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WASTE SEGREGATION PRACTICES IN HEALTH FACILITIES IN AKUAPEM NORTH MUNICIPALITY

BY

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SEPTEMBER, 2020

DECLARATION

I hereby declare that this Dissertation is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Name:

Candidate's Signature……. Date:……

Supervisor's Declaration

I hereby declare that the preparation and presentation of the Dissertation were supervised in accordance with the guidelines on supervision of project work laid down by the Presbyterian University College, Ghana

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Supervisor's Signature :……. Date :……..

ABSTRACT

The desire of international organizations and governments to ensure health care waste from our various health care facilities are properly sorted and segregated is enormous. As a result, different policy programs have been rolled out from sectorial ministries and departments to ensure this noble agenda is achieved. However, it appears the efforts and resources deployed by government and other foreign donors are not yielding the desired outcomes. As a result, the researcher sought to evaluate the awareness level of health care workers on the policies on waste segregation practice under the ministry of health policy guidelines on waste management in Akuapem North municipality. The overall aim of the study is to examine the state of existing waste segregation practices employed by the health care facilities within the Akuapem North municipality as well as the efficiency level of the segregation. This became very necessary due to the likely outbreak of diseases which will adversely affect public health when health care waste is not properly segregated. The methodology used were descriptive design which was used to study the level of awareness of health care workers on the color-coding system as well as the existing health care waste segregation practices, however experimental design was used to study the level of efficiency of the segregation at health facilities. The statistical package for social scientists (SPSS) 20th version as well as Microsoft excel was used for data analysis. From the findings of the study, it was also evident most of the health care workers are ignorant of the need for waste segregation

hence they do not practice it, the few ones who practice it, only segregate the waste at the various units but end up mixing them up with other wastes at the end of the day.

I recommend that, supervisory ministries should enforce the guidelines of the ministry of health policy on managing waste at the various health facilities.

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DEDICATION

To my lovely wife Mrs. Linda Agyeibea Ofori Appiah for her support and love and to my wonderful kids Jayden Ottopah Appiah, Jasmine Oparebea Appiah and Jayson Otutu-Larbi Appiah.

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INTRODUCTION

1.1 Background to the Study

Management of health care waste has become a global issue, especially in developing countries like Ghana due to the effects and impacts it has on society and the Nation as a whole if not properly

managed. Improper management and disposal of these wastes can affect a chain of people including, healthcare workers (paramedics and janitors), waste management handlers (contractors), the communities which live in and around land fill sites etc. Waste generated by health care activities includes a broad range of materials from used needles and syringes to soiled dressings, body parts, diagnostic samples, blood, chemicals etc. These wastes must be treated after segregation before it ends up at the final disposal site. These harmful wastes if not properly segregated at source and treated; have the tendency to cause infections to contact persons, air pollution if just dump in pits and burnt, contaminating our rivers and water bodies when dumped at final disposal sites without treatment, eventually causing a major health risk for all.

According to the World Health Organization (2014) all the waste generated within health-care facilities, research centres and laboratories related to medical procedures have a high tendency of causing harm if not properly treated and managed. In addition, the same types of waste originating from minor and scattered sources, including waste produced in the course of health care undertaken in the home (e.g. home dialysis, self-administration of insulin, recuperative care) should also be considered highly in dealing with the appropriate means and approaches in managing such waste. Most often attention is only given to waste generated in the course of health delivery at health centre ignoring the potential harm of home care delivering wastes The nature of pollutants can be classified as biological, chemical and radioactive. (WHO 2014). Environmental problems can arise from the mere generation of medical waste and from the process of handling, treatment and disposal.

Worldwide, an estimated 16 billion injections are administered every year. Not all needles and syringes are disposed of safely, creating a risk of injury and infection and opportunities for reuse.

(WHO/UNICEF,2015). In 2010, unsafe injections were still responsible for as many as 33, 800 new HIV infections, 1.7 million hepatitis B infections and 315 000 hepatitis C infections. *(*Pépin, Chakra, Pépin, Nault, & Valiquette,2010). A person who experiences one needle stick injury from a needle used on an infected source patient has risks of 30%, 1.8%, and 0.3% respectively of becoming infected with HBV, HCV and HIV. Additional hazards occur from scavenging at waste disposal sites and during the handling and manual sorting of hazardous waste from health-care facilities. These practices are common in many regions of the world, especially in low- and middle-income countries like Ghana. The waste handlers are at immediate risk of needle-stick injuries and exposure to toxic or infectious materials. (WHO, 2018**).**

Researchers have estimated between 75% and 90% of the waste produced by health-care providers is comparable to domestic waste and usually called "non-hazardous" or "general health-care waste". It comes mostly from the administrative, kitchen and housekeeping functions at health-care facilities and may also include packaging waste and waste generated during maintenance of health-care buildings. The remaining 10–25% of health-care waste is regarded as "hazardous" and may pose a variety of environmental and health risks (WHO, 2014). Similarly, when health care waste is properly segregated, 85% or more of healthcare wastes are general waste with the same risk as domestic solid waste. Typical breakdown of healthcare waste puts chemical/radioactive (hazardous) waste at 5% of total waste generation, infectious (hazardous) at 10% and general or non-hazardous at 85% of total waste generated (UNDP/WHO, 2012). High-income countries generate on average up to 0.5 kg of hazardous waste per hospital bed per day; while low-income countries generate on average 0.2 kg. However, health-care waste is often not separated into

hazardous or non-hazardous wastes in low-income countries like Ghana making the real quantity of hazardous waste much higher. (WHO, 2018).

Some health care facilities may either practice one of the following to treat their wastes after effective and efficient segregation: incineration, autoclaves, mechanical/chemical disinfection, microwave, irradiation, vitrification are among some treatment procedures worldwide. Incineration is the controlled burning of the medical waste in a dedicated incinerator. Among industry professionals, these units are often referred to as hospital/medical/infectious waste incinerators (HMIWIs). Autoclaves are closed chambers that apply heat and sometimes pressure and steam, over a period of time to sterilize medical equipment. Autoclaves have been used for a century to sterilize medical instruments for re-use. Surgical knives and clamps, for instance, are put in autoclaves for sterilization. (https://www.malsparo.com/autoclave.htm)

Mechanical processing can be grinding, shredding, and/or compacting Mechanical treatment does not kill pathogens or disinfect equipment, but it can reduce waste volume in preparation of further treatment or disposal. Equipment involved can include crushers and milling machines. Mechanical shattering or splintering of waste can also alter its appearance, which can be useful in lessening the psychological impact of the waste on human observers (https://www.malsparo.com/treat2.htm)

The cost component of managing medical waste is also burden on many health facilities, according to Zafar (2019), Medical waste management is a concern of healthcare facilities all over the world; about 10-20% of the facility's budget every year is spent on waste disposal. As cited in his paper, according to the WHO, about 85% of the total amount of generated waste is non-hazardous but the remaining 15% is considered infectious, toxic or radioactive. The only means to ensure proper

waste management at the health centres in Ghana is to effectively and efficiently segregate waste at the point of generation.

In Ghana, there is a national policy on the management of medical waste in health centres in designed by the Ministry of Health published in March 2006 which guides and directs health institutions and facilities on the appropriate means and methods to manage such waste so as to safeguard the environment and protect the general public. It also comes with an implementation and supervision plan for all levels. For purposes of this study, the district health centre's implementation will be carried out by the District Health Management Team (DHMT) (Ministry of Health Policy and Guidelines for Health Institutions,2006).

The policy gives guidelines on the management of healthcare waste from the point of generation to the final disposal site. It critically spells out the ideal management from generation, segregation of healthcare waste into appropriate color-coded containers, internal storage, packaging and labelling, internal transportation, transportation to treatment plant, treatment and final disposal. At the point of segregation, Black container is for the storage of general waste including kitchen, paper, sweeping waste etc. Yellow container for infectious waste including sharps, patient waste, cultures or specimens with the biohazard label, and radioactive waste with the radioactive symbol. Red container for pathological waste including human and animal tissue, limbs, foetus or highly infectious waste. Brown container also for the storage of hazardous waste including expired drugs, vaccines and chemicals. Although the Akuapem North Municipality can boast of a number of health facilities including the Tetteh Quarshie Memorial Hospital, Medicas hospital, Centre for Plant Medicine Research hospital and a host of clinics, how these facilities segregate their medical waste must be considered.

1.2 Statement of the Problem

Poor segregation of medical waste at source in health facilities have the tendency to affect public health and cause an epidemic. As a result, many researches and studies have been done currently on the segregation and management of medical waste within Ghana and Akuapem North in particular. For instance, according to Amfo-Otu (2018) who studied "Hospital Solid Waste Management Practices in the Eastern Region", hospital solid waste management activities could best be described as below standard. The hospital solid waste storage, segregation or separation were all not properly done to ensure a safe working environment for the staff, patients and caregivers. This raises a serious concern for public health due to the sensitive nature of medical waste which has the potential of causing an epidemic in and around the Municipality. Health centres within the municipality do not strictly adhere to the ministry of health policy guidelines on medical waste management as well as the Legislative Instrument on waste segregation and disposal through the use of the color-coding system. There is no evidence or document to support health personnel in the municipality having knowledge of the effective and efficient way of segregating medical waste as well as their understanding of the color-coding system. This research sought to identify segregation practices of health centres within Akuapem North Municipality and their adherence to policy guidelines regulating the segregation of medical waste so as to fill the knowledge gap.

1.3 **Purpose of the study**

This study seeks to identify the waste segregation practices of health centres within Akuapem North municipality and to outline or bring to bear the negative impacts poor segregation of medical waste has on public health. This study will also seek to fill the knowledge gap of health care

workers on appropriate segregation practices as well as the color system so as to ensure safe disposal of all medical waste and to protect the environment and the health of the general public.

1.4 Objectives

The main objective is to asses health care waste segregation practices in health facilities within Akuapem North Municipality.

Specific objective

1. To examine the existing health care waste segregation system in the health facilities.
2. To assess the level of awareness of the color-coding system for efficient segregation practices in health care facilities.
3. To ascertain the efficiency of the waste segregation practices in the health facilities.

