UNIVERSITY FOR DEVELOPMENT STUDIES

CLINICAL WASTE MANAGEMENT PRACTICES IN TAMALE METROPOLIS, GHANA

HUSSEIN HAWAWU

DISSERTATION SUBMITTED TO THE DEPARTMENT OF COMMUNITY DEVELOPMENT, FACULTY OF PLANNING AND LAND MANAGEMENT, UNIVERSITY FOR DEVELOPMENT STUDIES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF ARTS IN ENVIRONMENTAL SECURITY AND LIVELIHOOD CHANGE

2011

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BY

HUSSEIN HAWAWU (BSc. STATISTICS)
UDS/MAE/0010/09

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OCTOBER, 2011

DECLARATION

I hereby declare that this dissertation 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:

Candidate's Signature.....Date.....5/12/2011

Name.....HUSSEIN HAWAWU.....

Supervisors Declaration

I hereby declare that the preparation and presentation of the dissertation were supervised in accordance with the guidelines on supervision of dissertation laid down by the University for Development Studies

Principal Supervisor Signature:.....Date.....5/12/2011

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ABSTRACT

The management of health care waste is becoming a source of worry to the people worldwide and Tamale is no exception. The premise of this study stems from the researchers personal observation where children who loiter around the landfill site are found playing with used needles, infusion sets and other waste products. Thus the research sought to dig into the reasons that account for this by looking at the existing waste management practices used by the selected hospitals.

Data for this research was collected using questionnaires and interview schedules to determine staff perception about health care waste management options and existing policies. Field observations were also used to collect much of the necessary information. Further, to determine the impact of health care waste on water bodies, samples from four different sources was taken, these were maturation pond, general waste water, and hospital waste water. The following parameters were measured, PH, BOD, COD, Total Suspended Solids, Nitrate, Nitrite, Sulphate, bicarbonate and the values compared with the EPA Guideline. The field data was analyzed using Statistical Package for Social Science (SPSS) version 16.

Tamale metropolis has no structured health care waste disposal and management system in place. There is also no legislation in Ghana nor any bye-law in Tamale Metropolis regarding the management of health care waste. The study also showed inadequate administration of medical waste and weak cooperation between the TMA/WMD and the selected health facilities on issues related to proper health care waste management. The study revealed that most staff of the selected hospitals do not follow the proper procedures in management, thus have little knowledge in segregation, transfer and disposal methods. The average waste generated per day by selected hospitals was about 1.5kg/bed/day which confirms EPAs claim that HCW could be increasing. There is the need for a national legislation on health care waste as a base for improving healthcare waste practices in Ghana.

ACKNOWLEDGEMENT

The success of this project is as a result of numerous contributions, suggestion, and advises from several distinguished personalities from diverse professions. It is impossible to enumerate all those who have contributed to the success of the project. However, I wish to acknowledge the immense contributions and support of the personalities that space can allow. My first salute and gratitude for the cooperation given me goes to the Administrators of Tamale Central and Tamale West Hospitals Mr Hashim Kernnel and Mr Damasus respectively. To Madam Bintu, Head of Environmental Health Unit, Tamale Teaching Hospital I say thank you. Next in the list comes Mr. David Ananias of the Waste Management Department, Tamale. He has been resourceful and very supportive in my data collection and presentation. To Mr. Abdul Karim Abass, a Biomedical Scientist in the Public Health Reference laboratory, Tamale and Mr. Jerome Kpan of The University of Cape Coast Research Laboratory. These humble men helped me with my water quality test, I express my gratitude to you. Then to Mr. Mohammed Awal Hussein, my lovely brother whose impulse, incessant inspiration and seasoned advice galvanized me into stardom, I have no words to express my sincere gratitude to you. The entire staffs of Center for Continuing Education and Interdisciplinary Research (CCEIR), UDS demand more gratitude than I can offer. My father Alhaji Hussein Musah and mother Khalil Sawdatu who have constituted themselves into adorable angels whose parental care and responsibility demand more than human gratitude. To them I bow and salute. The ultimate pocket of my gratitude goes to my supervisor Madam Emelia Guo and My Co-supervisor Mr. Maxwell Anim Gyampo. Their contributions to this project can neither be quantified nor fully paid for. Please accept my genuine and generous gratitude.

DEDICATION

Dedicated to my Parents and Siblings

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LIST OF ABBREVIATIONS

AIDS : Acquired Immune Deficiency Syndrome

CSF : Cerebro Spinal Fluid

CSM : Cerebro Spinal Meningitis

DA : District Assembly

EPA : Environmental Protection Agency

EEA : Environmental; Experts Association

MMDAs : Metropolitan , Municipal, District Assemblies

MoH : Ministry of Health

GHS : Ghana Health Services

GW : General Waste

GWW : General Waste Water

HWW : Hospital Waste Water

IIPE : International Institute for Educational Planning

SW : Special waste

HCW : Health Care waste

PVC : Polyvinyl Chloride

POPs : Persistent Organic Pollutants

TCH : Tamale Central Hospital

TTH : Tamale Teaching Hospital

TWH : Tamale West Hospital

UNEP : United Nation Environment Program

UNESCO : United Nations Educational Scientific and Cultural Organisation

WMD : Waste Management Department

WHO : World Health Organisation

CHAPTER ONE

INTRODUCTION

1.0 Background

The issue of waste have become a matter of concern worldwide. Man in his quest to seek for economic growth and satisfaction found various means to exploit the natural resources resulting in massive ıste generation, which can pose serious threat to humankind and environment.

aste includes any substance which constitutes a scrap material, an effluent or other unwanted surplus sing from the application of any process or any substance or article which requires to be disposed of ıich has been broken, worn out, contaminated or otherwise spoiled; this is supplemented with ything which is discarded otherwise dealt with as if it were waste shall be presumed to be waste less the contrary is proved (EPA, 1990). This definition was amended by the Waste Management censing Regulations 1994 defining waste as "any substance or object which the producer or the rson in possession of it, discards or intends or is required to discard but with exception of anything cluded from the scope of the Waste Directive (www.wasteawareness.org).

inical waste comes from hospitals, nursing homes, dentists, surgeries, laboratories etc. and can clude wastes from the household. Similarly, hazardous/special wastes are hazardous for a variety of ısons including toxicity, explosiveness etc. They must also be handled and dealt with differently ɔm other wastes.

inical waste is a mounting problem in many countries worldwide and Ghana is no exception to that. recent years, there have been numerous interventions toward medical waste being disposed off in an appropriate manner. The people that have been most affected by clinical waste are the poor or disadvantaged of society. The inappropriate management and disposal of clinical waste has also caused much concern in the world.

Numerous studies indicate that incinerators have been associated with a wide variety of health problems such as hormonal imbalance, immune and reproductive systems, and also cancers. The poor or disadvantaged in society have not been given a platform to voice their concerns regarding the health impacts that health care waste and incineration has had on their quality of life.

Ghana has an area of 238,500 square kilometres, divided among 10 regions, with a population of around 22,931,299 (GSS, 2007), and an annual population growth rate of 1.97 percent. There is very little control over how medical waste is stored, handled and disposed and sometimes dumped together with household waste in many parts of the country. Although some of the major hospitals in Ghana have incinerators, majority of the health care facilities especially district hospitals and clinics do not have incinerators. The few that have, do not give any attention to waste segregation. The worst problems arise in small rural hospitals and clinics, which are unable to give the required care in ıdling medical waste because of lack of resources. Many rural clinics openly burn their municipal ste on site in pits.

male metropolis is one of the regional capitals of Northern Region of Ghana with an estimated pulation of about 365,000(projected, 2010). The Metropolis has three major hospitals, the Tamale aching Hospital, Tamale Central Hospital and Tamale West Hospital with about 21 Clinics nplementing the works of the hospitals. All these health facilities have little or no waste ınagement processing plants.

male metropolis has no structured health care waste disposal and management system as well as licies in place. Black polythene bags are mostly used at the hospitals for all types of waste except sharps and body parts, besides this, clinical wastes also include infectious medical waste (for ample dressings, used swabs, sanitary pads, used gloves, and in fact all waste contaminated with ɔod, syringe and needles and bodily fluids).

e inappropriate disposal of the health care waste in the metropolis has had negative effects on the alth of the people leaving around the disposal sites. This research is therefore seeks to find the ects of clinical waste on the people of the metropolis and suggest best practices or solutions to avert s menace.

1.1 Statement of the Problem

The management of health care waste is becoming a source of worry to the people worldwide. There have been numerous outcries over the years about medical waste being disposed off inappropriately. The increase in the health care waste is partly due to the technological advancement in medicine which has resulted in the propagation of the use of disposable medical kits or materials. For instance, a hospital survey conducted by the Waste Management Department of Accra Metropolitan Assembly (WMD/AMA) in 1992 in six major hospitals in Accra showed that the unit total generation of medical waste was 1.2kg /bed/day (EPA, 2002).

In spite of this linear increment in health care waste, there has been very little control over how medical waste is stored, handled and disposed off, it is sometimes dumped together with municipal waste in municipal landfill sites. This exposes health workers, patients as well as the local community to certain infectious materials which in turn result in diseases. There have been cases where children were found playing with medical waste such as syringes and needles, for example "Tygerberg Hospital treated 48 children with AZT after some were pricked with needles and others ate potentially lethal pills they found in a field in Elsie's River" (Leonard, 2005). An attempt by The Star Newspaper to help ck down a family member led to the gruesome discovery of corpses stacked in industrial fridges in a ıidential area, while 80 tons of medical waste was removed from a house in Johannesburg in South rica (Leonard, 2005)

cent years has seen the upsurge and inappropriate management of clinical waste in the metropolis. r instance, the unit total generation of medical waste could be estimated 1.5kg/bed/day (EPA ıideline, 2002) which is far greater than the national per capita of 0.45kg of general waste (WMD, 09). Most hospitals in the Tamale metropolis lack the capacity to effectively manage their waste due the absence of incinerators and other waste management resources. They open-burn their waste in municipal site, those with on-site incinerators do not give incentive to segregating the waste before cineration. It must be mentioned that using incinerators is also not entirely the best alternative; this is cause numerous studies have shown that incinerators are associated with a variety of health oblems such as disrupting the body hormones, immune and reproductive systems, and have caused ncers. The Environmental Protection Agency of the United States of America in 1994 found that ıissions from incinerators in health care facilities were responsible for high level chemicals such as oxin and furan in the atmosphere (Malkan, 2005).

ıe region has a very high illiteracy rate coupled with the limited access to drinking water and poor ıitation, and this exposes the inhabitants to a lot of health hazards. The prevalence of diseases such as malaria, diarrhoea, anaemia, acute respiratory infections, gynaecological disorder and other epidemics like cholera, can be traced to the poor waste management system of the community and that includes health care waste products. This shows how appalling the situation is and demands an equally urgent response.

1.2 Objectives the Study

The main objective of the study is to assess the effect of health care waste management on the people of the Tamale metropolis;

The specific objectives; includes;

- To assess the efficiency and effectiveness of existing health care waste management policies.
- To assess the infectious potential of health care waste.
- To determine the quantity of health care wastes produced by each facility per day.
- To determine the level of collaboration between the selected hospitals and the Tamale Metropolitan Assembly on health care waste management.
- To ascertain the effects of health care waste on the people living closer to the various dumping sites or landfill.

:search Questions

- What are the existing policies for health care waste management and how efficient are they?
- What are the effects of health care waste on the people of Tamale?
- How much waste does each health facility produce?
- Is there any collaboration between selected hospitals and the Tamale Metropolitan Assembly?

3 Significance of the Study

obally, waste management has become a major concern and interest to the general public, and ıana being part of the globe cannot be left out since we have a fair share of our waste burden nerated day in day out. Waste generation comes about as a result of our daily activities in our bid to make life comfortable for ourselves.

On the contrary, these waste generated regularly makes life very uncomfortable for us. This is because the waste being generated causes serious sanitation problems which in turn cause diseases that make life uncomfortable for us. For instance, poor management of HCW exposes healthcare workers, waste handlers and the community to infections, toxic effects and injuries. Ironically, the health facilities we are suppose to seek remedies from when we are found in this situation also generate health care waste which tends to pose serious health risk to the patients, staff and the entire community within which it operates.

It is for this reason that this research is seeking to suggest possible solutions to the health care problems that has eluded our attention for some time now. The research will go a long way to help in the improvement of health care waste management in the metropolis.

Also, it will help provide information on how effective the existing policies are and offer suggestions to smoothening the rough edges of others that undermine the health and safety of the patients, medical staff and the community as a whole. It will also serve as a platform to give voice to the voiceless who are affected by this health care waste problems and do not know where to send their concerns to.

4 Scope of the Study

ıe study area is the Tamale Metropolis. This covers an area of seventy thousand three hundred and ghty four square kilometres with an estimated population of about 365,000 (Projected figure, 2010). ıree main hospitals namely the Tamale Teaching Hospital, Tamale West Hospital, Tamale Central ɔspital were selected from the metropolis for this research.

ımale, just like other metropolis in the country, is faced with numerous sanitation problems caused untreated waste and contributes to outbreak of diseases like cholera, diarrhoea, malaria, typhoid ver and many others resulting from waste products.

5 Outline of the Study

ıe dissertation is organized into five main chapters. Chapter one introduces the topic, the statement the problem, the objectives of the study, the significance of the study, the scope of the study and the tline of the study.

ıapter two deals with the literature review whereas the methodology employed and the data analysis found in chapters three and four respectively. The summary, conclusions and recommendations and ggestions are under chapter five.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter deals with the reviewing of relevant material in relation to subject matter. Relevant areas to be reviewed includes health care waste policies, effect of practices of health care waste management on the community, classification of health care waste, and regulation of health care ıste, problems that may arise in the course of managing waste, treatment and transportation, ɛntification of various waste management options.

l Definition of Waste

ıe Environmental Protection Act 1990, waste includes any substance which constitutes a scrap ıterial, an effluent or other unwanted surplus arising from the application of any process or any bstance or article which requires to be disposed of which has been broken, worn out, contaminated otherwise spoiled; this is supplemented with anything which is discarded otherwise dealt with as if were waste shall be presumed to be waste unless the contrary is proved. This definition was ıended by the Waste Management Licensing Regulations 1994 defining waste as 'any substance or ject which the producer or the person in possession of it, discards or intends or is required to discard t with exception of anything excluded from the Scope of the Waste Directive ww.wasteawareness.org).

ıerefore, the producers of waste must ask themselves questions which will help identify waste, such , is it a scrap material? Is it an unwanted surplus substance? Broken or worn out? Anything ɜcarded or otherwise dealt with as if it were a waste.

ıving defined the material waste, various pieces of legislation including the Environmental ı ıotection Act 1990, the Controlled Waste Regulations 1992 and the Waste Management Licensing Regulations 1994 sought to further define the types of wastes as they are legally defined by the processes or premises from which they are produced.

Controlled waste encompasses household, industrial and commercial waste.

Household waste is that which arises from dwellings of various types including houses, caravans, houseboats, campsites, prisons and wastes from schools, colleges and universities.

Commercial waste comes from premises used wholly or mainly for trade, business, sport, recreation or entertainment; excludes household and industrial waste.

