

UNIVERSITY FOR DEVELOPMENT STUDIES

**MANAGEMENT OF HOSPITAL WASTE IN THE TAMALE TEACHING
HOSPITAL**

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HOSPITAL

BY

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DECLARATION

Student

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

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Candidate's Signature:..... Date.....

Supervisor

I hereby declare that the preparation and presentation of this thesis was supervised in accordance with the guidelines on supervision of thesis laid down by the University for Development Studies.

Name: Prof., Dr., Juventus B. Ziem

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



ABSTRACT

In a typical Ghanaian hospital such as the Tamale Teaching Hospital (TTH), the effective management of solid waste is a growing challenge and concern due to its related potential effect on public health. To assess the management of hospital waste in the TTH, a cross-sectional descriptive study was conducted. TTH has a waste management team of 64 made up of 54 cleaners and 10 unit heads and all were included in the study. Data was collected with the help of a questionnaire and an on-site observational checklist. SPSS was utilized to analyze the data into descriptive and inferential statistics. The results revealed that 90.6% of the team segregated waste, 9.4% knew of a waste treatment system, 96.9% said they disposed at the landfill, knowledge on colour coded containers was less than 50% for cleaners and unit heads, 7.8% knew of waste policies and 42.2% aware of waste plans. To establish any association between unit heads knowledge on risk with infectious waste and that of the cleaners using Pearson chi square at a significance level of 0.05 revealed that cleaners knowledge on awareness of risk with infectious waste was not significant ($\chi^2 = 0.1222$, $p=0.727$, $n=54$). Improper segregation, lack of yellow coded containers, absence of a treatment plant and open burning of waste were observed. The study concluded that waste was poorly managed in the hospital. Close supervision of waste activities, provision of yellow containers and training of the waste team on HCWM among others are recommended to ensure an effective waste system by Management.



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DEDICATION

This piece of work is dedicated to my late father John Jimah Bakeri, my mother Adia Mumuni, my wife Stephany, Jonathan and Joel my sons and the entire Bakeri family for their continuous love, support and prayer.



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LIST OF ABBREVIATIONS

Abbreviation	Full Meaning
EPA	Environmental Protection Agency
EHU	Environmental Health Unit
GHS	Ghana Health Service
G-TEQ	Gram Toxic Equivalence
HCWMC	Health Care Waste Management Committee
ICRC	International Committee of the Red Cross
JHS	Junior High School
MOH	Ministry of Health
MLGRD	Ministry of Local Government and Rural Development
MMDA's	Metropolitan, Municipal and District Assemblies
OPD	Out Patient Department
SPSS	Statistical Package for Social Sciences
SHS	Senior High School
TTH	Tamale Teaching Hospital
TTHED	Tamale Teaching Hospital Estate Department
TTHRD	Tamale Teaching Hospital Records Department
TTHEHU	Tamale Teaching Hospital Environmental Health Unit
W.H.O	World Health Organization



CHAPTER ONE INTRODUCTION

1.1 Background to the Study

Hospital waste is defined as any untreated solid or liquid material generated as a result of the diagnosis and treatment of humans in the hospital or during the performance of medical research (MoH, 2006).

Hospital waste and by-products cover diverse range of materials that includes infectious waste, pathological waste, sharps, chemicals, pharmaceuticals, genotoxic waste, radioactive waste and heavy metals waste (WHO, 2011). Generally, hospital waste can be classified as general or non-hazardous waste and hazardous waste based on their level of health risk. An estimated 80% of waste generated by health institutions are considered non-hazardous and does not post any health risk to persons who handle it (WHO, 2011). Examples of non-hazardous waste include paper, trash, boxes, bottles, plastic containers and food. They can be discarded by burning or sent to the local landfill or dumpsite. The remaining 20% of waste generated by health facilities are classified as hazardous (WHO, 2011). Waste considered hazardous includes tissue and body parts, expired drugs, disinfectants, sharps and blades which tend to have great adverse effects on both human and the environment due to its carcinogenicity, toxicity and corrosiveness. They need special arrangements in terms of incineration and other effective treatment options before the final point of disposal (MoH, 2006).

Studies show that hospital waste has not received the needed attention and priority in developing countries (Ibijoke et al., 2013). Improper disposal practices often result in the reuse of discarded syringes, IV tubes, blood bags and other equipment not designed for either sterilization or reuse (Jawed, 2006). If hospital waste is not properly managed



and disposed of, injuries can arise from contaminated sharps leading to infections (Jawed, 2006). Improper management of hospital waste can affect the whole environmental system in the form of water and soil contamination, effect on food and natural vegetation (Nadeem, 2014).

The management of hospital waste varies from country to country. However, it is generally recommended that hospital waste should be segregated at point of generation, stored in appropriate colour coded containers, treated, transported and disposed of in a proper and safe manner. The options available for the treatment of hospital waste before final disposal may include incineration, mechanical/chemical disinfections, microwave disinfections and autoclaving, taking into account the composition of the waste, technical aspects and environmental conditions (Asante et al., 2014). The proper management of hospital waste mainly depends on the commitment of the institutional administration, proper legislations, involvement of all stakeholders in the waste management process and a dedicated budget allocated for waste in each health institution (WHO, 2005; MoH, 2006; ICRC, 2011; Akum, 2014).

In developed countries, the management of hospital waste largely depends on the implementation of waste legislations, dedicated allocation of budget towards waste management, segregation of waste at point of generation and the use of environmental friendly technologies for the treatment of the hospital waste (Asante et al., 2014).

For most nations on the African sub-continent, hazardous and non-hazardous waste are usually handled and disposed together with domestic waste in the form of illegal dumping and burning which has health implications for persons who come into contact with them. Waste management appears to be unsatisfactory and poor since awareness



on issues relating to medical waste management are generally poor or lacking among generators and handlers and hence rendering such waste unsafe (Stanley et al., 2011).

Ghana, with a population of 25 million people has poor standard hospital waste management system (Asante et al., 2014). In Ghana, the provision of waste management services in general has always been viewed as a multi-sectoral effort with the Ministry of Local Government and Rural Development and the Environmental Protection Agency playing key roles in waste management issues (MoH, 2006; Akum, 2014). Hospital waste management is therefore the responsibility of health facilities and institutions in the country (MoH, 2006). It must be noted that despite the fact that current medical waste management practices vary from hospital to hospital, the problematic areas are common to all healthcare facilities and at all stages of management (Tsakona et al., 2007).

In many developing nations including Ghana, waste is usually not properly segregated at the point of generation resulting in a mixture of infectious waste and non-hazardous waste (Asante et al., 2014). Common methods employed in the management of waste include the use of inappropriate containers for the storage of waste which are left for a day or more, lack of treatment plants and open burning of waste. Some hospitals also have incinerators which are broken down or not in use due to frequent power outages in the country or are not environmentally friendly (Akum, 2014; Asante et al., 2014).

In Tamale, the story is not different, most hospital waste is often treated like domestic waste. Such waste is usually collected and stored temporally in unapproved containers and burned openly within the premises of health facilities. A few locally designed incinerators are also available for the treatment of hospital waste. Some hospitals in



Tamale are also in some sort of contract with private waste companies (Zoom lion, Ghana Company Limited) who are mainly responsible for the hauling of waste containers from the hospital to the Tamale Landfills and other open places for final disposal (TTH / EHU, 2015).

1.2 Problem Statement and Justification

Issues of waste in general have been of great concern worldwide resulting in increased risk for water, sanitation, and hygiene (WASH)-related diseases. It is estimated that about 5.2 million people die annually from WASH related diseases (WHO, 2005). Solid waste management remains a major problem and a source of worry to many countries of the world. Hospital waste is yet to receive the necessary attention in the overall waste management systems of many developing countries and often times neglected. Although medical waste constitutes a small fraction of municipal solid waste, the potential effects could be of great magnitude (Longe et al., 2005). It must be noted that poor hospital waste management result in the spread of diseases such as hepatitis and HIV/AIDS. Studies (Silva et al., 2005; Debere et al., 2013) have shown that various inappropriate waste disposal methods at the health facilities have impacted negatively on health care staff, patients and hospital environment.

The effective management of healthcare waste largely depends on a number of factors including ability to dispose off waste safely by health staff, adequate knowledge of health staff on waste management issues and a devoted waste working group, plans and policies (WHO, 2005; MoH, 2006). In Ghana, the generation of health care waste is rapidly increasing as a result of expansion of various healthcare establishments (WHO, 2011). It is reported that designated containers for storage of waste were unacceptable and served as breeding grounds for flies and rodents. Open burning was also a common



practice in most health institutions for the management of their waste (Abor, 2012). This however contradicts the international best practices in the effective management of health care waste as recommended by the World Health Organization.

It is estimated that the total health care waste generated by health institutions in the Tamale metropolis alone stands at 1.5kg/bed/day (EPA, 2002). Most of these institutions lack structured waste management systems hence waste is often stored in temporal containers and burnt openly within the hospital premises (Hussein et al., 2014). They further noted that in some cases waste from Tamale Teaching Hospital are managed in much the same way as household waste and finally carried to the Tamale Landfills without adequate treatment and segregation.

It is however reported that the common method of managing waste in the Tamale Teaching Hospital is open burning emitting 0.225 g-TEQ/year into air and 0.020 g-TEQ/year into ash waste which is harmful, especially to vulnerable groups like women and children (UNDP, 2015; Amfu-Out et al., 2014). A preliminary investigation carried out by the researcher at TTH confirmed that waste at the hospital was not properly segregated at the point of generation. Also the absence of a waste treatment plant made it impossible for the treatment of waste before final disposal. These inappropriate waste management practices have the tendency of spreading diseases in the metropolis (Hussein et al., 2014; Leonard, 2016) and hence should be given serious attention. The safe and smooth implementation of any hospital waste management system is therefore crucial in order to avoid potential exposure of health care staff, patients and the general public to diseases as well as protecting the environment. It is against this background that the study investigates management of hospital waste in the Tamale Teaching Hospital.



1.3 Research Questions

The research questions to be addressed include:

1. What hospital waste management system is in place at the Tamale Teaching Hospital?
2. What is the level of knowledge of hospital waste workers and hospital unit heads regarding the hospital waste management system?
3. Are waste management policies and plans available in the Tamale Teaching Hospital?

1.4 Objectives of the Study

The main objective of the research is to assess the management of hospital waste in the Tamale Teaching Hospital of Ghana.

1.4.1 Specific Research Objectives

1. To identify and evaluate the hospital waste management system.
2. To assess the hospital waste workers and unit heads knowledge in dealing with hospital waste.
3. To determine the availability of waste management policies and plans.

1.5 Relevance of the Study

The Tamale Teaching Hospital is located in the Tamale Metropolis and serves as a referral point to many district hospitals and even smaller hospitals in the northern part of Ghana. It has the potential of generating huge amount of hospital-based waste due to the large number of people who visit the hospital on daily basis. Data from this study will add to the insufficient knowledge and information concerning hospital waste management system in Ghana and particularly in TTH where the study was conducted.



The information will also assist management of hospitals in the formulation of policies and programs that will ultimately improve the hospital-based waste management systems in the country and reduce the hazards associated with improper hospital waste disposal practices.

Also, this study will provide useful and functional information for persons who handle hospital waste, the health worker and the general public at large on the potential dangers that can arise as a result of improper handling, transportation, treatment and disposal of solid hospital based waste in the metropolis.

1.6 Scope of the Study

This study was conducted in the Tamale Teaching Hospital (TTH) to assess the waste management system in a typical Ghanaian teaching hospital. The study primarily identified and evaluated the hospital waste management system, waste management team's knowledge in dealing with hospital waste and the availability of waste management policies and plans at the TTH. Generally, the study classified hospital waste into two namely solid and liquid. Issues of hospital waste are broad in nature therefore this study particularly focused on solid hospital waste management in the TTH. All parameters in the study were compared with the guidelines set by the World Health Organization and the Ghana Health Service on hospital waste management as well as linking findings with some references in the literature.



