoplastics flushed into watercourses may damage aquatic life or contaminate drinking water.

- Burning of waste at low temperatures or in open container results in release of toxic pollutants (e.g. dioxin) into air.

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- Carcinogenic waste such as heavy metals, chemical solvents and preservatives pose serious human health risks not only to workers but to the general public as well.

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- Inefficient and insecure sorting and disposal may allow drugs beyond their expiry date.

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- Unprotected and insecure landfill may pose health hazard to the scavengers and inhabitants at the vicinity.

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- Unprotected and insecure landfill may pose health hazard to the scavengers and inhabitants at the vicinity.

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2.7 Occupational Risks

Potential occupational exposures include direct exposure to patients, visitors and workers who handle or come into proximity to waste. Fereres, (1991) defined that all personnel at the hospital are exposed to health hazards of contaminated or infectious wastes, especially those involved directly. Nursing personnel and laboratory technicians are exposed to blood and blood soaked objects from patients. Reinhardt *et al* and Gordon, (1991) stated that occupational risks are also a serious concern outside of the institution.

2.8 Management of medical waste

The management of medical waste is an emerging issue that is magnified by lack of training, awareness, and financial resources to support solutions. The proper collection and disposal of this waste is of great importance as it can directly and indirectly impact the health risks to both public health and the environment (Baraka *et al*, 2006; Abdulla, *et al*, 2008).

The waste generated from hospitals is now recognized as a serious problem that may have detrimental effects either on the environment or on human beings through direct

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or indirect contact. Industrial and medical wastes constitute a larger part of ~~fn~~ what is known as 'hazardous wastes' (Chul-Jang, ~~et al.~~ *et al.* 2006). The production of these wastes is and will continue to be an ongoing phenomenon as long as human civilization persists. Worldwide, management of hazardous wastes has received much attention since the early 1980s mainly due to its toxicity and infectious nature. Concerned with this situation Agenda 21, adopted in the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in June, 1992, set the following goals and targets with regard to waste management in cities:

- All countries must establish waste treatment and disposal criteria and develop the ability to monitor the environmental impact of waste by the year 2000.
- By 2025, developing countries should ensure that at least half of the sewage, wastewater and solid waste are disposed according to national and international guidelines.
- By 2025, all countries shall dispose of all waste according to international quality guidelines.

In the management of some medical waste such as the pathological waste, the religious believe of the patient in question is sometimes taken into consideration.

In some religions, it is important to bury the entire body, including any body parts that may have been amputated or otherwise removed surgically. For patients with such beliefs, the body parts should be made available to the patient or the patient's family for burial by a mortician.

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Otherwise, it is the responsibility of the hospital to dispose of body parts.

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Incineration is often the method of choice for pathological wastes because this technique takes care simultaneously of both potential infectiousness and aesthetics. Steam sterilization, however, leaves the pathological wastes intact, and the problem of aesthetics remains. It is not acceptable that recognizable body parts be placed in a landfill (Chong Kin Fook, 2007).

Therefore, when pathological wastes are steam sterilized, additional processing is necessary before disposal; options include incineration and grinding of the sterilized wastes.

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Resource Conservation and Recovery Act (RCRA) of 1978 recommended that management plan for hospital wastes should be established to ensure protection of public health and environment. The plan should incorporate a cradle-to-grave approach to infectious medical or hospital wastes (Meaney and Cheremisinoff, 1989).

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The major elements of a management strategy for medical wastes are (Victoria-EPA, 1993):

- Waste Minimization
- Waste Segregation
- Labelling and Packaging
- Waste Handling and Transportation
- Waste Treatment and Disposal.

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In addition, the management plan must outline the required training, refresher training, record keeping, storage and any hospital or medical plans for staff dealing with medical wastes.

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2.9 Waste Minimization

Waste minimization is the use of practices or processes which reduce, as much as possible, the amount of waste generated, or the amount which requires subsequent treatment, storage, or disposal. It includes any activity other than dewatering or compaction that results in the reduction of total volume, quantity, or toxicity of industrial (hospital) [waste](#).

Two aspects of waste minimization are:

1. ~~1.~~ Source reduction
2. ~~2.~~ Recycling

2.9.1 Source Reduction

Hazardous and Toxic Materials Office Board of Public Works, Los Angeles (1995) identified that source reduction can be achieved by materials or process modifications and by the implementation of policies and procedures that would reduce wastes. The key operating practices that can be utilized to affect waste minimization are as follows:

- a. Waste segregation,
- b. Centralize purchasing and dispensing of drugs and other hazardous chemicals,
- c. Require inventory checks before ordering or using new stock,
- d. Minimize acceptance of free samples that are likely to leave as hazardous waste, and
- e. Provide employee training in hazardous materials management and waste minimization.

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2.9.2 Recycling

Recycling is the retrieval of materials or products either for reuse in their original form or for reprocessing into products of similar composition e.g. spent solvents in the hospitals are generated by the laboratory, pathology, histology and maintenance departments, sometimes aqueous-based cleaners can be substituted for hazardous solvents used in maintenance and many solvents can be recovered by on-site distillation and recycled (Victoria-EPA, 1993).

2.10 Segregation and Handling

Generally medical wastes are segregated at the point of generation by generators into clearly marked containers that take into consideration the waste type. To minimise cost facility, staff must segregate waste which are specifically defined as medical. Segregation should be carried out at source (M. Tsakona, *et al.*, 2006).

Non-sharp biohazardous waste should be segregated into disposable leak-proof containers or plastics bags that meet specific performance standards. The bags should be constructed to preclude clipping, tearing or bursting under normal use. It should also be secured to prevent expulsion of its content during handling, storage or transport.

Sharps should be contained in rigid leak-proof, puncture-resistant containers that can be tightly lidded during storage handling or transport.

If containers are to be reused they must be well washed and disinfected.

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2.11 Labelling and packaging

Standard code of colour is used in solid medical wastes management for every plastic bag and containers for effective and safe packaging (Chong Kin Fook, 2007). In Environmental Quality Act, 1989 of Malaysia it is an obligation to labelled each solid medical wastes collection plastic bags and containers with biohazard symbol Figure (2.1)

[Biohazard symbol](#)

Table 2.1: Malaysian colour code for medical waste

TYPE OF COLOUR CODE	TYPE OF WASTES EMBOSSED
Black	Household waste
Yellow	Clinical waste to be disposed by incinerator
Light Blue	Clinical waste from high risk disease
Red	Infectious
Blue	Non-infectious

Source: Chong Kin Fook, 2007/ Reza Mziray 2009

Table 2.2: Recommended colour coding scheme for Ghana

COLOUR	TYPE OF WASTE EMBOSSED
Black	General waste (e.g. kitchen waste, paper, cardboard, sweeping etc.)
Yellow	Infectious waste (e.g. sharps, patient waste, human/animal tissue and cultures/specimens) with the biohazard label

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Brown	Hazardous waste (e.g. expired drugs, vaccines, chemicals etc.). Where only small amounts of chemical wastes are generated, these may be added to the infectious waste.
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Source: Ghana Health Service, 2008

2.12 Use of biohazardous symbols

Biohazard symbols are generally used as a warning so that those potentially exposed to the biologically hazardous substances will know to take precautions.



Figure 2.1: Biohazard symbol

2.13 Storage

Facilities that store medical wastes should have specific storage area for that purpose.

The storage area should be inaccessible to unauthorised entry.

The area should offer protection from animals, the elements (e.g., rain and wind), and should not provide a breeding place or a food source for insects or rodents. Storage time and temperature should be considered due to putrefaction of the waste with time. Microorganisms will grow and decompose the waste in storage, creating the unpleasant odours associated with putrefaction or rotting garbage.

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2.114 Medical Wastes Treatment Methods

Treatment of medical waste is very crucial in the management of medical waste. This is because untreated medical waste has a potential menace on both human and the environment.

According to Diaz et al (2005), some of the common treatment and disposal methods utilised in the management of infectious healthcare wastes in developing countries includes: autoclaves, microwave disinfection systems, chemical disinfections and combustion or incineration. Akternasima, (2000) suggested factors that influence the use of treatment methods in the developing countries.