Industrial waste is waste from a factory or industrial process; it excludes wastes from mines and quarries and agricultural wastes. Wastes from agriculture (non natural wastes) and mining and quarrying recently came into the same controlled waste regime.

Some controlled wastes are further classified and subjected to further regulation because of the nature of the waste and the need to handle them differently.

unicipal Solid Waste are refuse from households, non-hazardous solid waste from industrial, mmercial and institutional establishment (including hospitals), market waste, yard waste and street veepings(Schuber, 1996). Health care waste refers to any untreated solid and liquid waste generated ıring the administration of medical care, veterinary care or the performance of medical research volving humans and animal (EPA Guide, 2002).

ıe Ministry of Health also defined health care waste as all untreated solids and liquid waste (both ızardous and non hazardous) generated during the administration of medical care, or the performance medical research involving humans and animals (MOH, 2006). These waste may include, risk or fectious waste, pathological waste, hazardous waste, pharmaceutical waste and non hazardous or ıusehold waste. For the purpose of this study healthcare waste may be sub divided into General 'aste (GW) and Special Waste (SW).

2 Healthcare Waste Policies

ıere are several challenges facing health care waste management, thus the current World Health rganizations' policy is oriented towards the following principles;

- preventing the health risks associated with exposure to health-care waste for both health workers
- and the public by promoting environmentally sound management policies for health-care waste;
- supporting global efforts to reduce the amount of noxious emissions released into the atmosphere
- to reduce disease and defer the onset of global change;
- supporting the Stockholm Convention on Persistent Organic Pollutants (POPs);
- supporting the Basel Convention on hazardous and other waste; and

- reducing the exposure to toxic pollutants associated with the combustion process through the promotion of appropriate practices for high temperature incineration (WHO, 2000).

- it is important to note the following three elements in designing policies for healthcare waste management as suggested by WHO, they include

1. The establishment of comprehensive system of health-care waste management, from the generation of waste to its disposal- to be implemented gradually.

2. The training of all those involved and increasing awareness.

3. The selection of safe and environmental-friendly options for the management of health-care waste (WHO, 2000).

is therefore important for government to create framework for the safe management of health care aste, this can be done by collaborating with the Ministry of Health and the Ghana Health Services as ell as other stakeholders. It is equally important that when laws are enacted the designated authorities enforcement bodies should make sure that laws are followed to the later, such that facilities that nerate health care waste will be duty-bound to set up comprehensive environmental friendly systems d policies to manage health care waste.

2.1 Existing Policies

ıe current environmental policies of Ghana work in tandem with the international environmental inciples. These include the Basel Convention, concerned with transport of waste across boundaries. ıe "polluter Pays" Principle, which means that the waste producer must be financially and legally sponsible for the safe disposal of the waste such that it does not cause any harm to the environment.

ıe "Precautionary" principle, concerned with the adoption healthy and safe measures when the agnitude of a particular risk is uncertain. The "Proximity" principle whereby hazardous waste including health care waste is disposed off in the nearest location from its source so as to reduce risk involved in its transportation.

Other government policies include;

This seeks to guide development in tone with quality requirements to prevent, reduce, as much as possible, eliminate any pollution and nuisance (EPA, 2002).

2.2.2 The National Environmental Sanitation Policy

The policy requires all health care facilities to establish institutional waste management system for the primary management of waste. It however is not comprehensive enough to deal with changing trends health care waste. This policy further states that District Assemblies shall provide separate llection of hazardous and health care waste.

ıe above clearly shows that district assemblies are expected to enact bye-laws to enable the efficient anagement of both health care and general waste. However, most districts only have bye- laws for neral waste, For instance, Accra has old bye-laws for dealing with hospital waste that are being vised. Kumasi has recently privatized handling of medical waste. Saema, Tema and Tamale, ıwever, have bye-laws governing sanitation but not medical waste. (Sample Workshop on Targeted ɔllaboration in Ghana)

2.3 Health Care Waste Management Policy, Ghana

ıe World Health Organisation in collaboration with the Ministry of Health commissioned the velopment of the policy guidelines. The policy delved into the legal context, scope, policy ıtement, technical guidelines, capacity building and research, information, education and mmunication (IEC), policy implementation and lastly monitoring and review (MoH, 2006)

:gal context, currently, There is no specific law that addresses the management of health care waste Ghana (MOH, 2006). However, the Ministry of Local Government and Rural Development and the ıvironmental Protection Agency are the key players in implementing and regulating waste ...anagement policies in Ghana. Their duties are discharged through District, Municipal and Metropolitan Assemblies. The pocket of the responsibility goes to the waste generator; thus, health care providers are responsible for the waste they generate. The criminal code of Ghana provides that whoever places or permits to be placed, any carrion, filth, dirt, refuse, or rubbish, or any offensive or otherwise unwholesome matter, on any street, yard, enclosure, or open space, except at such places as may set apart by the local authority or health officer for that commits a punishable offence (MOH, 2006). This means that it is punishable by law to leave the waste you generate at the mercy of the environment without properly disposing it off. Thus, health care institution can be dragged to court if they go contrary to the above provision. Enforcement however has been the major problem in Ghana.

The focus of the policy is on the level of compliance of laws and regulation to ensure health care waste effectively managed. It also applies to health institutions whether private, public, quasi-governmental, non-governmental or faith-based, that operate in the country and at all levels. These institutions includes hospital, clinics, health centers, laboratories, health research institutions. Others constitute traditional healers, traditional birth attendance, mortuaries, funeral homes, pharmacies etc. Home based care for ailments like diabetes; HIV/AIDS as well as service industry such as wanzams, hairdressers, barbers are not left out in the policy.

ıe policy statement prescribe that any kind of waste that meets the definition of hazardous waste all be considered as such and treated in line with the policy and other legal requirements. It looks at : responsibilities of health institutions as regards separation, storage, labelling, treating, transporting d disposing of health care waste so as to ensure the safety of staffs, clients and the environment. It ;o encourages that designated disposal site for treated health care waste must be approved by the strict Assembly, Municipal, and Metropolitan in consultation with the EPA. Further, health ;titutions in the same location are encouraged to use centralised treatment plants so as to minimize st and to ensure treating of waste close to the point of generation. Minimum risk options that are vironmentally friendly should be adopted for waste treatment. It further requires the Ministry of :alth, the Ministry of Local Government and Rural Development (MLGRD) and other stakeholders collaborate effectively to ensure safe management of health care waste. Thus, environmental health ficers are to be employed to this effect. To ensure the health and safety of staff, contingency plans d safe system of work are to be developed to provide guidance, medical monitoring, immunization ntrol unexpected incidents. Information, Education and Communication is to be used in educating : general public on the importance of proper management of health care waste management and to sure its effective implementation.

l the above provisions are excellent, however, some of these provisions are yet to see the light of the ...y. For instance, in spite of the fact that labelling of waste is necessary at the health facilities it is not always practiced. Segregation, one of the important waste management tools is not strictly practiced, for example observations made by the researcher revealed that in most of the hospitals, it is only sharps that are sometimes separated from the other waste, the rest of the waste namely swabs, soiled cotton and gauze, and some laboratory specimen are dumped together with paper, and other waste that could qualify for non hazardous waste. Also, the three hospitals could explore the proximity principle by sharing one common waste treatment plant sited at more convenient and accessible place to all, on the contrary they all have individual treatment plants which is not cost effective.

The technical guideline component of the policy focused on the classification of health care waste (hazardous and non hazardous). This system was adopted based on the point of generation, method of storage and treatment options available. The guide was not all inclusive and specific to all situations. Thus, it gave health facilities the power to decide which material, device or substance is regarded as hazardous waste depending on the information and guidance from the DA, MOH, and EPA. This provision is not exhaustive enough as decisions may be left in the hands of the health facilities to classify waste which may not correspond with the national or international classification. This can lead certain categories of waste found at wrong places, for example as in the case of Tamale Landfill te, where syringe and needles are exposed on the site and children are found scavenging for this aste.

eps in managing waste were also outlined in the policy, namely waste generation, segregation, ntainerization, internal storage, internal collection and transport, external storage, external transport, eatment, collection of residues and disposal. To ensure efficient segregation the policy included a lor coding system for waste containers for both internal (not exceeding 24 hours) and external orage where black is for general waste, yellow for infectious waste and brown for hazardous waste r chemicals.

here the facility is having an incinerator, solid waste minimisation plan can be used by incinerating e waste. For external collection and transportation, where the facility is not equipped enough the cility can liaise with a waste management contractor accredited by the DA to manage waste.

or waste water treatment and disposal, waste water containing bacteria, viruses and helmints scharged from wards after treating patients infectious diseases can be connected to sewerage system available, however, in case of epidemics high risks types of waste must be pre-treated by chemical sinfection before disposal. For toilets and latrines, bio digesters can be an option for treatment. For emical wastes water like drugs, vaccines requires a high temperature incineration, however, there is no incinerator for chemical waste in the country currently, hence dilution and neutralisation and then washing down the drain may be used. Decontamination may be used for organic substance and solvents. Record keeping is an important component of the policy where health institutions are required to religiously maintain and audit records (MoH, 2006).

Training, capacity building, research, information, education and communication constitute another essential component. Pre and post service training is encouraged from time to time to educate and inform staff of new challenges of waste management. However, the policy did not give the reference period for which staff must be trained hence living it at the discretion of the health facility to decide.

Also, there is the need for collaboration between health institution and other research organisations such as the universities to facilitate adaptation of new technologies for health waste management. Advocacy is to be pursued vigorously to solicit support from stakeholders for some key issues in this respect.

The backbone of every policy is implementation. For proper implementation, health care waste management requires a multi-sectoral approach where all hands must be on deck, that is ministries, department and agencies to ensure previous policies (for example the polluter pay and proximity inciples) as well as future policies are strictly adhered to without fear or favour.

ıfortunately, the major weakness of most departments and agencies has been policy implementation ıere they either lack political will or attitude. As such much effort is needed if this policy is to rvive. To ensure proper implementation therefore, monitoring and review were taught of to be itical component of the policy. Included in this were, supervisory processes involved in waste anagement, auditing plans, controlling to detect errors and provide for correction in good time. onitoring also ensures periodic review to assess programme impact and to design new and future ogrammes to fit into new dynamics of waste management.

3 Regulation of Health Care Waste

ıe developed countries are advanced in waste management in the areas of legislation and regulation, ucation, collection, storage, treatment, transportation as well as private sector participation. One ajor concern about waste in the developed world is what to do with the waste after collection; this is cause most of their facilities lack suitability of the disposal structures. For example, there have been ported cases of the increase in dioxin in the atmosphere as a result of use of incinerators. Thus the e of incinerators also raises a lot of public concern (WHO, 2000).

ost advanced countries focus on source reduction, For instance, in the U S A, emphasis is on reduction, recycling and reuse. In Germany, integrated waste management approach is being adopted with special emphasis on source reduction, reuse and recycling, and there has been comprehensive approach to make waste a source to generate electricity to the national grid (Addo, 2005).

In developing countries, authorities are still struggling with fundamentals of waste management. As described by the World Bank report (1994) that solid waste services in developing countries as being rudimentary. This implies that there is still more to be done in the area of legislation, regulation, education and structures (both administrative and technical). As a result, statistics involving waste management in developing countries is either not up to date or incomplete.

There is therefore the need for a national legislation on health care waste as a base for improving healthcare waste practices in developing countries. This will enable agencies responsible for the disposal of healthcare waste such as the Ministry of Health, Environmental Protection Agency and Ministry of Environment Science and Technology to put pressure for their implementation. There should be a clear designation of responsibilities before the law is enacted. It is also important to consider the cultural practices and beliefs of the people about waste handling of the country or location in question, so that it can be synergised into the policy document and technical guidelines. For instance, it was noted by the (EPA, 2002) that "In some cases, Placentae are sent home because of ltural beliefs" of the people.

4 Effects of Health Care Waste on the Community

ıere exists a lot of public health risk due to the unsafe disposal of health-care waste (for example, ntaminated syringes and needles). Contaminated needles and syringes constitute enormous threat. ıis is because failure to dispose off healthcare waste properly may lead to unsafe reuse as it can be avenged from dumping sites either by children or unscrupulous individuals to be resold. Example, HO estimates in 2000, showed that, contaminated injections with contaminated syringes caused:

21 million hepatitis B virus (HBV) infections (32% of all new infections);

two million hepatitis C virus (HCV) infections (40% of all new infections); and

at least 260 000 HIV infections (5% of all new infections).

addition to this, the reuse of contaminated equipments, glass ware, injection etc poses a great risk health workers, waste handlers, scavengers and children. Epidemiological studies indicate that a rson who experiences one needle stick injury from a needle used on an infected source patient has ks of 30%, 1.8%, and 0.3% respectively of becoming infected with HBV, HCV and HIV (WHO, 06).

There have been numerous instances where health care waste has been dumped in residential areas, this poses a lot of health hazard to the community and environment. Due to illegal dumping in disadvantaged residential areas, there have been situations where children have been found playing with medical waste, that is children pricked with syringes, etc. Example, "Tygerberg Hospital treated 48 children with AZT after some were pricked with needles and others ate potentially lethal pills they found in a field in Elsie's River" (Leonard,2005).

In 2002, the results of a WHO assessment conducted in 22 developing countries showed that the proportion of health-care facilities that do not use proper waste disposal methods ranges from 18% to 64%. This is due to the fact that, most health facilities in developing countries either lack the funding to support proper management of health care waste or the expertise to handle the proper disposal of this waste. For instance, personal enquiries by the researcher with the Northern Regional Solid Waste Manager revealed that of the three major hospitals under study, the Tamale Teaching Hospitals incinerator is broken down. When the management of the hospital were contacted they confirmed it : indicated that a new one was under construction. The Tamale West Hospital has been closed down e to its improper management, whiles that of the Tamale Central hospital is operational.

s worthy of notice that, the incinerators are responsible for the high levels of dangerous chemicals ch as furan and dioxin in the environment. For example, The Environmental Protection Agency of United States of America in 1994 found that emissions from incinerators in health care facilities re responsible for high level chemicals such as dioxin and furan in the atmosphere (Malkan, 2005).

ioxins, furans and co-planar PCBs are by-products of various industrial processes, including the mbustion of wastes containing polyvinyl chloride (for example, some plastics, some blood bags and id bags) which are toxic substances. This happens when wastes are incinerated at temperatures low 800 degrees Celsius or when the wastes are not completely incinerated. Dioxins, furans, co-nar PCBs and other toxic air pollutants may then be produced as emissions, in bottom or fly ash. In ne circumstances dioxins and furans can be produced under natural conditions for example volcanic ivity and forest fires (WHO, 2006)

oxins, furans and co-planar PCBs do not easily break down into the environment. It also bio-cumulate in the food chain that is from plants to animals. Thus, most human exposure to dioxins, ans and co-planar PCBs is through the intake of food. Another concern of medical waste cinerators is the contamination of mercury into the environment (WHO, 2006).

2.5 Classification of Healthcare Waste

Healthcare waste refers to any treated or untreated waste (Solid and Liquid) produced as result of administering medical treatment to either humans or animals. Various authorities have classified medical waste although largely similar, but with slight variations.