1.7 Conceptual Framework

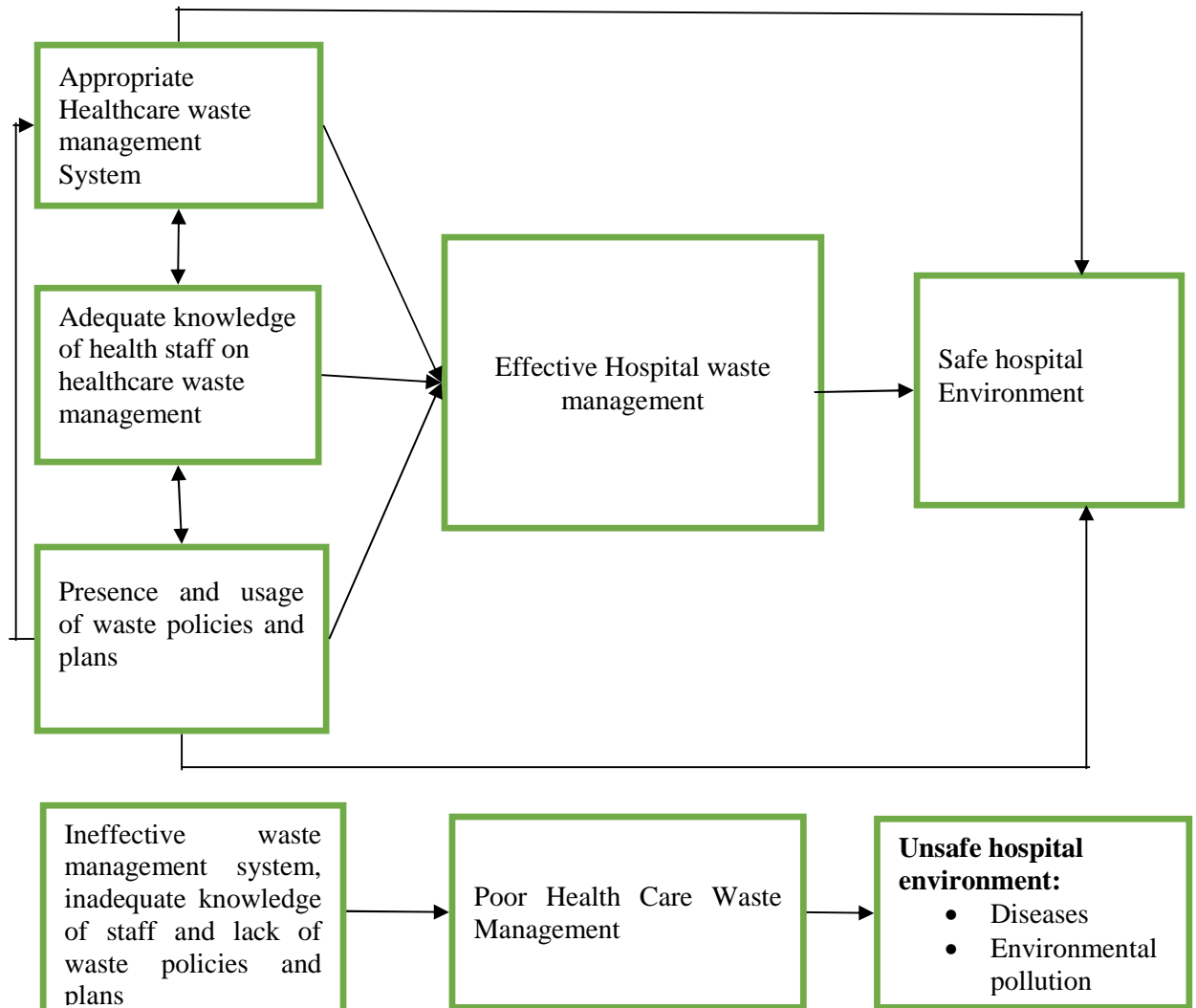


Figure 1. 1: Conceptual Framework (Author's Construct)

From figure 1.1 above, the conceptual model is built to help give a sound analytical framework to the study. This thesis was conducted based on the notion that the presence of the following factors (appropriate waste management system, adequate knowledge of health professionals in dealing with healthcare waste and the presence and usage of waste management policies and plans) will lead to an effective hospital waste management system and hence a safe hospital environment for health staff, patients and the general public visiting TTH. However, the absence of these factors will



lead to poor health care waste management which will eventually lead to unsafe hospital environment and hence exposure of health staff and the general public to infectious diseases such as Hepatitis and HIV/AIDS. This will also pollute the environment as well.

1.8 Structure of the Thesis

The thesis is organized into six chapters. **Chapter one** covers the introduction, which include the background to the study, problem statement and justification, research questions, objectives of the study, relevance of the study, scope of the study, the conceptual framework and the structure of the thesis.

Chapter two reviews available literature relevant for this study. This chapter also focuses on literature on general studies of hospital based waste. **Chapter three** covers the research methodology i.e. the study design, sample size and characteristics, sampling techniques, research variables, data collection and study instrument and quality control as well as the data analysis. **Chapter four** describes the main findings of the study. The discussion of the study results is presented in **Chapter five**. Conclusions drawn from the study and the study recommendations made are presented in **Chapter six**.



CHAPTER TWO

LITERATURE REVIEW

This chapter reviews the relevant literature on hospital waste management system from various secondary data sources including articles and summary of the relevant provisions of the Ghana health service policy guidelines on waste management. The reason for this review is to see whether there are gaps in existing literature, critique existing literature and to find out methodologies employed in existing literature in order to serve as a guide to achieve objectives of the study. The literature review thus focuses on key concept, methods and challenges of solid hospital waste management and fundamental principles of a waste management program.

2.1 Definition and Description of Hospital Waste

According to the McGraw-Hill Concise Dictionary of Modern Medicine (2002), hospital waste is any material discarded by a hospital without the intention for further use.

The terms hospital waste, special waste, health care waste and medical waste are interchangeable (Nema et al., 2011). Whatever the terminology used, the most important thing is that it should be waste arising or generated from a health establishment.

Hospital waste is also defined as any waste produced by health institutions which may include needles, syringes, blood samples, body tissues, chemicals, medical devices, soiled dressings, pharmaceuticals and radioactive materials (WHO, 2014).

Health-care waste includes waste generated within health-care institutions, research centers and laboratories. It also includes waste originating from minor and scattered



sources, including waste produced in the course of health care undertaken in the home (e.g. home dialysis, self-administration of insulin, recuperative care etc.).

Hospital or biomedical waste materials are generated in hospitals, nursing homes, veterinary hospitals, clinics, dispensaries, blood banks, animal houses and research institutions. Medical waste can also be generated in households (Anand & Stapathy, 2000).

According to the Ghana Health Service (2006), health care waste includes all untreated waste which could be liquid or solid produced during the treatment process of human beings and animals or medical research.

Medical wastes is also seen as any solid waste generated as a result of the treatment, diagnosis or immunization of human beings, animals and also during the performance of any health-related research from health institutions and medical laboratories (George, 2013).

Shaner, and McRae, (1999) define hospital waste as all waste produced from a health institution or facility which could be waste from offices, food vendors or canteens and construction works. They however view medical waste as a small component of hospital waste generated in the treatment process of human beings and animals. They concluded that medical waste which has the ability of transmitting disease pathogens is a sub set of hospital waste which must first be addressed by any medical waste management system in any health facility.

From the various definitions, it is clear that the Hospital is an institution for the delivery of health care services thereby generating waste which have public health implications and must therefore be managed carefully to avoid the potential exposure of health staff, patients and the general public visiting the hospital to diseases.



2.2 Classification of hospital waste

Sources of health care waste can be grouped into major and minor sources. The main sources of medical waste are hospitals and other healthcare facilities ranging from pharmacy, outpatient departments, administrative facilities, laboratories, dialysis activities and autopsy facilities as well as research facilities (Katoch & Kumar, 2008; Cheng et al., 2009; Palanisamy et al., 2011). The minor sources of medical waste may come from psychiatric hospitals, chiropractors, funeral services, ambulance services and home treatment (Katoch & Kumar, 2008). With the presence of blood borne diseases, more attention is being centered on medical waste which has the potential of transmitting disease pathogens and its disposal (Toyobo et al., 2012). It is thus crucial for the proper management of hospital waste by all health institutions (Babanyara et al., 2013).

Medical waste can be non-hazardous and hazardous in nature. Non-hazardous or non-risk waste approximately constitute 75-90% of the waste generated in healthcare establishment (Akum, 2014). This include waste from food remnants, paper cartons, fruit peels and packaging materials.

Hazardous or risk medical waste constitute 10-25% of all waste generated in health care establishment. It can be injurious to humans or animals and deleterious to the environment and would require special attention for its final disposal (Shinee et al., 2008).

Literature shows that only small proportion of overall medical waste are considered hazardous waste and mainly originating from clinics and hospitals, with small amount originating from industrial and domestic sources (Nadeem, 2014).



The composition of hazardous and non-hazardous waste varies from country to country and depends on the total or overall quantum of waste produced within a country, which is also dependable on a number of factors (Akter, 2000). For instance, in Pakistan it stands at about 20%, whereas in the United States 15% of hospital waste is considered as infectious waste, and in India the range varies between 15-35% (Nadeem, 2014). In Ghana, 75% to 90% of hospital waste is comparable to household waste which do not entail any particular hazard while the remaining 10% to 25% is classified as infectious or special waste (GHS, 2006).

The International Committee of the Red Cross however, classified hazardous medical waste into five main groups namely sharps, waste entailing risk of contamination, anatomical and infectious waste, pharmaceutical, cytotoxic, heavy metals and chemical waste, pressurized containers and radioactive waste which is of much concern.

Sharps waste are waste that could cause a cut or puncture leading to injuries. In other words, such waste can be said to be waste entailing risk of injury and include syringes, knives and needles. In order to avert injuries, such waste must be placed in appropriate containers for disposal (ICRC, 2011; WHO, 2011).

Waste entailing risk of contamination include waste containing blood, secretions or excreta. Body parts and tissue forms part of the anatomical waste. Waste containing large quantities of material, substances or cultures entailing the risk of propagating infectious agents (cultures of infectious agents, waste from infectious patients placed in isolation Wards) are referred to as infectious waste. No matter the particular waste generated in this category special arrangements need to be put in place for the safe



disposal of such waste in order to prevent the possible infection of people (ICRC, 2011; WHO, 2011; Khalaf, 2009).

Pharmaceutical waste include spilled/unused medicines, expired drugs and used medication receptacles for example bottles, connecting tubes and vials (Katoch & Kumar, 2008; WHO, 2007). This must be treated with care to avoid explosions after use (WHO, 2011). The cytotoxic waste may also include expired or leftover cytotoxic drugs and equipment contaminated with cytotoxic substances. Batteries, mercury waste (broken thermometers or manometers, fluorescent or compact fluorescent light tubes) for part of waste containing heavy metals. This has the potential of polluting water bodies due to high mercury levels. Waste containing chemical substances: leftover laboratory solvents, disinfectants, photographic developers and fixers are all waste considered as chemical waste (WHO, 2011; ICRC, 2011).

Pressurized containers consist of gas cylinders or aerosol cans with pressurized liquids or gas and used in the theater, wards and by the ambulance services. Such used cylinders or cans could be refilled or discarded. Gas cylinders and aerosol must not be incinerated since explosions could occur and hence causing injuries (ICRC, 2011; WHO, 2011).

Radioactive waste comprises of liquids, gas and solids contaminated with radionuclide whose ionizing radiations have genotoxic effects (Khalaf, 2009). In order words radioactive waste is waste containing radioactive substances: radionuclides used in laboratories or nuclear medicine, urine or excreta of patients treated.



World Health Organization, (2011) classified or grouped hospital wastes into eight categories namely, infectious waste and potentially infectious waste and general waste, pathological waste, chemical waste, sharps, pharmaceutical waste, pressurized containers and radioactive waste. These various forms of medical waste classifications are expatiated below;

Infectious waste are waste suspected to contain pathogens and may include viruses, parasites, fungi and bacteria which in their sufficient quantities could cause diseases in susceptible host (Kaseva & Mato, 1999; WHO, 2011; Pruss et al., 2013). Examples may include cultures and stock from laboratories which might be infectious, infectious waste emanating from surgery and autopsy activities such as blood and secretions or excreta. Waste from infected patients in isolated wards such as the chest ward all falls under infectious waste. Waste infected with patients undergoing hemodialysis cannot be under estimated. This may include tubing and filters, disposable towels, gowns, gloves and laboratory coats. Exposure to these infectious waste could lead to skin infection, viral Hepatitis, meningitis, gastro enteric infection, genital infectious among others. The proportion of hospital waste usually considered as infectious waste is estimated at 20% which needs special arrangement in order to render such waste safe for disposal (WHO, 2011).

The remaining 80% is considered non-hazardous and can be disposed of just like the ordinary household waste (Akum, 2014; Fadipe et al., 2011; Haylamicheal et al., 2011; Abah and Ohimain, 2011; WHO, 2011). This is usually general waste which is generated as a result of administrative task and may include paper. Such waste could also be produced through the activities of canteen services, schools and construction



works undergoing on in the hospital (Kaseva and Mato, 1999). It must be noted that a mixture of general waste and infectious waste renders the entire waste stream unsafe for handling (WHO, 2011).

Pathological waste is another classification of medical waste which consist of waste from sharps, body parts, blood, body fluid and human tissue which is capable of transmitting diseases if not properly handled. This form of classification is usually a subset of infectious waste which must be handled with precaution even if such waste contains healthy body parts (WHO, 2008; WHO, 2011; Hossain et al., 2011; Pruss et al., 2013).

All waste containing chemical substance are classified as chemical waste. This could be in the form of liquid, solid or gas which could be hazardous or non-hazardous. Such waste considered as hazardous waste must be genotoxic, toxic, reactive, flammable or corrosive in nature (Kaseva & Mato, 1999; WHO, 2011). Examples of hazardous chemical waste includes formaldehyde used for disinfecting hospital equipment, photographic chemicals used in the X-ray department for the fixing and developing of solutions, solvents (chloride, chloroform, methanol among others) used by various departments of the hospital, organic chemicals such as phenol-based used in scrubbing, mopping, disinfecting or cleaning of hospital floors and inorganic chemicals such as oxidants and alkalis. The non-hazardous medical waste may include some organic and inorganic salts and amino acid (Khalaf, 2009; WHO, 2011; Pruss et al., 2013).

Items with edges capable of causing cuts are known as sharps. In the hospital environment such edged items are referred to as sharp waste after being used and may include surgical blades, needles, scalpels, knives, infusion sets, nails and broken



glasses. These waste could be highly infectious and must be handled and disposed in a safe and proper manner (WHO, 2011; Pruss et al., 2013).

Another important classification of hospital waste or medical waste is pharmaceutical waste which include expired drugs, boxes, bottles, vaccine and connecting tubing (WHO, 2007; Katoch & Kumar, 2008). Such waste could also be hazardous to both human and the environment which needs practical steps in discarding or disposing them (WHO, 2011; Pruss et al., 2013).

Most gases used in the hospital setting are stored in aerosol cans, cylinders and cartridges. For instance compressed air used in the laboratory, anesthetic gasses used at the theatre and ambulance services, oxygen stored or supplied in cylinders and ethylene oxide for surgical equipment sterilization. These cylinders and cans may be of no further use which is expected that appropriate measures are put in place for their safe disposal in order to avert explosions (Khalaf, 2009; WHO, 2011).

Waste containing radioactive substances are also known as radioactive waste. This waste is generated as a result of in-vitro, in-vivo and tumour localization diagnosis carried out during therapeutic analysis. Radioactive waste contains radionuclides which maybe short half-lives or longer half-lives. The short half-lives loses their activity relatively faster than the longer half-lives. Examples of the longer half –lives include needles and pins which may be reused on other patients after being disinfected. Radionuclides may be grouped into gases and exhaust from stores and fume cupboards, excreta from patients treated and waste from syringes and needles (WHO, 2011; Pruss et al., 2013).