Table (2.3): Factors influencing the use of treatment methods, advantages and the disadvantages

Methods	Parameters	Advantages	Disadvantages
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<u>Incineration</u>	<u>Turbulence and mixing</u>	<u>Reduction of waste volume, and weight</u>	<u>Public opposition</u>
	<u>Moisture content of waste</u>	<u>Ability to make waste unrecognizable</u>	<u>High investment, operational cost</u>
	<u>Temperature and residence time</u>	<u>Acceptability for all waste types</u>	<u>Formation of dioxins, furans</u>
	<u>Maintenance and repair</u>	<u>Heat recovery potential</u>	<u>High maintenance, testing and repair costs</u>
			<u>Vulnerability to future restrictive emissions laws</u>
<u>Autoclave Disinfection</u>	<u>Temperature and pressure</u>	<u>Low investment cost</u>	<u>Inability to change waste appearance</u>
	<u>Steam penetration</u>	<u>Ease of biological testing</u>	<u>Inability to change waste volume</u>
	<u>Size of waste load</u>	<u>Creation of residue that is less hazardous than incineration</u>	<u>Lack of suitability for some waste types</u>
	<u>Length of treatment cycle</u>		<u>Production of uncharacterized air emissions</u>
<u>Microwave Disinfection</u>	<u>Waste characteristics</u>	<u>Ability to make waste unrecognizable</u>	<u>High investment cost</u>
	<u>Moisture content of waste</u>	<u>unrecognizable</u>	<u>Increased waste weight</u>
	<u>Microwave source strength</u>	<u>Significant volume reduction</u>	<u>Potential to expose workers to contaminated shredder</u>
	<u>Duration of microwave exposure</u>	<u>Absence of liquid discharge</u>	<u>Production of uncharacterized air emissions</u>
<u>Mechanical/Chemical Disinfection</u>	<u>Chemical concentration, treatment, pH</u>	<u>Significant waste volume reduction</u>	<u>High investment cost</u>
	<u>Contact time with chemical</u>	<u>Ability to make waste unrecognizable</u>	<u>Lack of suitability for some waste types</u>
			<u>Production of uncharacterized air emissions</u>
	<u>Waste and chemical mixing</u>	<u>Rapid processing</u>	
	<u>Recirculation versus flow through</u>	<u>Waste deodorization</u>	<u>Need for chemical storage and use</u>
<u>Methods</u>	<u>Parameters</u>	<u>Advantages</u>	<u>Disadvantages</u>

<u>Incineration</u>	<u>Turbulence and mixing</u>	<u>Reduction of waste volume, and weight</u>	<u>Public opposition</u>	Formatted: Font: 11 pt
	<u>Moisture content of waste</u>	<u>Ability to make waste unrecognizable</u>	<u>High investment, operation cost</u>	Formatted: Space Before: 0 pt, After: 0 pt, Line spacing: 1.5 lines
	<u>Temperature and residence time</u>	<u>Acceptability for all waste types</u>	<u>Formation of dioxins, furans</u>	Formatted: Space After: 0 pt, Line spacing: 1.5 lines
	<u>Maintenance and repair</u>	<u>Heat recovery potential</u>	<u>High maintenance, test and repair costs</u>	Formatted: Space Before: 0 pt, After: 0 pt, Line spacing: 1.5 lines
<u>Autoclave Disinfection</u>	<u>Temperature and pressure</u>	<u>Low investment cost</u>	<u>Inability to change volume appearance</u>	Formatted: Space Before: 0 pt, After: 0 pt, Line spacing: 1.5 lines
	<u>Steam penetration</u>	<u>Ease of biological testing</u>	<u>Inability to change volume</u>	Formatted: Font: 11 pt
	<u>Size of waste load</u>	<u>Creation of residue that is less hazardous than incineration</u>	<u>Lack of suitability for some waste types</u>	Formatted: Space Before: 0 pt, After: 0 pt, Line spacing: 1.5 lines
	<u>Length of treatment cycle</u>		<u>Production of uncharacterized air emissions</u>	Formatted: Space After: 0 pt, Line spacing: 1.5 lines
<u>Microwave Disinfection</u>	<u>Waste characteristics</u>	<u>Ability to make waste unrecognizable</u>	<u>High investment cost</u>	Formatted: Font: 11 pt
	<u>Moisture content of waste</u>	<u>Significant volume reduction</u>	<u>Increased waste weight</u>	Formatted: Space After: 0 pt, Line spacing: 1.5 lines
	<u>Microwave source strength</u>	<u>Absence of liquid discharge</u>	<u>Potential to expose workers to contaminated shredder</u>	
	<u>Duration of microwave exposure</u>		<u>Production of uncharacterized air emissions</u>	

2.17 Staff training

The medical waste management plan should address specific training and educational needs for professional staff and housekeeping/custodial staff. Training should include:

- An explanation of the waste management plan
- Assignment of roles, responsibilities, and expectations
- Risks associated with the waste management work environment
- The location and proper use of personal protective equipment
- Components of the waste management system (waste identification, segregation, containerisation, labelling, transport, treatment and disposal)
- Regulations and the consequences of failing to comply (regulatory enforcement consequences)
- Procedures to follow should a needle stick or other exposure occur

Training should be conducted following development and implementation of the management plan, when new employees are hired, whenever management practices change and as a periodic refresher.

It should also include chemical hazards, spill prevention, preventive maintenance and emergency preparedness and response. Hospital and other health care organizations that generate infectious wastes should provide employees with infectious waste management training. The training should include an explanation of the infectious

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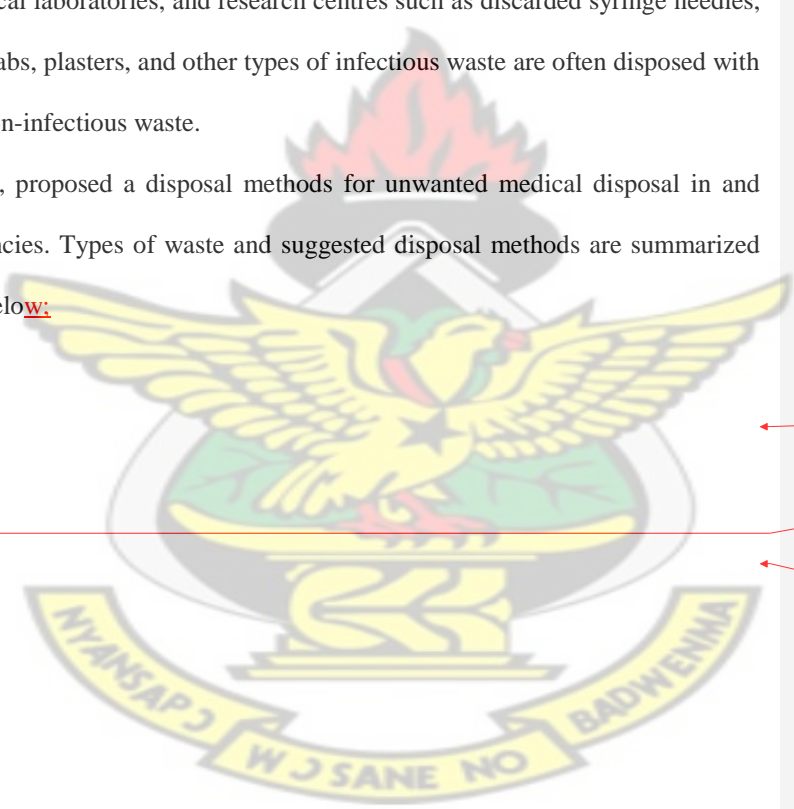
waste management plan and an assignment of the roles and responsibilities for implementation of the plan. This training is important for all employees who handle medical wastes.

2.18 Disposal of medical waste

Disposal of hospital and other medical waste requires special attention since this can create major health hazards. This waste generated from the hospitals, health care centres, medical laboratories, and research centres such as discarded syringe needles, bandages, swabs, plasters, and other types of infectious waste are often disposed with the regular non-infectious waste.

WHO (1999), proposed a disposal methods for unwanted medical disposal in and after emergencies. Types of waste and suggested disposal methods are summarized in the table below:

Table 2.18



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Table 2.4: Types of medical waste and their disposal methods

Disposal methods	Types of medical waste
Return to donor or manufacturer, transfrontier transfer for disposal	All bulk waste pharmaceuticals, particularly antineoplastics
High temperature incineration with temperatures greatly in excess of 1200°C	Solids, semisolids, powders, antineoplastics, controlled substances
Medium temperature incineration with two-chamber incinerator with minimum temperature of 850°C. Cement kiln incineration	In the absence of high temperature incinerators, solids, semi-solids, powders. Controlled substances
Immobilization: Waste encapsulation	Solids, semi-solids, powders, liquids, antineoplastics, controlled substances
Inertization	Solids, semi-solids, powders, antineoplastics, controlled substances

Source: Guidelines for safe disposal of unwanted medical waste in and after emergencies (WHO, 1999).

Safe Management of Bio-medical Sharps Waste in India, (1998) also summarized medical waste category and their treatment and disposal as follows:

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Table 2.5: Types of medical waste with their treatment and disposal methods

Type of Waste	Treatment and Disposal
Human Anatomical Waste	Incineration; deep burial
Animal Waste	Incineration; deep burial
Microbiology and biotechnology waste	Local autoclaving/micro-waving / Incineration
Waste sharps	Disinfection (chemical treatment; autoclaving/micro-waving) and mutilation/shredding
Discarded medicines and cytotoxic drugs	Incineration; destruction and drugs disposal in secured landfill
Soiled Waste	Incineration; autoclaving/ micro- waving
Solid Waste	Disinfection by chemical treatment; autoclaving/micro-waving and mutilation/shredding
Liquid waste	Disinfection by chemical treatment and Discharge into drains
Incineration Ash	Disposal in municipal landfill
Chemical Waste	Chemical treatment; and discharge into drains for liquids and secured landfill for solids.

Source: Safe Management of Bio-medical Sharps Waste in India (1998)

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CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Area

The SefwiWiawso District with its present boundaries was defined and created in 1988. It ~~is was~~ one of Ghana's original District Councils bounded by ~~Sankore Brong Ahafo region to the North, Aowin-Suame to the South, and Juaboso District to the West, Aowin-Suame to the South, Bibiani, Anhwiaso, Bekwai District to the East and WassaAmenfi to the South East.~~

The district ~~was is~~ named after its capital Wiawso and its dominant ethnic group is the Sefwis, who are Akans. It lies in the Western region of Ghana between latitude $6^{\circ}00'$ and $6^{\circ}30'$ ~~N~~North and longitude $2^{\circ}15'$ and $2^{\circ}45'$ ~~W~~West which covers a total land area of 2,397 km².