Healthcare activities have led to the production of waste that can have adverse health effects. Although like the household waste, a greater proportion of this health care waste is relatively less risky. However, some types of healthcare waste represent a higher risk to health of the human; these include

infectious waste (15% to 25% of total healthcare waste) among which are sharps waste (1%), body part waste (1%), chemical or pharmaceutical waste (3%), and radioactive and cytotoxic waste or broken thermometers (less than 1%) (WHO, 2006). This means that out of total waste produced by every facility about 75-80% is general waste or household waste.

This is in resonance with the Ghana EPA Guide, 2002 projections of about75-90 % non-risk or general waste with about 10-25% regarded as risk or hazardous. These include infectious, pathological, radioactive and pharmaceutical waste. Thus, health care waste can be classified broadly into General Household waste and Special or Risk waste. About 85% of the total general waste produced by alth facilities is uncontaminated waste and does not pose any serious risk to persons who handle it. amples of non contaminated waste include paper, trash, boxes, bottles, plastic containers, and food. ey can be disposed of by the usual methods or sent to the local landfill or dumpsite (CDC 1985; tala 1993).

.1 General Waste

is stream of waste is similar to the household waste. It poses no serious harm or risk to those who ndle it although it is produced within the hospital environment. It includes, paper, food residues, ckaging materials, containers, glass (EPA, 2002).

neral waste may include solid and liquid waste. Solid waste can be described as waste that has a cise size and shape. This shape can be regular or irregular. Thus, its management may require cial handling or treated like any normal waste. Sorted materials from these wastes can be recycled re-used. This may reduce the burden of waste on the environment.

.2 Special Waste

is waste may include discarded materials from health care activities on humans or animals. That is, and out patients, it may carry microorganisms that can infect health care workers, patients and the community at large. This waste therefore requires special measures in its management. Infectious waste may include but not limited to pus, blood, urine, semen, stool, CSF and other body fluids. Furthermore, items and medical devices that come into contact with body fluids, such as used gauze and cottons, sharps can cause injuries to people and are capable of spreading diseases like hepatitis B, hepatitis C and HIV. Wastes from theatre, labour rooms, pathological units (human tissue, amputated limbs, placenta blood, blood soaked sponges), waste from laboratories and blood banks (blood and blood products, stool and urine specimen , and microbiological culture specimen such as sputum, csf, pus, used swabs sticks, smears etc). Other health care waste that do not contain infectious materials,

but are hazardous to the environment include: chemotherapy chemical and pharmaceutical residues (for example, cans, bottles or boxes containing expired drugs and vaccines, laboratory reagents and disinfectants such as formaldehyde, glutaraldehydes, and organic solvents such as acetone and chloroform); cytotoxic waste (for example, drugs typically used in cancer);(Infection Prevention Guidelines 8 – 1 Waste Management)

2.6 Quantity, Management and Financing of Health Care Waste

Recent decades have seen the upsurge of waste worldwide; Ghana is not an exception, as waste is reasing daily in an alarming dimension. For instance, Ghana with an estimated population of 20 llion has an average daily waste per capita of 0.45kg.Ghana generates annually about 3.3 million ıs of solid waste. Tamale Metropolitan Assembly with an estimated population of about 365,000 1 a floating population of around 1,500 generates about 56,000 tons of solid waste and about 0,000 gallons of liquid waste annually (TMA/WMD, 2009).

extension, health care waste is also constantly increasing. This is due to the continuous change in pattern of medical consumables. For example, the increase in the delivery of medical services, the vancement of medical technology and the propagation of the use of disposable material. For tance, a hospital survey conducted by the Waste Management Department of Accra Metropolitan sembly (WMD/AMA) in 1992 in six major hospitals in Accra showed that the unit total generation medical waste was 1.2kg /bed/day (EPA, 2002).

veral factors account for the enormous generation of health care waste by health facilities. They lude waste management policy, the level of economic development of a country, the size of the alth facility and the type of the medical specialties practicing in a particular country (Yimer, 2005). is means that quantities may be higher in Teaching, Regional, District, and low in health centres and vate hospitals (Gabela 2007) noted that Public sector clinics in Guateng produced HCRW at a rate 0.002kg/patient/day to 0.5kg/patient/day, while private sector clinics produced 0.06 kg/patient/day to 0.48 kg/patient/day.

Management of health care waste in public health care facilities requires a comprehensive institutional framework. The Ministry of Health is responsible for the institutionalisation of health care in Ghana. The Medium Term Health Strategy of the Ministry of Health provides for the development in the health sector within the framework of "Vision 2020" (EPA, 2002). This framework identifies the collaborative roles of households, communities, private sector, NGO's, government, etc in health financing. This means that for a health institution to be able to manage its waste effectively and efficiently, it should consider the above mentioned stakeholders. Thus, public health institutions by

Ministry of Health policy are required to set up public health units in larger health facilities to oversee the general public health activities in their respective hospital. Management of health care waste falls under this category. By this, each health care facility shall establish a Health Care Waste Management Committee (HCWMC) appointed by the head of institution, or make an acceptable alternative arrangement to supervise, advise and monitor waste management within the facility (EPA, 2002). Comprehensive training programmes should therefore be organized for staff on awareness creation and waste auditing as well as environmentally friendly methods of disposal.

managing health care waste, it is also important to consider the entire life span of the waste that is m generation to its disposal. According to Cantanhede (1994) medical waste should be managed ough a pathway that includes generation, segregation, collection, storage, processing transport, atment and disposal. However, prevention and source minimisation must be encouraged since it luces the cost and environmental burden of treating and disposing waste.

lvanced countries are gradually focusing on waste reduction, reuse/recycling. For instance, in rmany, integrated waste management approach is being adopted with special emphasis on source luction, reuse and recycling, and there has been a comprehensive approach to make waste a source generate electricity to feed the national grid (Addo, 2005). It is believed that if Ghana follows this otstep holistically the waste problem could be reduced if not completely eliminated.

5.1 Waste Financing

ıe major problem identified by UNEP (1988) in a study of waste management involving 22 veloping countries is the lack of adequate funds. This study pointed out that proper revenue system of critical importance to the long term success of any waste management programme. Thus money needed for the running cost as well as capital expenditure necessary to maintain or improve services ddo, 2005). Again, Rayamajhi (1990) noted that proper waste handling cost a lot of money which veloping countries cannot afford and at the same time, people do not get direct output from it, therefore, governments of developing countries should think about the cost involved in waste handling and treatment system as a resource recovery process. This implies that for a sustainable waste management, waste financing must embody capital cost, cost accounting, budgeting, cost reduction and recovery monitoring and evaluation etc. Unfortunately, these methods are rarely used by waste management bodies. Hence, for effective and efficient management these methods need to be embodied in the institutional framework.

In Ghana, waste is supposed to be funded by District Assemblies through the District Assembly Common Fund. This poses a lot of challenges to the assemblies since they have a lot of developmental

activities that depend on the common fund. And since the health facilities are generally under the districts, municipal and metropolitan assemblies they are required to collaborate with these bodies to ensure proper health care waste management.

Further, the producer pay principle must be extensively applied such that waste producers pay for the waste they generate. Thus health care facilities including Teaching hospitals, regional hospitals, district hospitals, private hospital and clinic, chip compounds etc must pay for the waste they generate. The means of charging people or institutions includes kerbside charges, landfill levies, product arges, recycling and credit schemes.

erbside charges - Although this method is mostly applied to households, it can as well be used for spitals and clinics. By this method a charge is levied on health facilities according to the quantity of aste they generate and dispose off. The charge is determined by using a prepaid rubbish bags or a own cost of a standard bin and frequency of collection.

andfill levies - This is a method whereby health facilities are taxed or levied depending on the nount of waste deposited on the landfill. The external cost of the landfill is usually considered in termining these charges.

oduct Charges - This type of charge allows for the cost of production and the external cost of oduction (cost of collection and disposal) to be added to the price of the product. One advantage of is is that it encourages waste reduction at source. This is because producers will not want to burden eir consumers with high prices. Especially, as consumers can decide to go for substitutes with atively lower prices.

ecycling credit scheme - This type also encourages waste reduction at source as people are couraged to sort out and collect certain types of waste that can be recycled. Some financial savings e made as result of the waste reduction and such people can be paid from this financial gain.

2.7 Waste Storage and Treatment

Storage is the time period between waste production and collection for final disposal. There are two types of storage, these are internal and external storage. Internal storage is the temporary holding of the waste from the point production and then transferring to the external storage sites for treatment and disposal. It is important to reduce the storage time of waste to avoid the risk of infection of health care workers, waste handlers and patients.

2.7.1 Waste Segregation

There are different methods of managing waste; one effective way is by carefully sorting out the different types of waste generated in the hospital. For example, separating hazardous/infectious waste from non infectious waste. Sorting out waste from the point of generation is critical to waste management. Waste segregation by type ensures that appropriate pathways are followed from the point of generation through storage, treatment, and transport to disposal. It does not only reduce cost but also ensures that the environment as well as public health is protected.

or effective implementation of waste segregation plan, there should be training of staff on entification and definition of health care waste. That is, both staff who are directly in charge of waste id those who create it. For instance, a nurse or laboratory personnel who uses syringe and needle ust know where to dispose the needle and where dispose the syringe. The waste collector must know e designated containers of what she/he has collected from the ward, laboratory, X-ray departments t.c and why the need for the waste segregation.

egregation can best be achieved by using the colour coding system. This can be done by using olours to code the waste container. For instance the EPA, Ghana recommended the following colours r the various categories of waste. Black for general waste (papers, kitchen waste e.t.c), yellow for fectious waste (needle, sharps, human or animal tissue and culture, specimens), and brown for azardous waste (for example expired drugs, chemicals, vaccines etc) (EPA Guide, 2002)

7.2 Reduction of Waste

Waste reduction is the process of preventing or reducing the generation of waste, it is usually commended to prevent waste production from source. Reduction of waste can be done by the reuse second hand products, repairing the broken equipment for reuse instead of buying the new ones, sing of light weight material rather than heavy weight material and then opting for paper bags or otton bags which are combustible.

2.7.3 Recycling

Another important aspect of waste management or treatment has to do with the extraction of value resources from the waste stream. This is known as recycling, it conserves scarce resources and also reclaims old material and reusing for a different or same purpose. The term recycling has two meanings in common usage. It may be used to refer to the reusing of something such as refillable beverage containers. With regards to the management of solid waste, recycling refers to the reprocessing of discarded materials into new and useful products (Cunnigham and Siago, 1995). There

are number of methods by which the waste can be recycled or reprocessed. For example used aluminium cans can be melted and cast into new cans. Some of the recyclable products include wood, vehicles, plastics, batteries, metal etc.

Recycling as a waste management option is a vibrant financial venture, thus for it to be successful, recycling plants must be put in place to ensure recyclable materials can be recycled into completely new products, this will create employment for the youth and bring income to the nation. Caution must be taken in recycling liquid waste from health facilities, as this can cause much more health problems.

2.7.4 Transportation of Waste

It is the responsibility of the health care waste producer to ensure that the waste generated is correctly packaged, labelled and transported to the appropriate site for treatment and final disposal. This process can be facilitated by the colour coding system for waste containers already discussed above. It aids in the easier identification of the waste contents in the various containers and reduces the risk of secondary infection. Vehicles designed for the purposes of health care waste must be enclosed and lined internally with a stainless steel so as to avoid scattering of waste or any form of nuisance to the society. Inscription must be displayed boldly on the vehicle for easier identification

Figure: 2.1 International symbol of medical waste (HCWH, 2009)

2.7.5 Treatment of waste

Treatment may include all processes and procedures used to change the biological feature or composition of waste. It requires the establishment of standard operating procedures coupled with efficient and effective monitoring of the entire processes for successful treatment. Some treatment method includes; incineration, sterilization, disinfection, irradiation, thermal inactivation etc.

2.7.5.1 Incineration

Incineration is the controlled burning of combustible waste usually in large furnaces with temperatures high enough to reduce from organic matter to inorganic matter by dry oxidation, Before incineration, recyclable waste is scavenged and sorted out from non recyclable waste leaving the combustible and non combustible to be burnt in the large furnaces. After completion of the process, only the ash and the non combustible waste are left at the end. This can therefore be disposed into the landfill.

ıe EPA recommends the following criteria for selection of health care waste incinerators. :mperature at the outlet of the main incinerator should be minimum of 800 °c with an average nperature of 1200°c. Combustion must be complete, the combustion process should be automated d exhaust gas quality must meet EPA recommended guideline values. The incinerator must have an tomatically charging closing sluice. (EPA Guide, 2002).

ıur main types of incineration technology are used in the treatment of health care waste. These are uble-chamber pyrolytic incinerators designed specially to burn infectious waste. Where the double-amber incinerator is not affordable, single-chamber furnances with grate are used since they are less pensive. Rotary Kilns incinerator operates at high temperature and capable of destroying cytotoxic bstances and heat-resistant chemicals. The last incineration technology is the drum or brick :inerator, it operates at low temperatures and less effective compared to the above mentioned :inerators, but can be made with local materials.

7.5.2 Waste that should not be incinerated

aste that should not be incinerated includes; Pressurized gas containers (aerosol cans), large amounts reactive chemical waste, silver salts and photographic or radiographic wastes, halogenated Plastic ntaining polyvinyl chloride (blood bags, IV tubing or disposable syringes) and lastly waste with gh mercury or cadmium content, such as broken thermometers, used batteries and lead-lined wooden panels (WHO, 1999)

2.7.5.3 Advantages of Incineration

They are basically two major importance of incineration, the first is that it reduces waste to the bearest minimum, as noted by (Smith and Enger, 2000). Incinerators drastically reduce the amount of solid waste up to 90% by volume and 75% by weight. Apart from this, they also reduce all forms of micro organisms on the waste that are pathogenic. This in turn decreases the risk attached to the health care waste. Also the heat generated by incinerators can be recovered and redirected to produce electricity.

2.7.5.4 Disadvantages of Incineration

The use of incinerators comes with both monetary and environmental cost. It is therefore important to consider these costs in making a decision to purchase one. The monetary cost includes the direct cost in purchasing the incinerator, cost of installing as well as cost of maintaining the plant. Thus, even if a health facility is able to afford one, maintenance cost becomes a problem which eventually results in its breakdown. The EEA noted that at one time there were 7 incinerator plants in Romania, but today only one remain as a working facility (EEA, 2006)

ıe other cost associated with the use of incinerator is environmental cost. Incinerators emit gaseous bstance that causes air pollution, such pollutants include nitrogen oxides, carbon monoxide and ganic compounds that can evaporate and enter the atmosphere. For instance the Environmental ɛpert Association (EEA) in their report on the International POPS Elimination Project (2006) noted at healthcare waste incinerator are an acknowledge major source of Persistent Organic Pollutants OPS) and other heavy metals which the Stockholm Convention seeks to reduce or eliminate mpletely.

ırthermore, Small-scale incinerators often operate at temperatures below 800 degrees Celsius. This ay lead to the production of dioxins, furans or other toxic pollutants as emissions and/or in ɔttom/fly ash. Dioxin is produced when plastics that contain high levels of PVC are incinerated. This oves up the food chain, i.e from plant to animals to human. In addition to risks to health from fectious agents, long-term low-level exposure of humans to dioxins and furans may lead to ıpairment of the immune system, and impaired development of the nervous system, the endocrine stem and the reproductive function (WHO, 2006).