2.3 Hospital waste risks and impact on health and the environment

Hospital waste constitute a large amount of infectious waste which may contain disease pathogens (Addulla et al., 2008). Over the years human activities has led to the generation of huge volumes of medical waste which has threatens the very survival of human beings in particular and the environment in so many ways (Oweis et al., 2005).

Poor management of waste in any health institution or facility has the ability of predisposing all persons who come into contact with such medical waste to hospital related diseases due to its infectious nature (Pruss et al., 1999). Persons at risk of infection from infectious hospital waste usually include hospital staff, patients and scavengers. The health risk associated with infectious hospital waste can be classified into risk of trauma, chemical, explosion, radioactivity and environmental pollution (ICRC, 2011).

A study in Pakistan, suggests that the adherence of medical waste management practices by medical professionals are often neglected hence leading to injuries to themselves and clients of the hospital. Scavengers who also collect used syringes to sell for financial gains are also prone to infectious disease (Ramesh et al., 2010).

Improper handling of healthcare waste can lead to negative consequences on the environment and mismanagement of landfills which serve as final disposal points for waste which eventually lead to contamination of underground water (Kallman, 2008). Disease pathogens associated with improper waste management practices include skin diseases, typhoid, parasitosis and viral hepatitis (Bassey et al., 2006). There is also the possibility of transmitting of HIV due to contact with infected sharps (WHO, 2004). In



addition, improper waste management could also have serious health implications to the health worker, general public and the environment (Abor, 2007; Coke et al., 2009; Mesdaghinia et al., 2009).

The World Health Organization (WHO) estimated that in the year 2000, global accidents caused by sharps accounted for 66,000 cases of infection with the hepatitis B virus. Hepatitis C viral infection was 16,000 and between 200 to 5,000 HIV infection cases amongst staff of health institutions (ICRC, 2011).

2.4 Solid Hospital Waste Management

According to Johannessen et al., (2000), hospital waste management involves the segregation, storage, transportation, treatment and disposal of hospital waste. Medical waste is also seen as the process of ensuring good hygiene in health facilities while ensuring safety to both the health worker and the community (Sanitation Connection, 2002).

Solid waste management is also defined as the control of waste generation, storage, collection, transfer and transport, processing and disposal of solid wastes consistent with the best practices of public health, economics, financial, engineering, administrative, legal and environmental considerations (Othman, 2002). Therefore, the accomplishment of an efficient and orderly manner of any solid hospital waste management involves the identification and understanding of the fundamental aspects and relationships in a waste management system.

The safe and smooth implementation of any hospital waste management system therefore, depends on a number of factors including appropriate hospital waste management system, adequate knowledge of health staff on health care waste



management issues, presence and usage of waste management plans and policies by health institutions, dedicated budget for healthcare waste, devoted waste management team and good hospital administration (WHO, 2005; MOH, 2006). Other scholars also recommended the use of appropriate technology and the training of health staff on the appropriate management of healthcare waste (Akum, 2014; Silva et al., 2014; Abdulla et al., 2008).

It is expected that a good health care waste management system in the area of proper waste segregation at source, well labelled and the use of appropriate colour coded containers designated for waste, appropriate storage, transportation, treatment and final disposal system are all necessary steps in the containment or effective management of healthcare waste (WHO, 2005; MOH, 2006).

Knowledge and practices of health staff also plays a vital role in the effective management of health care waste. The ability of health staff to be able to identify hazardous and non-hazardous waste is important since contaminated waste can pose serious health threat to any person who comes into contact with such waste. It is also expected that health professionals have adequate knowledge in dealing with hospital waste and are also able to report injuries resulting from the handling of hospital waste (Akum, 2014; Silva et al., 2014; Abdulla et al., 2008).

The presence of a waste working group is very important for proper healthcare waste management practices in hospitals. The team is to supervise, advice and manage health care waste. The activities of the waste management team are to be guided by underpinning waste management plans and policies developed from national legislations on healthcare waste management. Such laws must be enforced in other to



ensure effective waste management in every health establishment (WHO, 2005; MOH, 2006).

Hospital administration also have a responsibility towards waste management in their facilities. A devoted waste budget and a sense of commitment to proper waste management and disposal cannot be over looked since hospital waste is capable of transmitting diseases. The use of appropriate technology in the treatment and disposal of waste and equipping health professional with relevant skills and knowledge especially those who deals with health care waste are all necessary conditions for the effective management of waste in our health institutions (WHO, 2005; MOH, 2006).

The escalating problem on solid hospital waste management can be attributed to inefficient and inappropriate waste management system, inadequate financial resources and low priority given to waste management issues by many health institutions. Each health institution or facility is thus responsible for its waste generated. In order to achieve a comprehensive and efficient waste management system, all these challenges must be taken into consideration (WHO, 2011).

One major issue related to current hospital waste management practices in many facilities is the fact that many of these facilities are not able to regulate and enforce hospital waste laws (Mathur et al., 2012).

Existing final disposal sites for municipal solid waste in Ghana are not engineered and may be described as crude dumpsites (Sam, 2009). There is no segregation of waste at the sources of generation, therefore hazardous and clinical wastes are often handled together with municipal solid waste (Asante et al., 2014).



2.4.1 Medical Waste Generation

Waste generation embodies routine processes through which material which are no longer of use are discarded (Puopiel, 2010). For the proper management of waste, information on the quantities, composition and types of waste generated in a municipality must be identified to enable future plans for the treatment and best disposal methods that should be employed (Rushbrook & Pugh, 1999). Usually, the quantum or volume of waste generated by a health institution depends on a number of factors ranging from hospital type, capacity, location, national income and instrumentation to status of the health institution (Da Silva et al., 2004).

The total quantity of health care waste generated across the world varies from hospital to hospital and from country to country all over the world depending on the area of specialty of the hospitals and national income of countries among others. It is estimated that in developed nations, hospital waste generated is closer to 5.24 kgs with countries such as the Netherlands and USA generating 4.2kgs and 4.5kgs per bed per day respectively.

In developing countries and Sub-Saharan Africa, data is limited but the quantity of hospital waste generated is estimated at 1.0 to 2.0 kgs per bed per day for general waste and 0.2 to 0.8 kgs per bed per day for hazardous waste (WHO, 2011). In Portugal it is 3.8 kg/bed/day (Alvim Ferraz et al., 2000). A study in Thailand indicate waste generation to be 1 kg/bed/day (Kerdsuwan, 2000). Another study in Egypt indicate daily waste generation of 2.07kg/bed/day (Abd El-Salam, 2010). In Jordan it is estimated between 0.5 and 2.2kg/bed/day (Abdulla *et al.* 2008). South Africa reported 0.6kg/bed/day healthcare waste is produced (Nemathaga *et al.*, 2008). Developed



nations such as the United States generate healthcare waste of between 4.3 to 5.8kg per bed per day (Hossain et al. 2011).

Out of the total amount of waste generated by health-care activities, about 80% is general waste comparable to domestic waste. The remaining 20% is considered hazardous materials that may be infectious, toxic or radioactive and would require appropriate disposal (WHO, 2011). Other studies however indicate that estimated healthcare waste varies from country to country (Azage & Kumie, 2010). According to them estimated health care waste generated in Nigeria stands at 26.5%, while that of other countries in the Sub-Saharan Africa is perked between 2 to 10%. Also, estimate hospital waste produced in Pakistan is 25%. Other scholars are also of the view that estimated health care waste generated in some parts of Eastern Africa specifically Tanzania is 50% (Manyela & Lyasenga, 2010). Another study in Bangladesh estimated health care waste generation to be 36.3% (Sarkar et al., 2006).

Monreal (1993), indicated that the average rate of hospital wastes generated at Brazilian hospitals is 2.63 Kg/bed/day, of which about 15% to 20% are residues classified as infectious or biological. Also, a study in Morocco revealed that hospital waste production rate varies from 0.4 to 0.7 Kg/bed/day with a weighted average of 0.53 Kg/bed/day. The percentage of infectious and hazardous wastes in the total medical waste stream was estimated at about 30.5%. The remaining 69.5% was non-hazardous waste similar in properties to municipal waste (Mbarki et al., 2013).

According to the ICRC (2011), a university hospital in a high income country can generate not less than 10kg of waste per bed per day and also an ICRC hospital with 100 beds will generate between 1.5 to 3 kg of waste per patient per day. In Pakistan, it



is estimated that about 250,000 tons of hospital waste are generated and it is observed that the waste is improperly managed. This indeed contributes to both environmental and health repercussions on the immediate hospital and the larger population in the country. Generally, waste generated worldwide in advanced countries is greater than those generated in middle income and developing nations with generation rate of about 6kg to 3kg per person per year (Ramesh et al., 2010).

In 1992, the department of waste of the Metropolitan Assembly of Accra conducted a study in some major hospitals in Accra which showed the unit of health care waste produced to be 1.2 kg/bed/day. The study also revealed that the waste produced vary in proportion to the level of cases handled, the number of in- and out- patients and the number of auxiliary departments and units within the facility e.g. out-patient department, laboratory etc. Thus the quantum of waste produced were found to be at a higher side in the government hospitals most especially the teaching hospital as compared to the private clinics and health posts (MOH, 2006). It must be noted that due to limited data base in Ghana not much is known in other parts of the country of which Tamale is not an exception with regard to the quantities of waste generated.



2.4.2 Identification, packing, labeling and documentation of hospital waste

Every waste management system is depended on the ability of the waste management team to be able to identify the various types of waste at the point of generation and the level of hazards. Therefore it is very vital for every waste management team to be able to identify and separate waste appropriately since each waste stream has a way of disposing it in order to avert possible harm to persons who come into contact with it (Berger et al., 2000; Wiafe et al., 2015).

Hospital waste are expected to be packaged in order to protect persons who come into contact with it from possible injuries and harm that might come about as a result of exposure to such waste. It is thus the responsibility of hospital management to provide special containers for the containment of both infectious and non-hazardous waste such as safety boxes and plastic bags (Sawalem et al., 2008; Wiafe et al., 2015).

Labelling of hospital waste entails putting adequate information in terms of writing or symbols on waste containers to help waste workers and the general public visiting the hospital to enable them identify each type of waste stream and to also help them place waste appropriately (Coker et al., 2009; Wiafe et al., 2015).

Documentation of health care waste which is often neglected by most developing nations is important in every waste management system across the world. Proper documentation gives an inventory of the quantities of waste generated, the type of waste generated by each health facility, injuries occurring from the management of waste, budget allocation towards waste issues, treatment and disposal options (Marinkovic et al., 2008; Wiafe et al., 2015).



2.4.3 Segregation and Storage of Hospital Waste

Waste generated by hospitals should be segregated to clearly identify the various types of waste before final disposal. This helps in minimization and separation of the various groups of waste especially at the time of generation (Sagoe-Moses et al., 2001; Rao *et al.*, 2004; Wiafe et al., 2015). Segregation is done through the use of colour coding storage systems. Universally, black colour is used for general waste e.g. kitchen waste, paper, cardboard and sweeping, yellow is used for infectious waste e.g. sharps, patient waste, human/animal tissue and cultures/specimens and brown code is for hazardous waste e.g. vaccines, expired drugs and chemicals (WHO, 2011).

Storage refers to the way in which the waste is kept during the time it is produced and collected until its final point of disposal. This is categorized into internal storage and external storage. Storage of waste must take into account the type of waste dealt with and the potential risk of infection to health staff and the general public. It is advised that labels on waste containers should be clear enough for the entire storage period (MOH, 2006).

Studies carried out in most developing countries on hospital wastes management practices indicated that waste segregation and collection using recommended colour coding containers and storage of waste in safe premises have not been satisfactory (Mostafa et al., 2007; Coker et al., 2008; Patwary et al., 2011).

A study conducted in Bawku in the upper east of Ghana indicated that there is no place for the storage of medical waste. Hospital wastes was however moved from within the various departments to two (2) large storage containers where all waste from various department are emptied into within the premises of the hospital which was not



covered. The study also pointed out the absence of hospital waste burning practices within the domain of the hospital and recommended that it was a positive practice by the hospital (Akum, 2014).

2.4.4 Collection and Transportation of hospital waste

Collection of waste involves the gathering and hauling of waste after collection to the point where the collection vehicle is emptied. Waste generated at health institutions must be collected at regular intervals within the day and must not over stay where it is generated. It is therefore the responsibility of each health facility to develop a comprehensive waste management program aimed at daily collection, segregation and storage of waste (Chuks et al., 2013).

In the hospital setting, the transportation of waste is usually in two phases, the first phase has to do with the movement of waste from the point of generation to a temporal storage system on the premises of the hospital. The second phase deals with the transportation of waste from the temporal storage system within the hospital to an off-site treatment and disposal plant (Coker et al., 2009).

As far as possible, the means used for transporting waste must be reserved for that purpose and different means must be used for each type of waste. These transportation system must have easy system of uploading of waste, labeled appropriately and such vehicles must be kept clean all the time (Chuks et al., 2013). It must however be noted that many countries across the world transport their waste in uncovered vehicles and also with bear hands which have serious health implications (Sawalem et al., 2008; Coker et al., 2009).



2.4.5 Treatment and Disposal of hospital waste

There is no one universally accepted treatment and disposal method for hospital waste. However, any treatment option should aim at reducing the health risk of waste to both humans and the environment as well as the financial strength of the hospital (ICRC, 2011).

Treatment of waste has to do with rendering of waste safe for disposal which must follow the Environmental Protection Agency regulations and guidelines. It is a method which involves the change of the biological composition of waste (Marinkovic et al., 2008; Wiafe et al., 2015).

World Health Organization (2004) indicated that the proportion of health care facilities that did not use appropriate waste disposal methods ranged from 18% to 64%. Improper management practice impacts both directly and/or indirectly on the healthcare staffs, patients and hospital environment (Patwery et al., 2009; Tamplin et al., 2005). According to the WHO, thousands of HIV infections and millions of cases of hepatitis could have been avoided yearly if proper disposal methods were adhered to (WHO, 2011).