1.5 Research Questions

a. What is the existing health care waste segregation system in the health facilities?

b. What is the level of awareness of the color-coding system among the health workers?

c. What is the efficiency of the waste segregation practices**?**

1.6 Significance of the Study

This study seeks to contribute to fill the exiting knowledge gap on waste segregation and provide information for other researchers on the topic. The study will also help health care facilities to plan and provide the entire requirement for ensuring proper segregation. These requirements can be in the form of financing support or logistical support. Health workers may be prompted to update their knowledge and skills on waste segregation. And to improve health care delivery and prevent the likelihood of spreading infection in and out of health facilities in general.

1.7. Limitation of the study

The study has a degree of limitation to it, for instance, the study did not involve high sophisticated quantitative analysis. This would have enabled the researcher to point out some issues of causality based on the findings of the study. Furthermore, the study also sampled only a few organizations, this was due to the difficulty in getting as many firms as possible. This also limited the findings of the study; thus, the study was not able to get a more generic view from the respondents

1.8. Organization of the Chapters.

The study will be organized in five chapters. Chapter one will look at background of the study, problem statement, research questions and objectives etc. Chapter two will be made up of literature review, (theoretical framework) Chapter three will have methodology (study population and sampling procedure). Chapter four results and discussions (data analysis). Chapter five Summary, conclusions and recommendations. There will be references and appendices.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter deals with review of relevant literature related to the subject matter understudy. Areas covered are the theoretical framework which will be used for the study, definitions of healthcare waste, characteristics of healthcare waste, knowledge and awareness of health workers on healthcare waste, policies and guidelines on segregation of healthcare waste, legal framework and the composition and generation rate of healthcare waste.

2.2 Theoretical Framework

This study is based on the Systems Theory or the General Systems Theory (GST), which generally looks at the roles and contributions of various units or bodies working together as a whole to achieve a common goal or purpose. The term "General Systems Theory" originated from Ludwig Von Bertalanffy. Von Bertalanffy (1968) wrote that a system is a complex of interacting elements and that they are open to, and interacts with their environments. In addition, they can acquire qualitatively new properties through emergence, thus they are in a continual evolution.

The Systems Theory thus, as, applied in this study explains how various units and stakeholders (Hospital Administrators, Nurses, Matrons, Orderlies, Laboratory Technicians, Environmental Protection Agencies, Ministries of Health etc.) in the management of medical waste could be linked together to ensure proper and safer management of these wastes.

2.3 Definitions and Characteristics of Healthcare Waste

Providing health care, like any other human activity, generates some forms of waste which has to be managed and disposed of in a safe manner in order to minimize risks associated with the exposures to such waste to the health of health workers, clients and the community at large. Health care waste includes all untreated solid and liquid waste (both hazardous and non-hazardous) generated during the administration of medical care, or the performance of medical research involving humans and animals. These include infectious (including pathological and sharps) radioactive, pharmaceutical and other hazardous wastes as well as general waste. (MOH, 2006) 10-25% of healthcare wastes are infectious that needs special treatment and is referred to as the healthcare risk waste. Healthcare risk waste includes infectious waste, pathological and anatomical waste, hazardous pharmaceutical waste, hazardous chemical waste, and waste with a high content of heavy metals, pressurized containers, sharps, highly infectious waste, geotoxioc /cytotoxic waste and radioactive wastes (Meghala et al., 2013) Similarly Healthcare waste, medical waste, biomedical waste and hospital waste are terms which are used interchangeably. Healthcare waste constitutes a special category of wastes because they contain potentially harmful materials and can cause ill health to those exposed to it (Tadelle *et al*., 2018).

Health-care waste contains potentially harmful micro-organisms which can infect hospital patients, health-care workers and the general public. Other potential infectious risks may include the spread of drug-resistant micro-organisms from health-care establishments into the environment. Waste and by-products can also cause injuries, for example: radiation burns, sharps-inflicted injuries, poisoning and pollution through the release of pharmaceutical products, in particular, antibiotics and cytotoxic drugs, poisoning and pollution through waste water; and

Poisoning and pollution by toxic elements or compounds, such as mercury or dioxins that are released during incineration. (NC Nwachuku *et al* 2013)

Healthcare waste (HCW) is defined as the all waste generated by health care activities which includes, infectious and non-infectious waste i.e., sharps, non-sharps, blood, body parts, chemicals, pharmaceuticals, medical devices and radioactive materials. 1. Improper management of health-care waste poses a significant risk to patients, health-care workers, the community and the environment (Priya *et al*., 2013).

According to Medpro (2018), Medical waste **is** any kind of waste that contains infectious material (or material that's *potentially* infectious). This definition includes waste generated by healthcare facilities like physician's offices, hospitals, dental practices, laboratories, medical research facilities, and veterinary clinics. Medical waste can contain bodily fluids like blood or other contaminants. The 1988 Medical Waste Tracking Act of the USA. defines it as waste generated during medical research, testing, diagnosis, immunization, or treatment of either human beings or animals.

(https://archive.epa.gov/epawaste/nonhaz/industrial/medical/web/html/tracking.html) Some examples are culture dishes, glassware, bandages, gloves, discarded sharps like needles or scalpels, swabs, and tissue. Medical waste goes by several names that all have the same basic definition. All of the terms below refer to waste created during the healthcare process that's either contaminated or potentially contaminated by infectious material: Medical Waste, Biomedical Waste, Clinical Waste, Biohazardous Waste, Regulated Medical Waste (RMW), Infectious Medical Waste and Health care waste. (Medpro,2020)

These terms are used interchangeably, but there's a distinction between general healthcare waste and hazardous medical waste. The WHO categorizes sharps, human tissue, fluids, and contaminated supplies as "biohazardous," and non-contaminated equipment and animal tissue as "general medical waste." In fact, office paper, sweeping waste, and kitchen waste from healthcare facilities is still technically medical waste, though it's not regulated and non- hazardous in nature. (WHO 2012, Medpro 2020)

2.4 Knowledge and Awareness of Health Workers on Healthcare Waste Management

When people who work directly or indirectly with such waste have limited or no knowledge of the likely health impact of the exposure to such waste, then it raises lots of concern. However Poor management of these wastes can jeopardize health workers, employees who handle healthcare waste, waste pickers, patients and their families, and the community at large to infection, toxic effects, and injuries, and risks of polluting the environment (Tadelle *et al*., 2018).

Cleaners in hospital waste management are exposed to occupational hazards such as infectious diseases and sharps injuries from which training, knowledge and good practice may potentially reduce any risk (U.K. Department of Health, 2006). In a study done by Ngwuluka *et al*. (2010) it was discovered that though the healthcare establishments sampled for their study claimed that the waste handlers were trained but the outcome of the survey indicated other-wise. If indeed they were being trained, then the training was inappropriate and had not been impacted on their skills and knowledge of the recommended measures for hazardous waste management.

Another research also indicates that HCW management may be affected by lack of formal training, lack of knowledge on HCW management, limited interest from hospital administration (Nkonge *et al*., 2012). Wafula *et al.* (2018) discovered in their research that Concerning Knowledge on

HCW management, most health workers had high knowledge especially on waste segregation and level of risk to health posed by HCWs. Similar findings have been reported in other studies where most health workers were aware of the risk of hazards such as injuries, infections (HIV/AIDS, Hepatitis B and C), and environmental pollution caused by improper HCW management.

In a related study by Bansal et al. (2011), they concluded that the awareness regarding biomedical waste management was satisfactory in medical personnel while poor in para and non-medical workers. As these workers are regularly engaged in the process of biomedical waste management and handling, there is an urgent need for orientation training regarding the issue to the entire health care personnel especially para and non-medical workers to protect themselves and people visiting the hospital and the nearby communities. Also, there is a need for stricter implementation of guidelines of biomedical waste management and regular supervision and monitoring by a separate committee, exclusively formed for the implementation of rules related to the safe management and handling of hospital waste in the entire District.

2.5 Policies and Guidelines on the Segregation of Healthcare Waste

In line with the UN Sustainable Development Goals (SDGs), particularly SDG 3 on health, SDG 6 on safely managed water and sanitation and SDG 12 on sustainable consumption and production, the Water, sanitation and hygiene (WASH) in health care facilities: Global action plan aims to ensure that all health-care facilities have basic WASH services by 2030 (WHO & UNICEF, 2015a). This includes safe healthcare waste management involving segregation, collection, transportation, treatment and waste disposal. This document highlights the key aspects of safe health-care waste management in order to guide policy-makers, practitioners and facility managers

to improve such services in health-care facilities. It is based on the comprehensive and detailed WHO handbook, Safe management of wastes from health-care activities (WHO, 2014).

Five guiding principles are widely recognized as the basis for effective and controlled management of waste. These principles have been used in many countries when developing their policies, legislation and guidance: the "polluter pays" principle; the "precautionary" principle; the "duty of care" principle; the "proximity" principle; and the "prior informed consent" principle.

According to the MOH Policy and Guidelines for Health Institutions (2006), Waste Management in Ghana is a multi-sectoral effort with the Ministry of Local Government and the Environmental Protection Agency playing key roles as implementer and regulator respectively. This responsibility is discharged through the District, Municipal and Metropolitan Assemblies. The ultimate responsibility for ensuring that waste is disposed of, however, lies with the person or institution that generates the waste. Health care institutions are therefore responsible for the waste that is generated by their activities and are required to take practical steps to ensure their separation, storage, treatment and safe disposal.

Improper management and disposal of medical waste is a threat to the enjoyment of human rights, including the rights to: life, the highest attainable standard of physical and mental health, safe and healthy working conditions, and adequate standard of living Those affected include medical staff, patients, support service workers, waste workers, recyclers, scavengers and the general public as a result more attention to this issue is needed. (United Nations Special Rapporteur, July 2011 on Medical Waste and Human Rights) Global healthcare waste project Module 3: International and National HCWM Laws –Legislative, Regulatory and Policy Aspects

Lack of awareness about the health hazards related to health-care waste, inadequate training in proper waste management, absence of waste management and disposal systems, insufficient financial and human resources and the low priority given to the topic are the most common problems connected with health-care waste. Many countries either do not have appropriate regulations, or do not enforce them (WHO/UNICEF, 2015).