According to the 2010 population census, the projected population ~~figure~~ of the district is 11,7046 comprising 58,767 males and 58,737 females. The mainstay of the economy is agriculture, employing over 80 % of the population.

~~Sefwi Wiawso district has twenty-two health facilities which include two hospitals, two health centres, two clinics, two private maternity homes and fourteen CHPS compounds.~~

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The SefwiWiawso Government Hospital was established in the 1992 with its mission; the provision of affordable world class quality health care to the people of the SefwiWiawso and its surrounding communities.

3.1 indicates the various health facilities and their location in the district.

Table 3.1 Health institutions in Sefwi Wiawso District

NUMBER	INSTITUTION	LOCATION
1	Sefwi Wiawso Government Hospital	Sefwi Wiawso
2	St. John of God Hospital	Sefwi Asafo
3	Green shield Clinic	Mpomom
4	Keytees Clinic	Boako
5	S.D.A Clinic	Asawinso
6	Anyinabrim Health Centre	Anyinabrim
7	Asawinso Health Centre	Asawinso
8	Lizzy Maternity home	Asawinso
9	Amafia CHPS	Amafia
10	Anhwiam CHPS	Anhwiam
11	Nsuasua CHPS	Nsuasua
12	Nyameagyiso CHPS	Nyameagyiso
13	Ahonkwa CHPS	Ahonkwa
14	Abrabra CHPS	Abrabra
15	Sui CHPS	Sui
16	Boako CHPS	Boako

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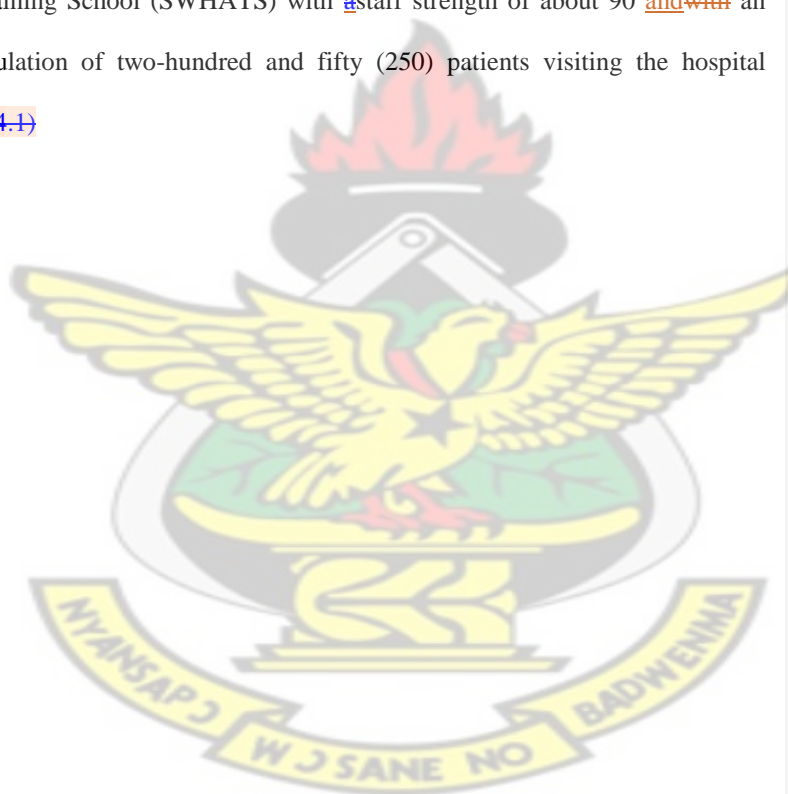
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18	Benchema CHPS	Benchima
19	Aboagyekrom CHPS	Aboagyekrom
20	Ahwiaa CHPS	Ahwiaa
21	Paboase CHPS	Paboase
22	Bosomeiso CHPS	Bosomeiso

The hospital currently serves as a teaching hospital for the SefwiWiawso Health Assistant Training School (SWHATS) with a staff strength of about 90 and with an average population of two-hundred and fifty (250) patients visiting the hospital daily. (Table 4.1)



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3.2 WASTE GENERATED IN THE HOSPITAL 3.2 Materials and Methods

a. ~~Structured and unstructured questionnaire~~

~~Structured and unstructured questionnaire were used to collect data on waste management practices. In all, seventy questionnaires were administered. Fifty questionnaires were administered to doctors, nurses, laboratory technicians, whiles twenty were administered to cleaners. Regular visits were made to the female and maternity ward, male and children's ward, laboratory, out-patients department (OPD) and the theatre to record, observe and write notes about the practices of solid medical waste management by staff responsible for waste management.~~

b. 3.2.1 Sampling of solid medical waste

Waste bins, safety boxes, polythene bags, weighing scale were the materials used to collect data on wastes generated in the male and children's ward, the female and maternity ward, the laboratory, the theatre and the out-patient department. Data collection on waste samples was done between 6:00am - 9:30 am (waste collection time in the hospital) every two days in the week within the period of three months (from November 2011 to January 2012). During this period, all hazardous medical waste and sharps generated at the various units were collected in bins and safety

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boxes respectively. The hazardous wastes were transferred into polythene bags and their weights were taken with the aid of the weighing scale. The weight of the safety boxes was taken prior to the data collection and for that matter sharps were weighed in the safety boxes.

Indicate if you weighed all waste

3.2.2 Segregation of wastes

Segregation of waste was ~~also preceded~~ carried out for the period of one month (February 2012).

Medical wastes from the various units were separated into sharps, pathological, infectious and pharmaceutical wastes. This was done by placing bins at the various units to determine the level of compliance. This was done between the hours of 6:00am and 9:30am using the weighing scale.

3.2.3 Measurement of wastes

Wastes generated in the various units of the hospitals were weighed using a top pan weighing scale and their weight recorded for the period of the study.

3.3 QUESTIONNAIRE ADMINISTRATION

3.2.1 Structured 3.3.1 Structured and unstructured questionnaires

Structured questionnaires were used to determine the management practices observed by the medical waste workers while unstructured questionnaires were

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used to collect data on waste management practices from people in key positions such as the hospital Administrator. Regular visits were made to the female and maternity ward, male and children's ward, laboratory, out-patients department (OPD) and the theatre for record taking and observation regarding the practices of solid medical waste management by staff responsible for waste management.

Add info on when the weighing was done and how.

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3.3.2 Observational Survey check list

This was done using a check list, used to cross check and confirm the responses given by the respondents of the structured and unstructured questionnaires and also seek information on other issues which were not in the questionnaire.

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3.4 Data analysis

The Statistical Package for Social Science (SPSS) software version 15 was used and excel were used to analyse all the data generated. The t-test and ANOVA were used to determine the significant differences at 95% confidence interval.

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CHAPTER FOUR

RESULTS

4.1 Patient attendance at the hospital

The hospital which currently serves as a Teaching Hospital is the only government hospital which provides health care services to the people of SefwiWiawso and its surrounding districts. It attends to an average of two hundred and fifty patients a day (Table 4.1).

Table 4.1 Average monthly attendance of patients in the hospital

Month	UNITS				
	Theatre	Laboratory	Male and Children's ward	Female and Maternity	OPD

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November	12	70	55	65	272
December	8	55	30	43	224
January	10	65	47	55	254

4.2- Quantity and Composition of solid medical wastes generated in the hospital

Varieties of medical waste were generated from the activities performed in the hospital. These were classified into various types based on [the classification made by the World Health Organisation \(WHO, 2011\)](#) and the nature of wastes which were identified during the period of the study. [The quantity of Pharmaceutical waste was the least \(24.20±6.00Kg\) during the study period \(Table 4.2\).](#)

Table 4.2: Mean Quantity and Composition of solid medical waste generated in the SefwiWiawso Government Hospital.

Types of Solid Medical Wastes	Sources of Solid Medical Wastes	Mean Quantity (kg)	Percentage (%)
Pathological wastes	Tissues, and organs such as Foetuses, placentas, and blood fluids	25.67±8.08	20.43
Infectious wastes	Sponges, Soiled dressings, Cotton wool, Surgical gloves, and Swabs as tubing and filters, disposable towels, gowns and aprons, gloves and laboratory coats	45.56±11.80	36.27

Sharps	Hypodermic needles and syringes, intravenous needles and tubing, scalpels lancets saws, blades, broken glass and nails	30.20±5.17	24.03
Pharmaceuticals	Expired drugs and their containers, bottles or boxes with residues, gloves, masks, connecting tubing, and drug vials	24.20±6.00	19.26
Total		125.63±9.77	100

4.3. Quantity of medical wastes generated in the various units

The study revealed that the various types of solid medical wastes were generated by different units in the hospital and were observed to be in varying quantities (Table 4.2).

Table 4.3: Mean Solid Medical Wastes generated per month in the Sefwi Wiawso Hospital.