The following treatment or disposal techniques are commonly used for medical waste disposal: incineration technology, non-incineration technology, autoclaving, microwave irradiation, chemical methods, plasma pyrolysis and sanitary landfills (Puopiel, 2010; Mathur et al., 2012). An examination of these methods is vital in any waste management system.



Incineration technology thus involves the application of heat in a controlled manner for the treatment of waste. This method can be fueled by wood, gas or electricity. There are many types of incinerators used for the treatment of medical waste and may include controlled air types and rotary kiln (Mathur et al., 2012). It continues to be the preferred choice of healthcare waste treatment (Marinkovic et al., 2008). It must however be noted that if an institution or country decide to use incineration as treatment options then practical steps must be put in place to regulate the level of emissions in order to reduce exposure of risk to waste workers and the environment which is usually a problem for most developing countries (Rahele et al., 2013). The improper use of incinerators were reported in most hospitals in Ethiopia (Crown, 2007).

Another method of waste treatment is by the non-incineration technique which involves rendering waste safe by destroying pathogens which are capable of transmitting diseases to humans and potential effects on the environment through biological, chemical, irradiation and thermal means. This method is gradually becoming the most dominant treatment option, primarily due to high costs associated with raised air emission control standards required for incineration facilities (Kobus & John, 2008).

Autoclaving is also another method employed in the treatment of waste which involves the use of steam at great temperatures to destroy all microorganisms in the waste (Mathur et al., 2012).

Microwave irradiation method cannot be left out in the treatment of hospital or health care waste. This methods make good use of high amounts of frequency waves to produce the needed heat enough to destroy or kill all pathogens in the waste (Mathur et al., 2012).



The chemical method involves the use of chemicals powerful enough to kill pathogens in waste generated from health institutions e.g. Hypochlorite solution. Plasma Pyrolysis technology converts organic waste material into syngas, predominantly Carbon monoxide (CO) as Hydrogen (H₂). The syngas can be converted to energy (steam or electricity) which is commercially useful. The heat generated by this technology is environmentally friendly which also makes it possible for medical waste to be discarded in a safe and proper manner (Mathur et al., 2012).

Sanitary land filling involves digging and burying of waste or closing up of waste with soil. This aids in the reclamation of land for agricultural or other land use purposes. This method of waste disposal can be said to be one of the oldest system in the management of waste and it is widely or mostly used by many developing nations with financial and technological challenges (Puopiel, 2010).

2.5 Hospital Waste Management in Developed Nations

The management of hospital waste largely depends on the implementation of waste legislations, dedicated allocation of budget towards waste management, segregation of waste at point of generation and the use of environmental friendly technologies for the treatment of hospital waste (Asante et al., 2014).

In advanced nations there exist appropriate laws governing the operations of the medical waste management system (Gupta & Boojh, 2006). There also exist appropriate technologies which are considered among the best practices in the treatment and safe disposal of medical waste.



A study in most hospitals in the developed nations revealed that hospital waste was well managed and measures are also being put in place to drastically reduce significant levels of pollutions as a result of waste incineration. Laws and regulations on biomedical waste are also enforced to help improve the waste management system in these counties (Othigo, 2014).

Health institutions in Canada are now moving away from on-site incineration of healthcare waste to a central location where waste from several health institutions could be incinerated in order to reduce the pollution levels in the country (Walkinshaw, 2011). This also has low cost financial implication for the effective and efficient management of health care waste.

It must however be noted that many countries in the developed nations could have saved a lot of money through proper waste segregation but this is not so due to low priority given to health care waste management issues (Tudor et al., 2009; Udofia et al., 2015). Waste often get mixed up and there is always inadequate budget for hospital waste management. The waste management system in the area of storage, transportation and disposal are still a great challenge for most developed nations (Blenkharn, 2007). Continuous capacity building for staff is also still a challenge (Coker et al., 2009; Debere et al., 2013; Sawalem et al., 2009). These practices are not different from what pertains in most developing countries of the world.



2.6 Hospital Waste Management in Developing Countries

In developing countries, hospital waste management have not received the needed attention it deserves and still remains a major challenge (Silva et al., 2005). This can be as a result of scarce resources with competing demands. Hospital waste is handled just similar to household waste instead of being segregated from the other waste stream in developing countries.

It is estimated that approximately 282, 447 tons of health care waste are generated from an estimated 67, 740 health facilities in Africa (AGENDA, 2009; Udofia & Nriagu, 2013). Meanwhile the proportion of such waste considered to be infectious is estimated by other studies to be between 10 to 25% (Udofia et al., 2015; Haylamicheal et al., 2011; Fadipe et al., 2011; Abah & Ohimanin, 2011). Studies indicate that Africa is not prepared to handle the quantum of waste being generated and most often waste could be seen dumped openly without being treated (Nkhuwa et al., 2008; Nemathaga et al., 2008; Sawalem et al., 2009; Coker et al., 2009; Saad, 2013). It must also be noted that though there has been increasing awareness on solid medical waste management by individual countries in Africa, the total picture of solid waste management is still unclear (Udofia et al., 2015).

Over the years many interventions are put in place by the World Health Organization for the safe management of health waste in order to reduce the impact on both humans and the environment (WHO, 2005). Findings in developing countries on hospital wastes management indicated that waste was not segregated at the point of generation, stored in appropriate colour coded containers, treated and disposed of in a safe and proper manner. Personal protective cloths were not available for hospital staff



(Mbongwe et al., 2011; Manga et al., 2008). Hospital waste were also dumped or burned on the premises of health institutions (Muluken et al., 2013). The challenges in Africa in the area of waste management can largely be attributed to a number of factors including poor infrastructure and lack of awareness of the health risk associated with hospital waste by stakeholders involved in all waste management issues in their respective countries.

In Kenya, most health care waste are disposed together with municipal waste and they use common methods such as open burning and burying in the disposal of waste. The country has beautiful laws on health care waste management but due to lack of a dedicated budget, monitoring often becomes a great challenge (Othigo, 2014)).

An assessment of private health institutions in Nairobi Province in 2009 revealed that none of these facilities had a comprehensive waste management plan. Waste segregation was not done at the point of generation and persons who come into contact with such waste risk being injured or infected (Othigo, 2014).

A study in South Africa revealed that management of health care waste was problematic as hospitals had no waste management policies, plans and a dedicated waste management team (Othigo, 2014). The study further revealed that some African countries met to see the way forward in the area of hospital waste management since it was becoming a challenge in order to come out with solutions in tackling the situation in a holistic manner. It was also further noted that health care waste in hospitals in South Africa were poorly managed and falls short of WHO recommendations.

In Zimbabwe vehicles are used to convey waste bins from various hospitals to central storage site daily (Taru & Kuvarega, 2005). Studies have also shown that hospital



waste management practices in Tanzania were very poor (Leonard, 2004; Manyele, 2003). They further noted that awareness on issues of proper waste management practices were generally lacking among waste workers. It is worth noting that though medical waste management practices were poor in the country led to the construction of small scale incinerators in various parts of the country in order to improve on the medical waste management system (Manyele, 2004).

A study in Ghana in 2012 showed that hospital waste management practices are not the best in the Country. Awareness needs to be created on the policies and laws governing the handling, treatment, and final disposal of healthcare waste as recommended by the Ministry of Health policy guidelines in 2006. The hospitals must institute regular training regime for their staff members in charge of healthcare waste management (Othigo, 2014; MOH, 2006).

Also, a study carried out in the Tamale metropolis in Ghana revealed that most of the hospitals lack the capacity to effectively manage their waste due to the absence of incinerators and other waste management resources. Openly burning of waste was carried out on the premises of the hospitals (Hussein et al., 2014).

It is however worth noting that a study (Udofia et al., 2015) on the compliance of African countries on WHO standards on waste management indicate that in the area of waste segregation and final disposal most African countries were now adhering to standards. This practice is similar to what pertains in most of the developed nations of the world.



2.7 Private Sector Involvement in Solid waste Management

Over the years, there has been a call for the involvement of the private sector in solid waste issues which was once considered as a public sector service in order to improve efficiency and effectiveness in the waste management system (Agypong, 2010; Post et al., 2003).

Studies indicates that the private sector involvement in solid waste management is gaining interest in most developing countries (Karanja, 2002; Mwangi, 2003; Obiri, 2002; Awortwi, 2003; Mbuligwe, 2004; Kassim, 2006; Post et al., 2003).

The private sector involvement in the area of solid hospital waste could take the form of contracting out, open competition, franchise and concession or leasing by the state or health institutions (Cointreau-Levine, 2000).

Contracting out involves the award of a contract to the private sector for the delivery of services such as cleaning of hospital surroundings and the management of disposal sites. This is usually done when due procurement processes have been followed and the private sector is mandated to go strictly according to the laid down terms and agreements governing the contract (Cointreau-Levine, 2000).

Franchise arrangement involves the government or health institutions outsourcing services from duly registered liability companies guided by terms and conditions set out in the franchise agreement between the parties involved for the effective and efficient management of hospital waste. The private firm now recover its cost from direct charges from the facility served (Cointreau-Levine, 2000).



The state or health facilities can also award concessions to private investors to establish or set up facilities for health care waste management using state or health institution's resources. For instance the establishment of a central treatment plant for hospital waste management to take care of health facilities at one geographical place or region. The state or health institution may decide to take part of the cost while the remaining cost maybe taken care of by non- state institution such as private hospital through fees paid for the service (Cointreau-Levine, 2000).

In line with government policies in creating an enabling environment for waste service delivery in Ghana, more than 80% of waste management service delivery in the country are now handled by the private sector (Agyepong, 2010).

This has seen Zoom Lion Ghana Limited a leading waste management company in the country engaged in various waste management activities. The company was established in 2006 with the goal of using simple but modern methods and technologies in the effective management of waste in the country. The company provides services such as cleaning and landfill management (Boamah, 2011). Other methods such as incineration, waste to energy and anaerobic digestion have not been exploited by the company (Agyepong, 2010). He further noted that the company in collaboration with some universities within and outside the country are now engaged in the training of people in the waste management industry. According to UNESCO (2005), partnership in waste management issues has provided job opportunities for so many people.

Hospitals in Ghana are responsible for solid waste generated and are encouraged to engage the services of private waste management companies in the management of their hospital waste (MOH, 2006). This has seen the Tamale Teaching Hospital



engaging the services of Zoom Lion Ghana Limited in the management of some aspects of their waste in the area of hauling of waste to the Tamale landfills (TTHEHU, 2015).

2.8 Relevant Provisions of the Ghana Health Service Policy Guidelines on Hospital Waste Management

2.8.1 Waste Management policy and Legal Context

National legislations are vital for the effective management of waste in any country. It establishes the legal frame work and allows the national agency responsible for waste management to effectively see to the smooth implementation of the law which should spell out the policy document and technical guidelines for the effective management of waste.

In Ghana, the Environmental Protection Agency (EPA) and the Ministry of Local Government and Rural Development (MLGRD) have the responsibility of enforcing waste management regulations. This mandate is carried out through the auspices of the office of the Environmental Protection Agency (EPA) and the Metropolitan, Municipal and District Assemblies (MMDA's), which are directly under the EPA and MLGRD respectively.

They are expected to collaborate with health institutions in finding comprehensive ways in the management of waste generated by these institutions because there are no specific provisions in the law, which assigns or accord health institutions clear roles in dealing with hospital waste.

The Ministry of Health developed the Ghana Health Service policy document and technical guidelines on hospital waste management in the country in March, 2006. It



must however be noted that despite this policy document, there exist a gap between the law and policy hence there is no specific comprehensive national legislations on the handling of hospital waste even though, some institutions are assigned functions on waste management under the laws of the county. Each health institution or facility therefore has the oversight responsibility of taking necessary steps in ensuring the smooth implementation of the waste management process (MOH, 2006).

2.8.2 Waste Management Plans and Policies in Ghana

Health institutions are expected to develop waste management plans and policies, which will guide their operations in the management of waste generated as a result of their activities. They are also expected to have a contingency plan in the case of unexpected incidents such as fire outbreak, spillages, flooding etc (MOH, 2006).

Each institution is also expected to establish a Health Care Waste Management Committee (HCWMC) or a waste management working committee or team composed of the head of the institution, the Environmental Health Officer and three other senior officers (MOH, 2006).

Every good medical waste management system in a hospital depends on a dedicated waste management team, good administration, careful planning, sound organization, underpinning legislation, adequate financing and above all the full participation by trained staff (WHO, 2005; ICRC, 2011).

A study conducted by Akum (2014) at the Bawku Presbyterian Hospital of the Upper East Region of Ghana also recommended the formation of a dedicated committee on medical waste management and ensuring regular meetings of the working committee.



2.9 Summary of Literature Review

A review of available literature looked at pertinent literature on management of hospital waste from various secondary data sources including articles and summary of the relevant provisions of the Ghana health service policy guidelines on waste management. The literature review provided a greater understanding of the concept of the definition, description and nature of hospital waste, solid hospital waste management processes, fundamental principles of a waste management programme and the Ghana Health Service policy guidelines on medical waste. It also gave guidance and organization for the ideas relating to hospital waste.

The review revealed that despite various waste management policies and laws governing the efficient and effective management of health care waste across the world, various inappropriate waste management practices are still used particularly in developing countries of which Ghana is not an exception. This tends to negatively affect the health staff, the general public and the environment as well.

It is also worth noting that a good number of scholars conducted research in the area of medical waste management. However, these studies are limited in scope in terms of geography and methodology. Most of them were conducted in the developed countries and few in the developing countries which are still battling with waste issues. Little is known of solid hospital waste in Ghana and Tamale Teaching Hospital in particular.

The effective management of health care waste is therefore crucial in any health establishment or institution in order to advert possible exposure of people unknowingly to infectious diseases such as hepatitis and the HIV/AIDS virus.



It is however evidently clear that there is significant knowledge gap in the literature pertaining to solid hospital waste in the Tamale Teaching Hospital. It is therefore prudent to conduct further studies into how hospital waste was managed in a typical Ghanaian hospital such as TTH.