7.6 Sterilization

ıis type of treatment can be done either by dry heat, gas or steam (autoclave). With the first, a dry ɛat of about 121-180°c is exposed to waste at minimum of 30-60 minutes is required to inactivate most micro organisms. For the Gas sterilization, gas agents such as ethylene oxide or formaldehyde are exposed to the equipment or waste in an air tight box. Lastly, for the steam sterilization waste loaded into an enclosed chamber, usually an autoclave and hot steam is exposed to inactivate all forms of infectious materials.

Advantages

Sterilization is used for reusable medical equipments. Also, the gas sterilization can be used for reusable equipment that cannot withstand heat or moisture.

Disadvantages

Sterilisation can be used only for limited number of waste. The gas sterilization also exposes the worker and the environment to the harmful gases which may have health impact in the long run.

2.7.7 Chemical Disinfection

This method of treatment involves the mixing disinfectants with waste in the same container to inactivate pathogens. The resultant waste is then drained into sewer and then the residue usually made of solids is released into a landfill.

dvantages

emical disinfection is suitable for treating liquid waste such as CSF, blood, seminal fluids, stool, ine etc. It is also suitable for highly infectious waste that should not leave the working area without sinfection.

isadvantages

emical disinfection may expose waste handlers to risk.

7.8 Thermal Inactivation

his method allows the waste to be held in chamber for a definite period under a pre-defined mperature. The temperature should be high enough to destroy infectious waste.

e advantage of thermal inactivation is that, it is used for large volume of liquid waste. The sadvantage however is that it requires a lot of time and energy.

her treatments methods include the use of ultra violet lights to destroy infection agents, the use of icrowave to heat waste under pre-defined temperature to destroy infection. Prior to disinfection, compaction and shredding is also used to reduce the volume of waste and make waste more homogeneous. This is to aid easy disinfection of infectious waste.

2.8 Disposal Methods

Disposal is the release of waste into land, water or air without the intention of recovery. Thus, the final stage for treated waste such as sludge, disinfected waste, incinerator ash etc is a specially made sanitary landfill site. Other waste such as body parts can be buried at burial site.

It must be noted body parts such as placentas, amputated body parts etc in Tamale are sent home for burial due to religious and cultural beliefs, this is in consonance with a similar practice in Iran where pathological waste (with bones attached) is given to patients or relative for burial according to religious rites (Askarian et al 2004b)

2.8.1 Landfill

A sanitary land fill entails the designing of a specially engineered land in which waste is disposed off in an environmentally friendly manner. By this method, waste is spread out in thin layers and then mpacted afterwards into smaller volume. This is followed up by spraying it with lime and then vering it with a compacted laterite (soil) at an interval depending on the frequency of disposal or as ıy be deemed fit by the waste management authorities. Drainage and gas management systems are ıtalled throughout the landfill to control the drainage of leachate as well as the emission of isonous gas (methane) into the atmosphere.

'eated health care waste may be land-filled with municipal waste with caution. A specially designed l must be demarcated for the disposal of treated health care waste. However, it must be monitored ›sely so as to avoid scavenging. "Health care waste can be deposited in a specially constructed small rial pit at the municipal waste disposal site designated to receive healthcare waste only. The pit can 2 m deep and filled to a depth of 1 m. Each load of waste should be covered with a soil layer 10-15 ı deep" (EPA Guide pp 24, 2002).

3.2 Landfill Site Selection

is important to consider certain factors when choosing a site for a landfill. Such factors include the ›ography, ground water table, surface water, geology, hydrogeology and site specific information ›il and rock). This helps to evaluate the possibility of contaminants migrating to groundwater and nce re-sitting can be done in case the study proves otherwise. This was indicated in the document olid Waste Guideline No. 23, 2009, the purpose of past site characterisation efforts was mainly to identify subsurface water-bearing zones, to avoid designing landfills where waste is placed in contact with ground water. Aside this, the sitting of landfills in arid regions is relatively safer since such areas encounters little rainfalls which reduces leachate production. Where it is not possible to avoid ground water pollution, it can be designed to minimize leachate production, for example tipping vertically rather than horizontally (UNEP, 1995).Also, the concerns of the local people must be considered, thus areas with little economic value can be choosing for landfill purposes.

2.8.3 Types of Landfill

Three types of landfill exist, these are Historic closed sites, Historic still operating and Green field site. The historic closed sites involve the management of problems that might have been created by close down sites based on past experience and what aftercare measure was adopted. The historic still operating is the type of old sites that are still being used, but managed based on the level of knowledge of previous resources used, hinges in the nature of such inputs as well authorisation systems that were provided for improved control and management regimes.

ıe last is the green field site; they are set up depending on the waste being handled and subjected to propriate licensing conditions, operated with the required quality standards and should not present ıch problems as regards operational, aftercare and restoration problems (UNEP, 2002).

ł.4 Types of Landfill Designs (Operational Types)

ıere are three basic types of landfill design, these includes containment, entobment and attenuation.

ıe entombment requires a higher degree of site design and engineering. It has features that prevent d recover leakages, gas control and recirculation systems. It has the ability to store waste rmanently in dry form. And provides for the opportunity for use of new technology to deal with ›red waste in a more improved manner.

ith respect to the containment, a great deal of engineering is needed, well constructed structures such leachate liner, gas vent is usually installed to cater for the leaks and gas emission so that it will not tend beyond the landfill boundary. Thus, less poison is released into the environment as it is ntained in the landfill for long time to allow for biodegradation to take place.

ıe attenuation principle is generally used for unconfined site like dump sites, where little or no gineering is done. This allows the migration of leachate to the surrounding environment as such ollutes ground and surface waters alike. Natural attenuation requires areas with good hydro - geological and geological conditions

2.8.5 Liner Systems

Liner systems are used to line the landfill, it is installed to insulate and prevent toxic liquids formed as a result of waste from migrating beyond the confines of the landfill. There are two types of landfill liners systems; they are natural and synthetic liners.

The natural liners include clay and shale, the advantage is its attenuation capacity. It can also withstand wide range of organic and inorganic materials as well as natural environmental factors like

weathering, rock shifting e.t.c. The synthetic (Flexible Membrane Liners) have less attenuation to organic and inorganic materials but are relatively impermeable compared to the natural liners. It is therefore recommended to combine both in lining the excavated land to ensure complementary benefit.

2.8.6 Monitoring of landfills

An initial well of 100 to 200 m can be drilled for shallow water zone and much deeper water respectively. Wells are used to monitor a new site to determine the direction of flow of ground water and area that can first be used for waste disposal. Monitoring wells must be maintained for as long as : facility exist, this is necessary because historic data for a number of sites in Wyoming show that ɔnitoring wells that were dry for several months or years suddenly developed several feet for ground ıter (Solid Waste Guideline No. 23, 2009).

ɔnitoring the movement of ground water should start once the site for the landfill facility is chosen d the filling has started (Botkin and Keller, 1998). Monitoring ensures the early detection of ground ıter pollution either by methane gas or leachate. Leachate is produced as a result of biodegradation ıction that occurs as a result of bacteria, when it rains, the water picks up various contaminants from : many layers of the landfill. In other words, the water percolates the rotten garbage and trace metals form a solution. Thus, if not confined will be flooded to the surrounding environment. Leachate can drained and sprayed across the landfill to evaporate or used for sewage treatment purposes.

ıs formed at the landfill site is produced through microbiological reaction. Gases produced in the ıdfill mostly contain methane and carbon dioxide which if not monitored properly can cause plosion at the site. It is believed that it takes so much time for the landfill gas to decay to become ɜs harmful and so there is the need to monitor the landfill site regularly for at least 30 years after pping the site (Jones, 1995). It must be noted that if the gas controlled with appropriate technology n be used to produce energy for electricity as well as cooking.

2.8.7 Disadvantage of Landfill

Landfills account for the presence of several environmental problems including; risk of exposure to poisonous and green house gases to the atmosphere, water pollution, soil pollution, destruction of virgin forest, expensive to maintain. Again it is noted for the increasing volumes of odour, littering, noise, health risks e.t.c.

2.8.8 Liquid waste disposal options

Health care waste water must be treated with utmost care. Waste such as effluent, bacteria, helmints discharged from wards and laboratories may be disposed through the municipal sewerage system if

present, otherwise and on-site system (Septic Tank or waste stabilisation pond) must be created for such purposes. Others such as expired chemicals from the pharmacies and laboratory, radioactive isotopes and hazardous chemical can be treated separately.

Sewerage is the system for collection and transport of sewage. It includes the removal of excreta, flushed water from toilets, institution and households through a sewer network to a treatment plant and to disposal point.

T' ere are three basic steps of treating sewage; these are the primary, secondary and tertiary treatments. e primary treatment is the initial treatment. It reduces the biological oxygen demand (BOD) to out 30%-40%. This is achieved by removing all suspended solids through the use of a settling tank. e secondary treatment involves the use of microbial (aerobic or anaerobic) process to reduce the ncentration of organic compounds. The tertiary has to do with the use of chemical to remove organic atter (methods of liquid waste treatment, rpi).

3.8.1 The Lagoon System

e lagoon system has the following parts, the anaerobic pond, the facultative pond and maturation nd.

aerobic pond is a deep pond that allows the solid part to settle down at the bottom. It uses the mentation process for the treatment of sewage and liquid waste. Anaerobic ponds are usually used r the decomposition process of the sludge produced by primary and secondary treatments. aerobic digestion uses a large variety of facultative anaerobic bacteria. In the first part of the ocess, sludge is broken down in the absence of oxygen. The final product of anaerobic digestion are proximately 70% methane and 30% carbon dioxide, microbial biomass and a non biodegradable sidue.

he facultative pond which is relatively shallower than the anaerobic pond allows the solid part to settle. It also allows sunshine and air to kill germs and make the liquid part less harmful. The next is the maturation pond in which two or three ponds are interconnected to allow the sun to kill more harmful organisms. This water is safe and can either be used for irrigation purposes or to breed fish.

Personal communication with the supervisor of the Waste Management Department of the Tamale Metropolis that, they engage the services of Water Research Institute to periodically examine the water quality of their maturation pond. This is to ascertain the level of purity of the maturation pond and to determine whether it can support life or not.

2.8.9 Theoretical Framework

Managing waste involves the cost and benefit analysis of various management options. The quantity of waste generated is a function of economic prosperity, thus, to determine which the best management options, the economic approach may be used. It is also important to consider the environmental effects of the several management options. These management options include but not limited to segregation, reduction, storage, collection, transportation, resource recovery, financing and landfilling. The approach includes the Integrated Waste Management and the Willingness to pay approaches.

he Integrated Waste Management is based on the quantum of waste generated. This model takes into count the environmental effect, the geographical consideration and the economic impact for example considering the expectation of local rate payers. For instance, it strikes the balance between cost of urce reduction and it benefits. It also allows for synergies between existing and current waste anagement options. Again it assesses the cost and benefit of several disposal options in order to velop sound environmental and coherent policies for waste management. Such management options clude re-use, recycling, composting, landfill and incineration.

ıe Willingness To Pay has to do with the amount of money people are willing to pay for the waste ey generate. It measures the cost of waste generated and the benefits of various management options well as the human wellbeing. In using this approach, we must consider the income generating ilities of the individual or institutions. Since one's ability to pay is the function of his level of come. Thus, health institution that have relatively low income levels might not be able to pay as ose with high income levels.

ıere two ways of using this method, these are the direct and indirect. The direct method also known Contingent Valuation Method is used to check the willingness to pay for environmental quality. For to measure the willingness of people, they must be asked, to test their initial reaction toward the illingness to pay policy. This is because it is very difficult to measure environmental quality, since it is intangible with no real market.

The following steps were recommended by Field (1997), the identification and description of the environmental quality characteristic to be evaluated, for this purpose (Health care waste management practices). Next is the identification of respondents and the design and application of survey questionnaires through phone, interview, or personal contact, this is followed by the analysis of results.

The questionnaire must state clearly the environmental characteristic, that is what the people are being ask to estimate. The questionnaire must also describe the economic relevance of respondents such as income levels and size of facility.

Respondents can either be asked exactly how much they are willing to pay without probing or prompting or by bidding where the interviewer and the respondent will engage in price bargaining until an acceptable price is reached by way of compromise. The last method involves the provision ontions for price ranges for respondents to check the amount they are willing to pay. One thing that ıst be considered in using this last option is that environmental quality is a public good which is ɔstly intangible, as such the tendency to under-estimate it is high.

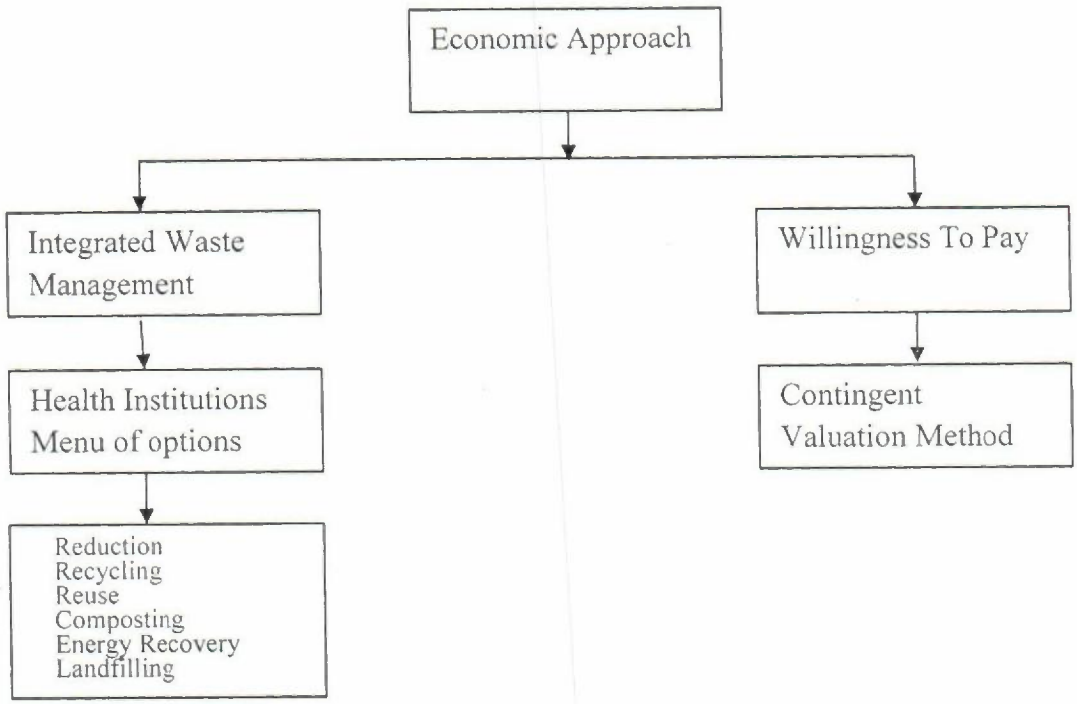

Figure 2.2: Diagrammatic representation of theoretical framework

CHAPTER THREE

STUDY AREA AND METHODOLOGY

3.0 Introduction

This aspect describes the study area, the processes and methods of data collection. It further deals with the type of data collected, the source, techniques used to collect the data.