Treatment and disposal of healthcare waste may pose health risks indirectly through the release of pathogens and toxic pollutants into the environment. The disposal of untreated health care wastes in landfills can lead to the contamination of drinking, surface, and ground waters if those landfills are not properly constructed (WHO/UNICEF, 2015). The treatment of health care wastes with chemical disinfectants can result in the release of chemical substances into the environment if those substances are not handled, stored and disposed in an environmentally sound manner. incineration of waste has been widely practiced, but inadequate incineration or the incineration of unsuitable materials results in the release of pollutants into the air and in the generation of ash residue. Incinerated materials containing or treated with chlorine can generate dioxins and furans, which are human carcinogens and have been associated with a range of adverse health effects. Incineration of heavy metals or materials with high metal content (in particular lead, mercury and cadmium) can lead to the spread of toxic metals in the environment. (WHO, 2018)

There are two basic conventions regulating the guidelines and principles of healthcare waste management. The Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal, the Basel Convention regulates the trans-boundary movements of hazardous and other wastes applying the 'prior informed consent' procedure (shipments made without consent are illegal). This convention is the most comprehensive global environmental

treaty on hazardous and other wastes. The Stockholm Convention on Persistent Organic Pollutants (POPs). (UNDP,1989).The Stockholm Convention is a global treaty to protect human health and the environment from POPs. POPs are chemicals which remain intact in the environment for long periods, they become widely distributed geographically, accumulate in the fatty tissue of living organisms, and are toxic to humans and wildlife. (UNEP, 2004) The principles of sustainable development have not been fully addressed by international and national organizations when advising upon best practice for healthcare waste management. This is now a priority, and the focus worldwide on the management of resources and the issues of sustainability has begun to concentrate attention on this issue.

For example, in the UK, ecological foot printing and a mass balance analysis has been carried out in the National Health Service (NHS) in England and Wales, and is reported upon by Barrett et al. (2004) in Material Health. In the NHS the rates for recycling are very low, on average at 1.8%, compared with the potential of 62% for household-type waste produced in medical establishments. Townend and Cheeseman (2005) sets out guidelines and a toolkit that can be used by managers of healthcare facilities to evaluate and assess the quantity of resources and wastes at their facilities enabling the principles of sustainable development to be improved. Another important Aarhus Convention of the United Nations Economic Commission for Europe Although regional in nature, it is by far the most impressive elaboration of Principle 10 of the Rio Declaration; it stresses the need for citizens' participation in environmental issues and for access to information on the environment held by public authorities (Townend, 2009).

2.6 The Legal Framework

There is no specific law that addresses the management of health care waste in Ghana at the moment. Existing laws and policies assign certain functions to some institutions such as District Assemblies and the Environmental Protection Agency (EPA) through EPA Act 490 (1994) and the National Sanitation Policy (1999) but lacks specific provisions for dealing with health care waste in a comprehensive manner. Some of the laws that have relevance for Health Care Waste Management include: The Constitution of the Republic of Ghana, 1992; The Environmental Protection Agency Act, 1994 (Act 490); Environmental Assessment Regulations, 1999 (LI 1652); The Local Government Act, 1993 (Act 462); National Building Regulations, 1996 (LI 1630); Town and Country Planning Ordinances, 1944 (Cap 84); Mosquito Ordinance Cap 75; and Infectious Disease Ordinance.

The policy seeks to ensure that health care waste is managed effectively in compliance with existing laws and regulations and others to be passed in future in order to protect health care workers, their clients (patients, caregivers and visitors) and the environment from potentially disease-causing waste materials. The Guidelines provide standards, procedures and processes for handling health care waste in the sector institutions and mechanisms for performance and performance monitoring. The Policy and Guidelines apply primarily to all health institutions whether public, private, quasigovernmental, non-governmental or faith-based, that operate in the country at all levels. The policy classifies waste into hazardous and non- hazardous waste and details steps in its handling; from generation, segregation, storage, transportation and treatment to final disposal as well as equipment and tools required. It also assigns roles and responsibilities to various stakeholders and further prescribes measures for protection of handlers.

2.7 Healthcare Waste Composition and Generation Rate

In many developing countries, the unavailability and inadequacy of data about the quantity and composition of health- care waste is one of the major reasons for inadequate and improper healthcare waste management (WHO, 2004). Therefore, it is important that the composition and generation rates of healthcare wastes be known for proper planning and implementation of healthcare waste management programs. Only few studies have been conducted on the generation rate and composition of healthcare waste in Africa. For instance, Tesfahune *et al*. (2014) investigated the generation rate and composition of healthcare wastes in six public and three private hospitals in Ethiopia. They conducted healthcare waste composition and characterization measurements for seven consecutive days in the selected hospitals following the protocol described by the World Health Organization (WHO). Their results revealed that the total generation rate of healthcare wastes of hospitals ranged from 0.25 to 2.77 kg/bed/day with a median value of 1.67 kg/bed/day for inpatients to 0.21-0.65 in kg/patient/day with a median value of 0.31 kg/patient/day for outpatients. The waste generation rate in private hospitals (median 3.9 kg/bed/day) was significantly greater (Kruskal-Wallis test, $P < 0.05$) than in government hospitals (median 1.5 kg/bed/day). The study revealed that the generation rate and proportion of hazardous waste significantly varies between public and private hospitals and number of patients treated per day. Another study by Meleko, *et al*. (2018) revealed that 57.9% of the total HCW produced in measured health centres of this zone was general and the remaining 42.1% was hazardous health care waste. Of the total hazardous waste stream sharps, infectious and pathological wastes constitute with mean (±SD) 0.267 ±0.107 (23.3%), 0.2695 ± 0.124 (23.6%), 0.441±0.157 (38.6%) respectively in all health centres. While the rest were pharmaceutical, 0.166 ±0.058 (14.5%) kg/day, which was not coherent with WHO guideline. The norm, according to the WHO

guidelines, is that health centres produce 75% to 85% general healthcare waste, and 10% to 25% hazardous healthcare waste.

Amfo- Otu and Doo (2015) in their study on Hospital Solid Waste Management at Tetteh Quarshie Memorial Hospital, Akuapem-Mampong, Ghana discovered that plastic component (37.6%) of the waste stream which consists of surgical gloves, polythene bags, empty sachets, plastic bottles, syringe and other related plastic materials was the dominant component due to rate of usage. The second highest component according to their results was organic (30.0%), which consists of food residues (vegetables, fruits, fish, meat etc.) from the wards and the kitchen of the hospital where foods are prepared for patients. This was followed by sharps (0.8%) which constitute needles, syringes, surgical blades, scalpels, test tubes, ampoules, glass instruments, broken pipettes etc. The infectious waste (8.6%) consists of cotton with blood stains and other materials contaminated with human blood or body fluids which are potentially infectious. They categorized the waste into domestic waste (86.1%), infectious waste (8.6%), pathological waste (4.5%) and sharps (0.8%). The total solid waste generation rate of the hospital was found to be 0.58 kg/bed/day. They reported that their finding is in conformity with WHO and World Bank (2005) report that small district hospitals generate 1 kg/bed/day; general hospitals generate 2 kg/bed/day while tertiary or major teaching hospitals generate 4 kg/bed/day.

Major literatures have discussed the issue of waste segregation as a very vital tool and mechanism in ensuring quality health and safety of care givers and recipients at health facilities.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter gives explanations on how the research was carried out, a brief description of the study area as well as the population and the target group for the research. It will always highlight the research tools, techniques and methodologies which were employed to undertake the investigation. The analysis of the study was done based on the objectives of the study.

3.2 Study Area

Geographic and Demographic features of the study area

The Akuapem North Municipal is one of the 260 Metropolitan Municipal and District Assemblies (MMDAs) in Ghana and forms part of the 33 Municipalities and Districts in Eastern Region. It was established in 1988 by Legislative Instrument (L.I.) 1430 and elevated to Municipal Assembly status by LI 2124 on 15th day of March, 2012. With Akropong as the Capital, the Municipal Assembly covers a land area of about 450 sq. km and is located in the south-eastern part of the Eastern Region and is about 58 km from Akuapem North, the capital city of Ghana. The Akuapem North District lies between longitude 0^0 00^0 E and 0^0 20^0 E of Greenwich Meridian and latitude 5^0 51^0 and 6^0 10^0 north of the equator.

Boundaries

The District shares boundaries with four other Districts within the Eastern Region and one in the Greater Akuapem North Region. The four Districts are Suhum Kraboa Coaltar in the West, New Juabeng in the North West, YiloKrobo/ Okere in the North East and Akuapem South in the South. Dangbe West in the Greater Akuapem North Region shares boundary with the District in the Southwest

Physical Features

Geology and Soils: There are two main types of rocks of pre-Cambrian age (a) Togo sandy shales series (b) Birimian series. Birimian series are found in Adawso area comprising of benisses and schist with granites and pegmatites, which are metamorphic rocks. Togo series are found in the North East to the South West from the Senya – Beraku part of the Akwapim Range, West of Akuapem North..Rocks stones, phythomites and sandy – shales. Sandy – shales: Found in Kwamoso area, Manye – Adamso road near mile 36. Sand series: The area stretching from the

Northwest slope of the Akwapem Range to the Nyensi and Nsaki Valleys. Phylites: Found in stream valleys e.g. Bump Valleys near Larteh. Quarzites: Cover greater part of the Akwapim Range, Mampong, Tutu, Amanokrom and Larteh.

Vegetation: Broken forest is mostly found on most hill tops with secondary forest on slopes and valleys Scrub and bush along the motor roads, and main footpaths. Thickets on the slopes facing the Akuapem North Plains Forest Reserves. There are two major forest reserves, there are a lot of forest patches and sacred groves scattered all over the District. Notable ones can be found in the following towns. Gyafiase, Larteh Junction, Bankana near Tutu, Akropong, Obosomase, Mampong and Saforo.

