UNIVERSITY OF CAPE COAST

SUSTAINABILITY OF HOSPITAL WASTE MANAGEMENT PRACTICES AND ITS CHALLENGES FROM THE PERSPECTIVES OF HEALTHCARE EMPLOYEES: THE CASE OF MAMPROBI POLYCLINIC-ACCRA

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BY

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A Dissertation submitted to the Department of Management, School of Business of the College of Humanities and Legal Studies, University of Cape Coast in Partial fulfilment of the Requirements for the Award of Master of Business Administration Degree in Management

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DECLARATION

Candidate's 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 the University or elsewhere

Candidate's signature..... Date.....

Name: VICTORIA KOSIKUMAH

Supervisor's Declaration

I hereby declare that the preparation and presentation of this dissertation were supervised in accordance with the guidelines of supervision laid down by the University of Cape Coast

Supervisor's signature..... Date.....

Name: .....

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Also, special thanks go to all my families and friends who helped me through all these endeavours.

KEYWORDS

Waste Management

Healthcare Waste

Healthcare Waste Management

ACRONYMS

EPA – Environmental Protection Agency

HCWM – Health Care Waste Management

HIV – Human Immune Virus

HWM – Hospital Waste Management

LMDIC - Low-Middle Developing Income Countries

UNCED - United Nations Conference on Environment and Development

WHO – World Health Organisation

WM – Waste Management

WMT – Waste Management Theory

ABSTRACT

Healthcare waste generation is an integral part of healthcare operations. Improper healthcare waste management and disposal can be detrimental to humans and the environment. This study examined sustainable hospital waste management and its challenges at Mamprobi Polyclinic, Accra. Further to examined the categories of hospital waste; the current methods used for treating and disposing hospital waste and the challenges burdened by the hospital in managing hospital waste in a sustainable way. The target respondents of the study were 150 staff from the polyclinic. A sample size for the study was 150 respondents, chosen using a census method, however 125 respondents answered the questionnaire. The statistical tools used to analyze the study was descriptive statistics which include percentages, mean and standard deviation. Overall, results showed that most of the hospital wastes were infectious. More so, incineration was the current method used to treat and dispose the hospital waste. However, in attempt to manage these hospital waste, findings revealed that the hospital was resource constrained, and that this challenge made it difficult to sustainably manage the hospital waste. Hence, it is evident that infectious waste are more than the non-infectious waste in the hospital, and that the hospital was unable to manage the waste in an effective way. Findings revealed that medical waste generated is treated using the traditional De Montfort medical waste incinerator, and sometimes the polyclinic turn to Korle-Bu Teaching Hospital for assistance. The study recommended that the government should give priority to hospital waste management in the budget so funds can be available to manage hospital waste sustainably. Also, the training of all the staff on management and proper waste handling within the hospitals using WHO guide lines manual, and conducting training sessions for proper hospital waste management.

DEDICATION

To my family and friends

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CHAPTER ONE

Introduction

This study is about sustainable hospital waste management from the perspectives of front-line staff employees at Mamprobi Polyclinic, Accra. In this study, there are five chapters and this is the first chapter that presents a general idea of the study. The chapter begins by providing the background of the study. This is followed by the statement of the problem, justifying the existing research gap that this study seeks to fill. Accordingly, this part of the chapter provides the purpose and specific objectives. The chapter then proceeds to define and provide the boundary of the study - delimitation. The limitations of the study, are also provided. This chapter ends with how the rest of the thesis has been organised.

Background of the Study

The hazards of poor management of medical waste have aroused the concern world over, especially in the light of its far-reaching effects on human, health and the environment (Khan, Cheng, Khan & Ahmed, 2019). Globally, there is a great concern on control and safe handling of hospital waste in and around the healthcare facilities setting. According to Georgescu (2011), developing nations face various health issues emerging from the burning and the management of small-scale medical waste incinerators results in deficiency waste destruction, inappropriate ash disposal and dioxins discharges, which can be even 40,000 times higher than emission limits set in global conventions.

According to Chartier (2014), World Health Organization (WHO) defines healthcare waste to include all the wastes generated within healthcare facilities, research centers, and laboratories related to medical procedures, as well as from minor and scattered sources, including wastes produced in the course of healthcare undertaken in the home such as home dialysis, self-administration of insulin, and recuperative care. WHO (2014) categorised medical waste into sharps waste, infectious waste, pathological waste, pharmaceutical waste, cytotoxic waste, pharmaceuticals, chemical waste, radioactive waste and non-hazardous or general health-care waste. It consists of a broad range of materials from used needles and syringes to soiled dressings, body parts, diagnostic samples, blood, chemicals, pharmaceuticals, medical devices and radioactive materials.

The most commonly noted issues in appropriate healthcare waste management (HCWM) are often safe disposal of wastes, occupational health and safety for healthcare workers and illegal scavenging. Safe disposal of healthcare waste (HCW) consists of key stages such as segregation, collection and storage, treatment, transport and safe disposal (WHO, 2008) where national legislation must be followed. Four major categories of HCW recommended for organizing segregation and separate storage, collection and disposal are: sharps, whether infectious or not; non-sharps infectious waste; general waste; and hazardous waste. Collection, storage and treatment of these wastes differ from each other. Segregation, disinfection, incineration, shredding and grinding, landfilling, recycling, composting, autoclaving and microwave irradiation have been adopted for the treatment of HCW in different parts of the world (WHO, 2008).

In many countries, hazardous and medical wastes are still handled and disposed together with domestic wastes, posing a great health risk to municipal workers, the public and the environment. Indeed, it has been noted that improper management of hospital waste has brought untold occupational, environmental, and public health hazards to hospital workers, patients, and communities worldwide (Emmanuel & Stringer, 2007). Developing countries, like Ghana is no exception since the management of hospital waste end up not getting the priority it deserves.

A number of needle-stick injuries have been reported among hospital workers and scavenger families while handling infected waste mixed with other types of waste (Salkin & Kennedy, 2004). A study by Ebrahimi and Khosravi (2007)) revealed that 7,550 needle-stick and sharps injuries were reported among 8,645 health workers in Taiwan, 66.7 percent of these injuries involving a contaminated hollow-bore needle. In Sub-Saharan Africa, the reuse of contaminated syringes and needles in medical care has accounted for five percent of HIV infections (Crabb, 2003). Additionally, there have been numerous instances where medical wastes have been dumped in residential areas. The illegal dumping of medical wastes in disadvantaged residential areas has resulted in situations where children have been found playing with medical waste materials such as syringes.

In general, the WHO estimates that each year there are 8-16 million cases of hepatitis B Virus, 2.3-4.7 million cases of hepatitis C Virus and 80,000-160,000 cases of HIV due to unsafe injections and mostly due to very poor hospital waste management system (WHO, 2017). Unregulated clinical waste treatment and disposal has been linked to several public health threats.

Solberg (2009) reported that 240 people in Indian State of Gujarat contacted hepatitis B after receiving medical care with previously used syringes acquired through the illegal trade of clinical waste. The improper disposal of medical waste constitutes a problem in most of the developing countries.

In Africa, over 67,000 healthcare facilities generates over 283, 000 tonnes of clinical wastes annually (Udofia & Nriagu, 2013). A WHO survey in 22 developing nations found that about 18% to 64% of healthcare centres' use inappropriate clinical waste treatment and disposal technologies (WHO, 2005a). This phenomenon poses public health risk due to the infectious nature of clinical waste (Alhumoud & Alhumoud, 2007). Mostly, the first group of people at risk are the healthcare staffs who are prevalently exposed to common diseases such as cholera, tuberculosis, hepatitis, skin infections, and food poisoning, etc., in either epidemic or even endemic form (Marinkovic et al., 2008). Consequently, studies conducted by (Alhumoud & Alhumoud, 2007; Marinkovic et al., 2008) revealed waste handlers as the prevalently exposed as compared to other healthcare workers.

Healthcare in Ghana have been caught up with the dilemma of disposal of their waste in a safe manner. Various methods have been adopted by these healthcare facilities for the disposal of waste for example, burial, treatment with chemicals, mixing with domestic refuse and careless dumping in overgrown environment. The stench that emanated from the burial of placentas, limbs etc. especially after rainfall are unbearable and awful within most healthcare facilities environments. To this end, the Waste Management Department of the Accra Metropolitan Assembly and the Ministry of Health following the United Nations Conference on Environment and Development

(UNCED) developed a clinical waste management manual for healthcare centres on how safe handling and disposal of both clinical and non-clinical waste generated and to monitor the environmental impact of wastes by the year 2025 (Nema et al., 2011).

Theoretically, the Waste Management Theory supports this study by indicating that waste management is implemented to prevent waste causing harm to human health and the environment (Pongrácz, Phillips & Keiski, 2004), and the waste management hierarchy places emphasis on reducing, reusing, recycling and composting as key to sustainable waste management (Gertsakis & Lewis, 2003). This was particularly important considering the waste that is indiscriminately dumped in undesignated places, such as streets and rural areas, is a serious concern for the surrounding residential communities (Dladla et al., 2016). While developed countries face difficulties with the sheer volume of waste matters from the utilization of disposable items, developing countries, whose supplies are restricted, are managing challenges of segregation and disposing of every types of biomedical waste in a classified manner.

Medical waste generation source, classification, quantity and quality are the bottom line problems on deciding an effective medical waste management practices (Adnan et al., 2013). According to WHO, (2001), when types of medical waste generated is not overseen appropriately, the healthcare personnel is exposed to contamination risk, occupational accidents and sicknesses for being always exposed to microorganisms. Implicitly, there has been lack of sustainable management of hospital waste management in Africa and for that matter Ghana and this has attracted a great deal of attention from

various sectors. Against this background, this study sought to contribute to the understanding of the sustainability aspects of hospital waste management at Mamprobi Polyclinic in Accra, Ghana.

Statement of the Problem

Poor healthcare waste treatment methods and practices in Ghana are creating serious environmental problems in cities and local communities, exposing residents and neighbours to foul odours, smoke, air pollutants, contaminated water, and toxic ash from surrounding healthcare facilities (WHO, 2014; Ranjbari et al., 2022). These hazards also pose risk to the health and safety of health workers, waste collectors and patients in the health facilities. Disposing of untreated bio-hazardous medical waste poses serious health risks to the people of Ghana, as mentioned above. Waste incineration for instance, produces very toxic emissions (dioxins, furans and heavy metals, etc.) into the environment which in the long-term have very significant negative environmental and health effects (WHO, 2011).

In the Greater Accra region, for example, 83% of health facilities do not sort their waste (Asante, Yanful & Yaokumah, 2014). Where they do, the infectious fraction sorted still ends up at the landfill sites, mixed with the general municipal waste if the health facility has no incinerator (Asante, Yanful & Yaokumah, 2014) or open-fire pit. In the context of hospital waste, healthcare facilities produce medical waste that has dire consequences for the already challenged waste management system in Ghana as the healthcare employees are exposed to contamination risk, occupational accidents and sicknesses due to infectious (Windfeld & Brooks, 2015).