CHAPTER THREE

METHODOLOGY

This chapter describes the various methods used in this study. It covers the study design, study area, study population, sample size and sampling procedure, data collection and study instrument, research variables, data analysis and quality control issues, permission to conduct study and study limitation.

3.1 Study type and design

A descriptive cross-sectional study was conducted in the Tamale Teaching Hospital (TTH) to assess the hospital waste management system. The study employed both quantitative and qualitative procedures to assess the generation, segregation, storage, treatment, transportation and disposal of waste in the hospital. The study also obtained data on staff's knowledge in dealing with hospital waste as well as waste management policies and plans in the hospital.

3.2 Study Area

The TTH initially commissioned as the Tamale Regional Hospital in 2nd February, 1974. TTH is located in the eastern part of the Tamale Metropolis with a total land area of approximately 0.12 km². Its catchment population is approximately 2.1 million (TTHRU, 2015).

The hospital attained a teaching hospital status in 2002 and by the close of 2008 was given accreditation to train housemen. The TTH currently serves as clinical teaching platform mainly for medical students from the School of Medicine & Health Sciences (SMHS) of the UDS and for nurses and other health professionals from many health institutions within the northern sector of Ghana. The hospital also serves as a referral



point for the three Northern and Brong Ahafo Regions, the neighbouring La Cote D'ivoire, Burkina Faso and Togo.

The TTH has a bed capacity of three hundred and thirty-nine (339) and currently undergoing major renovations and is expected to increase the bed capacity to six hundred (600) when work is complete (TTHRU, 2015). The annual outpatient attendance and in-patient admission is estimated at 97,488 and 20,952 respectively (TTHRU, 2015). This huge OPD and in-patient patients' attendance has great implication for hospital waste generation and management. An estimated 95% of all waste generated at the TTH comes from the physiotherapy, catering, tailoring, TB care, eye unit, children's ward, mortuary, and OPD with significant health implications if practical steps are not taken to ensure safe disposal (TTHEHU, 2015).

The administration of the hospital is organized into five main directorates namely: the medical affairs, nursing, finance, pharmacy and administration directorates. The various directorates are accountable to a Chief Executive Officer (CEO). The Medical Affairs Directorate is the largest of all and has the following departments under it: Out-Patient, Surgery, Internal Medicine, Pediatrics, Obstetrics & Gynaecology, Diagnostics & Rehabilitation (Laboratory, Radiology/Radiography, X-ray & Ultrasound, and Physiotherapy), Dental, Eye and Ear, Nose & Throat [DEENT], Accident and Emergency, Intensive Care Unit, Psychiatry and Clinical Psychology (TTHRU, 2015). (Refer to figure 3.2 for organogram)



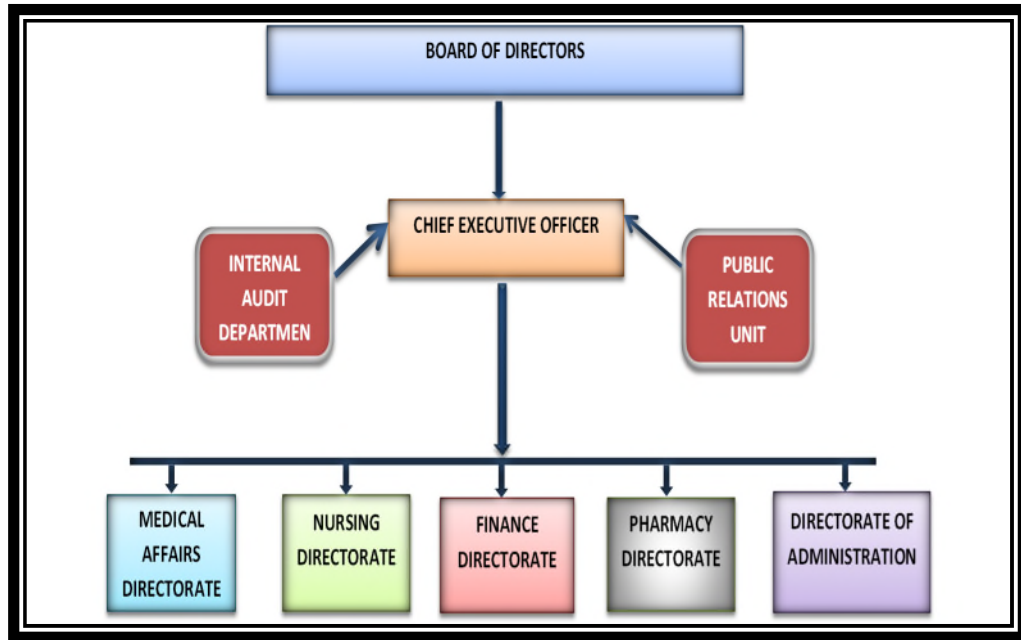


Figure 3.2: Present organizational structure of the Hospital

Source: (TTHRU, 2015)

3.2.1 Hospital Waste Management in TTH

Waste generated from the various units of the hospital is composed of both solid and liquid waste resulting from the process of patients care and other general services. Some waste is also generated as a result of general administrative task carried out in the hospital, construction activities and canteen services. Each unit is responsible for managing its waste generated. TTH has fifty-four (54) orderlies and porters who are responsible for the day-to-day cleaning of the various Departments and Units (TTHEHU, 2015).



3.3 Target Population

The target population is made up of all waste workers (54) and their supervisors (10) totaling sixty-four (64) at the Tamale Teaching Hospital. These people were selected because they have specific knowledge relating to health care waste management. They are also responsible for all waste management issues in the hospital and are exposed to infectious diseases such as hepatitis and HIV/AIDS due to the handling of healthcare waste and hence the need for the researcher to find out if these group of people effectively manage healthcare waste in the hospital.

3.4 Sample Size and Sampling Procedure

According to Tran & Perry (2003), one approach in determining the sample size is to use the entire population when it is too small as a sample. Therefore given the small nature of the target population, the entire members of the target population were included in the study. The use of the entire population is even the best way to measure the effect and impact of the study. This reduces the margin of error and improves upon the level of confidence in the results. The respondents therefore constitute the following; 54 waste workers and ten (10) unit heads who supervises waste management in the hospital. These group of people were purposively selected because they were directly engaged in all waste issues at TTH and have considerable knowledge in the subject matter of the study. The activities of waste workers in the hospital largely depends on their supervisors and hence knowledge of the cleaners was compared to that of their supervisors.



3.5 Data Collection and Study Instruments

In order to answer the research questions, quantitative and qualitative data collection tools were used in the study.

3.5.1 Quantitative study

In all, structured questionnaire were administered to solicit the views of the waste management workers of the TTH to constitute this part of the study. Data collected included demographic information of respondents such as age, sex, marital status, religious affiliation and educational level of respondents. Other data collected included information on the hospital waste management system, knowledge of cleaners and unit heads on waste management, waste policies and plans of the hospital. Each time it took between 35-40 minutes to complete a questionnaire. In order to facilitate the data collection process, three (3) research assistants were recruited and trained to assist in data collection.

Confidentiality was assured throughout the data collection process and beyond. The responses were kept confidential and only the researcher and researcher's team had access to individual data.

Responses in the area of knowledge of cleaners and unit heads regarding the hospital waste management practices in TTH was calculated by assigning "1" for "yes" answers and "0" for "no" answers to each item on the questionnaire. Total knowledge score ranged from 0 – 100%. "Inadequate/poor knowledge" was defined as correctly scoring between 0-49%, scoring 50% was "average knowledge" and scoring between 51-100% as "adequate/good knowledge".



To further assess the type of relationships between Unit Heads and Cleaners knowledge on the awareness of the risk associated with infectious waste, Pearson Chi-Square statistics at a significance level of 0.05 was used.

3.5.2 Qualitative Study

Throughout the study, non-participant observations were made on the waste management activities of TTH to form this part of the study. To achieve this, an on-site observational check list was used based on the Ministry of Health Waste Management recommendation guidelines (MOH, 2006).

The observations focused on key waste management practices by the waste management team in the various units or wards and the immediate hospital surroundings in the area of waste segregation at source, storage, transportation, treatment and disposal. The study also observed if waste bins were correctly labelled and displayed additional information to users where appropriate. The use of personal protective cloths by the waste management team in the Tamale Teaching Hospital was also observed. The walls and notice boards were also observed to find out if healthcare waste management posters were on display in order to educate the public.

The researcher and his team made two visits weekly to the hospital from February to March, 2015. The wards and units visited included the physiotherapy, catering, tailoring, TB care, eye unit, children's ward, mortuary and OPD because an estimated 95% of all waste generated at TTH comes from these units with significant health implications (TTHEHU, 2015). Temporal storage and disposal sites on the premises of the hospital were also visited. Notes were recorded in a field notebook about the waste management practices of waste workers at TTH.



In the process, pictures were taken with the help of a camera of heaps of hospital waste on-sites, waste containers overflowing with hospital waste, scattered hospital waste on the premises and inappropriate content of waste containers in order to complement the quantitative data.

All these observations were carried out to find out if TTH followed laid down rules and regulations as spelt out in the Ministry of Health policy guidelines on healthcare waste management.

3.6 Research Variables

The research variables include both independent and dependent variables. The independent variables include age, sex, marital status, religion and educational level. The dependent variables include waste policy, plans and waste working groups, knowledge on waste and waste management.

3.7 Quantitative Data Analysis.

All administered questionnaire from the field were entered into Microsoft Excel software version 2010. The data was cleaned for data entry errors and exported to Statistical Package for Social Sciences (SPSS) software for Windows, Student Version 23.0. Preliminary descriptive and inferential statistical analysis was carried out to further clean the data of errors and also ensure data completeness, accuracy and consistency of the responses.

Descriptive and inferential statistics was performed and data presented in the form of charts, tables, cross tabulations and percentages for the sake of clarity of presentation.



3.8 Qualitative data analysis

In the second phase of the data analysis, the qualitative data obtained by the use of observation were summarized and described in line with the study objectives. Pictures were also used to demonstrate points in line with the objectives. This was then integrated into the quantitative data.

3.9 Quality Control

To ensure reliability and adequacy of the questionnaire, the researcher pre-tested the questionnaire in the Zabzugu District Hospital, which was not included in the study. The pre-test site was chosen due to its close proximity to the researcher. The participants understood the instrument but however complained of the many items on the questionnaire, which took much of their time. Elements of the questionnaire were changed in order to standardize it for use in the main study.

3.10 Permission to conduct study at TTH

Formal permission was sought from hospital management to conduct the study in the Tamale Teaching Hospital with the help of an introductory letter from the University for Development Studies. The rationale of the study was explained to the Head of the Research Department of TTH. A permission letter was given by TTH research department for the study to be carried out in the hospital. Consent of participants was obtained and confidentiality was also assured to all participants.

3.11 Study Limitation

Some units were not prepared to respond to the questionnaire despite permission from the Tamale Teaching Hospital. Since it was their right to withdraw from the study at any point in time, other units were selected instead to make up for the number of units.



CHAPTER FOUR

RESULTS

This chapter presents the findings of the study. It is divided into two main sections; the first section presents the Socio-demographic Characteristics of the Waste Management Team of TTH. Specifically, this section looks at four main background variables. These include age, sex, religion and educational level. The rationale for selecting these variables is that they have implication for solid hospital waste management. The second section covers both the quantitative and qualitative aspects of the study answering the research objectives.

4.1 Socio-demographic Characteristics of Respondents

From table 4.1 below, out of a total of 64 respondents interviewed, age group analysis showed that most of them 48.4% (31) were within 31-40 years, 31.3% (20) within 20-30 years, followed by 14.1% (9) within 41-50 years and 6.2% (4) were above 50 years.

Sex analysis of the respondents revealed that 64.1% (41) of them were females and only 35.9% (23) of them were males.

In the area of religion, 61% (39) of the respondents practice Islamic religion and only 39% (25) belongs to the Christian religion.

In respect to education, most of the respondents 39% (25) had primary education, 36% (23) had JHS education, followed by tertiary education with 14% (9), SHS education was 9.4% (6) and only 1.6% (1) had no formal education (Table 4.1 below).



Table 4.1: Socio-demographic Characteristics of Respondents

Socio-demographic Characteristics	Number	Percentage (%)
Age		
20-30	20	31.3
31-40	31	48.4
41-50	9	14.1
51-60	6	6.2
Total	64	100.0
Sex		
Female	41	64.1
Male	23	35.9
Total	64	100.00
Religion		
Christian	25	39.0
Muslim	39	61.0
Total	64	100.0
Education		
Informal	1	1.6
Primary	25	39.0
JHS	23	36.0
SHS	6	9.4
Tertiary	9	14.0
Total	64	100.0



4.2 Identification and Evaluation of the Hospital Waste Management System

4.2.1 Segregation and appropriate placement of waste in designated containers

Table 4.2 below shows that out of a total of 64 respondents interviewed concerning various waste management practices at the Tamale Teaching Hospital, 90.6% (58) said waste was segregated at the point of generation and 9.6% (6) said waste was not segregated at source.

In all, 84.4% (54) placed infectious waste in the appropriate colour coded containers while 15.6% (10) did not place infectious waste appropriately as recommended by the Ministry of Health guidelines on waste management in the country.

Majority of them (93.7%) said general waste was placed appropriately in black coded containers with only 6.3 not placing such waste appropriately. Overall, 92.2% (59) of them said they place hazardous waste in containers designated for such waste and 7.8% (5) were of the view that such waste were not placed in recommended waste containers.



Table 4.2: Waste segregation and appropriate placement in designated containers

Variable	Frequency	Percentage (%)
Waste segregation at source		
Yes	58	90.6
No	6	9.4
Total	64	100
Appropriate system for placement of infectious waste		
Yes	10	15.6
No	54	84.4
Total	64	100
Appropriate system for placement of general waste		
Yes	60	93.7
No	4	6.3
Total	64	100
Appropriate system for placement of hazardous waste		
Yes	59	92.2
No	5	7.8
Total	64	100



It is however worth noting that an onsite observation on the hospital waste management system at TTH revealed that waste was not properly segregated in the hospital as recommended by the Ministry of Health policy guidelines on hospital waste management as all manner of health care waste could be found in designated waste containers.