Climate: Mean annual rainfall is in the municipality is 1270mm (50in). Mean temperature is 23.88ºC (75ºF). Rainfall pattern has two maxima from May to July and September to November. Minor Dry Season is in August. Major Dry Season is from December to February. The topography of the area is one main hill range, Akwapem range. The height is between 1,250ft (381m) and 16000ft (487.7m) with the highest point is at Amanokrom near the water tank, which is about 1642ft (500m). The District can be divided physically into two ridges, which are semi-urban, and the lowland area, which is rural. The lowest point is about 500ft.

Population: According to the Population Census publication of Ghana, the Akwapem, North District has a population of 68,247 in 1970 and growing at an annual rate of 1.6%. This increased by 24.7% to 85.131 in 1984. The growth rate between 1984 and 2000 is 1.8% with the population of the Municipalities according to 2010 population and housing census standing at 136,483 with 64,028 males and 72,455 females. About 25% of the total population lives in the urban area, which

are located on the Ridge with 53.3% of the population being women. The population density of the district is about 225 people per km.sq. (http://www.ghanadistricts.com).

3.3 Waste Management Contractors

Currently the municipality has two waste management contractors, Zoomlion Ghana Limited which manages the lifting of all solid waste within the municipality and an individual contractor who manages the final disposal site at Kwamoso.

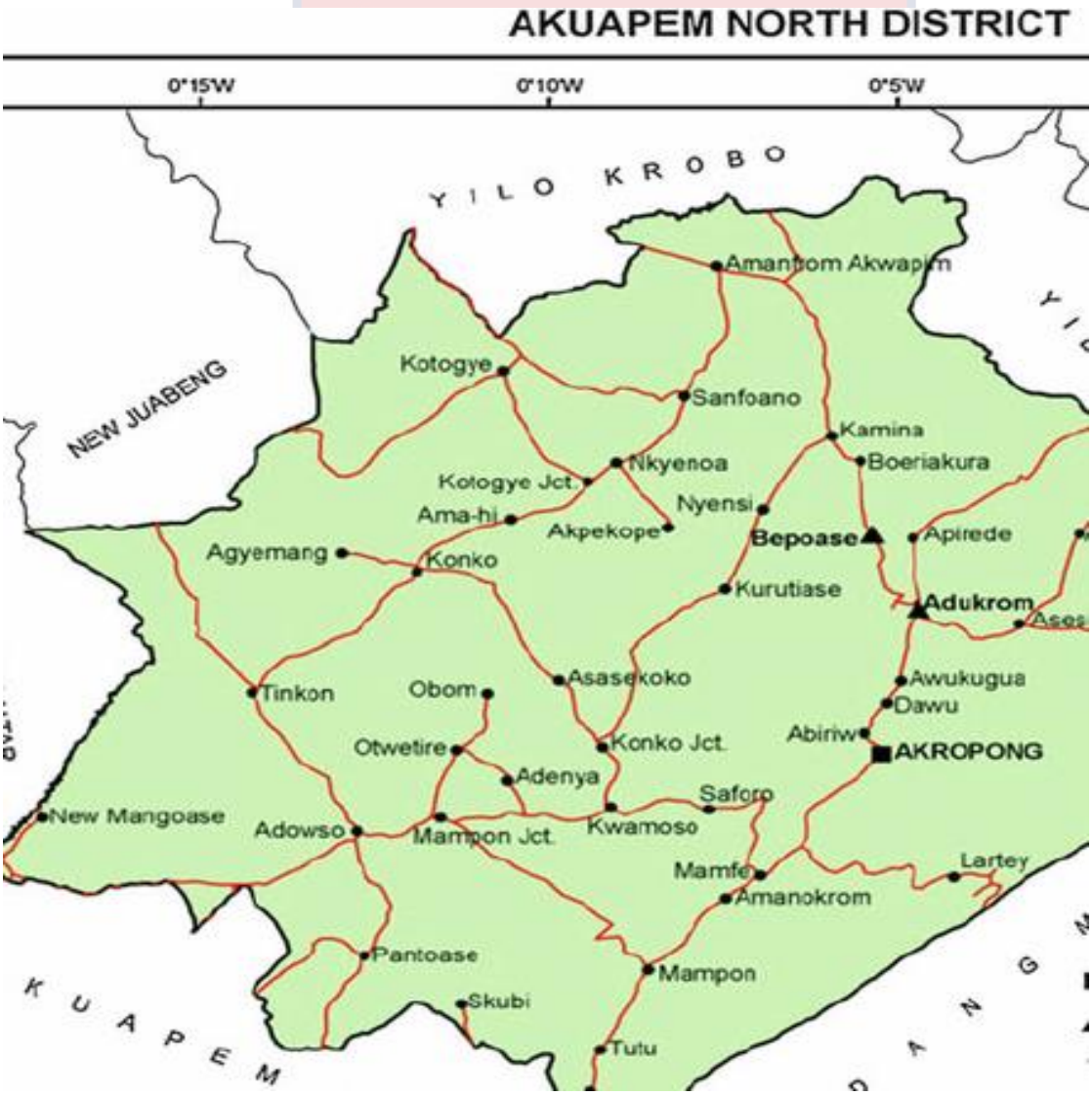


Fig 1 Geographic Map of The Study Area

Source: Akuapem North municipal assembly physical planning department

3.4 Study Population

The study or target population is a group of people, institutions or phenomenon that the researcher hopes to investigate for the study area. For the purposes of this study or research the target population will be health care workers (doctors, nurses, cleaners, environmental health or estate officers, and pharmacist, safety officers, paramedical staff (e.g. laboratory technicians, radiologist, and physiotherapist), hospital administrators, orderlies. District or municipal health directors, waste management administrators, waste management laborers, final disposal site attendees.

3.5 **Methodology**

3.5.1 ***Research Design***

Descriptive design was used to study objective one and two whereas experimental design was used to study objective three

3.5.2 ***Sampling Size***

According to Wikipedia, sample size determination is the act of choosing the number of observations or replicates to include in a statistical sample. The sample size is an important feature of any empirical study in which the goal is to make inferences about a population from a sample. In practice, the sample size used in a study is usually determined based on the cost, time, or convenience of collecting the data, and the need for it to offer sufficient statistical power. In real world situations, it almost or near impossible to study a whole population in a research, hence the need to take a part of the entire population to represent the whole. A sampling size of one hundred

and twenty (120) respondents was used. Making up of one hundred health workers (clinical and non- clinical staff) and twenty (20) administrative and other health professionals.

3.5.3 ***Sampling Procedure***

For the purposes of this study, the two main sampling techniques was used, that is the probability and non- probability sampling. Probability sampling is the selection of individuals or institutions from a large population so they are a representative of the population. Non- probability sampling however is the selection of participants or respondents due to convenience

Purposive sampling under non- probability technique was used to gather information from health centres where as probability sampling will be used to acquire needed information from respondents. Stratified probability sampling under quantitative procedure will be use to group respondents. The stratified sampling however allows researchers to group respondents into groups called strata based on their similar characteristics; this study will group respondents into different sets of strata as administrators, orderlies or cleaners, general nurses and paramedics, waste contractors etc. three major hospitals will be used in this study (one private two governmental) three health centres and one CHPS compound.

3.5.4 ***Data Collection Instrument***

A written closed and opened ended questionnaire was used in collecting the data for the study. A written questionnaire is a data collection tool in which written questions are presented that are to be answered by the respondents in a written form. It is less expensive, permits anonymity and may result in more honest responses. A written questionnaire also eliminates bias due to phrasing questions differently with different respondents. However, its downside is that, it cannot be used with illiterate respondents and there is often a low rate of response and questions may be

misunderstood. As a result, interview guide and field observations were also used to collect a complete data for the study.

3.5.5 ***Data Analysis***

Data analysis consists of getting meaning out of the data collected in a particular study. Data analysis includes the usage of statistical procedures to analyse and summarize the data collected to derive a meaning. Data cleansing began immediately after data collection. This the researcher did by going through each questionnaire to find out if all the questions have been answered before entering the data into the management tool. The data was coded after the cleansing to facilitate categorization and analysis by transforming the data into suitable format for computer-aided analysis. Descriptive statistics including frequency tables and simple percentages were computed. This analysis was done using Statistical Package for Social Sciences (SPSS) software and Microsoft Excel.

Data Examination: Checking for Errors and Outliers

Upon resolving issues of missing data as outlined above, other issues such as outliers needed to be inspected and sought out. One of the most important activities that should never be neglected in data analysis is data examination. Haier (2001) explained that though data examination could take much time, it enables the researcher to deal with the impacts of possible outliers, missing data due to wrong data entry or respondents' unwillingness to fill some part of questionnaire which could otherwise affect the results of the data (Hair, 2018). Issues of outliers were experienced with some of the variables, hence the impact of these outliers attracted attention, however after a cursory comparison of the means of the respective variables, it was observed that the difference was not

significant. Therefore, it is plausible to conclude that the outliers would not create much problems in the current analysis, hence those data were retained (Pallant, 2013).

Efficiency of waste segregation: waste segregation does not only end at the point of segregation but how efficient it was done. some facilities segregate their medical waste alright but if the act is not done with precision, it will defeat the purpose of the segregation. this is because in the process of segregation, if a hazardous waste is mistakenly or unknowingly mixed with a general waste it renders the entire waste in the waste bin hazardous. it is then very important to accurately and efficiently segregate these wastes to ensure the main purpose for the segregation is not defeated. As a result, a simple experiment will be conducted with segregated waste receptacles to determine the level of efficiencies of the segregation. The test will be carried out by sorted out all the waste kept in a designated waste bin by spreading a polythene bag on the floor and carefully selecting and grouping these wastes based on their hazardous nature or characteristics after which these wastes are weighed to determine the efficiency level. A simple formular is then used to determine the rate. Below is the formular.

$$\text{Efficiency} = \frac{\text{weight of waste correctly segregated}}{\text{Weight of waste segregated into a container}} * 100$$

3.5.6 ***Ethics:*** The study considered the need to protect the dignity and privacy of respondents and facilities. The consent of respondents was sought from management of the selected health centres to use their facilities for this study. Respondents consent was also sought before data collection. The privacy of respondents was also adhered to as well.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter focused on the results, interpretation and discussion of the results of the study. Data collected involved both descriptive which focused on the means and standard deviations as well as inferential statistics which were used in verifying the study hypotheses. The purpose of the present study was to asses health care waste segregation practices in health facilities within Akuapem North Municipality.