Types of solid medical wastes (kg)	UNITS					Total (kg)
	Theatre	Laboratory	Male and Children's ward	Female and maternity	OPD	
Sharps	2.57±0.50kg	4.37±0.83kg	6.45±0.41kg	13.77±0.09kg	3.27±0.20kg	30.43±4.45
Hazardous wastes	11.07±0.19kg	3.55±0.79kg	11.52±0.28kg	62.91±1.02kg	7.89±0.65kg	96.94±24.41
Total	13.64±0.62kg	7.91±1.62kg	17.97±0.65kg	76.69±1.10kg	11.16±0.85kg	127.27±4.45

An average waste of 127.27 ~~Kk~~kg per month was recorded during the period of study with the Ffemale and Mmaternity ward generating the highest (76.69 ~~Kk~~kg) quantity of solid medical wastes consisting of 13.77~~Kk~~kg of sharps and 62.913~~Kk~~kg of hazardous wastes (Table 4.3). From the result of Statistical analysis of the results indicated the diffidence in the means of waste generated in the various unit per months was not significant analysis, the p-value was found to be (P = 0.113) which indicate that the means are significant.

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Table 4.3: Mean Solid Medical Wastes generated per month in the SefwiWiawso Hospital.

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Types of solid medical wastes	UNITS					Total(kg)
	Theatre	Laboratory	Male and Children's ward	Female and Maternity ward	OPD	
Sharps	2.57±0.50kg	4.37±0.83kg	6.45±0.41kg	13.77±0.09kg	3.27±0.20kg	30.43±4.1
Hazardous wastes	11.07±0.19kg	3.55±0.79kg	11.52±0.28kg	62.91±1.02kg	7.89±0.65kg	96.94±24
Total	13.64±0.62kg	7.91±1.62kg	17.97±0.65kg	76.69±1.10kg	11.16±0.85kg	127.27±47

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4.4 Monthly weight of waste at the hospital

The results as shown in Figure 4.1 indicated that, November recorded the highest waste generated with 131.380 kg followed by January with 127.760 kg, whilst December had recorded the least of with 123.00kg. The analysis of the result showed that the mean state if the differences between the months were significant ($p=0.0001$).

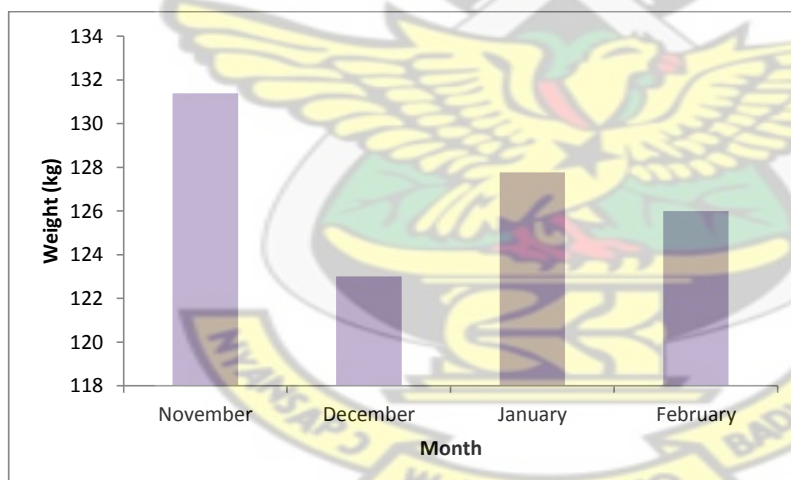


Figure 4.1: Total waste generated during the four months of the study

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~~The results (figure 4.1) indicated that, November recorded the highest waste generated with 131,380 kg followed by January with 127,760 kg. December had the least with 123,00kg.~~

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4.5:- Waste Segregation

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~~In~~ It was observed in the wards (before education on segregation) that, doctors and nurses for example, only separated sharps from other medical waste but this is not diligently followed. 'Users' of sharps sometimes left ~~ave~~ them on the hospital floor and posing this could be very dangerous to patients as well as the hospital staff.

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~~According to the proposal by WHO, (1999) and GHS (2008), hospitals have to provide plastic bags and strong plastic containers for infectious waste and containers for infectious waste should be marked with Biohazard symbol. During the period of the research, it was revealed that segregation of medical wastes into infectious medical waste and non-infectious medical waste was not carried out according to definite rules and standards proposed by the Ghana Health Service (GHS) and WHO, 1999. The hospital also does not label infectious waste with the Biohazard symbol. It was made known throughby the questionnaire respondents that only 36% of waste workers had knowledge on waste segregation.~~

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Medical waste workers were educated on the importance of segregation and how it should be done. The results showed positive acceptance of the concept and practice of segregation to a large extent as indicated in Table 4.4.

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Table 4.4: Segregation of solid medical wastes at the various units during the month of February

Types of solid medical wastes (kg)	UNITS					
	Theatre	Laboratory	Male and children's ward	Female and maternity ward	OPD	Total
Sharps	2.08±0.006 kg	3.60±0.03 kg	6.90±0.02 kg	14.70±0.03 kg	2.92±0.02kg	30.20±0.06kg
Infectious	1.260±0.006 kg	2.98±0.006 kg	9.52±0.006 kg	29.40±0.006kg	2.40±0.01kg	45.56±0.01kg
Pharmaceutical	N/A	N/A	6.80±0.0006kg	14.60±0.006kg	2.80±0.006kg	24.20±0.01kg
Pathological	7.120±0.012kg	N/A	N/A	18.55±0.006kg	N/A	25.67±0.01kg
Total	10.460±3.17kg	6.580±1.88kg	23.22±1.54kg	77.25±6.97 kg	8.12±0.26kg	125.63±9.9kg

During the month for the segregation the Female and Maternity ward generated the highest waste of 77.25kg followed by the Male and children's ward with 23.22kg while the laboratory generated the least waste of 6.58 kg as indicated in Table 4.4. The Female and Maternity wards generated the highest quantities of both infectious wastes and sharps (Table 4.4). The mean differences of the waste generated were not significant ($p = 0.8$).

4.6.1.2. Educational background of Waste Workers

Table (4.7.): Educational background of waste workers

	Frequency	Percentage
Middle school/ junior secondary	18	36
Senior secondary	10	20

<u>None formal</u>	<u>22</u>	<u>44</u>
<u>Total</u>	<u>50</u>	<u>100.0</u>

Thirty-six percent of the respondents indicated that medical waste workers at the hospital had MSLC / BECE while 20 % and 44 % had SSCE and no formal education respectively. The low levels of education obtained among the waste workers might have been the cause of non adherence to strict safety precautions and ignorant on issues relating to medical waste management.

Table (4.5): Educational background of waste workers

	<u>Frequency</u>	<u>Percentage (%)</u>
<u>Middle school/ junior secondary</u>	<u>18</u>	<u>36</u>
<u>Senior secondary</u>	<u>10</u>	<u>20</u>
<u>None formal</u>	<u>22</u>	<u>44</u>
<u>Total</u>	<u>50</u>	<u>100.0</u>

	<u>Frequency</u>	<u>Percentage (%)</u>
<u>Middle school/ junior secondary</u>	<u>18</u>	<u>36</u>
<u>Senior secondary</u>	<u>10</u>	<u>20</u>
<u>None formal</u>	<u>22</u>	<u>44</u>
<u>Total</u>	<u>50</u>	<u>100.0</u>

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4.76 Colour coding of wastes bins

During the survey, none of the hospital Solid medical waste workers interviewed at SefwiWiawso Government Hospital admitted that the hospital do practice had no knowledge on colour coding of bins for waste collection and disposal as shown in the table below.

Table 4.65: colour coding of medical waste for disposal

	Colour code bins for medical waste	Frequency	Percentage (%)
Valid	YES	50.00	100.00
	NO	50.00	100.00

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4.87- Solid Medical waste collection:

The study revealed that it was the responsibility of the wastes workers to collect and ~~dispose-dispose-off~~ all medical waste in the hospital. The waste was supposed to be collected between 5:30am to 6:30 am daily. Responses obtained from the waste workers indicated that collection was mostly done before 7:00 am (Figure 4.2). What was observed at the hospital was different. However the observational check conducted revealed that, the collection time was rather erratic. Wastes were in most cases (60%70%) collected and sent to the disposal site after 78:00am.

The medical waste workers indicatedrevealed that, at times, waste was transported late in the day when it was already in an advanced state of decomposition which may result in a nasty odour. It was also gathered that the workers collectsthe wastes in the presences of people, patients and nurses, thereby, exposing them to the infectious pathogensdiseases.



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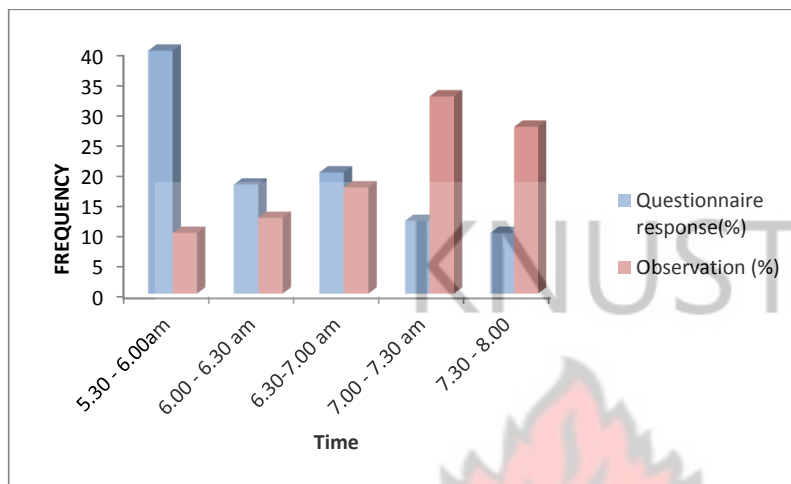


Figure 4.2: Medical waste collection time

4.98:- Storage of medical waste:

The research shows that once the wastes were generated in the various units, it was put into small bins with sharps separately in the safety boxes. The wastes in the bins were added to the general wastes which were kept in bigger bins in-front of the various units. These safety boxes were also kept in a store room for some time with the reason of getting more before sending it to the incinerator.