It was also found that there were no yellow coded containers designated for the containment of infectious waste in the hospital. However, some units and departments had safety boxes in place of the yellow containers. There were however black and brown coded containers for waste as recommended. The content of these containers were however not appropriate. Infectious, general and hazardous waste were mixed together as depicted by Figure 4.3 below





Figure 4.3: Container meant for General waste containing a mixture of all sort of solid waste



4.2.2 Presence of a Waste Storage System

Majority of the respondents 92.2% (59) agreed to the hospital having a storage system put in place for all waste generated in the hospital as recommended with only 7.8% (5) who were of the view that the hospital had no facility for the storage of healthcare waste (Refer table 4.3)

Table 4.3: Presence of a waste storage system

Variable	Frequency	Percentage (%)
Presence of a waste storage system		
Yes	59	92.2
No	5	7.8
Total	64	100



4.2.3 Type of Waste Storage System in Place at TTH

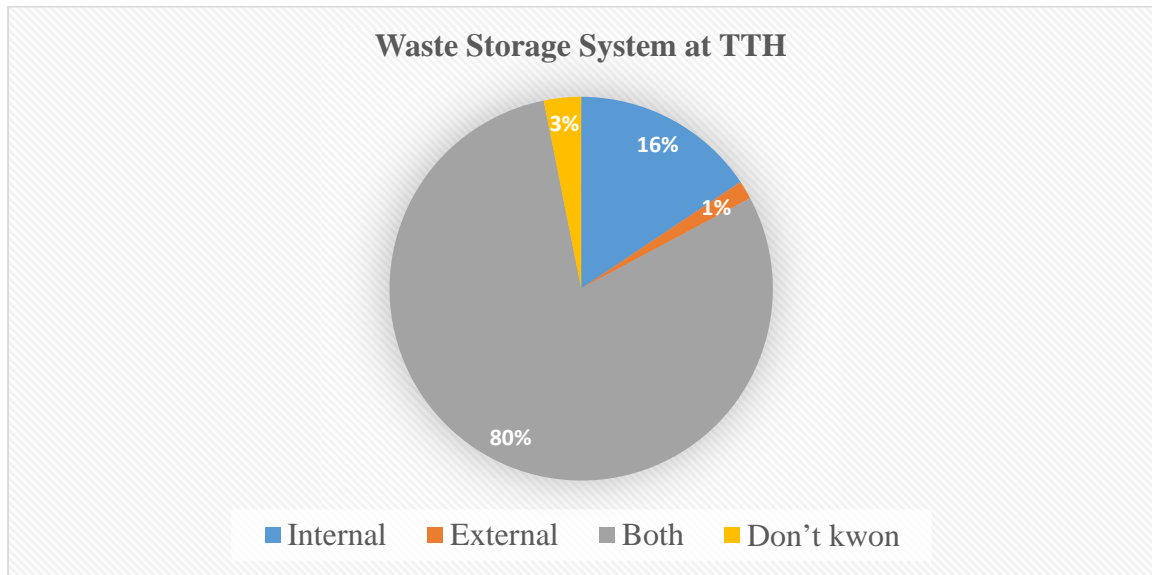


Figure 4.4: Type of waste storage system in place at TTH

Figure 4.4 above shows the storage system in place at the Tamale Teaching Hospital. In total, 80% of the respondents said waste was stored both inside and outside the hospital premises, 16% said the waste was stored exclusively within the hospital premises, 3% did not know where waste generated in the hospital was stored and only 1% said waste was stored exclusively outside the hospital.

An onsite observation also revealed the presence of waste container within the hospital. Storage was done with the help of dustbins, smaller containers and unapproved containers (figure 4.5) in the wards and transported to a bigger container located within the hospital for onwards transportation to the landfill. It must however be noted that these containers were not clean and stands the potential of transmitting diseases to the general public due to their proximity to some eating points. This container was also



filled to the brim and has not been emptied by the appropriate body for a while as shown in figure 4.6 below.



Figure 4.5: Container used for storage of waste at the chest ward



Figure 4.6: Waste container filled to the brim and close to a eating spot and waiting to be emptied

4.2.4 Presence of a Waste Treatment plant

Table 4.4: Presence of a waste treatment plant

Variable	Frequency	Percentage (%)
Presence of a treatment plant		
Yes	6	9.4
No	58	90.6
Total	64	100

From table 4.4 above, 90.6% (58) of the waste management team said the hospital had no treatment plant for waste while 9.4% (6) agreed to the presence of a treatment plant at TTH. An observation around the hospital confirms the absence of a treatment plant in the hospital.



4.2.5 Transportation System in Place at TTH

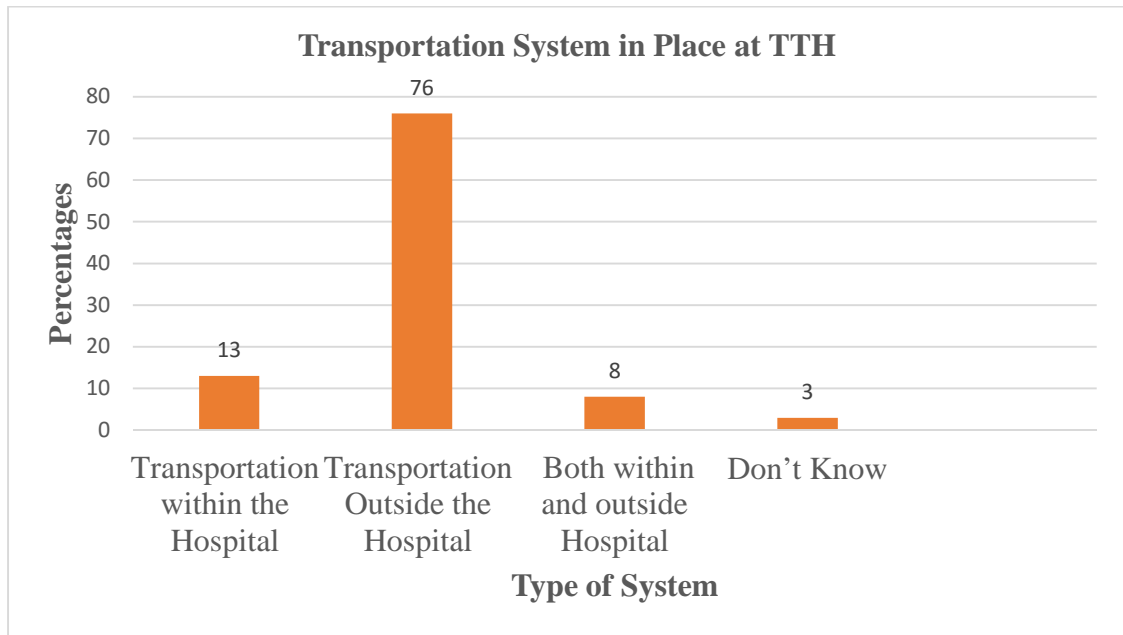


Figure 4.7: Views on waste transportation system in place in the Tamale Teaching Hospital

With regard to the waste transport system, 76% of the waste management team said that waste was transported off-site or outside the hospital to the landfills, 13% said waste from the various departments were transported manually by waste workers to a large storage container where all waste from the various departments are emptied into within the premises of the hospital and then finally transported off-site or outside the hospital to the landfills, 8% said waste was transported both within the hospital premises by waste workers and finally outside to the landfills by a waste company and 2% of them did not know how the transportation of waste was carried out in the TTH (figure 4.7).



The observational study confirmed that transportation of waste in the hospital was carried out manually with the help of waste workers and their supervisors to a temporal storage site within the hospital premises which is then finally transported to the Tamale landfills by the help of Zoom Loin Ghana limited which is contracted by the management of TTH for such purpose.

4.2.6 Presence of a Waste Disposal System at TTH

Table 4.5 indicates that out of 64 respondents, 96.9 % (62) said the hospital had a waste disposal system in place whilst 3.1% (2) were of the view that TTH had no system in place for the final disposal of their waste.

Table 4.5: Presence of a waste disposal system

Variable	Frequency	Percentage (%)
Presence of a waste disposal system		
Yes	62	96.9
No	2	3.1
Total	64	100



4.2.7 Waste Disposal System in Place at TTH

With regards to the final waste disposal points, figure 4.8 below shows that 75% of the respondents interviewed indicated that waste from the hospital is finally disposed of exclusively in the Tamale landfills, 17% said the final waste disposal points are either in the landfill or protected pits while 5% said only in protected pits. However, 3% did not know where waste emanating from the hospital was finally disposed off.

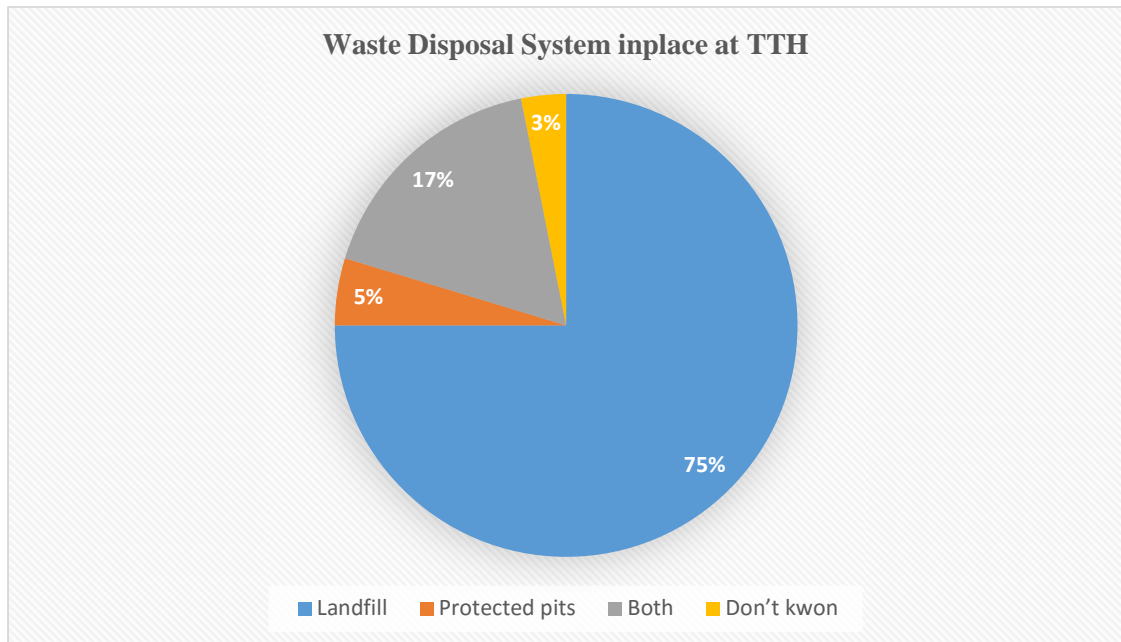


Figure 4.8: Views on waste disposal system in place at TTH



Observations around the hospital however revealed that some waste generated by TTH was scattered on the premises of the hospital (Figure 4.9). Waste could also be seen burned in an open space which was un protected as shown in figure 4.10 below. Majority of the waste was however carried to landfills for final disposal.



Figure 4.9: Infectious Waste scattered around an onsite disposal point within the hospital



Figure 4.10: Burnt Solid Hospital Waste in an unprotected area within the hospital premises.

4.3 Knowledge by hospital waste workers and unit heads regarding the hospital waste management practices in TTH

4.3.1 Knowledge by Hospital Waste Workers on Waste Management Practices at TTH

Table 4.6 below indicates that out of a total of 54 waste workers interviewed concerning their knowledge on the various waste management practices in the hospital, it was revealed that all waste workers (100%) had adequate knowledge on the identification of solid healthcare waste at TTH.

About 94% (51) had adequate knowledge on segregation of waste at the point of generation in the hospital while 6% (3) had no knowledge on the segregation of health care waste. In the area of waste disposal, 64% (35) had moderate knowledge level on the appropriate disposal of healthcare waste while 35% (19) had no knowledge on the disposal of such waste.

In the area of disposal of waste, 35 (64.84%) of the waste workers had adequate knowledge on disposal of healthcare waste in the hospital with only 19 (35.19%) not having such knowledge at the Tamale Teaching Hospital.

All the cleaners (100%) had adequate knowledge on the awareness of the risk associated with infectious waste and the need to handle such waste with care.

Further analysis to establish the association between Unit Head's knowledge on the awareness of risk associated with infectious hospital waste and that of the cleaners at a significant level of 0.05, revealed that, Pearson Chi Square = 0.1222, probability (p) = 0.727, and Number (n) = 54. Since P-value was greater than 0.05, there was no relationship between knowledge of Unit Heads and that of the cleaners meaning Unit Heads knowledge on the awareness of risk associated with infectious waste has no



influence on the cleaners knowledge on the awareness of risk associated with infectious hospital waste (Pearson Chi Square = 0.1222, $p = 0.727$, and $n = 54$).

Less than fifty percent (46.30%) had inadequate knowledge on the availability of waste manuals in the hospital while 53.70% had no knowledge on manuals in the hospital.

In respect to the use of personal protective cloths by staff, all waste workers (100%) had adequate knowledge and knew the importance and the need to be provided with such cloths by either the environmental health unit or management of the hospital.

Over fifty percent (72.22%) had adequate knowledge on the importance and the need for staff to be constantly trained on healthcare waste management while only 27.78% (15) did not have any knowledge and the need for staff training.

In all, 55.56% (30) had no knowledge on the appropriate use of colour coded containers as recommended by the Ministry of Health and less than fifty percent (44.44%) had inadequate/poor knowledge on the appropriate use of waste containers.