4.2 Descriptions of Participants

This chapter described the participants in this study with respect to their gender distribution, age distribution, level of education, status distribution and the number of years of working. A summary of the characteristics of respondents are presented in Table 1.

D. Variables	Items	Frequency	Percent
Gender	Male	83	69.2
	Female	37	30.1
Age	24-30 years	73	60.1
	31-35 years	42	35
	36-40 years	5	4.2
Education Status	SSCE/WASSCE	3	2.5
	Cert/Diploma	75	62.5

	Undergraduate Degree	42	35.0
Working Years	1-5years	47	39.2
	6-10years	73	60.1
	Above 10 years	0	0

Source: Survey data, 2020

Gender Distribution

Eighty-three respondents, representing 69.2% of the overall sample were males and thirty-seven representing 30.1% of the total samples were females. This indicates that a majority of the respondents were males.

Age Distribution

Seventy-three respondents, which is representative of 60.1% of the total sample were within the ages of 24 to 30. Forty-two of the respondents which is equivalent to 35% of the total sample were within the ages of 31 to 35, five of the respondents, which makes up 4.2% of the total sample of respondents were between the ages of 36 to 40 years. The average age of respondents who participated in the study was 33.5 years ranging from 24 to 40 years.

Education Distribution

Three of the total respondents which makes up 2.5% of the overall sample held senior secondary school certificates, on the other hand, the number of respondents who held diploma or HND certificates were seventy-five in number representing 62.5% of the total sample of respondents. Forty-two of the respondents who responded held undergraduate certificates, a 35% of the total sample of respondents.

Years of Work Experience

A majority of the respondents had worked as at the time of data collection for a period of between 6 to 10 years. The number representing this was 73 which is equivalent to 60.1% of the respondents who responded to the questionnaire. The remaining 39.9% had worked for a period of between 1 to 5 years, a total of forty-seven of the respondents.

Job Descriptions

The respondents consisted of 10 medical practitioners or physician assistants representing 8.3% of the total respondents, 5 administrators representing 4.16%, 21 nurses representing 17.5%, 35 cleaners representing 29.16%, 14 ward assistants representing 11.6%, 11 orderlies representing 9.1%, 21 waste handlers representing 17.5% and 2.5% representing others.

4.3 Measurement of Waste

Waste generated at the various hospitals ranged from 302.6kg to 1,559.2kg. Figure 2 shows the total waste generated over a period of three months from May 2020 to July 2020 Tetteh Quarshie memorial hospital generated the highest quantity of waste (1,559.2 kg) within the study period followed by Centre for Plant Medicine Research, (429.6 kg), MEDICAS hospital generated (335.1kKg) whereas the two major clinics within Akropong together generated (302.6 kg).

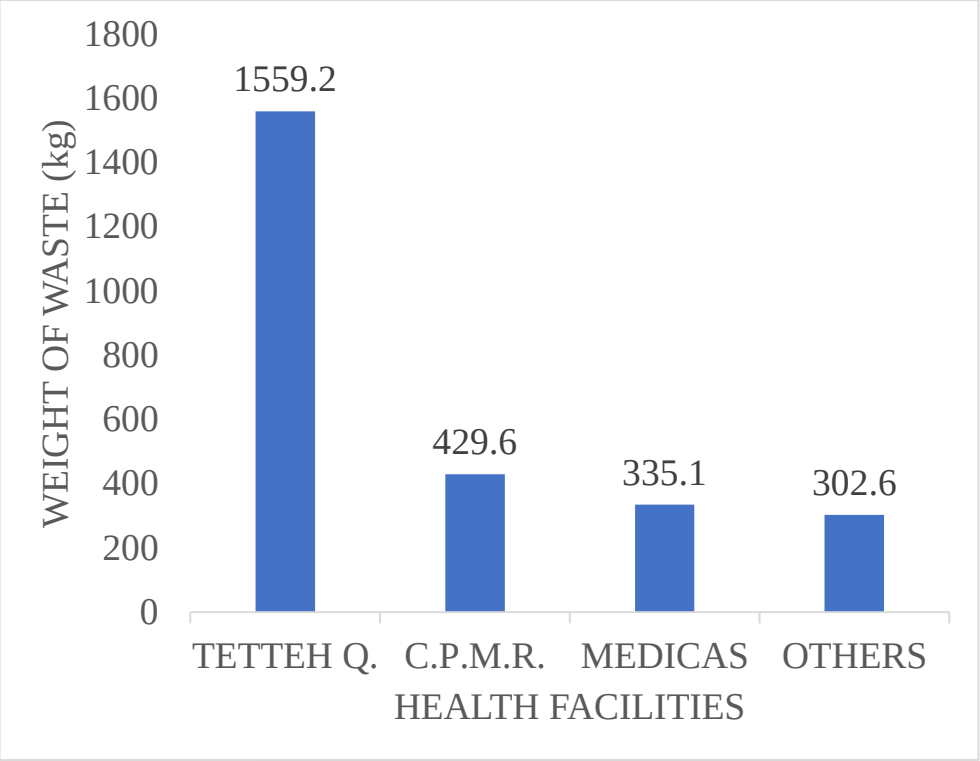


Figure 2: Average weight of waste generated between May to July 2020

Weight was obtained using tools such as weighing balance, buckets, plastic bags, safety gloves, odour and fly repellent and disinfectants. These testes were carried out to determine the efficiency level of healthcare waste segregation. this is because most units may segregate their waste but due to the lack of knowledge of the types and category of waste, some may mix other waste unknowingly. This test however identified a bin which has been tagged as segregated and carefully sort out the waste in the bin to separate the waste in the bin according to various categories of hazardous and non-hazardous waste.

4.4 Monthly Generation of Infectious Waste

Data from the questionnaire outlines all the healthcare facilities generate some form of waste ranging from general waste at the OPDs (out patients departments) to the labs and theatres where infectious wastes are generated. 15 respondents representing 12.5% of the sample size comprising administrators and OPD staffs indicated the waste they generate are non-infectious or non-hazardous 5(4.1%) also confirmed that the waste they generate are general waste mainly from the administration and OPDs, 4 respondents and 5 respondents representing 3.3% and 4.1% respectively confirmed the generation of non-infectious waste at their unit of operations totalling 29 (24%) of the sampled population. This means 76% of the respondents are indicating that they generate infectious waste at their various units these units include, labs, theatres, wards, pharmacies, X-ray rooms etc. Infectious waste generated at the various hospitals ranged from 13.8 kg to 81.6 kg.

Tetteh Quarshie Memorial Hospital generated the highest quantity of infectious waste (81.6Kg), followed by MEDICAS hospital (21.9 kg), C.P.M.R. hospital (21.3kg) and the least from other clinics (13.8 kg) in June, 2020. Tetteh Quarshie Hospital produced the highest quantity of infectious waste in May (73.7 kg) and June (81.6 kg) whilst community clinics produced the least quantity of infectious wastes in May (19.8 kg) and June (21.2 kg).

The bar chart below clearly indicates Tetteh Quarshie hospital generating the largest quantity of infectious waste than all the other health facilities. This is because Tetteh Quarshie hospital is the largest and biggest referral hospital within Akuapem north and its environs. it also serves as a referral centre for patients within the study area and even out the district. The clinics however are

the smallest facilities in size and utilization. The size and utilization rate of the various facilities accounted for the differences in the generation rates

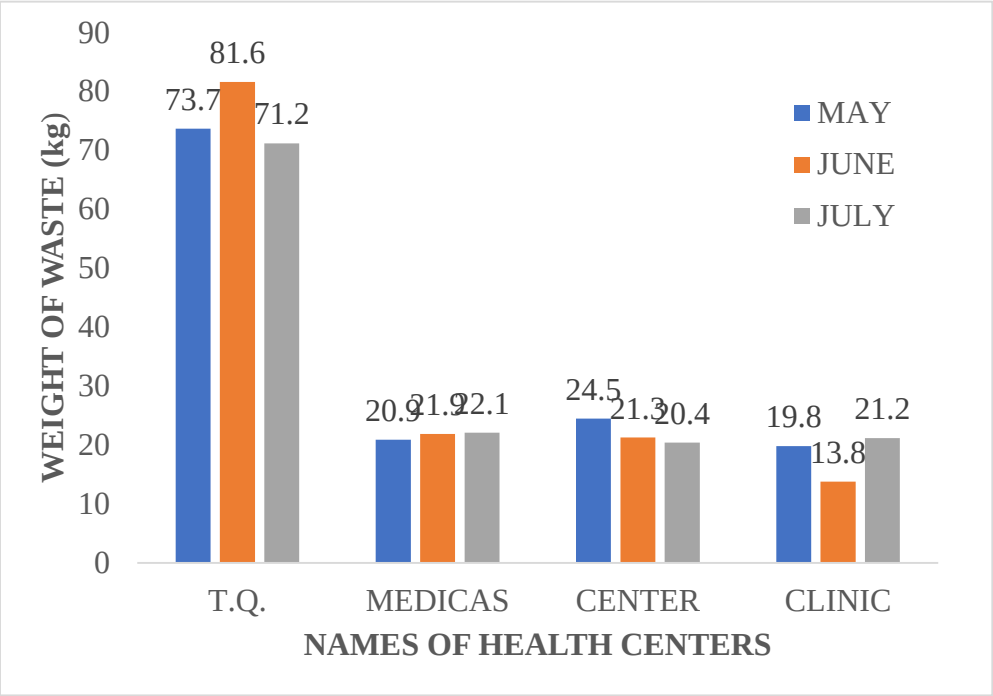


Figure 3: Monthly Infectious Waste Generation at the various Healthcare Facilities

Source:

4.5 **Segregation of waste**

Following education, sensitization and provision of color-coded bins, the level of segregation was generally low (0.3%). That is, only a negligible portion of the total waste was segregated at source. All the healthcare facilities however have some sort of waste containers at the various units of their facilities, ranging from paper boxes, polythene bags, plastic bins, and metal bins. At Tetteh Quarshie Hospital, only 2.2 Kg (0.14%) of the entire waste was segregated at source, MEDICAS 1.7Kg (0.40%), C.P.M.R. 1.3 Kg (0.43%) and other Health

Centres 1.1Kg (0.33%). The bulk of wastes at the various hospitals were not segregated representing 99.7% of the entire waste. The table below shows the source segregation of waste from the various health facilities.