3.1 The Study Area

The Tamale Metropolis is located at the centre of the Northern Region. It lies between latitude 9.16 ° and 9.34° North and longitudes 00.36°and 00.57. It shares common boundaries with Savelugu/Nanton District to the north, Tolon/ Kumbungu District to the west, Central Gonja District to the south-west, East Gonja District to the south and Yendi District to the east. It occupies approximately 750 km sq. which is 13% of the total area of the Northern Region. Source ;(Tamale Metropolitan Assembly)

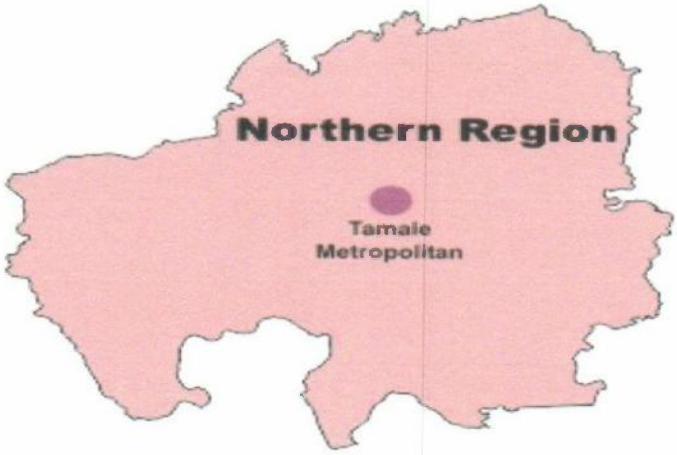

Figure: 3.1 Sketch Map of Northern Region

Source: (Tamale Metropolitan Assembly, 2009)

3.1.1 Relief

The Tamale Metropolitan Assembly is located approximately 180 metres above sea level. The topography is generally rolling with some shallow valleys which serve as stream courses. There are also some isolated hills but these do not inhibit physical development.

3.1.2 Drainage

The Tamale Metropolis is poorly endowed with water bodies. The only natural water systems are a few seasonal streams which have water during the rainy season and dry up during the dry season. ɔtable among these streams are the Pasam, Dirm-Nyogni and Kwaha. All these streams have their adwaters from Tamale which is situated on a higher ground. Aside this, some artificial dams and ıg-outs have been created. Two of such dams are the Builpela and Lamashegu dams.

ıere are about 91 of such dug-outs dotted around communities within the Metropolis some of which ɛre provided by communities themselves. Where these dug-outs have been provided, they serve as ıtering points for animals as well as for domestic purposes. Some of the dug-outs broke down in '89 as a result of heavy rains while others dry up during the dry season and both people and animals ve to travel long distances for water.

ɛspite this poor drainage system, the Metropolis still has the potential for an irrigation scheme. The ıgazaa stream which collects all the waters of the rivers mentioned earlier has the potential if it could dammed for irrigation purposes (TMA, 2009).

1.3 Climate and Vegetation

ıe Metropolis experiences one rainy season starting from April/May to September/October with a ak season in July/August. The Metropolis experiences a mean annual rainfall of 1100mm within 95 ys of intense rainfall. Staple crop farming is highly restricted by the short rainfall duration.

ıe dry season is usually from November to March. It is influenced by the dry North-Easterly (Harmattan) winds while the rainy season is influenced by the moist South Westerly winds. The mean day temperatures range from 33° C to 39° C while mean night temperature range from 20° C to 22° C. The mean annual day sunshine is approximately 7.5 hours.

The climatic conditions have to a greater extent influenced the vegetation of the area. The Tamale Metropolis lies within the Guinea Savanna belt of Northern Ghana. Apart from the preserved natural colonies of vegetation at fetish groves, forest reserves and community woodlots, the whole Metropolis exhibits tall grass interspersed with drought resistant trees such as neem, sheanut, dawadawa and

mahogany. During the rains the Metropolis becomes green making the vegetation more luxuriant. In the dry season, however, water becomes scarce as a result of poor vegetation cover, serious run-off and evapo-transpiration and leaching. The grasses dry up and the accompanying bush fires destroy the soil nutrients and even expose the soils to serious erosion.

There is one major natural forest reserve in the Metropolis located at Sinsab-gi-gbini. Beside this, there are other man made plantations which include the Water Works Plantation, Kogni Fuelwood Plantation and MOFA Area Fuelwood Plantation (TMA, 2009).

1.4 Soils

ıe Tamale Metropolis area is underlain by sandstone, mudstone and shale, which over time, have en weathered to different degrees. The main soil types that have resulted from the above natural ıenomenon include sand, clay and laterite ochrosols. These soil types are inadequately protected sulting in serious erosion during the rains.

2 Methodology

ıe research is mainly qualitative although it contains some aspects of quantitative data too, thus struments that are qualitative nature is used in the data collection. This aspect of the chapter deals ill deal with the type of data and sources of data, ethical approval, sampling procedure, sample size. ata collection instrument, data analysis and the limitation of the study.

2.1 Types and Sources of Data

ıere are two major types of data; these are primary and secondary data. Thus, in this study, both the condary and primary data was used.

ata for this study has been collected from the Waste Management Department of Tamale, the three ajor hospitals in the Tamale metropolis that is The Tamale Teaching Hospital, Tamale West Hospital and Tamale Central Hospital. Primary data was also collected from the community in which the landfill is sited.

The respondents included management of WMD of Tamale, management of the various hospitals, staffs of the hospitals as well as residents of the community in which the landfill is sited. The secondary data was collected from relevant books related to this study from the Environmental Protection Agency (EPA), Ministry of Health Policy on Health Care waste, Waste Management Department of Tamale. Also, estimates from the Ghana Statistical Services on population were used.

3.2.2 Ethical Approval

Ethical approval for the study was obtained from the ethical committee of the University for Development Studies.

3.2.3 Sampling Procedure

Samples were taken from the three major hospitals, namely the Tamale Teaching Hospital, Tamale West Hospital and Tamale Central Hospital. Respondents were chosen by means of quota sampling.

ıota sampling is a non probability sampling procedure. It is sometimes misleadingly referred to as epresentative sampling' because numbers of elements are drawn from various target population ata in proportion to the size of these strata (Ross, UNESCO IIPE). This method was considered cause observations within each stratum were homogenous.

ıus, each selected hospital was considered a stratum; hence number of staff selected from each spital depended on the staff strength of the hospital. Respondents from various hospitals were osen by stratified sampling. 30 respondents were chosen from Tamale Teaching Hospital, 20 from ımale Central Hospital, and 20 from Tamale West hospitals. Other respondents included the head of vironmental health unit of the Tamale Teaching Hospital, The administrators of the two other spitals and the landfill site engineer of waste management Department of Tamale.

ıe researcher also selected 20 respondents from the community where the landfill is sited. This was enable us assess how waste especially health care waste dumped at the landfill affects the quality of e. Further, it was also to establish whether there are health care wastes that are not suppose to be posited at the landfill site but are found there.

ater samples were also collected from the anaerobic ponds of Tamale treatment plant, the general aste disposal cell and the hospital waste water. This was to enable us compare parameters from one nd to another, and to determine whether they are the same or not. It was also to compare the Environmental Protection Agency standards. Parameters that were considered included the likely bacteria content, Biochemical Oxygen Demand, Chemical Oxygen Demand, Oxygen Demand, Dissolved Oxygen, Total Suspended Solids, PH, Nitrate, Nitrite, Chloride, Phosphate, Sulphate, Mercury and lead.

3.2.4 Sample Size

The total population size of the three hospitals and the community was 1840. The Sarantakos (1997) sample size from the total population of 1840 is 313. But due to time and financial constraints the researcher was unable to cover all, thus 100 samples were chosen with the following breakdowns.

Table 3.1: Population of selected health facilities and sample sizes

Name of facility	Population Size	Sample Size
Tamale Teaching Hospital	1300	30
Tamale Central Hospital	245	20
Tamale West Hospital	145	20
Gbalahi Community	150	30

ɔurce: Based on field survey

2.5 Data Collection Instrument

struments that were used to collect data included questionnaires and interview schedules. Two types questionnaires were designed, that is one for the community and one for staff of selected hospitals. ıe questionnaires were made up of both open and closed ended questions. Questions for health staff ɛre on issues relating to health care waste generation and its disposal. That of the community were how health care waste being disposed affects their life, for example their health. The questionnaires ɛre pretested and necessary corrections were made. After which it was personally administered by ɛ researcher and her assistant since a lot of the respondents are illiterates and could not answer the ıestion by themselves.

ıe interview schedule was made of semi structured questions, it was administered to the various ɔspital management and the management of waste management department, Tamale. This was to assess the level collaboration between the hospitals and the WMD which under the office of the Metropolitan Assembly. Also the researcher visited the selected hospitals to observe how waste is managed from the generation through storage to disposal. The landfill site was also visited to have a feel of how waste in disposed.

3.2.6 Data Analysis

Questionnaires were edited and cleaned to ensure consistency, sufficiency and relevance. It was coded for analysis. The software employed for the analysis was the Statistical Package for Social Science

(SPSS) version 16. Charts, Tables, Cross tabulations, frequency distributions, percentages and means were used for the analysis. The level of significance was assumed to be 5%.

3.2.7 Dissemination Plan

The findings of the research will be made available to policy makers so as to be factored into the development of health and environmental policies of Ghana. The outline of the dissemination plan is as follows; the Tamale Metropolitan Assembly, Tamale Waste Management Department, the Management of the selected hospitals, The Environmental Protection Agency, Ministry of Health, the Community leaders as well as Civil Society Organisations.

3.8 Limitations of the Study

Although to a large extent the research has met its main objectives, it was not without limitations. Some limitations encountered were financial and time constraints. Some major stakeholders were reluctant to give certain information that could have enhanced the research. But in spite of this, it did not off set it relevance since a lot of revelation came out the research that will be of interest to the Assembly and other stakeholder to help address the problems health care waste in the metropolis.

CHAPTER FOUR

RESULT AND DISCUSSION

4.0 Introduction

This section discusses the findings in the research and also looks at aspects of analysis of information gathered in the course of the study. The analysis is not only based on the objectives of the study, but also on the social impact health care waste management has on the people of Tamale and the nation as whole.

ıble 4.1: Occupations of people of Gbalahi

Occupation	Frequency	Valid percent
Public servant	3	10.0
Farmer	15	50.0
Trader	5	16.7
Others	7	23.3
Total	**30**	100.0

ıurce: Survey, July 2010

ıe table above shows the various occupations of people of Gbalahi, a community where the Tamale ıdfill is sited. 50% of the respondents are farmers, which means that farming is the major occupation almost half of the community, thus the livelihoods of about half of the population of the community tied to the land.

ıble 4.2: Land use before construction of the landfill

,and use	Frequency	Valid percent
lo use	1	3.3
Farming	11	36.7
Hunting	5	16.7
Conserve	4	13.3
Hunting and farming	9	30.0
Total	**30**	**100.0**

Source: survey, July 2010

In relation to the Table 4.2, about 36.7% indicated that the land was used for farming, whiles 30% indicated farming and hunting, it can therefore be seen that, the major use of the land was farming and

hunting which is a source of livelihood to the people of the community. Thus, taken away this land automatically meant that some people lost their source of livelihood.

Table 4.3: Compensation for land taken for landfill

Compensation	Frequency	Valid percent
Yes	4	13.3
No	24	80
don't know	2	6.7
Total	**30**	**100.0**

ɔurce: Survey, July 2010

ith respect to the Table 4.3 about 80% declared that there was no compensation given to them when e land was taken. They went further to state that they were deceived that the government was going establish fertiliser processing company, only for them to see waste being dumped after the landfill as commissioned in 2006.

ıble 4.4: Awareness on hospital waste dumped at the landfill

Awareness	Frequency	Valid Percent
Yes	21	70.0
No	4	13.3
Don't know	5	16.7
Total	**30**	**100.0**

ɔurce: Survey, July 2010

elating to Table 4.4, about 70% of the respondents are aware that health care waste is disposed off in ıe landfill site. However the rest of the respondents are unaware that health care waste is disposed off at the landfill site.

Table 4.5: Perceived harm of health care waste

Harm	Frequency	Valid percent
Yes	23	76.7
No	5	16.7
Don't know	1	3.3
4	1	3.3
Total	**30**	**100.0**

ɹurce: Survey, July 2010

Non response

relation to table 4.5, about 76.7% of the respondents declared that health care waste is harmful to eir health. Most of them claimed that it breeds mosquitoes and flies. This to them cause's diseases e malaria, typhoid, cholera, diarrhoea which were common in the community. They further stated at they are unable to dry their food items outside because flies have invaded the entire community d that on windy days some of the rubbish finds their way to their houses.

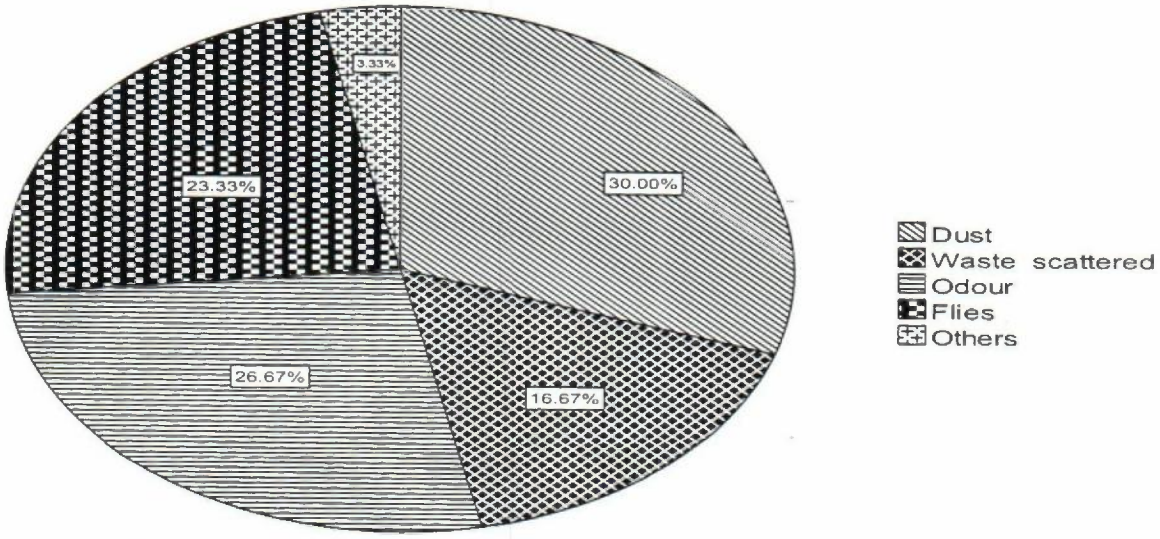

Fig 4.1: Proportion of discomforts faced by the people of Gbalahi Community

Furthermore, they claimed in a day an average of 9-10 waste management vehicles ply the road which is not tarred which makes the community dusty. Added to this is the fact that most of the waste vehicles do not have covers resulting in waste being scattered. For the liquid waste some of the tankers are so old to a point that the waste they carry in the form of faeces sometimes spill on the road creating

a lot nuisance. All this exposes the community to wide range of diseases. The figure below shows the percentage of discomforts the respondent feel the waste cause to them

One disheartening thing observed by the researcher during a field trip to the landfill was the presence health care waste such as expired drugs, syringe and needles, canulers etc. People especially children scavenge freely on the landfill for metals to sell as scraps. Some respondent complained of children playing with used needles, expired drugs, some even drink them. Below are pictures the researcher took from the landfill site of Tamale

Figure: 4.2 Special waste on the landfill

Figure: 4.3 A child on the landfill scavenging. Source: Taken during field work, 18/7/2010

These are excerpts from the landfill site of Tamale. The pictures seek to re-emphasize the need for management options such as colour coding, sorting out according to their infectious potential. If the above were strictly adhered to, as stipulated in the various health care waste management policies. These wastes would not have found its way to the landfill site and that would save these child and several others.