Currently, most health facilities in Ghana benefit from the communal collection system spearheaded by a private company, Zoomlion Ghana Limited, on behalf of municipal assemblies (Amfo-Otu & Doo, 2015). The company collects and mixes the non-hazardous wastes with hazardous wastes from many healthcare facilities and sends them to central disposal facilities. With no pre-treatment occurring at the disposal sites, the combined waste can still remain infectious. Therefore, the problem of medical waste disposal in the hospitals and other healthcare establishments has become an issue of increasing concern, prompting hospital administration to seek new ways of scientific, safe and cost-effective management of the waste, and keeping their personnel informed about the advances in these area.

Satawa (2019) emphasized that there is potentiality of injuries from sharps leading to infection to all categories of healthcare personnel and waste handlers. The risk of infection outside hospital for waste handlers, scavengers and general public living in the vicinity of hospitals, risk associated with hazardous chemicals to persons handling wastes at all levels. The hospital serves the public hence, due to its accessibility and affordability of healthcare services, leads to generation of voluminous waste. Every day, relatively large amount of potentially infectious and hazardous waste is generated in the health care facilities around the world. Indiscriminate disposal of hospital waste and exposure to such waste possess serious threat to environment and to human health that requires specific treatment and management prior to its final disposal. There is insufficient information about hospital waste management which is essential for identifying opportunities to improve and sustain medical waste management's systems.

However, although a lot of studies have been done in these areas, in Ghana, some healthcare waste management and assessment studies that have been done lay emphasis on the proportion of hazardous waste generated (Odonkor & Mahami, 2020). Besides, most of the studies have focused on better understand the facilities used in managing waste in cities (Oteng-Ababio, 2012) as well as examining inadequate waste management in households across the Metropolis of Ghana (Aziale & Asafo-Adjei, 2013). Efficient sorting of medical waste at source is critical to any effective waste management strategy in any jurisdiction around the world. Hospitals in Ghana such as Mamprobi polyclinic are required to acquire better methods for treating the waste in the long term.

The access to more efficient and environmentally sustainable treatment technologies are lacking due to limiting factors, such as poor financing and management, for this sector have resulted in irregular waste collection, improper handling and passing on the responsibility for discarding of the waste on to health facility workers (Ruhoy & Daughton, 2008). These create a knowledge gap as one does not know how this waste is handled within the various health facilities from its generation to disposal, and the challenges associated with hospital waste management sustainability. In order to improve healthcare waste management and develop a management strategy for the healthcare centres in Ghana as a whole, it is important to understand and evaluate current practices in medical waste management, hence the study.

Research Objectives

The main aim of the study is to determine the types of medical waste generated and the challenges associated with sustainability management practices of medical waste from the perspectives of healthcare personnel at Mamprobi Polyclinic, Accra.

The specific objectives of the study

1. To identify the categories of hospital waste generated within Mamprobi Polyclinic
2. To identify the current waste methods used in treating and disposing of clinical waste in Mamprobi Polyclinic
3. To examine the challenges to sustainable hospital waste management in the Polyclinic

Research Questions

1. What are the categories of hospital waste generated within Mamprobi Polyclinic?
2. What are the current waste methods used in treating and disposing of clinical waste in Mamprobi Polyclinic?
3. What are the challenges to sustainable hospital waste management in the Polyclinic?

Significance of the Study

The importance of this study is to create the necessary awareness to the staff of Mamprobi polyclinic regarding the health risk of hospital waste. Assessment of the health care wastes of the hospitals will help to assess current best practices and identify gaps that need to be addressed, provide initial reference point for the infectious wastes reduction and make improvement in the handling and segregation of the wastes at source and transportation. This will help in the reduction of the volume and quantity of the infectious waste. This will also help to enhance the occupational health and safety practices in healthcare facilities.

The findings of this study will also open up opportunities for many more studies, sensitizing the healthcare managers and guiding policy makers on the best way possible. This will encourage partnership between public and private hospital to facilitate for proper management of medical waste so that there will be best practices among healthcare personnel. It will also form management strategies and guideline which will equip health care facilities with modern equipment to manage medical waste in Ghana and other developing countries.

All these will lead into conducive working environment which will provide quality of life for healthcare personnel, and minimize the risk of spreading infectious diseases, and contribute to the global fight against climate change. Thus, government and policy makers will benefit from the study as they will employ the necessary strategies on waste collection, storage, treatment and disposal. In summary, this research will contribute in making

hospital leaders to have effectively implemented cost-effective waste management strategies which may improve communities' health and therefore contribute to positive social change.

Delimitation

The study was geographically restricted to only Greater Accra region while in terms of sectorial dimension, it was only Polyclinic at Mamprobi as the study centre. It was mainly about the views of the healthcare staff in this hospital. The research method was also based on quantitative.

Limitations

This study consisted of one health care system in the Greater Accra region. One of the limitations of a single case study design is the inability to generalize the findings to other hospitals or hospital systems in Ghana or other countries. Besides, this study only focuses on issues related to the sustainability aspects of medical waste management at Mamprobi Poly in Accra. However, there is a need to examine more hospitals in Ghana to make sufficient comparison for the current situations in hospitals and discuss sustainable means of management as well as research sustainable and environment friendly solutions for medical waste disposal in more detail. Finally, this study relied heavily on quantitative research method. Thus, the limitations that are inherent to this method such as lack of detailed narration of the challenges were also present. The study provided a detailed narration of each challenge faced by the Mamprobi Polyclinic.

Organization of the Study

This entire research includes five (5) chapters. Chapter one (1) focused on the introduction to the topic and showcase the research questions, chapter one also presented the purpose and limitation of the research. Chapter two (2) reviewed relevant literatures related to the research topic "the influence of service quality on customer satisfaction". Chapter three (3) discussed the research method used for data collection, analysis, and reliability and validity of this study; while Chapter four (4) presented the data and show the responses to the area being investigated which were documented with the answer relating to the questions asked, as well as discussing the result obtained from empirical study. Chapter five (5) presented the summary of key findings, conclusion, and useful and constructive suggestion formulated for stakeholders and interested parties, followed by a critical reflection and suggestion for future research.

CHAPTER TWO

LITERATURE REVIEW

Introduction

This chapter focused on literature that gives additional details on the background of the study. It captures diverse literature from a global viewpoint on the topic of research. The chapter discusses in detail the horizon of the study's knowledge base regarding the concept and meanings of variables, theoretical context, empirical research, and presents a conceptual framework analysis, which provides direction for the study.

Theoretical Review

This section of the study discusses the model underpinning the work. The study will be guided by the Waste management theory and the Waste Management Hierarchy model.

Waste Management Theory

Waste Management Theory (WMT) has been introduced to channel environmental sciences into engineering design. Pongrácz (2002) stated that WMT is a unified body of knowledge about waste and waste management. It is an effort to organise the diverse variables of the waste management system as it stands today. Prevention of waste creation is the main priority of waste management theory, which corresponds to the principal goal of waste management: conservation of resources. Moving toward waste minimisation requires that the firm commits itself to increasing the proportion of non-waste leaving the process. It has been argued that, it follows from the laws of

thermodynamics, that producing by-products is concomitant of a main product (Sankaranarayanan, de Swaan Arons, & Van der Kooi, 2004).

For this reason, industrial firms have to look beyond their factory walls, and seek for external utilization of their waste, in accordance with the principles of the theory. If we accept that waste minimization and resources us optimization is the most important objective of waste management (Pongrácz 2002), it is essential that the hospital considers resource use optimization and that it reaches beyond the tradition scope of waste management. Clearly, the theory of Waste Management is based on the considerations that waste management is to prevent waste causing harm to human health and the environment, and application of waste management leads to conservation of resources. It successfully combines waste minimization and resources use optimization measures, and ensures that resources are effectively circulated within ecosystems.

The Waste Management Hierarchy Model

The waste management hierarchy (figure 1) outlines a classification framework for waste management options in terms of their potential to minimize ruinous effects on the environment (Hill, 2010). Its main tenets are based in the assumption that the diversion of wastes from landfills and incinerators is congruent with the ideals of environmental sustainability. Subsequently, the hierarchy accentuates the concepts of reduce, reuse, recycle as most desirable options while incineration and land-filling are considered less favourable (White, Franke & Hindle, 1995).

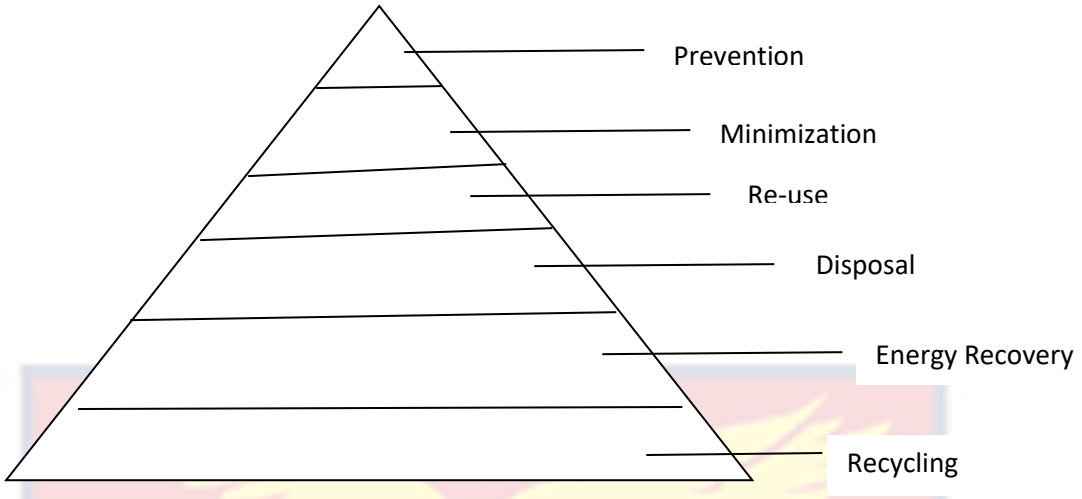

Figure 1: The waste management hierarchy

Theoretically, the emphasis on minimization, reusing and recycling as desirable options in the waste management hierarchy is congruent with the ideals of sustainable development. Such practices ensure the diversion of wastes from landfills and incinerators. In practical terms however, the hierarchy does not address socio-economic, technical, and political barriers to effective implementation of its preferred options. The waste management hierarchy also fails to highlight treatment of hazardous wastes as an option. A major weakness of the waste management hierarchy therefore lies in its view of waste as homogenous, rather than consisting of several unique characteristics. Such an oblique view may militate against the attainment of effective waste management outcomes. For example, the preferred options outlined in the hierarchy may not necessarily work favourably in the context of managing infectious and hazardous biomedical residue. Thus, the waste management hierarchy although a useful concept, is laden with some major weaknesses. The Agenda 21 recommendations stipulate, among others, the following:

(i) the prevention and minimization of waste production

(ii) the reuse or recycling of waste to the extent possible

(iii) the treatment of wastes by safe and environmentally sound methods

(iv) the disposal of final residues by landfill in confined and carefully designated sites.

Further, Agenda 21 stresses that waste producers should be responsible for the treatment and final disposal of their wastes; where possible each community should dispose of its wastes within its own boundaries. The safe management of wastes produced is formulated within the framework of a national plan for healthcare waste management (Dalal-Clayton & Bass, 2002).