Table 3: Segregation/Non-segregation of waste at the hospitals

Name Of healthcare facility	Total waste (May to July 2020)	Segregated waste (Kg)	W aste Segregated (%)
Tetteh Quarshie	1559.2	2.2	0.14
MEDICAS	429.6	1.7	0.40
C.P.M.R.	302.6	1.3	0.43
Other clinics	335.1	1.1	0.33

Source: field survey,2020

4. 6 Extent of Awareness of Colour-Coding Waste Segregation

It was also very important to determine the degree of awareness of WHO color-coding of waste bins in waste segregation method among the selected respondents. The Figure reveals that majority (75.8%) of the respondents were fully aware of the colour coding as a waste segregation method within their hospitals, this was followed by 10 (8.3%) of the respondents who affirmed that they were somewhat aware and 5 (4.2%) of the respondents also mentioned that they knew about waste segregation a little and finally 14 (11.7%) of the respondents surprisingly mentioned that they did not know about waste segregation. This is summarized in the Figure 6. Although majority of the respondents were aware of the segregation, most of them could not differentiate on which colour represent which type of waste to be put in.

Table 4: Level of Awareness of Colour Coding

Level of awareness	Number of respondents	Percentage
Fully Aware	91	75.7
Little Awareness	5	4.2
No Knowledge	14	11.7
Somewhat Aware	10	8.3
Total	120	100

Source: field survey,2020

4.7 Collection, storage and disposal

The facilities which keep waste bins at their various units keeps them covered but after waste handlers have collected them from the various units at the end of the day to a converging point waiting for final pickup, these bins are more often left uncovered, exposing the waste to flies. All the health facilities have dedicated portions or locations within their compounds where they keep waste bins collected from the various units waiting to be carried to the final disposal site by a waste contractor. most of them have smaller waste bins they use at the various units which they empty into a 240l waste bin or a $12m^3$ waste container every morning. Tetteh Quarshie Memorial hospital

has a garbage collection point at an isolated point where all waste from the various departments and units are sent to, same as MEDICAS hospital. C.P.M.R. hospital however uses a $12m^3$ refuse container at a dedicated point where all refuse or waste from the various units are sent to. With the exception of few clinics who bury their waste, all the other health facilities have contracted a private waste management company, Zoomlion Ghana limited who manages these wastes. All respondents have no knowledge where their waste ends finally and how the waste management company treats the waste at the final disposal site.

4.8 Existing Waste Management Practices

Most of the health facilities sampled have existing practices they use in managing their healthcare waste at every point in time, two of the clinics sampled practice segregation of waste only at the injection room where syringes are sharps are kept in boxes, at the OPDs and wards, used cotton, infusion and other waste are all kept in the same bin and disposed of together in a dugout pit behind their facilities. They also have placenta pits where they bury placenta after delivery or given back the mothers to take them home to disposed of, no records of types and quantity of waste generated, no waste management team available although they have knowledge about the colour coding of bins.

However, with the hospitals, some departments like the ward, lab, and pharmacy segregate their waste but they are all put together into one receptacle by the waste handlers thereby defeating the main purpose of the segregation. Tetteh Quarshie Memorial hospital and Centre for Plant Medicine Research hospitals all have existing waste management team and practice the colour coding of segregating waste, periodical trainings are also done. Below is a summary of the existing waste management practices at the facilities sampled.

Table 5. Availability of record on quantity of waste generation.

Name of Healthcare Facility	Responses	Frequency	Percent
Tetteh Quarshie	NO	20	17.0
MEDICAS Hospital	NO	30	25.0
C.P.M.R.	YES	1	0.3
Other clinics	NO	69	57.5
TOTAL		**120**	**100**

Source: field survey, 2020

With regards to proper record keeping of waste generation in the selected facilities, it was realized that only the head of environment and sanitation department at C.P.M.R. hospital which has documented records on the type and volume of waste generated, 0.3% representing a small fraction of the total respondents. This obvious indicates that 99.7% of the respondents either do not keep

records of waste they generate at their facilities or do not know if their departmental heads keep such records. All these facilities therefore do not keep any records of such. The responds also indicate none of the facilities interviewed have a dedicated unit or department for environment and waste management with the exception of C.P.M.R. hospital. At Tetteh Quarshie Memorial hospital, the various unit heads and departments provided the response to the data recording of the quantity of waste where as the various nurses and resident physician assistants at the clinics provided such information. However, at C.P.M.R. hospital, the head of the environment and sanitation department provided detailed data about the waste generation at the facility.

Table 6. Knowledge and colour coding of bins at health facilities

Name of Healthcare Facility	Variance	Frequency	Percent
Tetteh Quarshie	YES	20	17
MEDICAS Hospital	NO	30	25
C.P.M.R.	YES	1	0.3
Other clinics	YES	69	57.5
TOTAL		**120**	**100**

Source: field survey, 2020

Knowledge of colour coding of bins is the first step in waste segregation but from the survey, it was realized that almost all the health workers have heard about colour coding in segregation of waste and are actually practicing it at their various departments or units, out of the facilities

sampled its only MEDICAS hospital who do not use the colour coding of bins to segregate their waste. however, even the majority of the facilities who segregate their waste using colour coded bins end up putting all waste from the facilities together into one bin for final pickup by waste contractors.

4.9 Health Care Waste Management Practices among Studied Health Facilities

The pictures at appendix shows how Tetteh Quarshie Memorial Hospital keeps their waste at the various units of the hospital. Appendix 1 shows a 240-litre waste bin with a cover and a push where, but from the picture the waste in the waste bin has not been emptied almost overflowing and attracting flies as at 13:10 in the afternoon. These flies will end up settling on uncovered food or even the body of patients and workers at the ward transmitting hazardous bacteria. from all indications, it is clear the bin does not get emptied frequently and the rate of waste generation in the ward is far more than the quantity of bin supplied to the unit. The bin should be emptied every morning and evening and an additional bin/s providing for proper segregation.

Source: Field Survey, 2020

Fig. 7. Waste bin for the children's block at TQMH

The general store where most of the consumables of the hospital are kept, from medical suppliers to non-medical suppliers but they operate with only one 240litre waste bin (see appendix 2). There are no segregation practices at the general store of the hospital. in cases where medical supplies are damaged or broken or expired, they are all dump into the same bin putting the waste handlers who wheel these bins at risk of exposure to harmful wastes.

Appendix 3 shows a site which is an eyesore and a timebomb on its own, a careful look at the image reveals used syringes exposed to passes by and kids who usually play around such dumpsites. Flies can settle on the used cotton and other exposed medical waste and transmit infections to patients and workers as well as residents nearby. Dogs will easily pick soiled cotton, diapers and any material containing blood and take them to their homes, most of these dogs play

with their owners as domestic pets or even children. The potential of these stray dogs picking hazardous medical waste and infections to their homes is quite high and very risky.

A critical look appendix 4 shows waste field with used needle and syringe just between the coke can and the empty bottled water, exposing residents and the general public to the potential harm of contamination.

Source: field Survey, 2020

Figure. 10: Open dumpsite at TQMH

Source: Field Survey, 2020

Figure 11: Open dump site at TQMH

A critical look at the appendix 5 shows used carteta tube in the first picture, used and stained cotton, used gloves and expired medicine in the second picture. This particular open dump site being operated by management of TQMH is just few meters from a basic school. (Nana Ankobea School) school kids are naturally inquisitive are mostly get attracted to things which catch their attention and interest. These kids can easily play on this open dump, pick up certain used medical waste like syringes and needles which can accidentally inject them. they can even pick up certain harmful pathogens on their hands and carry them home to thereby transmitting these pathogens to his or her household. The burning of such wastes emits poisonous gases such as carbon dioxide, nitrogen oxides, and certain toxic substances (e.g. metals, halogenic acids), and particulate matter, plus solid residues in the form of ashes. All these harmful gases are inhaled by students and teachers of this school as well as residents living close to the Hospital.

The implication of this kind of healthcare waste management at a major hospital is the likely effects it will have on public health, flies can easily settle on these infectious wastes and settle on exposed surfaces and food, causing contamination and if people come into contact with such exposed contaminated surface, diseases may spread. The smoke which will emanate from this disposal site will also affect public health. This assertion is in line with what (*Asante et al.*, 2014) said in their journal article "healthcare waste management; its impact, A case study of the Greater Accra Region. According to this article, the current state of poor healthcare waste treatment methods and

practices are creating a serious environmental problem in cities and local communities, exposing residents and neighbours to foul odours, smoke, air pollutants, contaminated water, and toxic ash from surrounding healthcare facilities (Asante OB, Yanful E (Prof.), Yaokumah EB 2014).

Appendix 7 is a 240lt bin being used at CPMR hospital at mampong to manage their waste. This clearly shows all waste generated at the facility from the various units are kept in these bins and always kept under control by neatly covering the bin although the bin is exposed to flies because of the absence of a fly cover on the bin. These bins are emptied every morning into 12m3 skip loader container to ensure the waste bins do no overflow.

Source: Field Survey, 2020

Figure 13: Waste receptacle at C.P.M.R. Hospital.