4.1 Waste Water Quality

Water samples were taken from four sources to conduct laboratory examination to determine possible biological, physical and chemical components of waste water. The four samples considered were water from the maturation pond (1 & 2), general waste water, and hospital water. The following parameters were measured Bacteria content, PH, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Dissolved solids, Total Suspended Solids, Nitrate, Nitrite, Chloride, Sulphate, and Lead. The Physical and Chemical parameters were measured in the University of Cape Coast Research Laboratory, while the Microbiological test were conducted at Northern Regional Public Health Reference Laboratory.

The same samples were also used to carry out microbiological test to determine if there are any bacteria in them. The results are as follows.

Table 4.6: PH and the Suspended Solids of waste water.

Parameter	Unit	01A	02A	03A	04A
PH	-	7.65	7.71	7.28	7.16
TS	mg/L	1313	391	881	269
TDS	mg/L	874	315	705	256
TSS	mg/L	439	76	176	13

Source: field work, July 2005

The presence of carbonates, hydroxides and bicarbonates increases the basicity of water (pH>7). It is measured using pH/ISE meters, ORION Model 710A. Thus, the following PH indicates the presence of above parameters in the entire four samples although the hospital waste waters recorded the least.

To determine the suspended solids in the samples, the total solids (TS) and total dissolved solids (TDS) were measured using the Gravimetric method, while TSS was calculated by subtracting TDS from TS.

Looking at the Total Suspended Solids above, the 02A and the 03A representing the maturation pond 1 &2 respectively, the TSS were 76mg/l and 176mg/lb which outweighs the EPA standards of 30mg/l. That of the general waste water and the hospital waste water however yielded the highest and the lowest respectively. This may be due to the combined chemical reactions owing to the different components of general waste.

Table4.7: Oxygen Demand Analysis of waste water

Parameter	Unit	01A	02A	03A	04A
COD	mg/L	94.5	51.2	75	5.7
BOD	mg/L	85.24	50.72	61.5	11.7

Source: field work, July 2010

In order to determine the oxygen demand, the Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand were measured. The BOD is the measure of the amount of oxygen required by the bacteria to oxidize waste aerobically to carbon dioxide and water, while the COD is the measure of oxygen susceptible to oxidation by a strong chemical oxidant. The COD values however are greater than BOD values, but its weakness is its inability to show a difference between biologically oxidizable and biological inert organic matter. For this reason, the analysis will be based on the BOD, it is measured using ORION BOD fast respirometry system model 890 with measuring range 0-4000 mg/l at 200C incubation in a thermostatic incubator chamber model WTW.

The BOD analysis showed that, the maturation pond 1&2 had 50.2 mg/l and 61.5 mg/l respectively. The maturation pond 1 is almost about the same measure as the EPA standards for final effluent stabilisation pond of 50mg/l whiles the maturation ponds is beyond this acceptable limit. This means that it can infiltrate into ground and surface waters closer by. There appears to be an inverse relationship between the general and hospital waste waters. This is because where as the general waste has the highest BOD content of 85.24 ml/g that of the hospital waste had just 11.7 mg/l. This may be due to the fact that leachate production has started occurring in the general waste than in the hospital waste.

Table 4.8: Likely parameters in waste water

Parameter	Unit	01A	02A	03A	04A
Lead	mg//L	0.01	0.18	1.13	0.05
Nitrite	mg/L	30	45	50	35
Nitrate	mg/L	37	25	46	50
chloride	mg/L	131.79	139.72	170.15	166.6
Bucarbonate	mg/L	118.97	106.77	139.72	131.79
Sulphate	mg/L	241.1	292.98	302.98	120.51

Source: Field work, July 2010

Trace metals are measured using Inductive coupled Plasma-Optical Emission Spectroscopy (ICP-OES) with ultrasonic nebulizer (USN), this nebulizer decrease the instrument detection limits by 10%, this instrument is Perkin Elmer Optima 3000, USA.

The above parameters give a clear indication that there is combination of chemical components in the general as well as hospital waste waters. Also, even though the parameters of the hospital waste water appears to be greater than the general waste with the exception of sulphate. That of the final maturation pond appears to have the greatest component of each parameter.

01 A – General Waste Water

02A—Maturation Pond 1

03A— Final Maturation Pond 2

04A-- Hospital Waste Water

4.1.2 Microbiological Examination

This was done to determine the types of bacteria likely to be found in the waste waters. The examination was carried out based on standard significant growth of greater than 10^5. The media used were the Nutrient Agar, Blood Agar as well as Chocolate Agar to give the bacteria fertile ground to grow.

The following bacteria were isolated Salmonella Paratyphi c was isolated in the general waste water, whiles E coli was isolated in the maturation pond. The hospital and the final maturation pond had little growths which were insignificant hence they were not considered. For Salmonella Paratyphi c to be isolated especially on the general waste where children are freely allowed to go and scavenge means that they are exposed to typhoid or enteric fever.

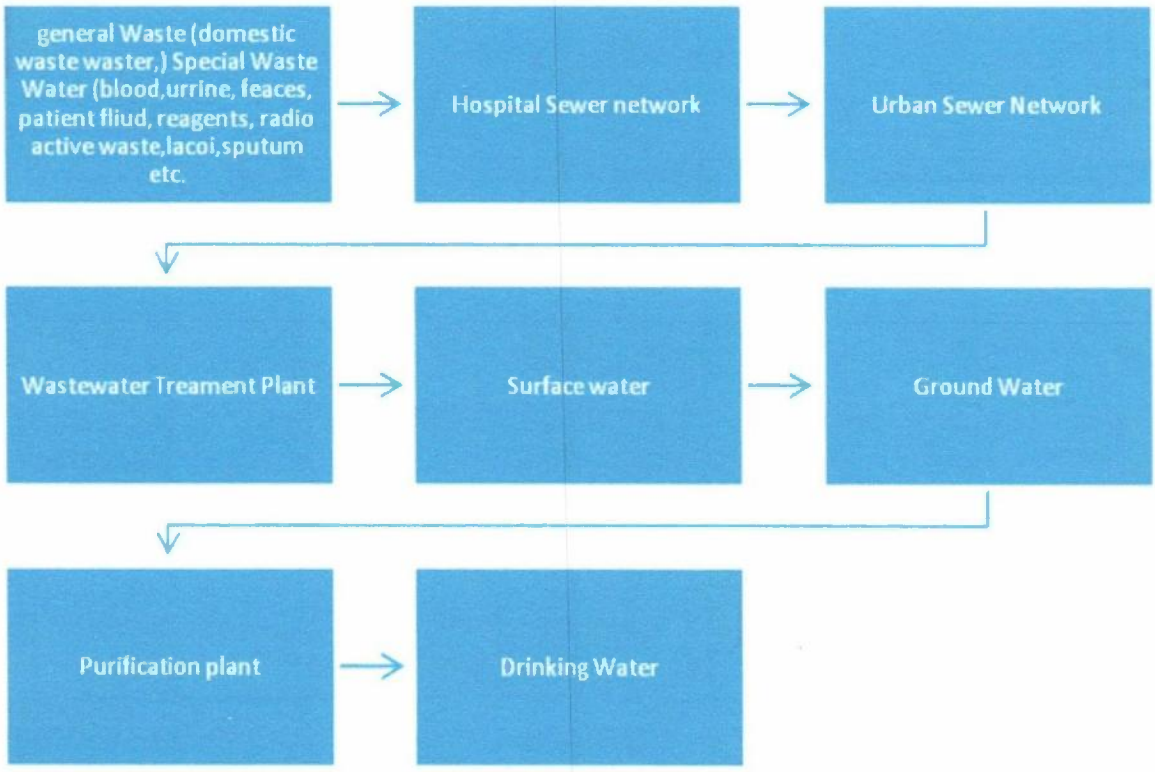

Figure 4.4: Diagramatic Representation of processes of waste water infiltration.

Table 4.9: Awareness of health care waste policy

Existence of policy	Frequency	Valid Percent
Yes	15	21.4
No	36	51.4
Don't know	19	27.2
Total	**70**	**100.0**

Source: Survey, July 2010

The above clearly shows the ignorance of staff about the existence of health care waste management policy. More than half of the respondents were not aware of the existence of this policy or any other policy relating to health care waste management.

Table 4.10: Health facilities and sorting requirements

Sorting before disposal	Name of health facility						Total	
	TTH		TWH		TCH			
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Yes	27	90.0	9	45.0	14	82.4	50	74.6
No	3	10.0	11	55.0	3	17.6	17	25.4
Total	**30**	**100.0**	**20**	**100.0**	**17**	**100.0**	**67**	**100.0**
Where is the sorting done								
Laboratory	9	30.0	4	44.4	4	28.6	17	32.1
Ward	15	50.0	5	55.6	8	57.1	28	52.8
Pharmacy	2	6.7	0	-	0	-	2	3.8
Office	1	3.3	0	-	0	-	1	1.9
Others	3	10.0	0	-	2	14.3	5	9.4
Total	**30**	**100.0**	**9**	**100.0**	**14**	**100.0**	**53**	**100.0**

Source: Survey, July 2010

With respect to the provisions of facilities and alternatives related to the sorting out process. As shown in the table above, 74.6% of the respondents indicated that sorting of waste was done prior to disposal. In Tamale Teaching Hospitals 90% of staff declared that waste was being sorted out before disposal, where as in Tamale West hospital 45% of the staff responded yes which means that the bulk of respondents indicated sorting was not done before disposal. This means that either sorting is not readily done before disposal or majority of the staff of the hospital are not aware sorting out of waste was done. In Tamale Central Hospital 82.4% of respondents indicated that waste is sorted out before disposal.

Also, 52.8% of the respondents suggested that sorting out is done in the ward with about 32.1% showing that sorting was done in the laboratory. This is so because the wards have the greater number in all hospitals. The table also indicates that almost all the sorting out is done at the various departments where the waste is generated and then ready for transportation for internal storage. One significant thing realized in all the hospitals was that staffs were willing to practice this management option but the necessary and suitable containers with codes to aid sorting were not there. Also, supervision and follow up mechanisms for sorting out process was almost none existing in all hospitals.

Table 4.11: Health facilities and types of containers they use

	Name of health facility							
	TTH		TWH		TCH		Total	
Types of container	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**
Plastic bin	11	37.9	10	50.0	8	40.0	29	42.0
Polythene bags	8	27.6	6	30.0	1	5.0	15	21.7
Cardboard boxes	2	6.9	4	20.0	7	35.0	13	18.8
Two	8	27.6	0	-	3	15.0	11	15.9
All	0	-	0	-	1	5.0	1	1.6
Total	**29**	**100.0**	**20**	**100.0**	**20**	**100.0**	**69**	**100.0**
Process before disposal								
Covered plastic containers	15	60.0	6	50.0	11	68.8	32	60.0
Disinfection & Autoclaving	6	24.0	3	25.0	4	25.0	13	25.0
Airtight card boxes	4	16.0	3	25.0	1	6.2	14	15.0
Total	**25**	**100.0**	**12**	**100.0**	**16**	**100.0**	**59**	**100.0**

Source: Survey, July 2010

Table 4.11: above shows the type of containers used by selected hospitals, a total of 42% respondents selected plastic bins as the type containers used, with Tamale West Hospital being the highest user of plastic bin. 21.7% of the respondents confirmed the use of polythene bags for some waste especially waste considered non infectious, while about 18.8% respondents indicated that card boxes were also used for the some waste especially sharp. 1.4% answered that all the categories of waste containers were used in Tamale Central Hospital.

For issues bothering on processing of waste before disposal, 60.4% of the respondents indicated that waste were collected in covered plastic containers, whiles 24.5% of the respondents indicated that some waste were disinfected with chemicals whiles others were autoclaved before Disposal. For instance expired blood and blood products as well as used culture plates from the bacteriology laboratory were autoclaved to about 120 degree Celsius before burying it in designated place in Tamale Teaching Hospital.

Table 4.12: Selected health facilities and colour coding system used

Any colour coding System used	Name of health facility						Total	
	TTH		TWH		TCH			
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Yes	15	50.0	3	15.0	6	35.3	24	35.8
No	15	50.0	17	85.0	11	64.7	43	64.2
Total	**30**	**100.0**	**20**	**100.0**	**17**	**100.0**	**67**	**100.0**
If yes, Please describe								
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Blue plastic containers with lid	1	6.2	0	-	3	60.0	4	15.4
Yellow containers with lid	10	62.5	3	60.0	2	40.0	15	57.7
Black plastic containers with lid	5	31.2	0	-	0	-	5	19.2
Brown plastic container with lid	0	-	2	40.0	0	-	2	7.7
Total	**16**	**100.0**	**5**	**100.0**	**5**	**100.0**	**26**	**100.0**

Source: Survey, July 2010

Table 4.12 shows the colour coding systems used by selected health facilities. About 35.8% of the respondents are of the view that colour coding system is used by the various hospitals. Only 15% of respondents from Tamale West Hospital thought that colour coding system is practiced by the hospital, 50% of the respondents of the Tamale Teaching Hospital are of the view that the colour coding system is used, whiles 35.3% of respondents from Tamale Central Hospital thought that the colour coding system is practiced their hospital. This data shows that little is done by the various hospitals to improve this system of colour codes for waste management; the colour coding system ensures that proper segregation of waste is done, so that wrong waste will not be found in the wrong container.

Also, when respondents were asked to describe special containers used for waste collection, 57.7% of the total respondents indicated that yellow containers were used with the least percentage being 7.7% indicating the usage brown containers. Tamale Teaching Hospital recorded the highest responses of 62.5% for yellow containers, while the Tamale Central Hospital had least responses of about 40%. Blue containers however recorded high responses in Tamale Central Hospital.

It is worthy of notice here that, most staff have little knowledge about the colour coding system as stipulated by both the EPA Guide, 2002 as well as the Ministry of Health policy on health care waste management, this is because there three standard colour indicated in the these policies, these are yellow, black and brown. Blue is not part of the colour codes, yet a good number of the respondents indicated blue as one.

Table 4.13: Methods of waste transportation in the health facilities

Transportation	Frequency	Valid percent
Wheelbarrow	35	53.8
Trolleys	19	29.2
By hand (polythene)	11	16.9
Total	**65**	**100.0**

Source: Survey, July 2010

Table 4.13 shows the methods used to transport waste from internal storage to external storage. 59% of the respondents indicated that waste was manually transported by wheel barrow, while the rest indicated is by hand and by the use of trolleys.