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4.109: Transportation of solid medical wastes in the hospital

Apart from sharps which were segregated at source and stored for some time, the other wastes were transported to the dumpsite in wheeled bins. The sharps are packed in a wheel barrow and sent to the incinerator.

4.110: Knowledge of Disposal Methods of Wastes at SefwiWiawso Hospital

Table 4.76: Disposal methods used at the available SefwiWiawso Hospital.

Methods	Frequency	Percentage
Incineration	13	26
Microwave disinfection	10	20
Chemical disinfection	7	14
Pit disposal	10	20
Land disposal	10	20
Total	50	100

It was ~~indicated~~~~revealed~~ during an interview that medical waste were treated and disposed as shown in ~~T~~able 4.76. Upon observation it was revealed that land disposal ~~method~~ was the most prevalent ~~method~~ (70%).

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Figure 4.3: Co- disposal of medical waste and domestic waste on dumpsite

4.121. Compliance to segregation and safety regulations

Safety boxes which were supposed to be filled up to the 3/4 mark were generally improvised and most of the times (62.5%) overfilled. Workers sometimes refused to put on protective clothes when handling medical wastes. Segregation of medical waste and the covering waste bins in and outside the ward were not adhered. Nevertheless compliance increase after education (Table 4.8).

Table 4.8: Compliance to segregation and safety regulations before and after education

Compliance to safety regulations ; n=16								
Compliance	Before education				After education			
	Yes	%	No	%	Yes	%	No	%
Use of protective cloth	5	31.25	11	68.75	11	68.75	5	31.25
Segregation	4	25	12	75	12	75	4	25
Filling of safety box to the ¾ mark	6	37.5	10	62.50	13	81.25	3	18.75
Covering of bins	3	18.75	13	81.25	11	68.75	5	31.25
Total	18/64	28.13	46/64	71.88	46/64	73.44	17/64	26.56

Observation of safety regulations were not at it best.

Safety boxes which were supposed to be filled up to the 3/4 mark were generally improvised and most of the times (65%) overfilled. (65%). Workers sometimes refused to put on protective clothes when handling medical wastes.



Figure 4.4: Improvised safety box over filled with sharps

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Figure 4.5: Medical waste worker, transporting sharps to the incinerator without protective clothes

4.12. Educational background of Waste Workers

Table (4.7.): Educational background of waste workers

Thirty six percent of the respondents indicated that medical waste workers at the hospital had MSLC / BECE while 20 % and 44 % had SSCE and no formal education respectively. The low levels of education obtained among the waste workers might have been the cause of non-adherence to strict safety precautions and ignorant on issues relating to medical waste management.

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4.13:- Respondents View on Reasons Main Factors Responsible For Poor

Medical Waste Management

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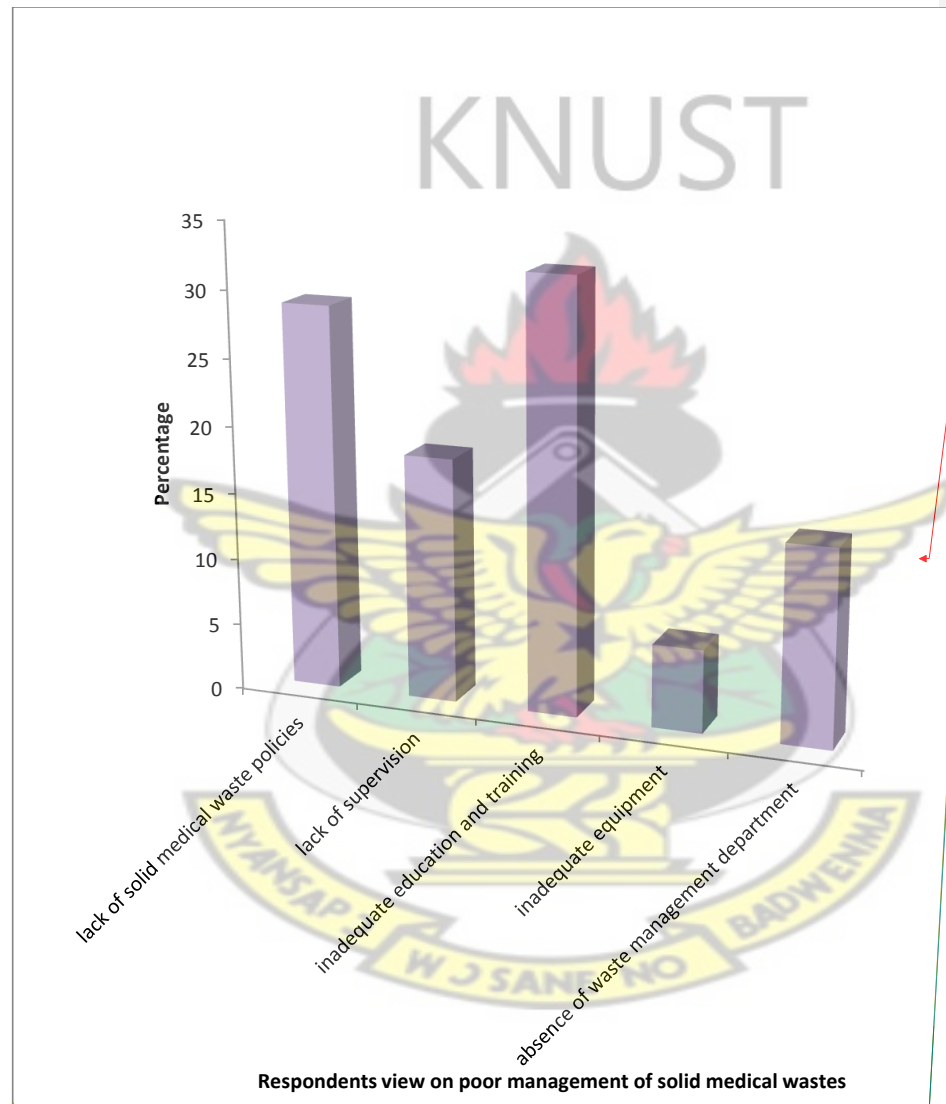


Figure 4.6: Factors associated with poor solid medical waste management in the hospital

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The study showed that, the main factors responsible for poor solid medical waste management at the SefwiWiawso Government Hospital include:

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Lack of policies: The hospital does not have a ~~adequateny~~ policy ~~onand~~ wastes management programme for managing solid medical wastes and other domestic wastes. There were also no policies and guidelines regarding the recycling of medical waste products.

Lack of supervision: There was no supervision on how medical waste should be managed. Management of medical waste was left in the hands of the waste workers.

Inadequate education: Most medical waste workers did not have formal education (table 4.7) and no in service training regarding medical waste management.

Inadequate equipment: These include protective equipment and others such as safety boxes and waste bins.

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Absence of waste management department: There was no waste management department and therefore no officer in charge of monitoring and supervising medical waste management practices during the period of the study.

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CHAPTER FIVE

DISCUSSION

Hospitals consist of several functional units (clinical laboratories, emergency rooms and surgery) comprises providing a of wide range of services and functional units which including diagnostic and treatment services, functions such as clinical

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~~laboratories, emergency rooms and surgery.~~ Other functions of the hospital are administrative, food services and out-patient related functions. These should be fundamental in patient care or bed-related functions (F. Carr, 2011).

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5.1 Patient attendance at the ~~H~~hospital ~~Infra~~structure.

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Though the hospital attends to an average of ~~only~~ two hundred and fifty patients a day, the infrastructure ~~was found to be~~ inadequate.

Owing to this, the hospital's three main blocks ~~which were to be used as wards (male and female), pharmacy and OPD~~ are currently used for other purposes apart from what they were meant for. Part of the male and female wards are now used ~~as for children's~~ and maternity wards respectively. The pharmacy block also accommodates the laboratory while part of the OPD now serves as consulting rooms and ~~at the theatre~~. have been divided into male and children's ward, female and maternity ward, OPD, laboratory and theatre. Please provide average rooms/capacity per block to prove the point

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The hospital wards which were designed to take a total number of eighty beds currently take ~~s~~ one hundred and ten beds with other patients sleeping on the floor.

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~~Disease~~ This can result in hospital-acquired infections (nosocomial infections) where patients and their attendants may contract infections caused by airborne pathogens or spores which may remain in the air within the wards for a long period (Manyele, 2004) or lead to occupational health hazards as a result of congestion which may impede free movement. ~~Patients and their attendants may contract infections~~

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~~caused by airborne pathogen or spores which may remain in the air within the wards for a long period~~ Manyele (2004).

5.2. ~~Quantity and Quantity and~~ Composition of solid medical wastes generated in the hospital

It was observed that the wastes were generated mainly ~~during in the~~ diagnosis, treatment, and immunization of patients. The ~~following~~ categories of solid medical wastes ~~were~~ identified ~~(conforms to the types of solid medical waste identified by WHO (2011) and these include: :-~~ pathological, infectious and ~~non-non~~ infectious wastes, sharps, pharmaceuticals and others which were considered ~~by who?????)~~ to be hazardous wastes (GHS, 2008). The pathological wastes consisted ~~of~~ ~~tutted~~ human body parts removed during surgery or autopsy which includes tissues and organs. Foetus, placentas, and blood, which resulted due to stillbirths, were also identified in the hospital ~~and these are usual constituents of pathological waste~~ (Periisset *et al.*, 1999).