Conceptual Review

Health Care Waste Management (HCWM)

According to Williams (2005), the definition of waste in general can be very subjective, because what represents waste to one person may represent a valuable resource to another. Whatever the definition, today hospital waste is accepted as a major problem of our society and should be handled by authorized and health personnel concerned. Waste management (WM) means to take care of any type of garbage in a technical and systematic way. In the context of health, healthcare waste (HCW), which is also defined as medical or biomedical waste, is the different types of waste that are generated from health centres and laboratories, health research facilities, emergency relief actions, and healthcare activities undertaken in homes (Doylo et al., 2019). WHO also defines healthcare waste more generally to include non-infections

waste products coming from all healthcare related entities (Caniato et al., 2015).

The major sources of HCW are hospitals, medical clinics, dispensaries, health care camps, medical and biomedical laboratories, medical research centres, mortuary and autopsy centres, animal research and hospitals, blood banks and so on. Additionally, it includes the waste originating from "minor" or "scattered" sources—such as that produced in the course of health care undertaken in the home such as dialysis, insulin injections, etc. (Abah & Ohimain, 2011). Thus, in general, the waste generated in a medical centre can be divided into two main categories: general (or non-clinical) waste and medical (or clinical) waste (Appleton & Ali, 2000). According to WHO (2014), between 75% and 90% of the waste produced by health-care providers isnon-risk or "general" health-care waste, comparable to domestic waste. It comes mostly from the administrative and housekeeping functions of health-care establishments and may also include waste generated during maintenance of health-care premises. The remaining 10–25% of healthcare waste is regarded as hazardous and may create a variety of health problems and these include syringes, sharp instruments, platelets, placenta, body parts, feotus, etc, whereas pharmaceutical waste which also constitutes less than 1% includes expired drugs and vaccines, left over drugs, etc (Katoch & Kumar, 2008; WHO, 2007).

With respect to management, Uwa (2014) posit that management of HCW is not strictly about data compilation and technology of waste treatment and disposal but also involves training, commitment, management, leadership and effective legislative. As rightly pointed out, treatment and management of

HCW for sustainability need to incorporate all the elements of both management and technical. These elements are listed as planning and procurement, staff training and behaviour, proper use of tools, machines and pharmaceuticals, proper methods applied to segregation, reduction in volume, treatment and disposal.

However, one problem within the study of healthcare waste management practices is that their concept and related themes, such as "medical waste" or "infectious waste" are still poorly defined and there is no universally accepted standard (Askarian et al. 2010). For example, while several studies (e.g., Abd El-Salam, 2010; Ananth et al., 2010; Chartier et al., 2014) propose a concept of healthcare waste as the waste generated by hospitals and therefore hazardous, Windfeld and Brooks (2015) argue that not all waste generated by hospitals and health institutions is potentially infectious, and can even lose its infectious character after autoclaving.

Classification of Waste

Clinical and Non-Clinical wastes are the two types of solid wastes that are generated at the health facilities: Non-clinical waste or General waste. General/domestic waste which constitute about 75%- 90% of the total waste that are generated include food surplus from the hospital`s kitchen, papers, cardboards, plastics, rubbers, etc. (WHO, 2005a). Clinical waste or Medical waste, on the other hand, comprises surgical and pharmaceutical wastes (WHO, 2007). Surgical waste can be grouped under infectious waste and pathological wastes and constitutes 10%-25%. Clinical waste can further be classified as major or minor sources according to the waste quantities

produced. The major source of clinical waste is generated at major hospitals (e.g., university teaching hospital, general and districts hospitals) and other health centres (i.e., emergency medical care services, health care centre and dispensaries etc.) (Cheng et al., 2009; Katoch & Kumar, 2008). The minor sources of clinical waste are generated at small health care establishment (such as physician officer, dental clinics, acupunctures, chiropractors etc.) and non-health activities involving intravenous or subcutaneous interventions basically with low waste generation (Katoch & Kumar, 2008).

Often, 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, pharmaceuticals, medical devices and radioactive materials (WHO, 2011).Poor management of health care waste potentially exposes health care workers, waste handlers, patients and the community at large to infection, toxic effects and injuries, and risks polluting the environment. It is essential that all medical waste materials are segregated at the point of generation, appropriately treated and disposed of safely (WHO, 2011).

In general, as outlined by WHO (2016), the composition of wastes generated by hospital is often a characteristic of the type of source as displayed by table one

Table 1: Waste by Type

Waste Type	Waste Type Description
Infectious waste	Waste contaminated with blood or

	body fluids human or animal. Examples include diagnostic samples, laboratory cultures, and waste from autopsies; waste from patients or animals in isolation; disposable equipment.
Pathological waste	Tissue, organs, and body parts from humans and contaminated animals.
Sharps	Needles and syringes, disposable surgical instruments, and blades.
Chemicals	Disinfectants, solvents used in laboratory preparations, toxic metals in medical devices (mercury) and batteries.
Pharmaceuticals	Expired, unused, or contaminated drugs and vaccines
Genotoxic waste	Waste that is extremely hazardous, mutagenic, teratogenic1 or carcinogenic, such as cytotoxic drugs used in cancer treatment and their metabolites

Radioactive waste	Waste containing a radioactive substance such as radioactive diagnostic material or radiotherapeutic materials.
Non-hazardous or general waste	Waste that poses no biological, chemical, radioactive, or physical hazard such as paper, plastic, diapers, and other general household type waste. Much of this waste is recyclable.

Source: WHO (2016)

From the table, it can be seen that healthcare facilities generate all forms of hazardous waste (Carnero, 2015). Health care waste management (HCWM) inadequacies are increasingly compounding adverse environment and public health conditions in many developing world cities. In general, the management component of HCW depends on good governance as one of the main strategic factors that need consideration for the success of raising the standard of HCW management. The others are institutional arrangements which include framing of appropriate HCWM policies, laws, regulations, guidelines, standards and enabling instruments. Other factors suggested includes clear cut roles and responsibilities, capacity building through knowledge sharing, enabling policy framework addressing economic and market-based instruments, facilitation or providing accurate and timely

information to all stakeholders and financing which is considered a fundamental issue (Moreira & Gunther, 2013).

Different Methods of Hospital Waste treatment

Medical waste treatment is a function of the type of medical waste to be processed and the ultimate disposal of the waste after treatment. Due to the fact that a portion of health care waste is toxic or hazardous to human, plant, and animal populations, most countries have laws regulating how entities must treat and dispose of it. As laws or regulations regarding the management of medical waste have evolved, there are a number of approaches that health care facilities have used to treat medical waste so as to minimize the hazards resulting from medical waste (WHO, 2010). These approaches include the various methods as discussed below

Segregation

Waste segregation is a critical first step for the achievement of waste minimization, cost reduction and sustainable waste management (Johnson et al., 2013) and offers the health facility the means to make more accurate assessment of their waste composition and also positions the facility for practical HCWM strategies. The emphasis in HCW is segregation of source. Segregation is useful since it prevents the contamination of non-hazardous waste by the hazardous waste and making the whole waste stream hazardous. Thus, this method will reduce the toxicity and the volume of the waste stream. Moreover, segregation makes it easier to transport the waste. Waste is

segregated depending on the quantity, composition, and the disposal method of the waste stream (Shareefdeen, 2012).

In developing countries, too, the local standards require source segregation of different waste streams into labelled and color-coded waste bags/containers. However, the implementation of the standards varies from one place to another due to lack of proper source segregation, (Al-Emad, 2011), lack of color coding (Abdulla et al., 2008; Mbongwe et al., 2008) and lack of records pertaining to waste composition and quantity (Bdour et al., 2007). Consequently, some waste components such as pharmaceutical and domestic waste are mixed together which makes segregation more difficult to be done (Abd El-Salam, 2010).

Often the system for segregation, packaging, labelling and marking involves separating the medical waste into categories, as described. The packaging is done in colored bags (Pradesh, 2010). However, if they are to be treated by *autoclave or microwave*, they are placed in red plastic bags or containers. In steam autoclaving, the waste is decontaminated by the effects of the saturated steam at elevated temperatures and high pressure. This method is not applicable for pathological, chemotherapy and radioactive wastes (Shareefdeen, 2012).

Disinfection

In order to reduce the toxicity of some medical wastes, chemical disinfectants (i.e. chlorine dioxide, sodium hypochlorite, or per acetic acid) are sometimes used (Datta, Mohi & Chander, 2018). For solid wastes, disinfection is effective if only waste materials are shredded. In some cases, the

disinfectants themselves are hazardous, thus it is not recommended for treating pharmaceutical, chemical and some types of infectious waste. However, there are technologies of different types of hospital wastes and wastewater disinfections. One of them is autoclaving, which is an efficient disinfection method/process which is done by using an autoclave. Waste is treated in pressurized condition and it requires a 60mint cycle at 121 o C and 1 bar [100kpa]. Reusable medical equipment [surgical, laboratory, pharmaceutical] is sterilized by this process and it is also used to sterilize solids, liquids and instruments of various shapes and sizes. It is not recommended for treating pathological waste (Wang et al. 2020).

Disinfection by Plasma is also another method. With this process, there is low temperature plasma which is produced by the plasma generator using air as working fluid organizes a combustion process. The medical waste is constantly mixed thus it maximizes the heat and mass exchange which saves any energy loss. The heat produced is used as an additional heat source in the process. This technology eliminates the formation and release of irregular forms of NOX and high-toxic substances (i.e. dioxins) into the atmosphere. Another main advantage is that it has low consumption of energy compared to other mineralization (i.e. combustion) processes (Shareefdeen, 2012).

Incineration

Incineration is safe, simple and effective, which has been one of the most widely used disposal technology especially in developing countries (Ghodrat et al., 2017). It is the process of destructing waste by burning it at elevated temperatures in furnaces. The temperature of the incinerator (outlet

temperature) is over 800ºC. This high temperature could not only completely kill microorganisms, but also incinerate and burn most organic matters and transform them into inorganic dusts. After incineration, the volume of solid wastes could be reduced by approximately 85-90% (Wang et al. 2020). The process removes hazardous materials, reduces the mass and volume of the waste and converts it into ash that is harmless. Incineration is suitable for wastes that are 60%combustible, pathological and infectious waste or sharp wastes.

Incinerators exist in several different types; each type has a specific function. A mobile incinerator called "drug terminator" is used for disposal of pharmaceuticals. A diesel fired medical waste incinerator called "MediBurn" treats pathological and infectious waste in small medical facilities, and laboratories. This unit is portable and easy to operate and it can incinerate everything from laboratory waste to animal remains (Wang et al. 2020). The waste preparation, waste incineration and flue gas purification in different hospital waste incineration treatment facilities are different. So far, the common incineration technologies include pyrolysis vaporization incinerators, rotary kiln incinerators, plasma incineration technology, etc. (Sapuric et al., 2016).While the incineration process has the advantage of reducing the volume of the waste by 50 - 400 times, its disadvantages include high costs, smoke generation and pollution risks (Rutberg, et al. 2002).

Shredding and grinding the infectious medical waste

A new technology for management of hazardous medical waste that transforms the regulated medical waste into municipal solid waste is recently

introduced. This method involves shredding and grinding the infectious medical waste bags via sharp cutting blades that are installed within the vessels. The blades rotate around 1750 revolutions per minute and the volume of the shredded waste is reduced by 80% (Lui et al., 2006). The steps included in the process are loading, shredding, heating, sterilization, cooling, draining, vacuum and unloading. The whole process is enclosed in a compact system and there is no intermediate handling of the waste within the process.