Table4.14: Health facilities and training requirements

Any basic training	Name of health facility							
	TTH		TWH		TCH		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Yes	14	48.3	11	57.9	14	70.0	39	57.4
No	15	51.7	8	42.1	6	30.0	29	42.6
Total	**29**	**100.0**	**19**	**100.0**	**20**	**100.0**	**68**	**100**
Rate of training								
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Monthly	2	14.3	2	18.2	5	33.3	9	22.5
Quarterly	2	14.3	1	9.1	1	6.7	4	10.0
Yearly	2	14.3	0	-	0	-	2	5.0
2 years	2	14.3	3	27.3	3	20.0	8	20.0
3 to 4 years	2	14.3	0	-	4	26.7	6	15.0
Above 5 years	4	28.6	5	45.5	2	13.3	11	27.5
Total	**14**	**100.0**	**11**	**100.0**	**15**	**100.0**	**40**	**100.0**

Source: Survey, July 2010

In relation to the Table 4.14 above the two district health facilities answered yes to basic training, percentage ranged from 57.9% to 70.0% in Tamale West and Central Hospitals respectively. In Tamale Teaching Hospital about 51.7% answered the contrary. This means that more than half of the respondents were of the view the facility does not organise training for staff of the hospital.

With respect to how often training and capacity building programmes were organized for staff, for rate of in-service training, 14.3% answered each for monthly, quarterly, yearly, 2 years, 3-4 years, however, about 28.6% that training were done in the interval of 5 years and above meaning that training programmes are not readily organised for staff on how health care waste is managed, which the health care waste management policy of Ghana encourages.

Table4.15: Health Facilitates and Incinerator use

Does your hospital have an incinerator	Name of health facility						Total	
	TTH		TWH		TCH			
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Yes	14	58.3	9	50.0	14	73.7	37	60.7
No	9	37.5	9	50.0	4	21.1	22	36.1
Don't Know	1	4.2	0	-	1	5.3	2	3.3
Total	**24**	**100.0**	**18**	**100.0**	**19**	**100.0**	**61**	**100.0**
Type of waste to incinerate								
Infectious waste	6	33.3	7	70.0	9	69.2	22	53.1
Sharps	12	66.7	3	30.0	4	30.0	19	46.3
Total	**18**	**100.0**	**10**	**100.0**	**13**	**100.0**	**41**	**100.0**

Source: Survey, July 2010

Table 4.15: shows the proportion of respondents who were aware of their hospital had incinerators or not. About 60.7% of the total population knew their hospitals had and use incinerators. The rest of the respondents who were not aware that their hospital use incinerators also constitute a great number, thus waste that may deserve to be incinerated at individual levels will be added to general waste or discarded in wrong way.

Also, of the number of respondents who were aware of the existence on site incinerators at their various hospitals, 53.1% of them indicated that infectious waste are suppose to be incinerated, whiles 46.3% indicated sharps are suppose to be incinerated.

From the above analysis, it can be seen that more needs to done in the area of policy implementation, this is because it appears that majority of the respondents lack the basic knowledge required to effectively waste management, for instance most respondents thought blue to be part of the colour codes, when indeed is not part.

Table 4.16: Perceptions of staff about types of waste hospitals generate most.

Types of waste	Frequency	Valid Percent
Solid	34	48.6
Liquid	31	44.3
Gas	4	5.7
N/A	1	1.4
Total	70	100.0

Source: Survey, July 2010

In relation to the above Table, staff of the selected hospitals was asked the types of waste the hospital generate most. About 48.6% of staff thought that the types of waste the hospital generate most was solid waste followed closely by liquid and lastly Gas.

Table4.17: Perceived waste by class hospitals generate most

Classes of waste	**Frequency**	**Valid percent**
Only general waste	19	28.8
Only special waste	4	6.1
General & Special waste	43	65.2
Total	**66**	**100.0**

Source: Survey, July 2010

It can be noticed from the above table that, general waste as well as special waste had the highest respond rate of 65.2% with the least being only special waste of 6.1%. Some proportion of staff think that hospitals generates only special waste whereas others think hospital waste is made up of only general waste. This calls for more pre and post or in service training and education on health care waste if proper management has to be achieved. This is because proper classification of health care waste ensures proper sorting of waste which in turns result in better management practices.

Table 4.18: Constituents of Special Waste

Constituent S W	Frequency	Valid percent
Only 1	11	16.4
1, 2 and 5	8	11.9
1 to 3	8	11.9
1, 3, 5 and 6	5	7.5
1to 6	3	4.5
2 to 6	4	6.0
All	28	41.8
Total	**67**	**100.0**

Source: Survey, July 2010

Key: 1= Sharps 2= Pathological waste 3= Infectious waste 4=Radioactive waste 5=Chemical waste 6= Pharmaceutical waste 7= Pressurized waste.

It is observed from the table that, staff who think all the above are special waste has the highest percent of 40% followed by Sharps with 16.4% with the least being pathological waste and pharmaceutical waste. Radioactive waste and pressurized waste were however not considered as special waste. This means that, most staff is ignorant about the fact that pressurized and radioactive wastes are special waste.

Table 4.19: Special waste and departments that generate them

Special Waste	Department																	
	Pharnacy		Lab		RCH Unit		Bloodbank		Dental		Medical ward		ICU		OPD		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Pharmarceutical waste	4	100.0	0	-	0	-	0	-	0	-	4	18.2	0	-	0	-	8	12.1
Sharps and infectious waste	0	-	12	54.5	4	100.0	2	100.0	5	100.0	17	77.3	3	100.0	4	100.0	47	71.2
Pathological waste	0	-	0	-	0	-	0	-	0	-	1	4.5	0	-	0	-	1	1.3
Chemical waste	0	-	3	13.6	0	-	0	-	0	-	0	-	0	-	0	-	3	4.5
At least two of the above	0	-	7	31.8	0	-	0	-	0	-	0	-	0	-	0	-	7	10.6
Total	4	100.0	22	100.0	4	100.0	2	100.0	5	100.0	22	100.0	3	100.0	4	100.0	66	100.0

Source: Survey, July 2010

The table above shows percentage of special waste generated by various departments. It can be seen that laboratory generate almost all the special groups waste with the blood bank being the least producer in the category of sharps and infectious waste. The medical ward appears to be the highest

generator 77.3% of sharps and infectious waste with pharmacy not generating any 0%. Sharps and infectious waste appears is generated by almost all the department except pharmacy.

Table 4.20: Health facilities and special waste

Special waste	Name of health facility						Total	
	TTH		TWH		TCH			
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Pharmaceutical waste	4	13.3	3	15.0	1	6.2	8	12.1
Sharps and infectious waste	19	63.3	15	75.0	13	81.2	47	71.2
Pathological waste	0	-	0	-	1	6.2	1	1.5
Chemical waste	3	10.0	0	-	0	-	3	4.5
At least two of the above	4	13.3	2	10.0	1	6.2	7	10.6
Total	**30**	**100.0**	**20**	**100.0**	**16**	**100.0**	**66**	**100.0**

Source: Survey, July 2010

In relation to the above Table 4.20, in almost all the health facilities, sharps and infectious waste appears to be the most special waste generated with an overall percentage of 71.2 of the total respondents. The least generated is Pathological waste with about 1.5%. Chemical waste appears to be generated in only Tamale Teaching Hospital.

Table 4.21: Infectious potential of special waste

Highest Infectious Potential	Frequency	Valid Percent
Inhalation of aerosols can infect staff and patients	24	46.2
Infectious sharp can prick staff	20	38.5
Some chemicals are poisonous to the body	3	5.8
Air Pollution	2	3.8
Others	3	5.8
Total	**52**	**100.0**

Source: Survey, July 2010

The above table shows perception of staff about infectious potential about the waste they generate. About 46.2% respondents rated Inhalation of aerosols as highest potential of infection, especially from waste such as sputum with positive bacilli are contagious and can be very infectious to patients and staff alike. Pricks from sharps is followed closely with about 38.5% with least being air pollution which can be harmful to the body. Others were of the view that broken testubes as well as bottles could also injury and infection as well.

4.2 Quantities of Waste Generated by the three Selected Hospital in Tamale

During the field study the researcher sought to find out the quantity of waste produced by each health facility a day. The weight, volume and densities of waste were considered. The following results were noticed in the study.

The study showed that the average generation rate was estimated to be about 1.5 kg/bed/day. The following are the breakdowns per hospital.

Table 4.22: Quantity of health care waste in selected Hospitals

Name of health facility	Quantity /Week/Tons	Quantity kg /bed/day
Tamale Teaching Hospital	23	1.3
Tamale Central Hospital	17.3	1.6
Tamale West Hospital	12	1.5

Source: Fieldwork, July 2010

This confirms the EPAs estimates in 2002 the total waste generated by health facilities could be estimated at 1.5kg/bed/days. However, in contrast to the fact that health care waste generation depends on the level of complexity and specialised function performed by the facilities, the teaching hospital seems to produce less solid waste than the two hospitals. This could be due to the fact that, the two hospitals equally have high attendance rate partly due to attention they receive from the staff of the two hospitals and partly due to proximity. These waste ranged from discarded medical plastic, paper, cotton etc.

Quantification of liquid and gas waste was however difficult since the hospital could not tell exactly how much of waste they generate.

Table 4.23: Possibility of recycle or reuse some waste

Recycle or Reuse	Frequency	Valid Percent
Yes	43	64.2
No	15	22.4
Don't Know	9	13.4
Total	**67**	**100.0**

Source: Survey, July 2010

From this Table 4.23, 64.2% of the respondents thought that it was possible to use recycling or reuse as waste management options. Out of this number about 65.1% said their hospital practiced the reuse method by disinfecting used testubes, slides, and culture plates by autoclaving. The practice of recycling is practically non-existing in all the hospitals.

4.3 Collaborations between Health Facilities and the Waste Management Department

The management waste requires a multi-faceted effort between the Ministry of Local Government and Rural Development and Environmental Protection Agency with roles as implementer and regulator respectively. Their authorities are being discharged through the District, Municipal and Metropolitan Assemblies which are directly under the Ministry of Local Government and Rural Development. Thus, health institutions are supposed to collaborate with the Assemblies to ensure proper disposal of health care waste.

What this research sought to do was to assess whether there is effective collaboration between the selected health institutions and the Tamale Metropolitan Assembly on issues relating to the management health care waste. An interview was conducted with the three hospitals using the major stakeholders who were responsible waste management in various hospitals as well as the landfill site manager of the Tamale Waste Management Department. The information gathered in all the hospitals revealed some level collaboration the WMD of Tamale.

For instance, in both the Tamale Central Hospital and Tamale Teaching Hospital it was revealed that the hospital contracts Zoomlion Ghana Limited to carry out the disposal of health care waste for the hospital. Zoomlion is licensed by the Metropolitan Assembly in accordance with the EPA policy guideline. The waste is collected and transported to the landfill for appropriate treatment and disposal. However, the Tamale West Hospital works directly with the Waste Management Department to dispose off their waste also at the landfill.

The waste management expert mentioned financial constraint as one of the major challenges confronting the WMD and the health facilities. The manager confirmed the hospital does not pay any levy for waste disposal, they occasionally give little but not enough to buy kerosene and other deodorants for the treatment and disposal of the waste. Another problem he related to was the difficulty of following the standards related to proper operation of incinerators. For that reason Tamale west Hospital was asked to stop using their incinerator since they are not following the required standards. An interview with The Tamale West Hospital Administrator revealed the contrary which means that there is a missing link between the hospital and the WMD. For this challenges to be resolved he suggested that collaborative meetings to held periodically to discuss issues relating the best disposal method.

CHAPTER FIVE

Conclusions and Recommendations

5.0 Conclusion

The research conducted showed a clear weakness on how health care wastes is managed at the various hospitals. Also, it showed the defects involved in the policy implementation.

Effectiveness and efficiency of the waste management policy

It was realized that most respondents were not aware of any waste policy. The supervisor of the Tamale Landfill site was not also aware of such a policy. This resulted in most people not having knowledge about most of the vital components of the policy. There is also no legislation that addresses the management of health care waste in Ghana. Furthermore, there is no bye-law in the Tamale Metropolis to regulate the management of health care waste.

Sorting out and Collection Methods

Sorting out of waste although known by majority of the people, was not readily practiced as required by the Ministry of Health and EPA guideline. Most staffs do not have adequate information about the composition of the waste they generate. Poor sorting out procedures were also observed in all hospitals. Thus infectious and non infectious wastes were mixed in some departments visited. Also, most people declared that sorting was done close to the waste generation site which was positive. Sharps are collected in airtight boxes and incinerated. Lastly, all the three hospital have and use incinerators to treat some of their waste.

Colour Coding

Majority of staff were not very conversant with the colour coding system. For those who answered yes a lot of them indicated blue as part of the colour which is not true. In all the hospitals waste was collected early morning before the start of the day to an internal storage place before disposal.

Training and Capacity Building

The study also showed weaknesses regarding the welfare responsibility on the part of management. Thus, it takes management of the hospital long time to organise training and capacity building programmes on health care waste for staffs, hence staff are not abreast with the changing trends and new policies on health care waste management. This may be due to the fact that even in the MoH Policy and Guidelines for health institutions, no stipulated time period is given for which staff must be trained. Furthermore, even though the policy encourages public education, the contrary is that most staff are not aware of it existence which defeats it purpose.

Transportation

Waste was collected and transported manually by hand or by uncovered wheel barrows and trolleys to the external storage site exposing staff and other patients to risk of contamination.

Classification of Health Care Waste

In terms of the classification of health care waste, it was realized that most staff were not conversant with standard ways of classifying health care waste. Thus, some were of the view that health care waste was made up of only special waste, while others thought it was made up of only general waste.

Effects of health care waste

Although staff of the various hospitals admitted health care waste was harmful to their health, the people of Gbalahi, the community where the landfill is sited equally have their share of the effects.

Some effects noted in the course of the study were;

- Health care waste such as sharps, expired drugs that should be incinerated or neutralised before disposal. Unfortunately it is disposed off at the landfill site where people especially children have free access to scavenge for this waste.
- The construction of the landfill in the community has resulted in the breeding of flies and mosquitoes in the community resulting in rampant diseases such as malaria, diarrhoea etc.
- Most waste vehicles do not have covers which is very dangerous.

- Almost all the waste vehicles do not have inscriptions posted on them to indicate they are carrying heath care waste.

Quantity of health care waste

The research also confirmed that the quantity of HCW is indeed increasing as the EPA Guidelines for Management of Health Care waste suggested. All the hospitals generated both general and special waste at different rates and with different compositions.

Collaborations:

Management of Hospitals and Tamale Waste Management Department (TWMD)

In the cause of the research, it was revealed that collaboration existed but was not entirely the best. The Tamale Metropolitan Assembly helps the various hospitals to treat and disposed off their waste at no cost, except for some token for kerosene and deodorants which is woefully inadequate. In some cases, where new treatment facilities that need approval from WMD are involved, the hospitals do not contact the Metropolitan Assembly for advice before use.

In summary, the various stage of management of HCW does not correspond with WHO requirement.

5.1 Recommendations

The study revealed a lot of weaknesses in the way HCW is being managed. Thus the recommendation seeks to suggest ways and means to contribute to improving standards and efficiency of managing health care waste.