Table 4.6: Knowledge by hospital waste workers on waste management practices

Variable	Frequency	Percentage (%)
Identification of solid hospital waste		
Yes	54	100
Total	54	100
Ability to segregate waste at point of origin		
Yes	51	94
No	3	6
Total	54	100
Knowledge on hospital waste disposal		
Yes	35	64.81
No	19	35.19
Total	54	100
Awareness of risk associated with infectious waste		
Yes	54	100
Total	54	100



Table 4.6: Knowledge by hospital waste workers on waste management practices

Variable	Frequency	Percentage (%)
Availability of hospital waste manuals		
Yes	25	46.30
No	29	53.70
Total	54	100
Provision of personal protective cloths		
Yes	54	100
Total	54	100
Staff training on waste management		
Yes	39	72.22
No	15	27.78
Total	54	100
Knowledge on colour coding containers		
Yes	24	44.44
No	30	55.56
Total	54	100



4.3.2 Knowledge by Unit Heads on Waste Management Practices at TTH

In the area of knowledge on the hospital waste management system, out of a total of 10 unit heads interviewed, 90% (9) had adequate/good knowledge on the awareness of risk associated with infectious waste and the remaining 10% (1) could not do so (Refer table 4.7).

Eighty percent (80%) had adequate knowledge on the importance and the need to have specialized waste workers in the hospital while 20% did not see the need. In all, 60% had moderate knowledge on staff training while only 20% had no knowledge.

Sixty percent (60%) had no knowledge on waste manuals in the hospital and only 40% had inadequate/poor knowledge in the availability of waste manuals. Majority of them (90%) had adequate knowledge in the use and the need for the provision of personal protective cloths to staff while the remaining 10% had no such knowledge.

Most of the unit heads (60%) had adequate knowledge that personal protective cloths should be monitored to ensure compliance in order to prevent possible injuries to staff. The remaining 40% had no knowledge in monitoring of these cloths.

In the area of appropriate use of colour coded containers, 70% of the unit heads did not have knowledge on such containers designated for the various types of waste in the hospital while only 30% had inadequate knowledge and knew of such containers as shown by table 4.7 below.



Table 4.7: Knowledge by unit heads on waste management practices

Variable	Frequency	Percentage (%)
Awareness of risk associated with infectious waste		
Yes	9	90
No	1	10
Total	10	100
Knows the importance of specialized waste workers		
Yes	8	80
No	2	20
Total	10	100
Staff training on waste management		
Yes	6	60
No	4	20
Total	64	100
Availability of hospital waste manuals		
Yes	4	40
No	6	60
Total	10	100



Table 4.7: Knowledge by unit heads on waste management practices

Variable	Frequency	Percentage (%)
Provision of protective cloths to staff		
Yes	9	90
No	1	10
Total	10	100
Monitors the usage of personal protective cloths		
Yes	6	60
No	4	40
Total	10	100
Knows appropriate colour containers for waste		
Yes	3	30
No	7	70
Total	10	100



4. 4 Availability of waste management policies and plans in the Tamale Teaching Hospital.

As illustrated by table 4.8, out of a total of 64 respondents with respect to waste management policies, plans and waste working groups, 92% (59) were not aware of a document outlining the hospital waste management policies and only 7.8% (5) were aware of the existence of waste management policies.

Overall, 57.8% (37) were not aware of the existence of waste management plans at TTH with only 42.2% (27) being aware of waste management plans to help give guidance to waste management activities in the hospital.

In all, 96.9% (62) agreed to the fact that waste management team was put in place and functioning as expected of it in ensuring the effective and efficient waste management process in the hospital while the remaining 3.1% (2) did not agree to the existence of a waste management team in the hospital (Refer table 4.8 below)



Table 4.8: Waste management policies and plans at TTH

Variable	Frequency	Percentage (%)
Existence of waste management policies		
Yes	5	7.8
No	59	92.2
Total	64	100.0
Existence of waste management plans		
Yes	27	42.2
No	37	57.8
Total	64	100
Existence of a waste management team		
Yes	62	96.9
No	2	3.1
Total	64	100



CHAPTER FIVE

DISCUSSION OF RESULTS

This chapter contains the discussion of the results of the study. It is divided into sections under the following headings; socio-demographic characteristics of respondents, waste management practices in the Tamale Teaching Hospital, knowledge of hospital waste workers and unit heads regarding solid hospital waste management and hospital waste policies and plans.

5.1 Socio-demographic Characteristics of Respondents

Age analysis of the waste management team of the Tamale Teaching Hospital revealed that most of them were between 20 and 50 years with only 4 of them above the age of 50 years. The implication is that TTH has virtually a young waste management team who may not be due for retirement any moment soon. This is useful in the human resource planning process of the hospital since they might not be employing or recruiting people in the short run but rather engage in capacity building and refresher training for the existing waste management team. This will also help them to prepare adequately in filling future vacancies resulting from a few of them who might reach their retirement age.

Sex analysis also indicates that there were more females (41) than males (23) responsible for waste management in the hospital. The possible explanation is that in a typical Ghanaian society certain gender roles are usually assigned to both gender groups from infancy of which cleaning is more associated with females. This implies that with majority of the waste management team being females this gender role assigned to them is expected to have an influence in the waste management activities of TTH.



Ghana practice three main religions namely Christianity, Islam and the African Traditional religion. These religions are associated with cleanliness. The study revealed that majority (61%) of the respondent's practice the Islamic religion and only 39% of them belongs to the Christian religion. This implies that each of the waste management team of TTH belongs to a religious denomination in the country and hence their religious orientation towards cleanliness will be brought to play in the waste management activities of the hospital.

Education they say is the worth of every nation since it gives a better understanding of attitudes towards waste management. The study found that almost all the waste management team of TTH had some level of education. Majority of them had primary education (39%), followed by JHS (36%), tertiary education (14%), SHS (9.4%) and with only one person having no formal education. The good thing about the waste manage team having some level of education is that they might be able to read, understand and be trained on basic waste management practice. The possible explanation to the low educational level of the respondents at TTH could be attributed to low prestige and priority given to waste related issues in the country and also often considered as menial jobs and an occupation meant for drop outs and people with low educational background. Another possible explanation could also be that management of TTH might not be able to hire the services of persons with high educational status and hence might resort to the hiring of persons with very low educational background since that labour might be cheaper. It was also observed that there were more females (41) in the waste management team than their male counterparts (23). This implies that



Ghanaians are now becoming increasingly aware of the need to educate females which was once the preserve for males.

5.2 Waste Management practices in the Tamale Teaching Hospital.

Concerning various waste management practices in the TTH, most of the study participants (90.6-96.9%) indicated that waste was segregated at the point of generation at the Tamale Teaching Hospital, general waste was also appropriately placed and there was the presence of a waste storage system within the hospital. They were also of the view that waste was stored and transported both within and outside the hospital. It is also worth noting that less than 20% of the waste management team said that infectious waste were placed in the appropriate container with less than 10% of the view that the hospital had a waste treatment system in place.

An onsite observation however revealed that waste was not properly segregated and placed in appropriate colour coded containers at point of generation. This current situation is worrisome and must be given a careful look in order to reach full segregation of infectious healthcare waste from the general waste. It is only through this that risk of infections associated with health care waste can be reduced. Unapproved containers such as boxes were used for temporal storage of waste. The study revealed the absence of yellow coded containers meant for the storage of infectious waste such as sharps in the hospital. Both infectious and general waste were mixed together and disposed off similar to household waste.

The results of this study is however not in line with what is spelt out in the MoH policy guidelines 2006 with regard to waste segregation and appropriate use of colour coded containers for hospital waste in the country. Colour coding of Health Care Waste



(HCW) according to its type is recognized as being a useful tool for waste segregation (Akum, 2014). The findings of this study is however similar to a survey conducted in the Greater Accra Region of Ghana which indicated that out of 120 healthcare centers visited, colour coded containers were not available (MoH, 2006). Another study in the Gaza Strip revealed that infectious waste were collected in special boxes which was in line with this present study (EQA, 2005). The results of this study are also similar to studies which revealed that healthcare waste are treated just similar to municipal solid waste due to improper segregation (Kgathi et al., 2001; Taru et al., 2005).

Our findings also indicated that the waste management team were aware of the fact that the hospital waste is stored within the hospital premises for some time and later to the landfills. The observational study corroborated these findings. However waste was left standing in the hospital for a long time before being transported out. It must be noted that these containers were not clean and stand's the potential of transmitting diseases to the general public due to their proximity to eating places. Our findings are in line with those found by Rasheed, et al., (2005) and Amal, et al., (2014).

Storage of waste within the hospital and outside the hospital are recommended by MOH policy guideline (2006). Storage within the hospital serves as a temporary placement of waste at the point of generation (e.g. ward, OPD) before transfer to outside storage points still within the hospital for final disposal. To ensure safe management of waste at the points of generation, storage within the hospital should not exceed 24 hours due to potential risk of infection to healthcare workers and waste disposal staff. (WHO, 2005; MOH, 2006). Multiple daily removal of the waste is recommended. Containers used for storage within the hospital as well as the storage



sites should be cleaned, disinfected and fumigated frequently which is in contrast to our findings.

Waste associated with high level of risk should be rendered safe before final disposal by a suitable thermal, chemical, incineration, filtration or other treatment method, or by a combination of such methods closer to point of generation of waste, involving proper validation and monitoring procedures (MOH, 2006; Mathur et al., 2012; Asante et al., 2014).

The study however revealed that the awareness level of waste treatment practices is low (only 9.4% of the waste management team at TTH were aware of any treatment system put in place for the treatment of healthcare waste in the hospital). No functionable incinerator or any form of treatment plan could be verified within the hospital. These findings are in line with the study of Asante et al., (2014).

With respect to the transportation of hospital waste, the MOH policy guideline (2006) recommends that where a health facility is not equipped to carry out on-site treatment and disposal of health care waste, the transportation and disposal of such waste shall only be done by the District Assembly or their accredited Waste Management Contractors. Where infectious wastes and other wastes have been mixed together, they must be considered infectious and managed as such. Potentially hazardous healthcare waste must be transported directly to the disposal or treatment site within the shortest possible time.

This study shows that the waste management team of TTH agreed to the fact that transportation of waste was done both internally and externally. An on-site observation revealed that cleaners picked up hospital waste from different departments and



transport it manually to a temporary storage area where it was kept before being taken to the final disposal site. It was also revealed that the hospital was in partnership with Zoom Lion Company limited in line with what pertains in the MOH policy guideline (2006).

Concerning disposal of hospital waste, the waste management team said that the final disposal of waste generated by TTH was carried to the Tamale landfills and a protected pit within the hospital for burning. This was confirmed by an onsite observation. However some waste was burnt in an open area within the hospital vicinity which was unprotected and also closer to places where food vendors operate. These findings are similar to that of Asante et al., (2014). The findings are also the same as those found by Blenkarn (2006).

5.3 Knowledge of hospital waste workers and unit heads regarding solid hospital waste management in TTH.

The study also assessed the knowledge of unit heads and waste workers in TTH on the waste identification, segregation, disposal, risk associated with infections, provision of personal protective cloths, training of staff on waste and appropriate colour coding containers vital for the management of hospital waste. Waste segregation allows for the appropriate handling, treatment and disposal of waste by type and also reduces costs and enhances protection of the public health. Segregation of waste is a vital step in every waste management plan system. Segregation involves the separation of risk waste from non-risk waste at source of generation which may include the ward, bed side, operation theatre, laboratory, or any other room in the facility where the waste is generated, by the doctor, nurse, or by any other person (Nosheen et al., 2011).



With respect to the provision of protective cloths to staff of TTH, the study shows that 90% of the Unit Heads and all the Cleaners (100%) agreed to the fact that provision of protective cloths for staff was done by management of TTH.

Surprisingly however, an onsite observation revealed that most of the cleaners do not use these protective cloths and this might be so due to improper supervision by the appropriate body responsible for these cleaners in the hospital. Similar results were found in the Bawku Presbyterian Hospital of the Upper East Region of Ghana where most waste workers do not use the personal protective cloths and if not monitored closely could expose themselves to risk of infection (Akum, 2014).

Out of a total of 54 waste workers, 77. 22% of them said they received training in the management of health care waste compared to 40% reported in a study in Iran (Askarian et al., 2004). Training in the area of medical waste management minimizes the negative impact that can be caused by poor management of health care waste. Similarly lack or inadequate training on HCW poses a serious risk to the patients, waste worker, the general public, and the environment (Miyazaki & Une, 2005).

The study also revealed that both cleaners and unit heads in the hospital were aware of the risk associated with infectious solid hospital waste. This is a positive step since cleaners and unit heads are directly involved in all waste activities in the hospital and are most likely to report injuries or see the need for vaccinations to be done to protect them against diseases. It is also expected that the knowledge of unit heads on the awareness of risk with infectious waste will have an influence on that of the waste workers. It was however revealed that there was no relationship between knowledge of Unit Heads and that of the cleaners. This means that Unit Heads knowledge on the



awareness of risk associated with infectious waste has no influence on the cleaners knowledge on the awareness of risk associated with infectious hospital waste (Pearson Chi Square = 0.1222, $p = 0.727$, and $n = 54$). The possible explanation to this could be that the sample size was too small and also targeted only the waste management team of the Tamale Teaching Hospital.

In the area of availability of waste manuals in the hospital, cleaners and Unit Heads were not aware of the hospital waste manual which implies that Cleaners and Unit Heads do not follow the standard procedures in the management of hospital waste. This is similar to that of Akum (2014).

Colour coding is used to separate and identify waste through the use of appropriate colour coded containers. Colour coding may vary from country to country but may have some similarities. In Ghana, the recommended colour coding specified by the Ministry of Health policy guideline (2006) are black for general waste, blue for hazardous waste and yellow for infectious waste. The study however revealed that less than $\frac{1}{2}$ of the cleaners interviewed knew about the appropriate colour coding system, whereas only a third of the unit heads knew of appropriate colour coding system for storage of waste. This is supported by the fact that general waste mixed with infectious and hazardous waste at TTH.



5.4 Hospital Waste Policies and plans.

The MoH has waste management policies to serve as guidelines to the management of hospital waste. This study examined the policies in relation to waste management practices in TTH. The study revealed that only 5 of the waste management team of TTH were aware of this document.