Due to the compact size, this system can easily be used for on-site treatment of the waste and installed in hospitals. This will reduce the transportation costs of the medical wastes. In terms of environmental aspects, it is a clean and chemical-free technology and does not have any hazardous emission or radiation (Lui et al., 2006).This method is economical and environmentally friendly and is reliable in terms of ease of use and maintenance.

Landfilling

As a waste management option, landfilling has several advantages. It is simple, versatile and relatively inexpensive to operate and maintain in comparison to other options such as incineration (Chermisinoff, 2003). It offers a final disposal route for waste generated from end of pipe-of-treatment processes such as incineration as well as other waste management options (Chermisinoff, 2003). Most sanitary and properly engineered landfills are equipped with gas extraction systems which serve the purpose of recovering and controlling the migration of gases (Chermisinoff, 2003). Through this process, landfill gases can be harvested and utilized for heating and energy

purposes as a low polluting fuel. Furthermore, old landfills can be used for leisure and recreational purposes thereby contributing to the creation of local jobs.

On the other hand, the process of land-filling carries several risks to the environment and human health. Landfills produce leachates which contains pollutants such as, dissolved organic matter, inorganic macro components, heavy metals and xenobiotic organic compounds (Renou et al., 2008). These substances are known to have subtle and long term effects on ecosystems and human health. Moreover, landfills generate toxic gases that can contribute to global warming including methane12, carbon dioxide (CO2), Hydrogen Sulphide (H2S) and Volatile Organic Compounds (VOC), Oxygen, Nitrogen, Benzene and vinyl chloride (Mondal et. al., 2023).

Recycling

Recycling involves the conversion of reject amenta into new useful products through physical, chemical or biological processes (Enger & Smith, 2004). Usually, recyclables are collected through buy-back, drop-off and/or curb-side programs and sent to recycling plants for conversion. As a waste management option, recycling has several benefits including the transformation of waste into a resource that can be retained or harvested as a raw material (Cunningham & Cunningham 2004). This has the potential to contribute to resource conservation, while diverting wastes from landfills and incinerators. Recycling can also create jobs and boost economic development in local communities. Notwithstanding these potential benefits, recycling as a waste management technique can face several challenges. In some cases, the

value of recycled products are sometimes not enough to cover the costs of collecting, storing, transporting, processing and packaging (Cunningham & Cunningham 2004). There also tends to be a misconception among consumers that recycling products are inferior. This can significantly induce reluctance to buy on the part of consumers. Furthermore, limitations in technological innovations can be an impediment to recycling (Enger & Smith 2004).

Composting

Composting is commonly defined as the controlled biological decomposition of organic material with the aid of air, moisture, temperature, fungi and bacteria (Medrano-Flores, 2023). The end product of composting is compost which is defined as a stabilized organic soil conditioner devoid of human and plant pathogens which is beneficial to plant growth (Jha, 2022). Compost is used primarily as a soil amendment or mulch by farmers, horticulturalists and households as nutrients that enable plant growth. The process of composting can take place either in closed reactors or in outdoor windrows. Closed reactor composting systems offer greater means of controlling the process in comparison to open systems although it has higher initial and operational costs (Temel, 2003).

Composting process involves first, sorting and/or separating the compostable organic matter such as garbage, grass, dung, etc. from the uncompostable ones such as plastic, leather, ceramic, clay or metal products that hamper the decomposition process (Ikhlayel, 2018). Secondly, it also includes mixing in equal proportion all wastes including animal manure, kitchen waste, weeds and house sweepings. It may be necessary to add and

mix human and animal waste to enhance and facilitate the biodegradation process. Adding these waste matters not only enhances the decomposition process but it also enriches the waste in nitrogen and phosphorous, which are essential elements for plant growth (Ferronato & Torretta, 2019). However, using human or animal waste need precautions as it may contain pathogenic organisms, which may contaminate the crops, the hand and feet of people working in the farm. This may create a perpetual communicable disease transmission condition outweighing the advantage of waste reuse (Ikhlayel, 2018).

Composting can be undertaken through aerobic and anaerobic processes. Aerobic digestion is defined as the bacterial process of decomposition or rotting occurring in the presence of oxygen (Jha, 2022). Under aerobic conditions, bacteria are used to rapidly consume organic matter and convert it into carbon dioxide. This requires by high temperatures which allow rapid decomposition. Anaerobic digestion (AD) on the other hand, is a process by which organic materials in an enclosed vessel are broken down by microorganisms, in the absence of oxygen. This process is typified by a slower rate of decomposition due to low operating temperatures as well as the discharge of a mephitis odour.

Composting as a waste management technique has several benefits. It assists societies to divert waste from landfills and incinerators by transforming waste into a resource that can be used to improve the aesthetics of an area. Compost also enhances the appearance and texture of soil, increase soil fertility, increases the ability of the soil to retain water, moderate temperature and also suppress the growth of weed and plant diseases (Damghani,

Savarypour, Zand & Deihimfard, 2008). In addition to its uses as a soil maintenance agent, compost can also be used as an earth covering application (Damghani et al., 2008). Despite its viability as a waste management option, there are a number of challenges associated with composting. Large scale composting technologies are expensive and can be labour intensive. There is also a danger of leachate pollution especially in areas where large scale composting is carried out. The release of ammonia gas during composting can contribute to devaluing the quality of compost and may also cause a myriad of environmental problems (Rushton, 2003).

Table 2: Waste Treatment and Disposal Techniques

Waste treatment Type	Description	Pros & Cons
Segregation	Waste is segregated depending on the quantity, composition, and the disposal method of the waste stream	Segregation is useful since it prevents the contamination of non-hazardous waste by the hazardous waste and making the whole waste stream hazardous. Thus, this method will reduce the toxicity and the volume of the waste stream. Moreover,

		segregation makes it easier to transport the waste.
Autoclaving (Steam Sterilization)	Treated with dry heat or steam at high temperatures that destroy IHW	Environmentally advantageous; appearance unaltered, is possible to incinerated following; does not reduce volume, high capital costs
Microwave irradiation	Microwaves used to heat IHW	Metal cannot be present; appearance unaltered; volume not reduced
Incineration	Burning waste at very high temp	Environmentally unfriendly (air pollution and other toxic gasses; low cost; ash sent to landfills
Pyrolysis, thermal treatment in rotary kiln	Heating organic material at high temperatures which reduces them into gaseous components, small quantities of	ROI 4 years; residual components must also be properly removed and disposed of

	liquid, or solid residue without oxygen	
Landfill	Burring solid waste materials under layers of earth	Adds to pollution of the environment; reaching maximum capacity in larger Urban areas
Composting	Organic material such as yard waste and food scraps in specialized container	Not appropriate for toxic waste; practical and economic; reduces waste sent to landfill; can be reused for fertilizer replacing chemical use byproducts (methane gas) can be repurposed but is also an explosion hazard.
Recycling	Reusing, repurposing, or converting used materials into new materials	Environmentally friendly; reduces costs; creates additional revenue streams

The above discussion of methods of waste treatment indicates that in developing countries like Ghana, different waste disposal practices might be

used in different hospitals within the same geographical area. In some cases, private contractors are hired for waste disposal through incineration (Yong et al., 2009) or land filling (Da Silva et al., 2005). In other cases, the hospitals themselves incinerate their wastes (Hanumantha Rao, 2009).

Challenges of Sustainable hospital waste management

Resource-constrained

In respect to sustainable waste management, there are various challenges that are confronted by hospitals authorities in the developing countries. Resource-constrained, has had limited positive effect on the implementation of laws that address the protection of human conditions against improper handling of toxic substances and the dumping of all forms of waste in unauthorized areas. In underdeveloped countries, socioeconomic conditions make adhering to governmental regulations difficult if not implausible (Ali, Wang, Chaudhry, & Geng, 2017; Caniato et al., 2015). Primary barriers to adhering to regulatory standards include managing the transportation and disposal to treatment facilities common (Njue et al., 2015). Many developing countries are unable for economic reasons to treat hospital waste on site, increasing the risk of exposure to hazardous infectious waste to their workers and the surrounding community.

Improper transportation

Improper transportation from the cite of waste generation to the storage and handling areas within the hospital as well as the improper use of personal protective equipment (PPE) are also reported as challenges (Assis, Gomes,

Balista, & Freitas, 2017; Kumar et al., 2015). Kumar et al. (2015) reported that the most significant issue to proper biomedical waste handling at their hospital was due to waste handlers lack of compliance with wearing appropriate PPE because they were not aware of the importance of doing so as well as climate conditions which made wearing such equipment difficult. It is also reported that lack of communication relating to the hazards of infectious waste and its proper handling, and weak supervision and monitoring of hospital has been a challenge (Anozie et al, 2017).

In some cases, onsite transportation is carried out by hospital staff and offsite transportation is carried by private contractors (Da Silva et al., 2005). However, there are lack of proper push carts/trolleys which could cause leakages and accidents (Bdour et al., 2007) and transportation in unsuitable vehicles passing through residential areas (Sawalem et al., 2009). There are no online tracking systems that can be used to implement and monitor proper medical waste transportation similar to those used in developed countries (Jang et al., 2006).

Absence of strategic capabilities or support by hospital leadership

Organizational barriers have also been seen to have reduced the ability for healthcare workers to engage in environmentally sustainable practices or follow regulatory requirements (Dunphy, 2014). There are scarcity of resources, underfunding, and absence of strategic capabilities or support by hospital leadership as barriers to the implementation of hospital waste management strategies. Nichols and Manzi (2014) discovered that lack of segregation bins resulted in the inappropriate disposal of waste and

noncompliance with local or national waste management policies. Additionally, Nichols and Manzi (2014) expanded on this issue by stating that a lack of physical space for segregation bins was also a barrier to cost containment efforts in developed countries as well.

Lack of staff motivation

Primary to waste segregation, scholars reported lack of staff motivation to achieving appropriate segregation (Caniato et al., 2015; Johnson et al., 2013). It has been found out that staff motivation has been a potential barrier to engaging in sustainability practices. A worker's level of awareness of environmental issues and their perception that their actions will have little direct impact on such issues affected their motivation to engage in sound HWM practices (Marshall & Farahbakhsh, 2013). Sari and Camponogara (2014) reported that management's motivation to environmental education (EE) profoundly influenced worker motivation to engage in environmentally sustainable practices. The conditions for change within the organization validated the value of sustainability among workers (Sari & Camponogara, 2014).

Moreover, Marshall and Farahbakhsh (2013 reported that worker's awareness of leadership's commitment to green practices played a role in the attitudes and actions toward adopting green practices. Akthar (2022) furthered the concept of supervisory support in worker motivations towards pro-environmental behaviour in his study and suggested that the theory of leader member exchange (LMX) played a mediating role in facilitating such adoption. Lloret (2016) reported that managerial enthusiasm and commitment

to the adoption of green practices played a significant role in worker's adherence to positive HWM practices.