Infectious wastes ~~which was the highest waste generated (45.56Kkg) identified~~ ~~was~~ ~~ere~~ considered to be those that were associated with humans known to be infected with highly contagious diseases. These included ~~d~~ wastes from surgeries and autopsy that were in contact with infectious wastes such as sponges, soiled dressings, cotton wool, surgical gloves, and swabs. Sharps ~~generated from the hospital~~

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consisted of hypodermic needles and syringes, intravenous needles and tubing as well as scalpels and lancets, also generated from the hospital.

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Infectious waste was the highest because they were generated in all the units of the hospital and also represent the majority of the hazardous waste, up to 15% of the total waste from health-care activities (WHO, 2012).

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Pharmaceutical wastes were made up of expired drugs and their containers, bottles or boxes with residues, gloves, masks, connecting tubing, and drug vials as indicated in

Table 4.2. Pharmaceutical waste was the least generated (24.20 Kg) and this could

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be attributed to the fact that most drugs are given when patients are discharged and

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the light weight of some pharmaceutical waste.

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Which of the categories is more and why? (ref)

Are the wastes expected in a hospital? Give some supporting references to that

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5.3:- Mean Solid Medical Wastes generated at the various units of the SefwiWiawso Hospital.

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The (highest) quantity of waste (76.69 Kg) generated was from the maternity ward and may be attributed to the high number of patients attendance recorded in the ward during the period (Table 4. 1) and other services such as delivery (Abor (2007)). Male and children's wards as indicated in Table 4.3 generated a significant quantity of wastes, but not as much as the female and maternity.

Laboratory generated the least amount of wastes. The difference in the means of total waste generated per month was not significant ($P=0.113$) due to the type of waste generated in the various units and the number of people who visited a particular unit in the hospital during period of the study. The above observation confirms with the earlier study made by Abor, (2007) indicating that the amount of waste

generated in hospitals depends upon various factors such as number of beds, types of health services provided, economic, social and cultural status of the patients.

~~How does delivery contribute, any reference~~

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5.4 Monthly weight of waste at the various units

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~~The~~It was recorded during the first month of study (November) ~~recorded the highest amount of waste generated, that~~ during this month, the female and maternity unit generated the highest waste with the laboratory generating the least. This observation was as a result of high female patients' attendance on admission and other services such as delivery for the month of November. The average number of delivery at the hospital per day ~~was~~ six, of which each generates between 3860g and 1000g of placenta ~~(ref(Geater et al., 2006))~~. Other infectious wastes such as swabs, soiled clothes, and sanitary towels among others are generated in both the maternity and the female wards.

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~~The month of December recorded the least waste generated. This could be attributed to the Christmas festivities with it public holidays which resulted in very few people visiting the hospital.~~

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January recorded the second highest waste generated for the ~~period. This could also be as result of people resuming to their usual way of living after the Christmas holiday~~ period while the month of December recorded the least waste generated.

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The mean differences of waste generated between the months were ~~signisigant~~ significant ($p\text{-value} = 0.0001$) and could be attributed to rate of infections ~~in the wet~~ which are generally high during wet months compared to the ~~and dry~~ seasons drier months (Fockset al, 1995).

During the dry season there is a reduction in infections especially ~~that of those related to water~~; mosquitoes and ticks ~~which~~ can desiccate easily and ~~thus~~ their survival decreases under dry conditions resulting in very few people visiting the hospital (Hales *et al.*, 2002).

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5.5 Waste segregation ~~after education~~

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According to the proposal by WHO (1999) and GHS (2008), hospitals have to provide plastic bags and strong plastic containers for infectious waste. Containers for infectious waste should be marked with Biohazard symbols (Priisset *al.*, 1999). During the period of the study ~~research~~, it was revealed that segregation of medical wastes into infectious medical waste and non-infectious medical waste was not carried out according to definite rules and standards proposed by the Ghana Health Service (2008 GHS) and WHO (1999). Only sharps were segregated from the other wastes.

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The study showed that about 64.0 % ~~and 40 %~~ of wastes workers ~~and generators~~ respectively do not have any knowledge on segregation and therefore ~~does~~ not segregate medical wastes into different categories while 36.0 % ~~of workers~~ generators do have but do not segregate at the point of source. This could be attributed to ~~lack of medical waste education and~~ low educational level of waste workers ~~and lack of medical waste education~~. Compliance to segregation increased to about 75% after education in both workers and generators (Table 4.8).

Here I think it has to do with the waste generators mor than the waste workers, please
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5.6 Disposal and Treatment Methods of Wastes at SefwiWiawso Hospital

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The final disposal of the solid medical waste generated in the hospital was done by the untrained wastes workers without any supervision.

The main disposal methods used in the final disposal site of solid medical waste was dumping-site and incineration as indicated in Figure 4.3 and table 4.6. Wastes from hospitals were collected from the point by wastes workers. Infectious and non-infectious wastes were disposed of using the land disposal method. The above observation in the hospital confirms to work by with—Diaz *et al* (2005) who indicated that the that most common treatment and disposal methods utilized in the management of medical wastes in developing countries include microwave disinfection systems; chemical disinfections; combustion (incineration); and disposal on land (dump site, controlled landfill, pits and sanitary landfill). The hospital during the time of the study did not have a subcommittee to monitor how the waste is should be managed and therefore no treatment ofs were given to the wastes was carried out prior to its final disposal.

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5.7 Educational Level of Waste Workers

Formal education and training of medical waste workers are very important for the proper management of medical waste (WHO 2004). This provides initial awareness on the risks associated to their work and safety practices that should be ensured.

The solid medical waste management task at the Sefwi Wiawso hospital is directly under the supervisor of the Hospital Administrator. Out of five medical waste workers in the hospital it is only one who has obtained Middle School Leaving Certificate (MSLC). The waste management workers have not received any formal training with regard to medical waste management since employed. Staff members were also not given any training on the effects of infectious wastes and were consequently unaware of the environmental health impacts of medical waste. Lack of proper training in the hospital with respect to waste management poses serious risks to the personnel as far as the hazards of hospital waste is concerned. The process of collection, segregation, and disposal of hospital wastes were not performed according to WHO's recommended standards (WHO, 2011), hence patients, visitors, society and the entire environment are exposed to the dangers of such wastes. The non-adherence to strict safety precautions and ignorant on issues relating to medical waste management might have been the results of low level of education of medical waste workers (Table 4.5). This observation was also made by Abor 2007 and therefore considered low level of education of workers as one of the factors contributing to poor medical waste management.

Provide some literature to support

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5.8 Time of waste collection

Collection of medical waste was erratic due to inadequate medical waste workers who work through the year with no leave. These workers sometimes get exhausted after a particular day's work and come to work late for the next day's activities which sometimes lead to the decomposition of the waste before disposal(WHO,2004).

Provide some literature to support

5.9 Chain of collection and disposal

For the reason that safety boxes were most of the times too full, some eventually drop over which endangered the health of the workers, as they were exposed to pricks and cuts.

It was also observed that waste collected from the wards and other units were put into larger dustbins which are kept in an open space in-front of the various units. This situation in the wards introduces flies which are effective carriers of sanitation-related diseases.

The staff interviewed at the hospital said that scavengers and domestic animals have access to the waste. Storage of waste was not secure and it was revealed that once in

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a while some infectious wastes, such as swabs and sanitary towels were found strewn near the bins in the morning. Dogs and crows could have access to these thereby, endangering their health which may expose people to health hazards. This act violates the proposal by WHO (2004), in the healthcare waste management manual of Pakistan which states that waste should not be stored over a certain period of time depending on the temperature of the storage area to avoid decomposition before disposal.

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5.10 Factors Responsible for poor management of solid medical waste

Medical Waste Management Policies and Regulations

The WHO in the year 2000 outlined some national policies for healthcare waste which include;

- ❖ Development of a national policy framework stating that the management of waste is part of the health-care system, and those health-care service providers should be assigned legal and financial responsibility for safe waste management and should manage their waste with duty of care.
- ❖ Allocation of sufficient human and financial resources
- ❖ Integration of waste minimization into national purchasing policies
- ❖ Segregation of waste into harmful and non-harmful categories

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❖ Routine monitoring of impact through process indicators (number of health-care establishments with safe waste management systems) and outcome indicators (e.g. number of accidents involving healthcare waste).

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At the SefwiWiawso Government Hospital There were no clear policies in place for managing medical waste and for purchasing the necessary equipment needed to provide the facility with the correct management of medical wastes.

The absence of these policies ~~led to the absence of~~ waste management plan is accountable for lack of colour coding and for that matter no segregation of waste, with little emphasis on sharps.

Other Factors Responsible for poor management of solid medical waste

These include Lack of supervision which led to workers coming to work late with no strict adherence to waste segregation thereby mixing medical waste with domestic waste.

Can you mention a few important policies and state how they improve efficiency etc with refs

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Lack of supervision: This also led to workers coming to work late with and no strict adherence to waste segregation thereby mixing medical waste with domestic waste.