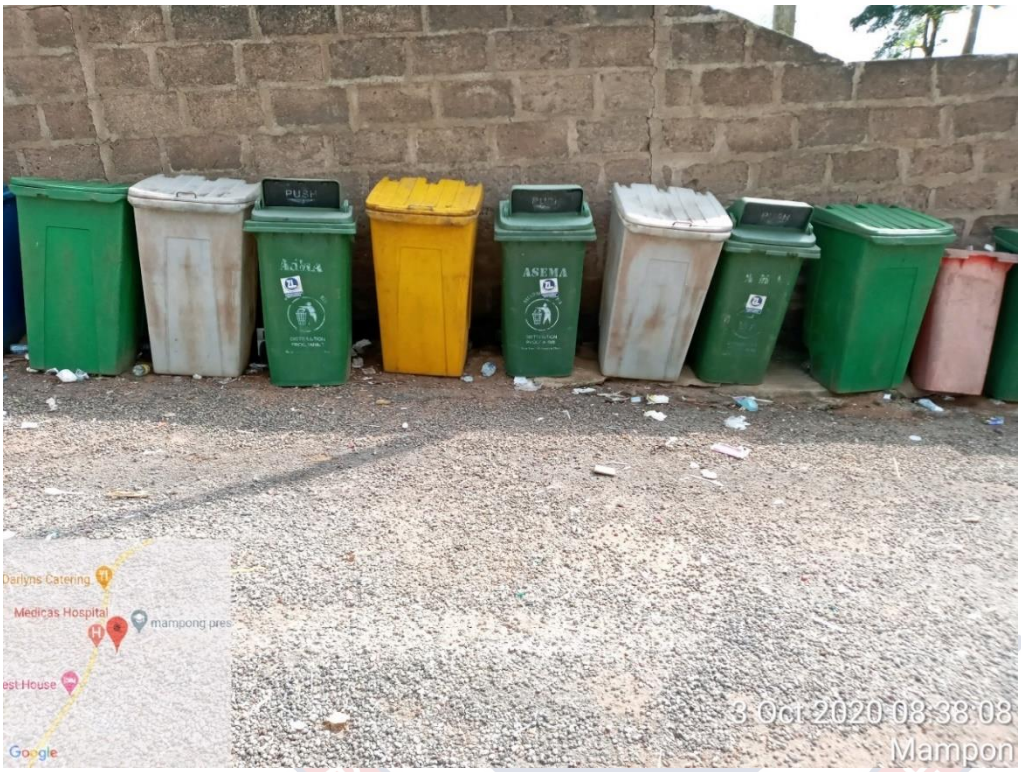
Unlike TQMH who practice open dumping of the waste from their various departments, CPMR hospital however, uses $12m^3$ skip loader container to contain all the waste from the various to be hauled by a waste contractor to a final disposal site (see Appendix 8).

Source: Field Survey, 2020

Figure 14: Skip loader container at C.P.M.R.

The skip loader container which accommodates all the waste in the facility from all the various units. the site neatly kept but the skip loader container is not covered, exposing the entire waste

to the general public and the staffs whose offices are close to the site. although waste from the various departments are neatly kept and segregated, they all end in this refuse container, rendering the entire waste in the container hazardous and exposed. Birds and flies and sometimes domestic animals like cats feed on these wastes which have a potential of infecting unsuspecting owners. the container should be covered.



Source: Field Survey, 2020

Figure 15: Waste bins at MEDICAS Hospital

This hospital also put all wastes from the various departments into these dedicated waste bins waiting for emptying by a waste contractor (appendix 9 and 10). The ground is not swept and cleaned or disinfected after the bins have been emptied. A critical look at the picture below one could see used syringe and needle, used and stained cotton, lancet etc. This clearly indicates the

mixing of all departmental for unit's waste with general waste before taking them to the final disposal site thereby rendering the entire waste highly infectious and dangerous.

After the waste bins have been emptied, there is no cleaning of the site, exposing sharps and other harmful waste to health workers. These bins should be replaced with new ones which has covers to be able to cover the bins to avoid exposure of the wastes to flies and other animals like birds and cats. labourers and waste handlers who work on these bins are at a danger of foot injury if they are not in safety boots due to the presence of certain exposed waste like the syringes and needles.

Source: Field Survey, 2020

Fig. 17 Private waste contractor emptying waste from health facilities.

Appendix 11 shows Kwamoso, the final disposal site of the only private waste collector in the Municipality. this site is not engineered and does not have any proper lay out for waste segregation. All the waste collected from households, markets and health centres end up here without any sorting out or segregation. This is the biggest challenge of waste medical waste management in health centres, this is because even if the health centres manage to segregate their

waste at source till final pick up by these contractors, the entire waste is mixed with other general waste and dump together at the final disposal site rendering the entire waste on the site very hazardous. Waste contractors should develop their waste disposal sites to landfill site to be able to segregate and manage all types of wate effectively to reduce the incidence of infection at the dumpsite. Regulators of the environment should see to this as well.

Appendix 12 shows some items scavenged by scavengers at the kwamoso dumpsite waiting to be carried to buyers in the town of Akropong. ironically, this same dumpsite does not have any segregation policy or practices hence all the waste from the markets, households' industries and health centres end up here together, missed up. these scavengers who pick these wastes do no put on any PPEs, they handle the items with bare hands with the potential of possible needle injection and exposures to certain hazardous waste at the site. they carry these infections to the buyers in the main town and possibly infect them as well who in turn carry these infections to their homes to their family who in turn infect those they also come in contact with. so, at the long run the infection picked by a scavenger at the dumpsite due to poor management of the dumpsite has long chain of people who gets infected one way or the other

All the waste generated from the CPMR hospital and that of the MEDICAS hospital end up at the final disposal site of a private contractor with the exception of wastes like placenta and other body parts which are usually buried. This puts the waste handlers who collects these wastes and the immediate community where this final disposal land is located at great risk of infection. A Nwachukwu et al.,2013 sited WHO in their study which estimates that, in 2000, injections with contaminated syringes caused 21 million hepatitis B virus (HBV) infections, two million hepatitis

C virus infections and 260 000 HIV infections worldwide, many of which were avoidable if the syringes had been disposed of safely. The re-use of disposable syringes and needles for injections is particularly common in certain African, Asian and Central and Eastern European countries. In developing countries, additional hazards occur from scavenging at waste disposal sites and the manual sorting of hazardous waste from health-care establishments. These practices are common in many regions of the world. The waste handlers are at immediate risk of needle-stick injuries and exposure to toxic or infectious materials.

In June 2000 six children were diagnosed with a mild form of smallpox (vaccinia virus) after having played with glass ampoules containing expired smallpox vaccine at a garbage dump in Vladivostok (Russia). Although the infections were not life-threatening, the vaccine ampoules should have been treated before being discarded. In June 2000 six children were diagnosed with a mild form of smallpox (vaccinia virus) after having played with glass ampoules containing expired smallpox vaccine at a garbage dump in Vladivostok (Russia). Although the infections were not life-threatening, the vaccine ampoules should have been treated before being discarded.

Most of the clinics visited uses mini waste receptacles about 60litres in volume where they keep waste generated in the day, all the facilities used puncture-proof or 'safety' boxes where sharps are kept. The pictures Figure 20 the improvised puncture proof box by health facilities, their main reason for improvising their own version of the box is to help accommodate larger waste in the day since the accepted yellow puncture proof box is too small to work with. The use empty boxes or cartons with a small opening at the side where the sharps are sneaked into the box.

Appendix 13 are safety boxes being used at some health facilities in the municipality, this type is not the approved type by the world health organisation but an improvised type used by Adukrom

health centre. According the health workers, the approved type is quite small and does not accommodate larger quantities of waste in the day hence they would have to empty the box often before the day ends. However, this particular improvised box is not puncture-proof and any needle put inside can easily puncture the box and can accidentally inject unsuspecting clients or workers.

Source: field survey

Fig. 21. Galvanized waste receptacles used at clinics.

The problem with these waste containers is that (appendix 14) they do not have lids and the safety boxes does not have the ability to avoid puncture from needles exposing health workers to likely infection from accidental injection. Flies will move from the exposed waste in the uncovered waste receptacle to cause public health concerns when they land on foods affecting food safety as well.

All the clinics and health centres visited do not have a contract with any waste management company to haul their waste to the final disposal site, hence they all have dug out pits (appendix 15) where all waste from the facility and general waste are dumped and burned. sometimes if it should rain in day, the waste is left to dry before burning which eventually affects public health.

Source: field survey,2020

Handling of these waste from the point of generation poses danger to the labourers and sometimes nurses who push or carry the waste to the open dump. This is because from the study, it was

observed that most of these health personnel including labourers do not have adequate training on proper healthcare waste handling and do not use the appropriate PPEs as well, this confirms the findings by (Amfo-Otu and Ayiku-Doo, 2015) that all the waste generated from the various units and departments were dumped at a designated site within the hospital premises and occasionally burnt. This is consistent with other studies done in other African countries which found that most hospitals do not have treatment facilities and resort to open burning of healthcare waste just as in the case of Tetteh Quarshie hospital and other clinics, (Oruonye, 2012). Moreover, a report on assessment of healthcare waste management in Africa concluded that there is considerable number of healthcare facilities with different capacities in Africa but its waste disposal methods needs to be critically considered (AERD, 2009).

Open burning of waste at the pit may pose environmental risks to staff and communities around the hospital. Safety practices among the waste handlers were not all that good. Even though they were occasionally provided with some personal protective equipment they were not using them. Training of workers on the use of the protective gear was missing from the personnel unit probably due to the lack of resources. Waste handlers indicated that for a long time they have not had safety training. A study by Oruonye (2012) also confirmed the poor attitude of most health personnel in handling medical waste. According to the findings of his study, most medical waste handlers, particularly in the private hospitals/clinics do not have formal training in waste management. Also, Alagoz and Kocasoy (2008) reported that in Istanbul (Turkey) use of personal protective equipment by hospital waste collectors was low and this was partly due to the lack of appreciation of the health implications and the irregular supply of the personal protective equipment.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter summarizes and concludes the study. It offers some policy recommendations. The first aspect deals with summary of the findings of this study; the second section provides the conclusions of the study. Finally, the last section presents recommendations based on the findings from the topic.

5.2 Summary

The main objective is to asses health care waste segregation practices in health facilities within Akuapem North Municipality whereas specifically, the objective of this study was to examine the existing health care waste segregation system in the health facilities and to assess the level of awareness of the color-coding system for efficient segregation practices in health care facilities. Finally, to ascertain the efficiency of the waste segregation practices in the health facilities. Primary data was taken from the respondents who were selected using the convenience sampling technique from the selected hospitals.