Lack of training and awareness

In developing countries, official rules pertaining to HWM require regular training for all personnel engaged in waste management activities. Consequently, healthcare workers lack knowledge about the dangers of inhalation or skin exposure of chemicals (Mbongwe et al., 2008). Similarly, lack of public awareness about the environmental dangers of hospital waste such as expired drugs is another concern (Uysal & Tinmaz, 2004). Moreover, the municipal staff responsible for off-site transportation of the hospital waste are sometimes not cautioned about hazardous waste management (Askarian et al., 2004b). It is therefore, important to educate all the stakeholders including patients, hospital staff, visitors, waste disposers and the general public about the dangers of unsafe hospital waste handling and management (Gerwig, 2008).

Lack of places for storing the wastes

There are lack of places for storing the wastes. Rules regarding hospital waste storage generally require the waste to be stored temporarily in properly labelled separate store rooms (Ali et al., 2017). The storage areas need to be well ventilated with water and sewerage access and these locations should be properly labelled with warning signs and should have restricted access limited to the workers only. There should be separate sections in the storage facility for the collection and storage of domestic waste. However, in

the developing countries, provisions for safe storage of hospital wastes have been lacking in some hospitals (Al-Khatib et al., 2020; Hanumantha Rao, 2009). In most of the other cases, hospitals lack properly labelled waste containers and store rooms (Yong et al., 2009).

Poor condition of the containers and lack of disinfection have been a challenge (Bazrafshan & Mostafapoor, 2011). In some cases, the store rooms are used to store other items such as the cleaning equipment (Da Silva et al., 2005). In other cases, the hospitals lack internal storage areas altogether (Sawalem et al., 2009; Stankovic et al., 2008), and waste is stored in open dumps or fallow lands in the vicinity of the hospital (Manga et al., 2011). In some instances, the containers are without lids and are not emptied until they are completely full (Longe & Williams, 2006), which can result in onsite waste spillage.

Empirical Review

In respect to empirical studies, it has been noted that several studies have been conducted in recent times with various methodologies being used all over the world to assess and quantify HCW. They include the use of physical observation, questionnaire administration and quantification (Adegbita et al., 2010; Olubukola, 2009), as well as checklists (Townend & Cheeseman, 2005) and private and public records (Coker et al., 2009). A study in Nigeria by Olubukola (2009) reported a mismanagement of healthcare waste which posed health risks to people and the environment by contaminating the air, soil and water resources. Thus, the study revealed that the similarity in waste data and HCW management practices in two General

hospitals was characterized by a lack of waste minimization or waste reduction strategies, poor waste segregation practices, lack of instructive posters on waste segregation and disposal of HCW with general waste.

A further study in Port-Harcourt metropolis in Nigeria by Ogbonna, (2011) was carried out to assess hospitals waste management practice. The study enquired into waste generation rates and various waste disposal options by different categories of hospital. It was further evident in this study that hospital waste management issues and problems are not peculiar to Port Harcourt metropolis alone. Solid waste disposal methods indicated that open dump sites is most preferred while incineration was non-existent in the hospitals, clinics. Most other hospitals do not segregate wastes into marked or colour coded containers for the different waste streams neither do they keep records of waste generation and disposal (Ogbonna, 2011). In addition, the survey revealed that both hospital waste generators and handlers treat hospital wastes as a usual domestic waste.

Al-Emad (2011) also conducted a qualitative study in Yemen in 5 government and 12 private hospitals in Sana'a aimed to evaluate waste-workers' and hospital administrators' knowledge and practices regarding medical waste handling. Through interviews and observations, the study results showed that the waste-workers were collecting medical and nonmedical wastes together manually in all hospitals without receiving adequate training and without using proper protection equipment. Furthermore, the study showed that there was poor awareness about medical waste risks and safe handling procedures among hospital administrators, and most hospitals did not differentiate between domestic and medical waste

disposal. Finally, budgets were not allocated for waste management purposes, which led to shortages in waste handling equipment and an absence of training programmes for staff.

Abor (2007) also conducted a study using a mixed method approach in South Africa with the aim of examining the medical waste management practices of a hospital. The results revealed that the hospital did not quantify medical waste. Segregation of medical wastes into infectious medical waste and non-infectious medical waste was not conducted according to definite rules and standards. Separation of medical waste and municipal waste was however practiced to a satisfactory extent. Wheeled trolleys were used for on-site transportation of waste from the points of production to the temporary storage area and staff responsible for collecting medical waste used almost completes personal protective equipment. Offsite transportation of the hospital waste was undertaken by a private waste management company. Small pickups were mainly used to transport waste daily to an off-site area for treatment and disposal.

The main treatment method used in the final disposal of infectious waste was incineration. Non-infectious waste was disposed off using land disposal method. In terms of policy, the study showed that the hospital did not have a policy and plan in place for managing medical waste. There were a number of problems the hospital faces in terms of medical waste management, including; lack of necessary rules, regulations and instructions on the different aspects of collections and disposal of waste, failure to quantify the waste generated in reliable records, lack of use of coloured bags by limiting the bags to only one colour for all waste, the absence of a dedicated waste manager,

and no committee responsible for monitoring the management of medical waste.

Kang'ethe (2008) also did similar work by investigating clinical waste disposal and handling in the context of a community home-based care (CHBC) programme in Kanye, southern Botswana. This was a qualitative study which involved 10 focus group discussions with a total of 82 HIV/AIDS primary caregivers in Kanye, one-to-one interviews with the five nurses supervising the programme, and participant observation. The study results revealed that numerous aspects of clinical or healthcare waste management were found to be hazardous and challenging to the home-based caregivers in the Kanye CHBC programme, namely: lack of any clear policies for clinical waste management; unhygienic waste handling and disposal by home-based caregivers, including burning and burying the healthcare wastes, and the absence of pre-treatment methods; inadequate transportation facilities to ferry the waste to clinics and then to appropriate disposal sites; stigma and discrimination associated with the physical removal of clinical waste from homes or clinics; poor storage of the healthcare waste at clinics; lack of incinerators for burning clinical waste; and a high risk of contagion to individuals and the environment at all stages of managing the clinical waste.

The study by Kagonji and Manyele (2016) emphasized that endorsement of the proper managing and removal of medical waste is essential for public health. In this case, every member of the society supposed to have the right to be knowledgeable about probable health hazards. Moreover, Kagonji and Manyele (2016) noted that the objectives of public teachings on medical waste contain: avoidance of contact to medical waste and associated

health hazards which might be intended in the case of scavengers or accidental as a result of insecure disposal techniques, formation of consciousness and foster accountability among patient and visitors in health facilities concerning sanitation and waste management. Emphasis should be put in informing the public about threats associated to medical waste focusing on people livelihood or working in close proximity to/or visiting medical institutions, family of patients treated at home, and searchers on waste in dumps (Sharma, 2010).

In a recent study in Ghana, Odonkor and Mahami (2020) investigated the healthcare waste management practices, aiming to provide needed data to inform policy decisions. The study was conducted using a cross-sectional study with quantitative data obtained from 497 respondents who worked in 25 major healthcare facilities. The finding of the study indicated that 52.4% of respondents had knowledge about healthcare waste management. However, only 12% of the respondents were open to training in healthcare or biomedical waste management. Less than half of the respondent (47.5%) practiced waste segregation at the sources of generation. There were significantly more healthcare waste disposal materials available (P = 0.001) in private than government and quasi-government hospitals

Similarly, in a recent study, Singh, Ogunseitan and Tang (2021) examined the available knowledge and current practices in medical/healthcare waste management worldwide, particularly in countries with transitional economies, including the dependence of medical waste generation rate on various socioeconomic and environmental parameters. With this study, they conducted a meta-analysis of medical and healthcare waste management practices in 78 countries. They identified impediments and challenges facing

the integration of medical waste management into a prospective circular economy according to statistical correlations with human development index (HDI), life expectancy (LE), healthcare expenditure (HE) per capita of gross domestic product (GDP), and environmental performance index (EPI). The results highlight the importance of knowledge and awareness of best practices for infection and injury prevention for waste management among workers. An average of 38.9% of medical waste was segregated for proper management, and only 41% of workers were trained in-service for medical waste disposal. Plastic materials constituted approximately 35% of medical waste, presenting an opportunity for sustainable resource recovery and recycling.

The idea emanating from these empirical studies is that there should be an increased access to waste collection services; since the public health implication of dumping anywhere could cause flooding, choke gutters, and lead to epidemic of cholera and vector borne diseases like malaria and dysentery. Thus, that all countries should adopt environmentally sustainable management of medical waste to prevent catastrophic stockpiling of infectious waste during and after pandemics.

Conceptual Framework

This study's conceptual framework is based on the four constructs looked at under sustainable hospital waste management at Mamprobi Polyclinic, Accra. This is illustrated in figure 1 below.

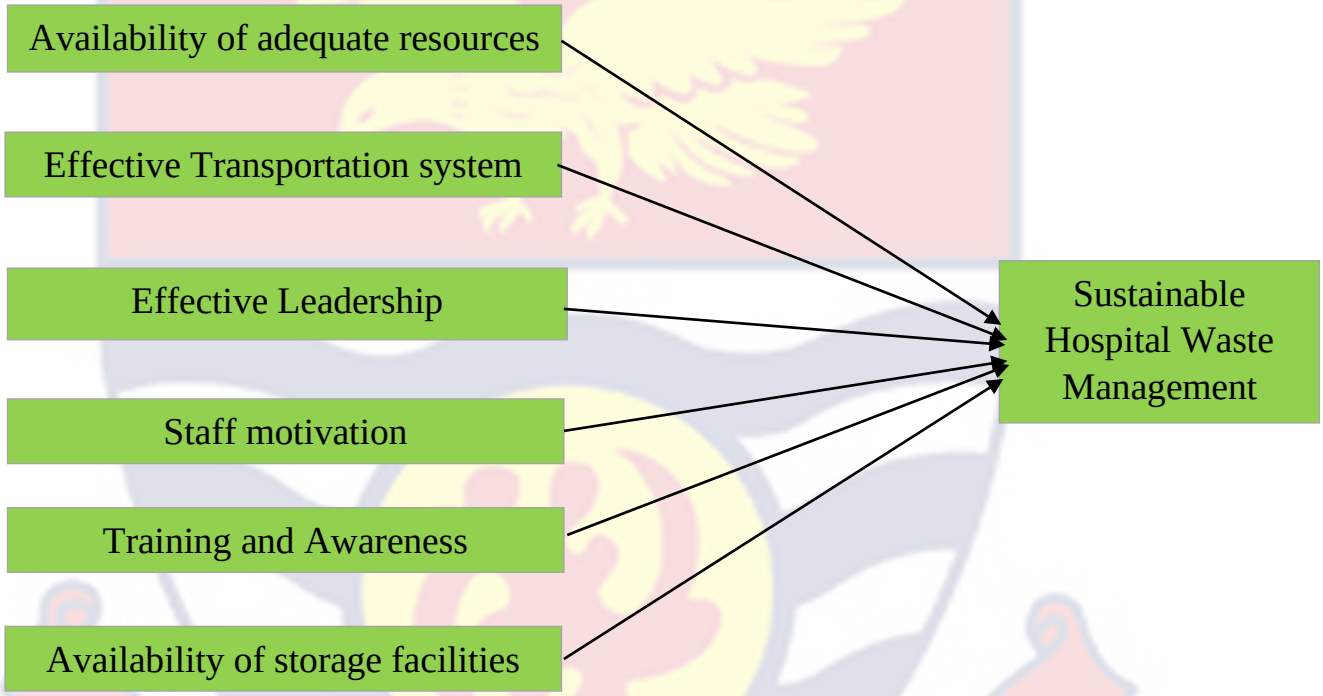

Figure 1: conceptual framework

Source: Author's construct, 2021

CHAPTER THREE

RESEARCH METHODS

Introduction

This chapter discussed the methodology of research. The chapter discussed the research design, target population, the sample frame, sample and sampling techniques. In addition, the chapter also identified the data collection instruments utilized for data collection, the data collection procedure, validity and reliability of the research instrument, data analysis and presentation.