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Inadequate education: This made the workers ignorant about issues in medical waste management and therefore handled medical waste carelessly which put them at a risk

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~~of getting infections through pricks, cuts and other occupational hazards(~~WHO 2012).

~~Inadequate equipment:~~According to the WHO (2012)basic requirements for the management of medical waste include theavailability of equipment.Workers at the Hospital sometimes took the risk of working with no protective clothes because these were inadequate.It also resulted in the use of improvised safety boxes and wastes.bins.

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~~Absence of waste management department:~~The WHO in 2012 again made mentioned that there should be a designatedauthority to ensure proper implementation of medical waste management processes.

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~~Due to the absence of waste management department,~~The hospital ~~was~~does not keepinghave records on the quantity of waste generated in the hospital.

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There were no regular report about how medical waste management was practiced and the process of performing respective studies was also not reported.

~~There were however no policies and guidelines regarding the recycling of medical waste products~~

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5.110 Impact on the environment and public health

~~The above method of medical~~ Medical waste management ~~in the Sewi Wiawso~~ Government Hospital may impact negatively on ~~both~~ the environment ~~and public health~~ due to the fact that:

÷

- Pollutants from medical waste ~~(e.g. heavy metals and PCBs)~~ are persistent in the environment

~~and Toxic chemicals from waste~~ may accumulate ~~with~~ in soil which can affect soil microbial population reducing ~~the rate of~~ decomposition ~~rate and , and generally lowering the~~ soil fertility. Pollutants from medical waste also contaminate ground water through percolation.

•

Also the dumping Combination of both degradable and non-degradable waste increase the rate of habitat destruction due the reduction in water percolation into the soil by non-degradable plastic waste which can affect plant growth, ~~to the increase in~~ number of sites necessary for disposal of wastes and also allows grazing of domestic animals on dumps, which have an added risk of reintroducing pathogenic micro-organisms into the food chain.

- ~~(degradation of habitat)~~

- ~~Non degradable plastic wastes may reduce the chance for water percolation into the soil during precipitation.~~

Finally the open air burning of the waste on the dumpsite does not guarantee proper incineration, and releases toxic fumes (dioxin) into the atmosphere from the burning of plastics i.e., PCB's. (WHO, 1999).

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5.11: Impacts on public health

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~~Poor management of medical waste could also have negative impact on the health of the public as well as that of the hospital staff. This is through:~~

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- ~~• The distribution of pathogens by rodents and insects that come in contact with unsafely stored waste~~
- ~~• Contamination of ground water when pathogens from the unlined pit travel into nearby water bodies leading to a decrease in water quality.~~
- ~~• Grazing of domestic animals in open dumps, which have an added risk of reintroducing pathogenic micro-organisms into the food chain.~~

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CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

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6.1- Conclusion

~~It was observed that wastes were generated mainly in the diagnosis, treatment, and immunization of patients.~~ The main types of solid medical waste generated were pathological, infectious, sharps and pharmaceuticals wastes.

~~The study revealed that the process of collection, segregation, and disposal of hospital wastes were not carried out according to WHO's recommended standards, hence patients, visitors, society and the entire environment were exposed to the dangers of such wastes.~~

~~It was~~The studyshowshown ed that 64.0 % ~~and 40%~~ of wastes workers ~~and generators respectively~~ do not have any knowledge on segregation and therefore were not segregating medical wastes into different categories while 36.0 % ~~and 60%~~ had knowledge but did not segregate at the point of source. ~~This could be attributed to low educational level of waste workers and inadequate medical waste education.~~ Knowledge on the segregation of waste increased from 36% to 75.50 % ~~in both among~~ waste workers ~~and generators~~after education, even though it was done under monitoring.

~~The main disposal methods used in the final disposal of infectious waste were dump site and incineration~~

~~The study revealed that the process of collection, segregation, and disposal of hospital wastes were not carried out according to WHO's recommended standards, hence patients, visitors, society and the entire environment are exposed to the dangers of such wastes.~~

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~~It was also observed that waste collected from the wards and other units were put into larger dustbins which are kept in an open space in front of the various units. This situation in the wards introduces flies which are effective carriers of sanitation-related diseases.~~ It was also observed that all the wastes workers at the Hospital collects the wastes in the presences of people, patients and nurses which may expose them to the infectious diseases.

To conclude medical wastes were not managed effectively during the time of study at SefwiWiaso Government Hospital.

6.2 Recommendations

Based on the findings of this study, the following recommendations are made to improve the medical waste management in SefwiWiawso Government Hospital:

1. Proper waste management ~~plan~~strategy is needed to ensure health and environmental safety from medical waste by introducing an environmental department.
2. Segregation of medical waste should be done at the point of generation.
3. Different coloured bags/ bins should be used for collection of hazardous and non-hazardous waste.

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4. Safety ~~precautions~~rotection must be taken in handling hazardous waste.
Gloves, masks, aprons, etc. must be used during handling of medical waste.
5. Training programme on safe handling of medical waste should be organised for medical staff.

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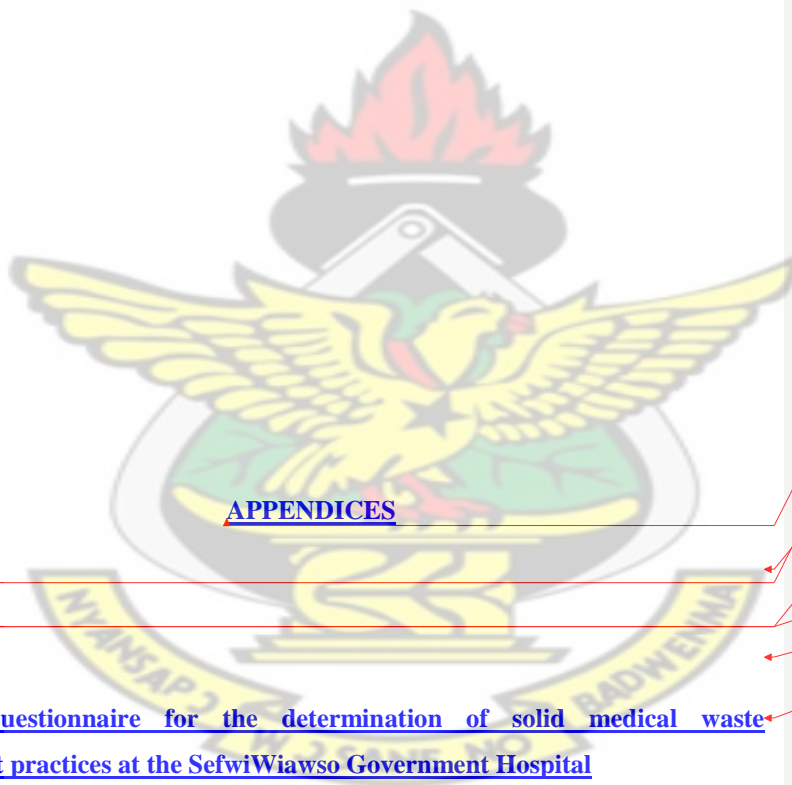
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APPENDICES

Appendix A

Research questionnaire for the determination of solid medical waste management practices at the SefwiWiawso Government Hospital

Questionnaire for professional staff of the hospital

1. Which unit do you work?

a. Theatre

b. Laboratory

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- c. Pharmacy
- d. Mortuary
- e. Female and maternity ward
- f. Male and children's ward
- g. Out- patient department (OPD)

2. What is the educational background of staff in charge of medical waste management at the hospital?

- a. Primary school
- b. Middle school / junior secondary
- c. Secondary School
- d. Tertiary
- e. None of the above

3. What are the major types of waste generated in the unit?

- a. Infectious
- b. Sharps
- c. Pharmaceutical
- d. Pathological
- e. Non infectious

4. Do you maintain a register for waste disposal?

- a. Yes
- b. No

5. Are there clearly defined procedures for the collection and handling of from specified unit in the hospital?

- a. Yes
- b. No

6. Are medical waste segregated into different categories?

- a. Yes
- b. No

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7. If yes who does the segregation?

- a. Doctor
- b. Nurses
- c. Auxiliary staff
- d. Cleaners
- e. Do not know

8. Does your waste management procedures involve the following:

- i. Identification of waste type
- ii. Separation of non-infectious waste from infectious wastes
- iii. Packaging
- iv. Transferring all waste bags on wheeled containers and using utility gloves when dealing with broken bags and waste and then decontaminate them.
 - a. Yes
 - b. No

9. Do you colour code the medical waste for disposal?

- a. Yes
- b. No

10. What facilities are available for waste management

- a. Autoclave
- b. Incinerator
- c. Microwave disinfection system
- d. Disposal site
- e. Burial
- f. Deep burial
- g. Burning

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11. How do you dispose off non- infectious wastes?

a. Land disposal and burning

b. Burial

c. Incineration

12. How do you dispose-off infectious wastes?

a. Land disposal and burning

b. Burial

c. Incineration

13. Is the infectious waste labelled with the bio-hazardous symbol?

a. Yes

b. No

14. Do you have disposal sub-committees in different units to monitor disposal of medical waste?

a. Yes

b. No

15. How often does the hospital train waste management staff?

a. 1-3 months

b. 4-6 months

c. 7-9 months

d. 10-12 months

e. 1-2 years

f. None of the above

16. What problems do you encounter in managing medical waste?

a. Lack of definite policies and budget allocated at the national and hospital level regarding hospital waste management

b. Inadequate training of waste management personnel of the hospital

c. Mixing of hazardous waste with domestic waste of the hospital

d. Poor supervision on the collection and disposal of waste

e. Inadequate protective equipment for waste collection

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17. Is there a manual or guideline document on management of hospital waste available at the SefwiWiawso Government Hospital

a. Yes

b. No

18. If yes give the title of the document

.....