The study however revealed that, most of the health facilities have existing waste segregation systems which is not properly done, this is because some selected departments practice the segregation of the waste at source but other departments just mix all waste together even at the point of generation especially the wards. The clinics only rely on dug out pits to serve as the final destination of all their waste generated. they burn these wastes at the end of the day with kerosine and when the pits gradually become full, it is covered neatly and a different pit dug out. the hospitals however use waste receptacles to collect waste from various departments and finally hauled to an unknown destination by a private waste contractor.

Knowledge of the color-coding system of waste segregation is also quite low as most of the hospital staff had very low level of awareness about the segregation of waste using the colour code of bins. That is, most of the respondents were not aware the reasons why some kind of colours were chosen for some type of waste with the exception of the hospital administrators and a few senior staff. Efficiency level of the segregation was are very low as only a small fraction of departments within the facility practices the segregation, the few percentages which segregated waste effectively at source, had the waste mixed up with other waste during the management process to the final destination thereby rendering the entire waste hazardous. This makes the degree of efficiency of waste segregation practices on the low side.

5.2 Conclusion

The main types of solid waste generated regarding the four hospitals studied were infectious, non-infectious and pharmaceutical wastes. The facilities did not keep records (documents) on the quantity of waste generated. With the exception of few sharps, and other pathological wastes which were segregated at source, no segregation of waste is done. Waste containers are not covered and not labelled according to the MoH and WHO recommendations.

There are no waste management training (in-service) programs for hospital workers with the exception of Centre for plant medicine research. It was also observed that workers managing waste do not use personal protective equipment (PPE). Through the survey, it came to light that no waste management department (officer) exists resulting in ineffective supervision. Non-existence of waste management policy (legislation/regulation), lack of manual (guide) document as well as delay in the final disposal of waste were revealed as some factors militating against improper management of hospital wastes. Generally, hospital wastes were not managed effectively and

efficiently which could have a lot of health implications on both humans and other living organisms as a whole.

5.3 Recommendations

Based on the findings from the study the following are recommended for the health care facilities to do to facilitate proper and safe management of health care waste.

1. There should be proper documentation of quantity of medical waste generated per bed/day/week/month/year to serve as a guide for effective and efficient planning to facilitate the management of the waste.
2. Provide the logistics required for waste segregation and management such as puncture proof boxes, colour-coded and properly labelled waste containers with covers since most of the facilities were improvising and not adhering to the colour coding system of the Ministry of Health.
3. All the health care facilities studied should consider adopting a better system for treating infectious waste separately from the non-infectious waste before disposal to reduce the potential risk of infection among those who may be exposed to the waste. This is because most of the facilities did not treat the infectious waste and mixed them with the non-infectious waste which increases the risk of acquiring infection from the waste.
4. The Municipal Health Directorate should facilitate the process to acquire one modern treatment system that can be shared among the health facilities in the municipality to be operated as a cluster system. This will reduce the cost of installing treatment facilities separately for all the health facilities in the Municipality.

5. There should be officers responsible for health care waste management who has the requisite knowledge in health care waste management in all the facilities to ensure effective supervision of the waste workers and Nurses to comply with segregation practices.
6. There should be regular training programmes on health care waste management and infection prevention in general for all categories of health workers since training was not frequently done for staff.
7. Health facilities should develop waste management plans and adopt the national policies on health care waste management to guide how waste would be managed in the facilities.
8. Standard operation procedure should be developed and implemented to guide healthcare staff and waste handlers on how best to handle medical waste such as infectious and non-infectious to reduce possible nosocomial infections, occupational injuries and risks to the general community members.
9. Staff of the health care facilities should collaborate with their hospital and health care facility management to implement safe waste management system by participating in trainings on health care waste management, properly segregating their waste and educating others to do same.
10. Private waste contractors should adhere to the national policy requirement for the collecting and transportation of healthcare waste. They should be registered and licenced to carryout such haulage services to ensure safety, with dedicated truck solely for medical waste.
11. Private waste contractors must ensure their final disposal sites meets the requirement for receiving medical waste for appropriate segregation at the site. Their final disposal site

should be engineered to WHO standards with the necessary machinery to treat and dispose off all medical waste. the final disposal site of such collectors should be void of any scavengers to avoid any form of accidents or injury.

12. Health centres using skip loader containers should ensure the containers sites are neatly kept and the container fitted with covers. These institutions should not rely on only one (1) skip container because it will defeat the purpose of the segregation from the various departments. containers should be at least two (1) to aid in segregation.

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APPENDIX

QUESTIONNAIRE

PREBYTARIAN UNIVERSITY COLLEGE, GHANA

FACULTY OF DEVELOPMENT STUDIES

DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES MANAGEMENT

Please, spend 20 minutes of your time to respond to the items on the questionnaire. This questionnaire is for academic purposes only and no part of it will be used to profit making or to sabotage the respondents and any information given will be treated in absolute confidence.

SECTION A

GENERAL INFORMATION (Name, Status, Service Provision, Patients Attendance Records and Available Units)

1. Name of Hospital…….....

2. Status of Hospital **[Tick one]**

Private Hospital[ ]Private Clinic [ ]Local Hospital/Clinic [ ]

Government Hospital [ ] Government Health Center [ ]

Mission Hospital [ ] Mission Health Center [ ]

3. Service Provision/Services being provided

Specialist Hospital [ ] General Hospital/Clinic Health Center [ ] Teaching Hospital [ ]

4. Location of Health Facility

Sub-District [ ] District [ ] Municipality [ ] Metropolitan [ ] **[Tick one]**

5. Sex of respondent/Worker Male [ ] Female [ ] **[Tick one]**
6. Age of respondent/Worker 24-30 [ ] 31- 35 [ ] 36-40 [ ]
7. Educational status of respondents/Workers SSCE/WASSCE [ ] Certificate/Diploma [ ] Undergraduate Degree [ ]
8. Working years of respondents/Worker 1-5 [ ] 6-10 [ ] Above 10 years [ ]
9. Job Description: Doctor [ ] Administrator [ ] Nurse [ ] Health/Ward Asst [ ] Orderly [ ] Lab Tech/Asst [ ] Waste Handlers [ ] Other [ ] If „Other', specify……
10. Patients Attendance Record: - (Provide the N^{o} of Patients/beds in the spaces indicated below):

FOR HOSPITAL ADMNISTRATORS

(i) N^{o} of Patients at OPD/day…… (ii) N^{o} of Beds at Male Ward……

(iii) N^{o} of Beds at Female Ward…… (iv) N^{o} of Beds at Children's Ward……...

(v) N^{o} of Beds at Maternity Ward……

11. **Tick** the **Unit** of the Hospital you are working at/on duty **(Tick one based on where on duty**). OPD [ ] Injection/Dressing Room [ ] Theater [ ] Laboratory [ ] Wards [ ] Pharmacy/Dispensary [ ] X-ray [ ] Emergency [ ] Renal [ ] Pathology unit [ ] Eye unit [ ]

SECTION B WASTE CATEGORY/NATURE OF WASTE GENERATION

12. List the type of wastes that are generated at the unit you are working at/on duty **(List for only the unit you Ticked in N^{O} 8 above)**

OPD ……

Injection/Dressing Room …… Theater

……..... Laboratory

……

Wards……

Pharmacy/Dispensary ……. X-ray

……..... Emergency

…….....

13. What is/are the nature of the waste**? [Tick as many asavailable/appropriate/applicable]**

Infectious [ ] Hazardous/Toxic [ ] Non-hazardous/non-toxic [ ]

General waste [ ] Highly infectious [ ]

SECTION C

Segregation, Collection, Storage, Handling and Disposal/Treatment)

14. Is/Are there waste container(s) at each unit of the health facility? **[Tick one]**

YES [ ] NO [ ] NOT AWARE [ ]

[Tick **one** or as **many** as appropriate/applicable/available from the information provided below]

15. Are the waste generated at each unit kept/put in the same container? **[Tick one]**

YES [ ] NO [ ] NOT AWARE [ ]

16. What type of waste container(s) is/are used? **[Tick the appropriate one(s)]**

Cardboard [ ] Paper boxes [ ] polythene bags [ ] NONE [ ]

Plastic bins [ ] Paper bags [ ] Metal bins [ ]

17. Are the waste container(s) if any, labeled? **[Tick one]** YES [ ] NO [ ] NOT AWARE [ ]

18. How are these waste containers if any, labeled? …….....

19. Are you aware of WHO recommended colour-code for different categories of hospital waste containers? **[Tick one]**
YES [ ] NO [ ] NOT AWARE [ ]

20. If YES write the colour-code for each of the following categories of hospital waste:

(i) Infectious waste…… (ii)Non-infectious waste……

(iii)Hazardous/Toxic waste…… (iv)Non-hazardous/toxic waste…… (v) General/Municipal waste……

21. How are these waste containers (if any), managed?

Uncovered/Not covered [ ] Not always covered [ ] Uncovered properly [ ]

Covered [ ] partially covered [ ]

22. How often are these hospital wastes collected? **[Tick one]**

Daily [ ] Twice/week [ ] Thrice/week [ ] irregularly [ ] Not often [ ] Not reliable [ ]

23. Where are these waste kept/put/stored after collection from the various units of the hospital before final disposal? **[Tick one]**

On the ground /floor [ ] In metal waste bins [ ] In plastic bins [ ] In polythene bags [ ] On hospital premises [ ] In paper boxes [ ]

24. How are these wastes disposed of from the hospital finally? **[Tick one]**

To Municipal dump site [ ] To landfill site [ ] Buried on hospital premises [ ] Dump behind hospital premises [ ] To community dump site [ ] Dump in plastic waste bins [ ] Dump on hospital premises [ ] Dump in open shallow pit [ ]

25. How are these waste treated after final disposal? **[Tick one]**

Burnt on the floor [ ] Recycle [ ] Buried in open shallow pit [ ]
Autoclaved [ ] Deep burial [ ] Incinerated [ ]
Open pit burning [ ] Reuse [ ] Sterilized/disinfected before disposal [ ]

26. How are sharps (e.g. needles) disposed of? **[Tick one]**

Burnt on the ground/ floor [ ] Deep burial [ ] Buried in pits [ ]

Dump on shallow open pit [ ] Dump on Municipal/Community dump site [ ] Not aware[ ]