Research Philosophy

The selection of the positivist philosophy for the study was informed by the fact that the positivist approach favors quantitative research design and therefore advances the mathematical rigor of the study which could provide more useful findings and explanations. Furthermore, positivism allows researchers to move away from unobservable beliefs and desires and to focus on objective facts. As Marsonet (2019) states, the design of positivism and the quantitative approach to research is to provide a system of generalization that can be used to make correct predictions about the consequences of events.

Research Approach

Habib (2021) claims a quantitative approach to understanding phenomena through the collection of numerical information analysed using mathematically determined methods (in particular statistics). This approach helps the researchers' principles not interfere with or become part of the

analysis, accordingly to Johnson and Onwuegbuzie (2004). This method usually starts with the collection of data based on hypothesis or theory. Quantitative approaches most always assume that there is only one "reality" independently of the experience of mankind (Lincoln, Lynham & Guba, 2011). This study therefore adopts a quantitative approach in understanding the variables: Sustainable Hospital Waste Management at Mamprobi Polyclinic through numerical information.

Research Design

The research design facilitates the framework of the various research operations, thereby making research as efficient as possible hence yielding maximum information with minimal expenditure of effort, time and money (Mugenda, 2008). This study used a descriptive and explanatory research designs. This type of research design focuses on explaining the aspects of the study in a detailed manner. A researcher starts with a general idea and uses this research as a medium to identify issues that can be the focus for future research. The purpose of explanatory research is to increase the understanding on a certain subject. It also explains why events occur to build, elaborate, extend or test theory (Creswell, 2013).

Explanatory research is interested in understanding, explaining, predicting and controlling relationships between variables than in detecting causes. Explanatory studies go beyond description and attempts to explain the reasons for the phenomenon that the descriptive study only observed (Yin, 2013). The study sought to be explanatory in nature because it increases understanding between common people, or other researchers among the topic

that is investigated. Zikmund, Babin, Carr and Griffin (2012) recommended explanatory research design because it is associated with greater levels of internal validity due to systematic selection of subjects.

Study Area

Quality health care is a necessity to live longer and healthier in our world today. To live happy and a healthier lifestyle, you need to visit the hospital very often for periodic medical checkups and assessments to know your health status. It is in this vein that we are bringing you some valuable information about the right place to go in case you need some medical check-up or evaluation. Mamprobi Polyclinic in Accra has been ugraded to the status of a primary hospital to meet the health needs of the growing population of the Ablekuma South Sub-Metropolitan District and its environs. The upgrade of the facility is expected to ease pressure on the Korle-bu Hospital as well as other health facilities and improve healthcare in the community. The then Mamprobi Clinic was built in the 1960s initially as an outreach point for community work in the Korle Bu Teaching Hospital. It's a 24-hour hospital that offers all-round services to patients in the metropolis and beyond. Its core mission and aim is to provide accessible health care to its patients. The various section they have is Cesarean section, Maternity Unit, Outpatient Department (OPD), Pharmacy Unit, and others.

Population of Study

According to Sekaran (2003), a study population is the study object and consists of individual groups, institutions, human products and events or

the conditions to which they are exposed. Thus, the *study population* is the subset of the *population* with the condition or characteristics of interest defined by the eligibility criteria. Although it is usually not practically and economically feasible to involve all members of the population in a research project due to mainly cost, time constraints and population size, it was felt that it would be important to involve all eligible employees of the institution who were senior members and had voluntarily consented to participation in the study. In essence, the group of participants actually studied is selected from the *study population.*

In this study, the population covered the healthcare workers at Mamprobi Polyclinic, who are considered to be approximately 150. The frame of the available population was identified through personnel records of the individual provided by the Division of Human Resource of the institution.

Measurement of Hospital Waste

The study adopted and modified the categories of hospital waste from WHO (2014). Also, the study adopted the methods used to treat and dispose hospital waste from WHO (2008) and EPA (2002), and from the studies of Muduli & Barve (2012); Yazie, Tebeje & Chufa (2019) and Tushar, Alam, Bari & Karmaker, (2023), the challenges of sustainable hospital waste management was adapted.

Sample Size and Sampling Technique

Yin (2013) explains that sampling is the procedure of selecting a representative of the total population as much as possible in order to produce a

miniature (small) cross section. Salvi, et al., (2010) define a sample as a small proportion of a target population selected for analysis. The study adopted a census method to arrive at the sample size. The study therefore targeted a total of 150 healthcare workers whose views on sustainable waste management will be taken. This purposive sampling method was adopted in the selection of the respondents because it enables the researcher to squeeze a lot of information out of the data that they have collected, thus, it allows researchers describe the major impact the findings have on the population.

Data Collection Procedure

As the study depended on primary data for the fulfilment of the specific research objectives, it became vital for dependence on reliable method that could guarantee access to the respondents as well as the right kind of data needed. These prospective respondents were personally contacted through mobile phone. This was done after the formal authorization for the gathering of the primary data had been granted by the healthcare authorities. The questionnaire were administered personally to the healthcare workers. The sharing and retrieval of questionnaire lasted for six months due to the type of respondents since it wasn't easy getting to most of them.

Research Instrument

The instrument used for data collection was a self-administered questionnaire. Questionnaire is a set of questions with a definite purpose designed for a target group of people to be administered by themselves within a particular time frame. According to Plano (2010), questionnaire guarantees

high efficiency in data collection and high generalizability of results over the more intensive research designs. However, Opoku et al., (2016) emphasise that questionnaire lacks flexibility in that once a questionnaire has been designed and distributed out it becomes difficult to change the categories of data collected. Questionnaire was selected for this kind of study, because it is a self-reported measure which guarantees confidentiality and therefore it is more likely to elicit truthful response with regard to the information required from the respondents.

The questionnaires were in closed ended form in which questions have response categories concerning relevant to the topic of study and it was given to all the health workers in the Mamprobi Polyclinic. The research instrument adopted in this study is a structured questionnaire, comprising of closed-ended questions. The closed-ended questions were designed using a 4- point Likert scaling ranging from strongly agree to strongly disagree, with 1 = strongly disagree; 2 = disagree; 3 = neutral, 4 = agree; and 5 = strongly agree All the variables in this study have a number of questions on the questionnaire items. Section A of the questionnaire consists of the demographic variables of the respondents.

The questionnaire was further divided into four sections. Section B consists of the categories of healthcare wastes according to WHO, Section C consists the current treatment and disposal methods used and Section C - challenges to Sustainable waste management of medical waste. According to Sekaran (2003) data collection instrument is the means by which information is obtained from the selected subject under investigation. The study collected primary data using questionnaires. Questionnaires are used for data collection

because of their simplicity in the administration and scoring of items as well as data analysis.

Administration of Research Instrument

The copies of the questionnaire were administered to the respondents by the researcher. The copies of the questionnaire were handed over to participants. The distributed questionnaire copies will be collected back after some months.

Data Collection Issues

The non-response of participants in a sample size is a daunting challenge in collecting the data. Researchers anticipate getting the smallest sample size to generate outcomes that are statistically consistent and generalizable as an insufficient sample can weaken the correctness of the conclusions (Kotrlik et al., 2001). It can unequivocally be said that the accuracy of quantitative research results hinges on the sample size of the population. Non-response rate should be decreased to the bare minimum. By so doing, a letter should be sent to the respondents in advance to reduce non-response rate (Hox & McNeish, 2020). An advance letter will pre-inform and prepare the respondent towards the answering of the questionnaire.

Data Analysis and Processing

Once all the questionnaires were received from the field, the researcher embarked on data editing, coding and analysis. When it comes to data editing, the researcher checked for completeness, accuracy, consistency of data by

arranging the data in a systematic manner. The filled questionnaires were checked for completeness at two levels where the data collectors verified that questionnaires were complete before they are taken to the researcher to do the final verification. This was done to ensure that any anomalies detected were corrected immediately before the questionnaires were collected from the respondent. Spelling and grammatical mistakes were also corrected. With editing the data, the researcher made sure that all responses were very clear to understand. Bringing clarity is important otherwise the researcher can draw wrong inferences from the data. Data coding refers to the process of transforming collected information or observations to a set of meaningful, cohesive categories. It is a process of summarizing and re-presenting data in order to provide a systematic account of the recorded or observed phenomenon. The questionnaire had both closed and open questions.

The responses from the closed questions were assigned numerical numbers which were entered into the SPSS software in preparation for analysis. The researcher generated themes for the responses from the open ended questions and grouped the responses that are similar. Data analysis was guided by the research objectives presented. All questionnaires received were referenced and items in the questionnaire coded to facilitate data entry. Quantitative data collected were analysed using descriptive analysis. Descriptive statistics such as the mean and standard deviation were used for the analysis of the collected data. The data was interpreted according to the mean and standard deviation values obtained from the analysis. The highest mean to the lowest mean were interpreted accordingly.

Ethical Considerations

Ethical clearance to conduct the study was obtained from the University of Cape Coast. A research permit was also obtained from the Mamprobi Polyclinic to conduct the study, and this granted permission to collect data. Further, an introduction letter was obtained from the University of Cape Coast that helped in introducing the study to the respondents, and it was given by head of department and submitted to Mamprobi Polyclinic. The respondents who were willing to participate in the study were provided with a consent form to sign that clearly stated that participation in the study is purely voluntary and no one was coerced to take part. To ensure anonymity the name of the respondents did not appear anywhere in the research instrument. The respondents were also informed that the study is purely academic and that their information was to be kept confidential. The researcher encouraged the respondents to respond to the questionnaire truthfully, honestly and in an unbiased fashion without any fear that their responses would put them in any physical or psychological harm.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

In this study, the main research objective has been "*to determine sustainable hospital waste management and its challenges at Mamprobi Polyclinic, Accra".* Based on this main research objective, specific objectives were used to achieve the study goal In line with these original research objectives and the method used, this chapter provides the findings and discussions which reflect on the core study specific objectives.

The first section discusses the response rate and the demographic features of the respondents However, the second section, addresses the main specific research questions relating to the topic namely:

1. What are the categories of hospital waste generated within Mamprobi Polyclinic?
2. What are the current waste methods used in treating and disposing of clinical waste in Mamprobi Polyclinic?
3. What are the challenges to sustainable hospital waste management in the Polyclinic?

Response Rate

A total number of 150 questionnaires were issued from which 125 were filled and returned, which represented a response rate of (83%) whilst 25 representing 17% was not returned. This is more than acceptable level of acceptance considering the argument made by Mugenda and Mugenda (2008)

who argued that 50% of response rate of any research could be judged to be acceptable and therefore satisfactory enough for analysis. The response rate is represented in Table 3..