19. Does the hospital have waste management plan

a. Yes

b. No

20. Are there waste management responsibilities included in the job description of the hospital supervisory staff (Head of department, nursing superintendent, pharmacist, laboratory supervisor etc)

a. Yes

b. No

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Appendix B

Questionnaire for cleaners

1. What department are you working in the hospital?
2. How many waste workers are in your department?
3. How long have been working in the department?
4. Have you received any training? Yes ☐ No ☐
5. If yes how many training have you undergo?
6. If yes what kind of training have you received?
.....
7. What is the period? One month ☐ two month ☐ three month ☐
if others specify.....
8. How often do you collect the waste? Everyday ☐ Every ☐ two days ☐ Every ☐
three days ☐ week ☐
Others please specify.....

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9. At what time of the day do you collect the waste? 5:30-6.00 am ☐ 6- 630am ☐ 6.30-700am ☐ 7- 00am ☐ : 00 am ☐ Others please ☐
specify.....

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10. Is the waste segregated (separated) at the point of collection? Yes ☐ No ☐

11. If yes how is it segregated?

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12. Are the bins covered? Yes ☐ No ☐

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13. Where do you dispose off waste?

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14. What are some of the challenges encountered in handling waste?

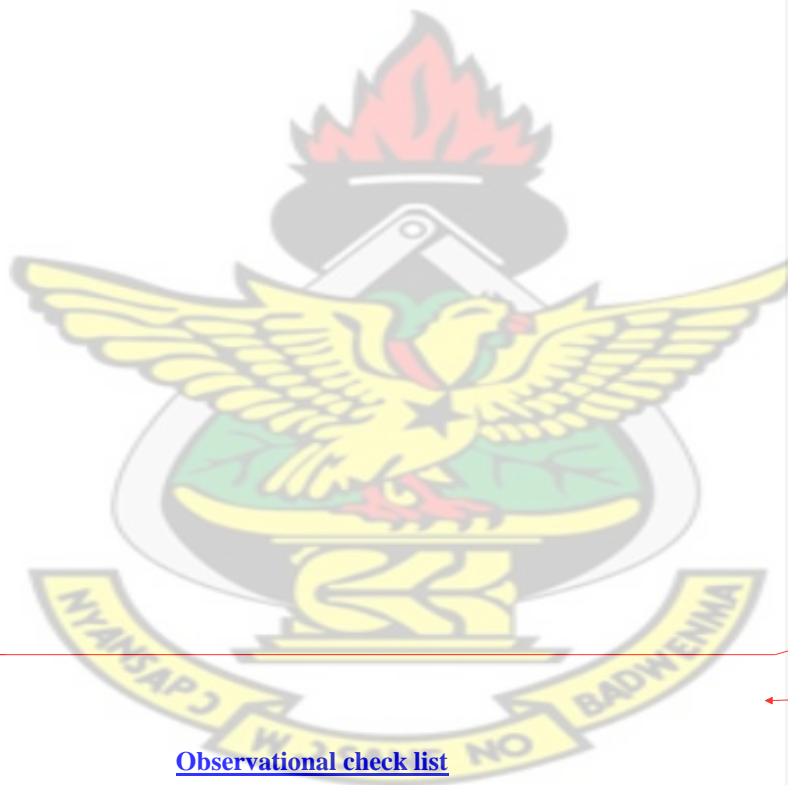
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AppendixC

Observational check list

1. Workers use of protective clothes Yes ☐ No ☐
2. Appropriate time for waste collection Yes ☐ No ☐
3. Adherence to segregation Yes ☐ No ☐
4. Safety box filled to the $\frac{3}{4}$ mark Yes ☐ No ☐

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5. Bins covered Yes ☐ No ☐

6. Wastes workers punctuality to work Yes ☐ No ☐

7. Disposal method. Land ☐ pit ☐ incineration ☐ microwave ☐
disinfection chemical disinfection ☐

8. Records on wastes generated Yes ☐ No ☐

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AppendixD

QUESTIONNAIRE RESPONSES

Educational level of medical waste workers at the hospital

	<u>Frequency</u>	<u>Percentage</u>
<u>Middle school/ junior secondary</u>	<u>18</u>	<u>36</u>
Senior secondary	10	20
<u>Senior secondary</u>	<u>10</u>	<u>20</u>
<u>None formal</u>	<u>22</u>	<u>44</u>
<u>Total</u>	<u>50</u>	<u>100.0</u>

How often does the hospital train waste management staff

	<u>Frequency</u>	<u>Percent</u>
<u>1-2 years</u>	<u>26</u>	<u>52.0</u>
<u>none of the above</u>	<u>24</u>	<u>48.0</u>
<u>Total</u>	<u>50</u>	<u>100.0</u>

What are the major types of medical waste generated in the hospital?

	<u>Frequency</u>	<u>Percent</u>
<u>Infectious</u>	<u>17</u>	<u>34.0</u>
<u>sharps</u>	<u>13</u>	<u>26.0</u>
<u>Pharmaceutical</u>	<u>10</u>	<u>20.0</u>
<u>Pathological</u>	<u>3</u>	<u>6.0</u>

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<u>Non infectious</u>	<u>7</u>	<u>14.0</u>
<u>Total</u>	<u>50</u>	<u>100.0</u>

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Knowledge on segregation

<u>Are medical waste segregated</u>	<u>Frequency</u>	<u>Percent</u>
<u>Yes</u>	<u>18</u>	<u>36.0</u>
<u>No</u>	<u>32</u>	<u>64.0</u>
<u>Total</u>	<u>50</u>	<u>100.0</u>

4.7.4 Facilities available

<u>Facilities</u>	<u>Frequency</u>	<u>Percent</u>
<u>Incinerator</u>	<u>13</u>	<u>26</u>
<u>Microwave disinfection</u>	<u>10</u>	<u>20</u>
<u>Chemical disinfection</u>	<u>7</u>	<u>14</u>
<u>Pit</u>	<u>10</u>	<u>20</u>

<u>Facilities</u>	<u>Frequency</u>	<u>Percent</u>
<u>Incinerator</u>	<u>13</u>	<u>26</u>
<u>Microwave disinfection</u>	<u>10</u>	<u>20</u>
<u>Chemical disinfection</u>	<u>7</u>	<u>14</u>

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<u>Pit</u>	<u>10</u>	<u>20</u>
<u>Land disposal</u>	<u>10</u>	<u>20</u>
<u>Total</u>	<u>50</u>	<u>100</u>

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AppendixE

ANALYTICAL RESULTS

Mean differences within a month (November)

<u>Parameter</u>	<u>-</u>
<u>Table Analyzed</u>	<u>Data 1</u>
<u>Column B</u>	<u>sharps</u>
<u>vs</u>	<u>vs</u>
<u>Column C</u>	<u>hazardous waste</u>
<u>-</u>	<u>-</u>
<u>Paired t test</u>	<u>-</u>
<u>P value</u>	<u>0.1133</u>
<u>P value summary</u>	<u>ns</u>
<u>Are means signif. different? (P < 0.05)</u>	<u>No</u>
<u>One- or two-tailed P value?</u>	<u>Two-tailed</u>
<u>t, df</u>	<u>t=1.918 df=5</u>
<u>Number of pairs</u>	<u>6</u>
<u>-</u>	<u>-</u>
<u>How big is the difference?</u>	<u>-</u>
<u>Mean of differences</u>	<u>-22.41</u>
<u>95% confidence interval</u>	<u>-52.46 to 7.638</u>
<u>R squared</u>	<u>0.4238</u>
<u>-</u>	<u>-</u>
<u>How effective was the pairing?</u>	<u>-</u>
<u>Correlation coefficient (r)</u>	<u>0.9603</u>
<u>P Value (one tailed)</u>	<u>0.0012</u>
<u>P value summary</u>	<u>**</u>

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<u>Was the pairing significantly effective?</u>	<u>Yes</u>
<u>Mean differences within a month (December)</u>	
<u>Parameter</u>	-
<u>Table Analyzed</u>	<u>Data 1</u>
<u>Column B</u>	<u>sharps</u>
<u>vs</u>	<u>vs</u>
<u>Column C</u>	<u>hazardous waste</u>
<u>Paired t test</u>	-
<u>P value</u>	<u>0.1134</u>
<u>P value summary</u>	<u>ns</u>
<u>Are means signif. different? (P < 0.05)</u>	<u>No</u>
<u>One- or two-tailed P value?</u>	<u>Two-tailed</u>
<u>t, df</u>	<u>t=1.917 df=5</u>
<u>Number of pairs</u>	<u>6</u>
<u>How big is the difference?</u>	-
<u>Mean of differences</u>	<u>-21.71</u>
<u>95% confidence interval</u>	<u>-50.84 to 7.411</u>
<u>R squared</u>	<u>0.4236</u>
<u>How effective was the pairing?</u>	-
<u>Correlation coefficient (r)</u>	<u>0.9644</u>
<u>P Value (one tailed)</u>	<u>0.0009</u>
<u>P value summary</u>	<u>***</u>
<u>Was the pairing significantly effective?</u>	<u>Yes</u>

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