Hospital Management

The hospital management should ensure that the following are adhered to;

Strict Sorting out procedures

- Staff must be empowered to understand how HCW is classified in relationship to the national and international policies.
- Sorting out is the life line to good management of HCW. Sorting out standards and protocols must strictly be followed and applied. There should be more monitoring and supervision to ensure that instructions are followed to the latter. This will help reduce waste

at source and reduce occupational health hazards as infectious and non infectious waste will be given the requisite treatment they deserve.

- To effectively aid proper waste segregation, colour coding system must be enforced so that infectious and non infectious waste will be put in their appropriate colour coded containers to aid easy identification.

- The Integrated Waste Management (IWM) can be factored in designing training programmes to exploit the benefits of recycling which most nations are now practicing.

Labour Welfare and Safety

As regards labour and safety, the management of various hospitals should ensure constant and proper education as well as training programmes for all categories of health staff ranging from the Doctor to the Orderlies to understand the risks involved in at all level of their work regarding health care waste. Needs assessment must also be conducted to determine the training requirement needed before commencement of training. It must also embody the local needs, for instance, or where in the absence of certain required facilities for treatment staff should be trained on how to use local material to improvise.

Tamale Metropolitan Assembly/Waste Management Department

Community Safety is paramount, thus TMA/WMD must put the following measures in place

- The waste management department must liaise with Environmental Protection Agency to ensure health care waste treatment procedure and guidelines are strictly adhered to. This can be done by constant monitoring and evaluation.

- The Metropolitan Assembly must consider establishing a clinic in the community to help with potential threats and diseases that waste poses to the community.

- The road should be tarred to reduce the negative impact the dust has on them.

- TMA and the Waste Management Department must ensure all waste vehicles have proper covers enough to prevent any nuisance to the public.

- The security at the landfill site should be improved so as to prevent people and children alike from scavenging on the landfill.

- The community must constantly be sprayed to prevent the breeding of mosquito and other insects.

- The assembly must consider enacting a bye-law for the management of health care waste

When hazardous waste is dumped at the landfill site it should be treated or burnt immediately to prevent people scavenging for them.

The Gbalahi Community

The people of Gbalahi must be constantly educated on the harmful effects of health care waste and dangers related to the landfill.

- Parents must discourage their children from going to the landfill site to scavenge for things, especially metals to sell as scraps.

- Members of the community should be advised to cover their foods and water to prevent flies and other insect from hovering around them.

Environmental Protection Agency (EPA)

Since the EPA is mandated to develop guidelines and standard operating procedures for firms and individuals alike to follow, they must:

- Collaborate with the TMA/WMD and the health institutions to design their institutional health care waste policies and must follow up to ensure compliance.

- Must champion the education of the general public on the likely risk they are exposed to health care waste.

Ghana Government

- The Ministry of Health should allocate a special budget to the management of health care waste in Ghana
- There is the need for a national legislation on health care waste as a base for improving healthcare waste practices in Ghana. This will enable agencies responsible for the disposal of

healthcare waste such as the Ministry of Health, Environmental Protection Agency and Ministry of Environment Science and Technology to put pressure for their implementation.

- There should be a clear designation of responsibilities before the law is enacted. This is to avoid duplication of efforts between institutions.

Collaborations

The Ministry of Health/Ghana Health Service, Metropolitan Assemblies and Management of hospital must hold periodic meeting to deliberate on measure to adopt to ensure proper management of Health care waste. The assembly in collaboration with the health facilities must develop health care waste policy for The Metropolis. There should also enact bye-law to regulate the management of HCW.

Lastly there should special budgetary allocation to constantly maintain facilities that are used for HCW treatments. Also Health institutions must be responsible to the waste they generate and be ready to pay for its management.

The Ministry of Health/Ghana Health Service, Metropolitan Assemblies and Management of hospital and other agencies should intensify campaigns so as to increase the awareness on the importance of proper management of Health Care Waste to the hospital staff and the public as whole.

To sum up, various stakeholders must ensure that the management of HCW conforms to the World Health Organisation's Standards.

Further Research

To further address the challenges, more research must be conducted in the area of health care waste especially liquid and gas waste which by their nature are very difficult to quantify and yet very dangerous to our health.

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APPENDIX I

UNIVERSITY FOR DEVELOPMENT STUDIES

MASTER OF ARTS IN ENVIRONMENTAL SECURITY AND LIVELIHOOD CHANGE QUESTIONNAIRE TO ASSESS THE LEVEL OF KNOWLEDGE OF PEOPLE OF GBALAHI ON CLINICAL WASTE MANAGEMENT AND ITS IMPACT.

ID number.....

1. Age

   15 -25 [ ] 26-34 [ ] 35-45 [ ] 46-54 [ ] 55-65 [ ] 66-74 [ ]

2. Sex Male [ ] Female [ ]

3. Occupation Public Servant [ ] Famer [ ] Trader [ ] Others [ ]

4. Level of education

   Non [ ] Primary [ ] JHS [ ] SHS [ ] Tertiary [ ]

   others .....

5. Marital Status Married [ ] Single [ ] Separated [ ] Widowed [ ]

6. Are you aware of the landfill sited in this community? Yes [ ] No[ ]

7. How long has it been in existence? 1-5 year [ ] 6-11 years [ ] 12- 17 [ ]

   18-22 [ ] 23- 26 [ ] Don't know [ ]

8. What was the land used for prior the construction of the landfill?

   Nothing [ ] Farming [ ] Hunting [ ] Conserved [ ]

9. Was there any compensation giving after the land was taken?

   Yes [ ] No [ ] Don't Know [ ]

10. If yes, what was it.....

11. Are you aware waste is been dumped at the landfill?

    Yes [ ] No [ ] Don't Know [ ]

12. Do you know the type of waste that are dumped there ? Yes [ ] No [ ]

13. If yes, what are they? .....

14. Have you ever been to the hospital or a clinic before Yes [ ] No [ ]

15. Do you know that they also generate waste?

Yes [ ] No [ ] Don't Know [ ]

16. Are you aware that these waste are dumped at the landfill ?

Yes [ ] No [ ] Don't Know [ ]

17. Are these waste harmful to your health?

Yes [ ] No [ ] Don't Know [ ]

18. If yes, how? .....

19. Estimate the average number of times waste vehicles ply your road in a day

1-2 [ ] 3-4 [ ] 5-6 [ ] 7- 8 [ ] 9-10 [ ]

20. Are the vehicles carrying the waste to the landfill having enough covers?

Yes [ ] No [ ] Sometimes [ ] Don't Know [ ]

21. Does it cause any discomfort to you?

Yes [ ] No [ ] Don't Know [ ]

22. What kind of Discomfort? Tick all that apply

Dust [ ] waste are scattered [ ] Odor [ ] Others [ ]

23. Does people scavenge on the landfill? Yes [ ] No [ ]

24. Do children roam around the landfill? Yes [ ] No [ ] Dont Know [ ]

25. Do they scavenge for things on the landfill. Yes [ ] No [ ] Dont Know [ ]

Any additional comment

.....

.....

APPENDIX II

UNIVERSITY FOR DEVELOPMENT STUDIES

MASTER OF ARTS IN ENVIRONMENTAL SECURITY AND LIVELIHOOD CHANGE QUESTIONNAIRE TO ASSESS THE LEVEL OF KNOWLEDGE OF HEALTH CARE WORKERS ON CLINICAL WASTE MANAGEMENT AND ITS IMPACT.

ID No.....

1. Name of Health facility

   .....

2. Age

   15 -25 [ ] 26-34 [ ] 35-45 [ ] 46-54 [ ] 55-65 [ ] 66-74 [ ]

3. Sex Male [ ]Female [ ]

4. Occupation, what category

   .....

5. Level of education

   Non [] Primary [ ] JHS [ ] SHS [] Tertiary []

   others .....

6. How long have you worked in this hospital

   1-5 [ ] 6-11 [ ] 12-17 [ ] 18-22 [ ] 23-27 [ ] 28 and above [ ]

7. What is your current job title

   .....

   If a waste handler/orderly skip to question 18

8. In which department do you work

   ?.....

9. What are the types of waste the hospital generate most. Tick all that apply

Solid waste [ ] Liquid waste [ ] Gas [ ] Don't Know [ ]

11 A you aware of any health care waste management policy?

Yes [ ] No [ ] Don't Know [ ]

10. What class of waste does the hospital generate

Only General waste [] Only Special waste [ ] General &Special waste []

Don't Know [ ]

11. What does general waste constitutes

Kitchen waste [ ] used stationery [ ] others.....

12. What does special waste constitutes, Tick all that apply.

Sharps [ ] Pathological waste [ ] infectious waste [] Radioactive waste []

chemical waste [ ] Pharmaceutical waste [ ] Pressurized waste [ ] Don't know [ ]

13. Which of the above waste by type does your department or unit generate

most.....

14. Does it require sorting out before disposal?

Yes [ ] No [ ]

15. Where is the sorting out done

16. Laboratory [ ] Ward [ ] Pharmacy [ ] Office [ ]

17. Briefly explain the processes it goes through prior to disposal

.....

18. What type of containers are used for the segregated waste

Plastic containers [ ] Metal container [ ] Card board boxes [ ]

19. Is any color coding system used

Yes [ ] No [ ]

20. If yes, please describe

.....

.....

21. Is it possible to recycle or reuse some of the waste you generate?

22. Which of the above method do you practice?

Reuse [ ] Recycle [ ]

23. Does the waste you generate poses any threat to your health?

Yes [ ] No [ ]

24. How? .....

Does your hospital have incinerator

Yes [ ] No[ ]

25. What type of waste do you incinerate.....

26. Do you have any basic training on how clinical waste is handled

Yes [ ] No [ ]

27. If yes, how often

Monthly [ ] Quarterly [ ] yearly [ ] 2 years [ ] above 5years [ ]

Others .....

28. Do you use any protective clothing during waste handling yes [ ] No []

29. Which of these do you use, tick all that apply Gloves [ ] Goggles [ ] Mask []

Coat [ ] Wallington boot [ ]

30. What type of container do you use for collection?

Plastic bin [ ] Polythene Bags [ ] Card Board Boxes [ ]

31. How do you transport the waste? Trolleys [ ] Wheel Barrow []

Others, please specify.....

32. Where is the waste stored before final Disposal

.....

33. Where is the waste finally disposed

Landfill site [ ] Buried in the hospital premises [ ] Incinerated [ ]

APPENDIX III

UNIVERSITY FOR DEVELOPMENT STUDIES

MASTER OF ARTS IN ENVIRONMENTAL SECURITY AND LIVELIHOOD CHANGE QUESTIONNAIRE TO ASSESS THE LEVEL COOPERATION BETWEEN MANAGEMENT OF HOSPITAL AND WASTE MANAGEMENT DEPARTMENT OF TAMALE OF ON CLINICAL WASTE MANAGEMENT.

1. Name of health facility

   .....

2. Type of health care facility

'eaching Hospital [ ] Regional Hospital [ ] District Hospital [ ] Sub District [ ]

Health Center [ ] others please specify.....

3. Average bed occupancy per week.....
4. Average daily admissions.....
5. Average daily outpatient attendance .....
6. Are you aware of any existing or current health care waste policy?

   Yes [ ] No [ ]

7. If yes ,tick all that apply.

   National [ ] Regional [ ] District [ ]

8. Does the hospital has its own policy on health care waste management.

   Yes [ ] No [ ]

9. How are waste classified in this hospital .....
10. What quantity of waste per type is produced by your health facility per week?

Solid.....

Liquid .....

Gas .....

11. How is this quantity measured.....

12. What are the types of waste that are produced in your facility.

13. How should this waste be handled in terms of

Collection .....

Transportation .....

Storage .....

Treatment .....

Disposal. .....

14. Who handles the waste in your facility?

15. What is their level of education .....

16. Have the waste handlers undergone any training on health care waste management methods

17. How often.....

18. Is the waste handler using any protective clothing?

Yes [ ] No [ ]

19. If yes state them.....

20. What types of containers is used for collection and transportation?

.....

.....

21. Is any segregation done prior to storage?

Yes [ ] No [ ]

22. Where is the segregated waste stored before disposal?

.....

23. Is your hospital having incinerator. Yes [ ] No [ ]

24. Which type of waste is incinerated?

.....

25. How is the incinerator ash disposed? .....

26. Is the waste disposed on-site in the hospital or in a landfill?

27. If at the landfill do you pay any levy for the disposal? Yes [ ] No [ ]

28. Which type of waste is disposed off in the landfill?

.....

29. Which type of waste is disposed on-site?

.....

30. Does the hospital contract some private organization to do the disposal for them?

Yes [ ] No [ ]

31. Is there any collaboration between the hospital and the metropolitan assembly with respect to waste management?

Yes [ ] No [ ] Don't Know [ ]

32. If yes, please explain

.....

.....

APPENDIX IV

UNIVERSITY FOR DEVELOPMENT STUDIES

MASTER OF ARTS IN ENVIRONMENTAL SECURITY AND LIVELIHOOD CHANGE QUESTIONNAIRE TO ASSESS THE LEVEL OF COLLABORATION BETWEEN WASTE MANAGEMENT DEPARTMENT OF TAMALE AND HOSPITALS ON CLINICAL WASTE MANAGEMENT.

1. Role of Tamale Waste Management Department in clinical waste management

   .....

2. What are the types of waste hospitals produce

   .....

3. How should the various types be handled in terms of

   Collection

   .....

   Treatment

   .....

   Transportation

   .....

   Disposal

   .....

4. How do you measure the various types quantity of this clinical waste?
5. Are you aware of any clinical waste management legislation?

   Yes [ ] No [ ]

6. If yes, please state .....

7. Are you aware of any document outlining clinical waste management policy

   Yes [ ] No [ ]

8. If yes, can you please state the name.....

9. Are there any bye-laws on clinical waste management in the metropolis ? Yes [ ]

   No [ ]

10. If yes, when was it enacted .....

11. If no. what is the waste management department doing about it.

12. How is the waste management financed in the metropolis.....

13. Is there any special allocation for the management of clinical waste?

    Yes [ ] No [ ]

14. If No, what policies should be put in place to finance clinical waste

.....

15. Are the various health facility meeting the expectations of the WMD

    Yes [ ] No [ ]

16. What are the challenges facing the WMD in respect to clinical waste.

17. How can these challenges be resolved

    .....

    .....

18. Is the metropolis having a landfill? Yes [ ] No [ ]

19. In which community is it sited?

    .....

20. How many meters away from the nearest village?.....

21. How long has the landfill been in existence?

.....

22. Is clinical waste disposed at the municipal landfill site with normal waste?

23. Are the hospitals levied for the waste disposal? Yes [ ] No [ ]

24. If yes, is there any specially demarcated area for this waste.

Yes [ ] No [ ]

25. Are there any other dumping sites apart from the landfill?

Yes [ ] No [ ]

26. Are there any complaints by the community near the landfill or dumping sites about any form of nuisance caused as result of waste? Yes [ ] No [ ]

27. If yes, what is the department doing about it.

.....

Any other comment in relation to waste management?

.....

.....

.....

APPENDIX V

A cross-section of anaerobic and facultative Pond for liquid waste for sludge settlement at the Tamale engineered Sanitary Landfill site.

APPENDIX VI

Maturation Pond (Final) where germs are killed to keep the water safe at the Tamale engineered Sanitary Landfill site.

APPENDIX VII

A section of the landfill site with a gas vent through which methane escapes into the atmosphere in the Tamale engineered landfill site.