Table 3: Response Rate

Questionnaire	Count	Percentage (%)
Returned	125	83
Non Returned	25	17
Total	**150**	**100**

Source: Field survey (2021)

Demographic Characteristics of the Respondents

In order to understand the demographic characteristics of the respondents, the study deemed it fitting to find out the demographic data of the respondents Table 4 presents demographic statistics on the frequencies and percentages of responses on gender received from the respondents.

Table 4: Demographic Variables of Respondents

Variables	Options	Frequency	Percent
Gender	Female	78	62.4
	Male	47	37.6
	Total	**125**	**100.0**

Age	21-30	23	18.4
	31-40	54	43.2
	41-50	32	25.6
	51 years and above	16	12.8
	Total	**125**	**100.0**
Level of Education	HCA	19	15.2
	Diploma	33	26.4
	1st Degree	39	31.2
	2nd Degree	25	20.0
	Professionals	9	7.2
	Total	**125**	**100.0**
Job Type	General nurses	31	24.8
	Health care assistants	45	36
	Physiotherapist	20	16.0
	Midwives	19	15.2
	Pharmacists	10	8
	Total	**125**	**100.0**
Employees' Years of Work	1-5 years	32	25.6
	6-10 years	66	52.8
	11-15	16	12.8
	16 years and above	11	8.8
	Total	**125**	**100.0**

Field Survey (2021)

Table 4 clearly illustrates that there were more male staff employees than female counterparts in this survey. More than half of the respondents (62%) were females while the remaining respondents were males represented 38%. This implies that a lot of females are employed in the service, which is not surprising considering the gender inequality in the health workforce. According to the Annual Report of Ghana Statistical Service, (2021) generally, around 156.4 thousand women worked in the human health and social work domain in Ghana as compared to men who are approximately 105 thousand. However, labour force participation rate of females in other sectors remains lower than that of males.

On the age distribution of the respondents, it was found out that the majority of the respondents are between the age of 31 and 40 years representing 43%, which gives a positive impression that most of the respondents are in their middle age and that the institution can be considered to have had a lot of potentials in terms of development in the future. Again, the result shows that 38% were more 40 years, implying that matured staff were employed in the service, which could mean that more matured staff with experience, critical thinking and sheer knowledge will be available to share with the few young adults who represent 18% in the health workforce.

With the educational levels of the employees, it was also realized that majority were first degree holders representing 31%, second degree holders – 20%, and diploma holders represented 26% of the sample population. These imply that most of the staff consider education as important to the growth of the country. However, only 15% of the sample population were healthcare assistants, who work under the guidance of a variety of healthcare

professionals representing only 7%. In terms of the how long each healthcare employee has worked in the health workforce, it was found that most of them fell within 6 to 10 years represented by 53%. About 25% has worked for less than 5years. And those who have worked between 11 and 15 years represented 13%, while those who have worked for more than 16 years represented 9%.

With regards to the job categories in the polyclinic, about 36% are healthcare assistants, while only 8% represent pharmacists. General Nurses represented 25% while physiotherapists and midwives represented 16% and 15% respectively. These show that more healthcare assistants understudy the professionals and are likely to gain more field experience, and take on more responsibility and help accelerate existing services in the polyclinic.

Findings of the Research Objectives

This section presents results and analysis based on the three key questions of this study. In line with the study objectives, a descriptive data analysis was done, as it has been indicated in the methods, the design of the research is descriptive and adopted a quantitative approach. The results and analyses are presented chronologically based on the stated objectives of this study.

Objective One: To identify the categories of hospital waste generated within Mamprobi Polyclinic

In line with the research objective one, the study sought to determine the categories of hospital waste generated in the polyclinic. To this end, respondents were asked to indicate their level of agreement on the categories of hospital waste that they find relevant in relation to the polyclinic. On this

basis, the respondents were asked questions and in response, the various categories were obtained and analysed. The results are shown in table 5

Table 5: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Infectious waste	125	1	4	3.22	.932
Pathological waste	125	1	4	3.02	1.062
Sharps	125	1	4	3.04	.937
Chemicals	125	1	4	2.98	1.211
Non-hazardous or general waste	125	1	4	3.19	.830
Pharmaceuticals	125	1	4	2.94	1.065
Genotoxic waste	125	1	4	2.99	1.066
Radioactive waste	125	1	4	2.82	1.050

Source: Field survey, 2021

As presented in Table 5, most respondents strongly agreed that the most of the hospital waste generated in the polyclinic is infectious waste (Mean =n3.22, SD = 0.932). The next waste, which the majority of respondents strongly agreed were general waste (Mean = 3.19, 0.830). This was followed by sharps (Mean = 3.04, 0.937); Pathological waste form part of the categories of waste with a mean of 3.02 with SD of 1.062. Also, genotoxic waste recorded a mean of 2.99 with SD of 1.066 followed by chemicals with a mean of 2.98 and SD of 1.211. Pharmaceuticals recorded a mean of 2.94 with SD of 1.065, while the majority agreed that the least waste generated in the hospital was the radioactive waste (Mean = 2.82; SD = 1.050).

The outcomes portray that the polyclinic has acknowledged that most of the waste contained infectious waste, and the second major part generated was general waste such as food, liquids, and paper. Most of the medical waste generated from healthcare settings is not always hazardous or more dangerous than general household waste. However, it depends on the type of medical waste that represents different health risk levels (WHO, 2018). Open dumping of contaminated sharps with infectious diseases, such as hepatitis, HIV/AIDS, cholera, typhoid, and respiratory complications, has been reported in many countries with economies in transition (Zafar, 2019; Khan et al., 2019).

It can said that if these infectious waste are not properly management, the dangers poses will cost huge financial lost and death of human beings as well as animals. These findings, however contradict with Mohee (2005), and Lee et al (1996) whose studies revealed that infectious waste turn to be low as compared to non-infectious. Also, findings contradict with Ogbonna, (2011) who enquired and concluded that both hospital waste generators and handlers treat hospital wastes as a usual domestic waste.

Objective Two: To examine the current waste methods used in treating and disposing of clinical waste in Mamprobi Polyclinic

In line with the research objective two, the study sought to examine the current waste methods used in treating and disposing of clinical waste in the polyclinic. To this end, respondents were asked to indicate their level of agreement on the current waste methods used in treating and disposing of hospital waste that they find relevant in relation to the polyclinic. On this basis, the respondents were asked questions and in response, the current

clinical waste treatment and disposal were obtained and analysed. The results are shown in table 6

Table 6: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Segregation	125	1	4	3.26	.993
Disinfection	125	1	4	3.18	1.003
Incineration	125	1	4	3.32	.725
Shredding and Grinding the infectious medical waste	125	1	4	3.07	1.049
Landfilling	125	1	4	3.02	.996
Recycling	125	1	4	3.05	1.015
Composting	125	1	4	2.58	1.025
Autoclaving	125	1	4	2.46	1.004
Microwave irradiation	125	1	4	2.47	.894

Source: Field survey, (2021)

As presented in Table 6, most respondents strongly agreed that incineration is the most current method used in treating hospital waste in the polyclinic (Mean =3.32, SD = 0.725). The next method, which the majority of respondents strongly agreed to was segregation (Mean = 3.26, 0.993). This was followed by the method called disinfection (Mean = 3.18, 1.003); Shredding and grinding of waste with a mean of 3.07 with its corresponding measure of dispersion (SD = 1.049). This was followed by incineration (Mean = 3.05, SD = 1. 015). The least methods used for treating and disposing off

hospital waste in the polyclinic, which was agreed by most of the respondents are landfilling (Mean = 3.02, SD = 0.996); Composting (Mean = 2.58; SD = 1.025); Microwave irradiation (Mean = 2.47, SD = 0.894) and Autoclaving (Mean = 2.46, SD = 1.004).

Incineration and landfills are the most common methods for medical waste management worldwide (Hong et al., 2018). Before 1997, more than 90% of medical waste in developed countries such as US was incinerated, which was one of the main sources (third largest) of dioxin emissions into the air (EPA, 2020c). This led the U.S. Environmental Protection Agency (EPA) to implement stringent emission standards for medical waste incinerators under the Hospital Medical Infectious Waste Incinerator standards, which took more than a decade for the government to effectively enforce and was approved in May 2013 (EPA, 2020d).

It can be seen that incineration is the main treatment method for medical waste in the polyclinic, where more of the medical waste are incinerated. This finding contradicts with WHO, who revealed that 85% of hospital waste is recyclable. A research by the University Health Group (2013) in Ghana concur with the findings of the polyclinic, where it revealed that most the common waste disposal method was incineration. Autoclaving, a heat-based, safe, and efficient treatment process was confirmed to be the least method adopted for treating and disposing hospital waste in this study. Though it is the second most popular method for medical waste treatment, its use is limited to countries such as Ghana because of its economic feasibility and the appearance of the treated waste (WHO, 2020b; Ferdowsi et al., 2018).

In many countries, where the safe disposal of medical waste either does not exist or is not well established, medical waste is often mixed with general household waste and treated as municipal solid waste either by incineration or is disposed of in open landfills (Singh et al., 2020a). In low and middle-income countries, the incineration plants used for medical waste treatment are often equipped with old and unsafe technologies that cause further heavy metal pollution and dioxin emissions. Findings concur with the theory, WMT, which is founded on the expectation that waste management is to prevent waste causing harm to human health and the environment taking into consideration waste generation, collection, method used in waste treatment and disposal. Findings also agree with Abor (2007) whose main treatment method used in the final disposal of infectious waste was incineration.

Objective Three: To examine the challenges to sustainable hospital waste management in the Polyclinic

In line with the research objective three, the study sought to examine the challenges to sustainable hospital waste management. To this end, respondents were asked to indicate their level of agreement on the challenges impeding sustainable hospital waste management, and that which they find relevant in relation to the polyclinic. On this basis, the respondents were asked questions and in response, the challenges were obtained and analysed. The results are shown in table 7

Table 7: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Resource-constrained	125	1	4	3.29	.705
Improper transportation systems	125	1	4	3.13	.813
Lack of strategic capabilities or management support	125	1	4	2.95	.771
Lack of proper technological advancement	125	1	4	3.05	.932
Lack of staff motivation	125	1	4	3.15	.934
Lack of trainings and awareness	125	1	4	2.86	.892
Lack of places for storing the wastes	125	1	4	3.06	.821

Source: Field survey, (2021)

In Table 7, most respondents strongly agreed that the polyclinic is resource-constrained, which is the greatest challenge to managing hospital waste sustainably (Mean =3.29, SD = 0.705). The second challenge, which the majority of respondents strongly agreed was that most of the staff lacked motivation when it came to managing hospital waste (Mean = 3.15, 0.934). This was followed by improper transportation systems (Mean = 3.13, 0.813). Lack of places for storing the wastes was another challenge (Mean = 3.06, SD

= 0.821), followed by the lack of proper technological advancement (Mean =3.05, SD = 0.932). However, the least challenges faced by the hospital in terms of managing waste sustainably are the lack of strategic capabilities or management support (Mean = 2.95, SD = 0.771) and the lack of training and awareness (Mean = 2.86, SD = 0.892) provided to the staff.