This however affirms a study conducted on Healthcare waste management practices among healthcare workers in healthcare facilities of Gondar town, Northwest Ethiopia. The study revealed that none of the healthcare facilities had healthcare waste management documents (Muluken et al., 2013). The results also agrees with studies carried out in Ethiopia in 2007 which indicated the absence of a waste document in one of the surveyed HCFs (Azage et al., 2013; Azage et al., 2010). Also, in Egypt the staff in healthcare settings were unaware of biomedical waste legislation due to the absence of written policies and clear guidelines (Soliman and Ahmed, 2007).

Contrarily to these findings, studies on the availability of waste documents in South Africa was 91% implying that most of the health professionals in that country were aware of the hospital waste management policies and plans (Azage et al., 2010; Ramokate, 2009) which is different from the result of this study which may be as a result of lack of regular supervision and enforcement of the Ghana's Ministry of Health policy guidelines in the hospital.

To ensure continuity and clarity in waste management practices, health care institutions are expected to develop clear plans and policies for the proper management and disposal of wastes. The hospital waste management plan outlines the standard procedures necessary for the management of hospital waste.



In ensuring the effective utilization of waste management plans in TTH for efficient implementation of the waste management process, the study revealed that out of a waste management team of 64, only 27% agreed to the fact that there existed a waste management plan. In verifying the existence of these plans in the hospital, it was revealed that TTH had no waste management plans which is not in line with the Ministry of health policy guidelines on health care waste management in the county (MOH, 2006).



CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter presents the summary of the findings of this study, the conclusion drawn and recommendations aimed at improving hospital waste management in the Tamale Teaching Hospital.

6.1 Summary of the Study

The goal of this study was to assess the hospital waste management system in the Tamale Teaching Hospital. Specifically, the study also intended to: identify and evaluate the hospital waste management system currently in use in the Tamale Teaching Hospital, assess waste workers and units heads knowledge in dealing with solid hospital waste and to determine the availability of waste management policies and plans in the Tamale Teaching Hospital.

6.2 Summary of the results

Waste storage, transport and disposal systems

1. In respect to waste management practices of the Tamale Teaching Hospital, the study established that out of a waste management team of 64 interviewed, 90.6% said they segregate waste. Also, 93.7% said they place general waste in appropriate colour coded containers. They were also of the view that hazardous waste was placed appropriately (92.2%). Overall, 92.2% agreed to the presence of a waste storage system in the hospital. In all, 80% of them also said waste from the hospital was stored both within and outside the hospital. Only 9.4% agreed to the presence of a waste treatment system in the hospital. In the area of



waste transportation, only 8% agreed that waste was transported both within and outside the hospital with the help of cleaners and an outside transport system. Regarding waste disposal, 96.9% said waste was disposed of at the Tamale landfills.

Knowledge on hospital waste management

2. All the cleaners interviewed had knowledge above 50% in the area of waste segregation, risk associated with infectious waste, use of protective cloths and waste training programs. However, their knowledge on the use of appropriate colour coding containers was 44.4%
3. The Unit heads had knowledge above 50% concerning risk associated with infectious waste, use of protective cloth and training programs. Their knowledge on the use of appropriate colour coding containers was below 50%

Waste Management policies and plan

4. Of the respondents interviewed, only 7.8% were aware of a document outlining the hospital waste policies, 42.2% agreed to the existence of a waste management plan and 96.9% knew of the existence of a waste management team in the hospital.
5. In verifying the existence of waste management policies and plans at TTH, it was revealed that the hospital had no written or documented policies and plans and hence were not made available to cleaners and unit heads.



Observational Study

6. An onsite observation revealed that infectious, general and hazardous waste were mixed together before final disposal.
7. Unapproved containers such as card boxes were used for storage of waste in some units
8. The study revealed that there were no yellow containers designated for infectious waste in the Tamale Teaching hospital.
9. Waste containers often stayed more than 24 hrs on the premises of the hospital before being emptied.
10. Temporal waste containers for storage of waste in the hospital were not kept clean.
11. An observation round TTH revealed the absence of a treatment plant.
12. An onsite observation revealed that some of the solid waste generated by TTH were burned openly on the premises of the hospital.

6.3 Conclusion

The main findings of the study is that waste is poorly managed in the Tamale Teaching Hospital and unit heads had much better knowledge about waste management compared to the cleaners. Also, while knowledge level of the various waste management practices was high among staff apart from knowledge on colour coded containers, in reality the level of practice was low. The hospital had no waste management policies and plans in place to guide the effective and efficient management of waste.



6.4 Recommendations

To improve the hospital waste management system in the Tamale Teaching Hospital, the following recommendations should be considered

- Management of TTH should ensure the development of waste management policies and plans to guide the operations of waste management activities in the hospital. These plans and policies could be developed by the Environmental Health Unit of the hospital.
- The hospital should also ensure the safe and smooth implementation of the waste management system in terms of proper segregation, storage, treatment, transportation and disposal in order to reduce potential risk of infection to the waste worker and the general public. This could be done through close monitoring and supervision of all waste management activities by the Environmental Health Unit of the hospital.
- Provision of appropriate colour coded containers for the temporal storage of waste within the hospital by the head of the waste unit with support from Hospital Management.
- The hospital should also ensure the use of a waste treatment plant for the treatment of health care waste to ensure waste is rendered safe before final disposal while avoiding open burning of waste within the hospital premises.
- All staff engaged in the waste management process most especially cleaners should be properly trained in order to enable them segregate, store, transport and dispose waste appropriately. This could be done through refresher training programs, periodic workshops and seminars organized by the Head of the



Environmental Health Unit of TTH in order to ensure proper waste management in the hospital.



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APPENDIX 1

**Questionnaire for assessing the hospital waste management system at the
Tamale Teaching Hospital**

QUESTIONNAIRE _____

The research on assessing the hospital waste management system of TTH by Bakeri Jacob Jimah is a study in partial fulfillment of the award of Master of Philosophy in Community Health and Development at the University For Development Studies.

You are kindly entreated to respond to this questionnaire by ticking or filling the gaps or alphabet that applies to you. You reserve the right to redraw from the study at any point in time. Data collected will be used purposely for academic purposes. All answers will be treated with optimum confidentiality. You are free to ask any question from my supervisor: Prof. Ziem, University For Development Studies-Tamale.

Section A: Background Information of Respondents

1. Age _____

2. Sex Male Female

3. Marital status Single Married Divorced
Widowed

4. Religious affiliation Christian Muslim Traditionalist

5. Educational level _____

6. Position _____



Section B:

**IDENTIFYING AND EVALUATING THE HOSPITAL WASTE
MANAGEMENT SYSTEM OF THE TAMALE TEACHING HOSPITAL**

Questionnaire for Administrator and Unit Heads

7. (a) Is waste segregated at point of origin? Yes No

(b) If no, why?

8. (a) Are general waste e.g. paper placed in black containers or bags? Yes No

(b) If no, what accounts for that?

9. (a) Is infectious waste e.g. sharps kept in yellow containers or bags?

Yes No

(b) If no, why?

10. Aware of risk associated with infectious solid hospital waste?

Yes No

11. (a) Brown containers or bags used for hazardous waste?

Yes No

(b) If no, what are the reasons?



12. (a) Do you have a storage system for waste in the hospital?

Yes No

(b). If yes, what is it? Within TTH outside TTH Both

Don't Know

13. Which transportation system of waste do you use in your hospital?

Transportation within TTH Transportation outside TTH Both

Don't know

14. (a) Do you have a waste treatment system in your facility?

Yes No

(b). If yes, which treatment system is being used by your hospital?

15. (a) Is there a system put in place for final disposal of waste? Yes No

(b) If yes, which of the following options is used by your hospital for final disposal of solid waste?

Landfill Protected pits Both Don't know



16. In your opinion, how can management of solid hospital waste be improved in the Tamale Teaching Hospital?



**Assessing waste workers and unit heads knowledge in dealing with hospital waste
in the Tamale Teaching Hospital.**

Questionnaire for Administrator and Unit Heads

17. Aware of risk associated with infectious solid hospital waste?

Yes No

18. Knows the importance of specialized waste workers? Yes No

19. Provide training for staff of the hospital on waste?

Yes No

20. Waste Manuals available?

Yes No

(a) If yes, provide a copy? Yes No

21. Provide personal protective cloths for staff? Yes No

(a) If yes, Provide List of distribution

22. Monitor the usage of personal protective cloths?

Yes No

23. Knows the appropriate colour coding of waste containers?

Yes No



24. Have enough waste workers in Hospital?

Yes No

(a) How many?

25. Units or Departments responsible for their waste?

Yes No

26. Considerable budget allocated for hospital waste management?

Yes No

(a). What amount was allocated to waste management in 2013?

(b) What about 2014?



Determining the availability of waste management policies and plans in the

Tamale Teaching Hospital

Questionnaire for Administrator and Unit Heads

27. Are you aware of a document outlining the hospital waste management policy?

Yes No

28. If yes, is there a manual or guideline document on management of hospital waste available?

(a) In the Ministry of Health?

Yes No

(b) If yes, provide a copy

(c) In your hospital?

Yes No

(d) If yes, provide a copy

29. Does your hospital have a Waste Management Plan?

Yes No

(a) If yes, can a copy be verified?

(b) If yes, are these waste Management Plans put into use?

Yes No



(c) If no, in your opinion why are these plans not put into use?

30. Does your hospital have a Waste Management Team (or Teams)

Yes No

(a) If yes, is the hospital Waste Management Team functioning?

Yes No

(b) And what is the composition of this management team if your answer to 12a is yes?

(c) If no, what are the reasons for management teams not functioning?

THANK YOU



APPENDIX 2

**Questionnaire for assessing the hospital waste management system at the
Tamale Teaching Hospital**

QUESTIONNAIRE _____

The research on assessing the hospital waste management system of TTH by Bakeri Jacob Jimah is a study in partial fulfillment of the award of Master of Philosophy in Community Health and Development at the University For Development Studies.

You are kindly entreated to respond to this questionnaire by ticking or filling the gaps or alphabet that applies to you. You reserve the right to redraw from the study at any point in time. Data collected will be used purposely for academic purposes. All answers will be treated with optimum confidentiality. You are free to ask any question from my supervisor: Prof. Ziem, University For Development Studies-Tamale.

Section A: Background Information of Respondents

1. Age _____

2. Sex Male Female

3. Marital status Single Married Divorced
Widowed

4. Religious affiliation Christian Muslim Traditionalist

5. Educational level _____

6. Position _____



Section B:

Identifying and evaluating the hospital waste management system of Tamale

Teaching Hospital

Questionnaire for Waste workers

7. (a) Is waste segregated at point of origin?

Yes No

(b) If no, why?

8. (a) Are general waste e.g. paper placed in black containers or bags?

Yes No

(b) If no, what accounts for that?

9. (a) Is infectious waste e.g. sharps kept in yellow containers or bags?

Yes No

(b) If no, why?

10. Aware of risk associated with infectious solid hospital waste?

Yes No

11. (a) Brown containers or bags used for hazardous?

Yes No

(b) If no, what are the reasons?



12. (a) Do you have a storage system for waste in the hospital?

Yes No

(b). If yes, what is it?

Within TTH Outside TTH Both Don't know

13. Which transportation system of waste do you use in your hospital?

Transportation within TTH Transportation outside TTH Both

Don't know

14. (a) Do you have a waste treatment system in your facility?

Yes No

(b). If yes, which treatment option is being used by your hospital?

15. (a) Is there a system put in place for final disposal of waste? Yes No

(b) If yes, which of the following options is used by your hospital for final disposal of solid waste?

Landfill Protected pits Both Don't Know



16. In your opinion, how can management of solid hospital waste be improved in the
Tamale Teaching Hospital?



Assessing waste workers knowledge in dealing with waste management in the

Tamale Teaching Hospital.

Questionnaire for Waste Workers

17. Able to identify solid hospital waste?

Yes No

18. Able to segregate waste from their point of origin?

Yes No

19. Have adequate knowledge on solid waste disposal procedure?

Yes No

20. Aware of risk associated with infectious solid hospital waste?

Yes No

21. Waste Manuals available?

Yes No

(a) If yes, provide a copy for verification

22. Provided with personal protective cloths for staff?

Yes No

(a) Provide distribution list for verification



23. Provided with training on waste management in Hospital?

Yes No

24. Have appropriate colour coding containers for storage?

Yes No

25. Considerable budget allocated for hospital waste management?

Yes No



Determining the availability of waste management policies and plans in Tamale

Teaching Hospital

Questionnaire for waste workers

26. Are you aware of a document outlining the hospital waste management policy?

Yes No

27. If yes, is there a manual or guideline document on management of hospital waste available?

(a) In the Ministry of Health?

Yes No

(b) If Yes, Provide a copy

(c) In your hospital?

Yes No

(d) If yes, provide a copy?

28. Does your hospital have a Waste Management Plan?

Yes No

(a) If Yes, provide a copy

(b) If yes, are these waste Management Plans put into use?

Yes No



(c) If no, in your opinion why are these plans not put into use?

29. (a) Does your hospital have a Waste Management Team (or Teams)?

Yes No

(b) If yes, is the hospital Waste Management Team functioning?

Yes No

(c) And what is the composition of this management team if your answer to 29b is yes?

(d) If no, what are the reasons for management teams not functioning?

THANK YOU



APPENDIX 3

Observational Check list for assessing the hospital waste management system of the Tamale Teaching Hospital

CRITERIA	YES	NO	COMMENT
Waste segregated at source			
Waste Management posters are on display			
Waste bins are in clean condition			
Waste workers wear personal protective cloths			
Waste bins are correctly labelled and display additional information to users where appropriate			
Contents of yellow bags are appropriate (Infectious waste)			
Contents of brown bags are appropriate (Hazardous waste)			
contents of black bags are appropriate (General waste)			
Bags waiting for collection are safely stored away from the public			
Site for final disposal of waste			