These outcomes reveal that the proper management and safe disposal of medical waste amid the COVID-19 pandemic is, therefore, a vital element in an effective emergency response that requires proper identification, safe collection and separation, storage and transportation to treatment plants and disposal sites, and safe practices including disinfection, and proper training of healthcare workers (WHO, 2020c; UNEP, 2020a). However, the findings of our study showed the absence of holistic approaches and inadequate technological adaptation that could accelerate the integration of medical waste management into a prospective circular economy (Kulkarni & Anantharama, 2020). A situation exacerbated by the lack of knowledge and awareness among medical waste workers and limited financial resources to ensure safe medical waste management, particularly in countries with economies in transition such as Ghana.

In addition, medical waste treatment practices in many countries with economies in transition are unregulated and often neglect the WHO guidelines for proper disposal of medical waste. Additionally, unlike hazardous and mercury waste which are covered under the international treaties such as Basel, Minamata, Rotterdam, and Stockholm Conventions, there is no international standard that directly covers medical waste management (UNEP, 2020b) Therefore, in the absence of global regulatory procedures of medical

waste, most countries have their own set of guidelines, and they vary substantially in each country. According to WHO reports, the unsafe disposal and management of medical waste not only causes environmental pollution and public health risks but also have implications for human rights due to the little attention paid by international communities.

Findings also concur with Al-Emad (2011) whose study results showed that the waste-workers were collecting medical and nonmedical wastes together manually in all hospitals without receiving adequate training and without using proper protection equipment. His study showed that there was poor awareness about medical waste risks and safe handling procedures among hospital administrators, and also budgets were not allocated for waste management purposes, which led to shortages in waste handling equipment and an absence of training programmes for staff. Abor (2007) study revealed that lack of necessary rules, regulations and instructions on the different aspects of collections and disposal of waste, failure to quantify the waste generated in reliable records, the absence of a dedicated waste manager, and no committee responsible for monitoring the management of medical waste resorted to the challenges impeding sustainable waste management.

Chapter Summary

In this chapter, the discussion has centred on the main research objectives, which reflects the sustainable hospital waste management at Mamprobi Polyclinic. Based on this main research objective, three specific objectives were discussed in this chapter. However, the first section discussed the demographic features of the respondents, while the second section,

addressed the main specific research questions relating to the topic. These objectives were to examine the categories of hospital waste generated within Mamprobi Polyclinic, the current waste methods used in treating and disposing of clinical waste, and the challenges to sustainable hospital waste management in the Polyclinic.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter presents a summary of the findings that emerged from the study and data analysis. It draws conclusions and makes recommendations on how best hospital waste can be treated, disposed and managed sustainably. Finally, suggestion for future research is also made.

Study Summary

The study set out to assess sustainable hospital waste management and its challenges in Ghana, specifically, at Mamprobi Polyclinic, Accra. There were three main specific objectives, which the study aimed to achieve and these included:

1. To determine the categories of hospital waste generated within Mamprobi Polyclinic
2. To examine the current waste methods used in treating and disposing of clinical waste in Mamprobi Polyclinic
3. To examine the challenges to sustainable hospital waste manageme nt in the Polyclinic

The study was based on the views of 125 employees from the study area. A self-administered questionnaire was the main research instrument The questionnaire contained several questions (items) and was subdivided into subscales The maximum and minimum score for each question ranged from 4 to 1 where 4 stands for Strongly Agreed, 3 is Agreed, 2 is Disagreed and 1,

Strongly Disagreed**.** The results from the survey were analysed using descriptive statistics (Mean and Standard deviation).

Key Findings

The major findings as they are related to the specific objectives of the study have been summarized. Firstly, it was revealed that most of the waste generated at Mamprobi polyclinic was infectious which are generated from contaminated with blood and other bodily fluids (e.g. from discarded diagnostic samples), cultures and stocks of infectious agents from laboratory work (e.g. waste from autopsies and infected animals from laboratories), and waste from patients with infections (e.g. swabs, bandages and disposable medical devices). Infectious waste contains potentially harmful microorganisms that can infect hospital patients, health workers and the general public.

Secondly, with regards to the incineration method used at the Mamprobi polyclinic, it was revealed that medical waste generated is treated using the traditional De Montfort medical waste incinerator, and sometimes turn to Korle-Bu Teaching Hospital for assistance. The Korle-Bu's incinerator is under-capacity, and cannot handle the medical waste generated at the hospital. This results in medical waste being disposed of without proper treatment.

Thirdly, the proper budgetary allocation and continuous training must be made compulsory for the heath protection. Regular monitoring of the hospital waste management practices should be conducted in order to minimize its impacts and to achieve the goal of sustainability. Furthermore, it

is not only the responsibility of a single person to do something to save human health andenvironment from future threats but also the responsibility of every person to do something in efficient manner to protect human health and environment from the risks/effects of improper hospital waste management.

Lastly, it was revealed that in the absence of financial and technological resources, precautions such as source segregation of the waste can help reduce the environmental footprint of hospital wastes as well as the cost of disposal.

Conclusion

The aim of this study had been to determine the sustainable hospital waste management and its challenges in Mamprobi Polyclinic, Accra. The findings of this research confirm the existence of various categories of hospital waste at the polyclinic, however it was revealed that most were infectious wastes. This denotes that it is very necessary for hospitals to classify the medical waste for easy identification and proper disposal. Also, it was revealed that the method used for treating and disposing hospital waste was that most of the wastes are incinerated. This was to ensure the health and safety of staff, visitors and patients who should be protected from dangerous exposure to medicine, contaminated equipment and sharps to mention a few, thereby minimizing the risks it poses to the health of the community at large.

The study finally concluded that the hospital is burdened by resource constraints, which limits the staff from treating, disposing and managing hospital waste sustainably. Notwithstanding these findings, the lack of staff

motivation, improper transportation systems, lack of places for storing the wastes the lack of proper technological advancement, the lack of strategic capabilities or management support and the lack of training and awareness provided to the staff are challenges the hospital staff are burdened with.

Recommendations

In view of the above observations, the recommendations were made based on the findings of the study. With hope of improving the management of hospital waste in Mamprobi Polyclinic

1. Firstly, hospital waste management is given very low priority in the budget due to limited finances. As a result very limited funds are provided by the government, and the levels of services required for protection of public health and the environment are not attained. The study therefore recommended that government should give priority to hospital waste management in the budget so funds can be available to manage hospital waste sustainably.
2. Also, the training of all the staff on management and proper waste handling within the hospitals using WHO guide lines manual. Awareness and training sessions should be conducted or organized for the proper waste management. The proper knowledge about waste management should be provided to the health care workers and staffs that deal with waste in order to minimize its overall impacts since such awareness practices also play crucial role in preventing the environmental and human health risks exerted by hazardous hospital waste.

3. Furthermore, there is need for proper segregation of infectious and non-infectious hospital waste. And the provision of plastic bags and strong plastic containers for infectious waste, the containers for infectious waste should be marked with Biohazard symbol.
4. Also, the hospital waste should be carried in a special purpose vehicle or in a special leak-proof, lidded container for in and outside waste disposal services.

Suggestion for Further studies

In the future, the researchers should not only focus on conducting situation analyses of hospital waste management in a developing country. They should also discover loopholes, if any, in the administrative/organizational structure of hospital waste management at hospitals. Moreover, they should discover if poor waste management practices have a bearing on the health of hospital staff. Suggestion of behavioural solutions may encourage better waste management practices at the hospitals. Finally, sustainable and environment friendly solutions for hospital waste disposal should also be researched in more detail.

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APPENDIX

QUESTIONNAIRE

UNIVERSITY OF CAPE COAST

COLLEGE OF DISTANCE EDUCATION

DEPARTMENT OF BUSINESS STUDIES

Master of Business Administration (Management)

Questionnaire

Dear Respondent,

This is purely an academic exercise and in partial fulfilment of the requirements for the award of Master of Business Administration (Management) by the University of Cape Coast. The main purpose of the study is to investigate sustainable hospital waste management and its challenges in Ghana, specifically, at Mamprobi Polyclinic, Accra. Please read each statement carefully and answer them as frankly as you can. Your responses will be accorded the utmost confidentiality they need. Your maximum cooperation is highly solicited. Thank you.

SECTION A: DEMOGRAPHIC INFORMATION

(Please tick to indicate your answer on the space provided).

1. Sex: (a) Male [ ] (b) Female [ ]

2. Age: (a) 20-30 years [ ] (b) 31-40 years [ ] (c) 41-50 years [ ] (d) 51-60 years [ ]

3. Education level: (a) HCA [ ] (b) Diploma [ ] First Degree [ ] (c) Second Degree [ ] (d) Professional Certificate [ ]

4. What is your job type?

General nurses [ ] Health care assistants [ ] Physiotherapist [ ] Midwives [ ] Pharmacists [ ]

5. How long have you been working in the hospital?

1-5 [ ] 6-10 [ ] 11-15 [ ] Above 16 years [ ]

SECTION B: SUSTAINABLE HOSPITAL WASTE MANAGEMENT AND ITS CHALLENGES

This section seeks to gather information on sustainable hospital waste management and its challenges in Ghana. Specifically, it is determine the categories of hospital waste generated; the current waste methods used in treating and disposing of clinical waste and the challenges to sustainable hospital waste management in the Mamprobi Polyclinic.

BI:

Using the scale of 1-5 given below indicate how accurately the following describe categories of hospital waste generated?

	Categories of medical waste	**SD**	**D**	**N**	**A**	**SA**
1	Infectious waste					
2	Pathological waste					
3	Sharps					
4	Chemicals					
5	Non-hazardous or general waste					
6	Pharmaceuticals					
7	Genotoxic waste					
8	Radioactive waste					

B2:

Using the scale of 1-5 given below indicate how accurately the following describe Methods used in the hospitals for waste materials?

	Methods	**SD**	**D**	**N**	**A**	**SA**
1	Clinical waste products are classified, divided and sorted (segregation)					
2	Crushed hospital wastes are mixed with chemical disinfectants such as sodium hypochlorite, calcium hypochlorite and chlorine dioxide which kills infectious microorganisms (Disinfection)					
3	Medical waste produced are burnt (Incineration)					
4	Clinical waste is cut or torn into smaller pieces for final disposal (Shredding and Grinding the infectious medical waste)					
5	Medical waste are buried in a well-engineered landfill (Landfilling)					
6	All forms of medical waste get shredded and then sterilised by wet steam (Recycling)					
7	Waste are biological engineered into solid biodegradable residues under controlled conditions (Composting)					
8	Waste are disinfected with a high pressure steam (Autoclaving)					
9	Medical waste are heated (Microwave irradiation)					

B3:

Using the scale of 1-5 given below indicate how accurately the following describe Challenges faced in the hospitals for disposing waste materials?

	Challenges	**SD**	**D**	**N**	**A**	**SA**

1	Resource-constrained					
2	Improper transportation systems					
3	Lack of strategic capabilities or management support					
4	Lack of proper technological advancement					
5	Lack of staff motivation					
6	Lack of trainings and awareness					
7	Lack of places for storing the wastes					

THANK YOU