KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

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DEPARTMENT OF THEORETICAL AND APPLIED BIOLOGY

MEDICAL WASTE MANAGEMENT PRACTICES AND ATTITUDES OF SOME HEALTHCARE WORKERS AT TEMA AND THE ENVIRONMENTAL IMPLICATIONS

A THESIS PRESENTED TO THE DEPARTMENT OF THEORETICAL AND APPLIED BIOLOGY IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE M.Sc. (HONS) DEGREE IN ENVIRONMENTAL SCIENCE

BY

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DECLARATION AND CERTIFICATION

I hereby declare that this submission is my own work towards the Master of Science (Msc) degree, and that , to the best of my knowledge it contains no material previously published by another person or material which has been accepted for the award of any other degree of the university ,except where due acknowledgement has been made in the text .

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ABSTRACT

The main objective of the study was to determine the waste management practices, awareness and attitudes of healthcare workers at selected Hospitals in Tema. Structured questionnaires were employed to collect data from 213 staff at Tema General Hospital, 125 staff at Tema Polyclinic and 76 staff at Manhean Health Centre alongside direct observation. The quantity of waste generated was estimated as 1.399 Kg /patient/day, 0.291Kg/patient/day and 0.23/patient/day at Tema General Hospital, Tema Polyclinic and Manhean Health Centre respectively. At Tema General Hospital and Tema Polyclinic segregation and containment was the most frequently used waste management facility whilst at Manhean Health Centre containment and burning was the most frequently used facility for waste management. A very large portion of the respondents at Tema General Hospital (97.18%) and Manhean Health Centre (82.89%) indicated that waste bags awaiting collection were safely stored away from the public, however, more than half (57.6%) of the respondents at Tema Polyclinic reported that waste bags awaiting collection were not safely stored away from the public. It was observed that, all three Health institutions had no facilities for external storage, hence, waste awaiting collection were not inaccessible from the environment. The greater portion of respondents from Tema General Hospital (94.84%) indicated that they used a colour code for waste disposal as against 76% and 84.21% of respondents from Tema Polyclinic and Manhean Health Centre respectively who reported that they do not use a colour code for waste disposal. It was observed that the final disposal site for all three Healthcare facilities was the Kpone landfill. None of the health institutions surveyed treated its wastes before disposal into the municipal dumpsites. A visit to the landfill revealed that medical waste was mixed with municipal waste, dumped directly on the site and burnt together in the open air. Additionally there were several scavengers at the dump sites. Thus the mode of disposal creates conditions that pollute the environment and risk public health. Generally, few staff were aware and had access to the Ministry of Health Policy and Guidelines for medical waste management. Even though majority of respondents from Tema General Hospital (95.77%), Tema Polyclinic (83.2%) and Manhean Health Centre (93.42%) reported that they would like to attend programmes on hospital waste management, the vast majority of respondents at Tema Polyclinic (84%) and Manhean Health Centre (90.79%) reported that they had not undergone any training on medical waste management, however, more than half of respondents at Tema General Hospital (58.22%) had undergone training. Most of the respondents from Tema General Hospital (59.62%) and Tema Polyclinic (53.6%) disagreed that 'safe management of health care waste is an extra burden on work' however, majority of the respondents at Manhean Health Centre (52.63%) agreed. There is therefore the need to increase training in conjunction with provision of facilities to enhance medical waste management as well as improving our attitudes towards maintenance of such facilities.

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Glossary of Abbreviations

World Health Organisation	WHO
United Nations Environmental Programme	UNEP
Ministry of Health	MOH

CHAPTER ONE

1.0 INTRODUCTION

"Recent events in major urban centres in Africa have shown that waste management has become a problem that has canceled the efforts by city authorities, states and federal governments and professionals alike" (Onibokun and Kumuyi, 1999). "The link between the speed with which cities have grown over the last few decades and the extent of the environmental hazards for its population is likely to be unproven. This is because many of the fastest growing cities are also the cities with the fastest growing economies and the cities where investments have been made in improving provision for pipe-borne water, sanitation, drainage, garbage collection and health care" (Satterthwaite, 1998).

The state of precariousness characterizing the management of urban wastes including biomedical pollutants in developing countries has been attributed to a multiplicity of factors chief amongst them is the phenomenon of rapid urbanization. Generally, many developing countries experience rapid urbanization due to the combined effects of high birth rates, reclassification of rural areas into urban centres and migration from rural areas (Potter, 1994; Pugh, 2000; Visaria, 1997).

Even though urbanization is not a new phenomenon in Africa, the current pace of uncontrolled and unplanned urbanization has resulted in an enormous amount of liquid and solid wastes being produced, so much that these wastes have long outstripped the capacity of city authorities to collect and dispose of them safely and efficiently (Porter and Boakye-Yiadom, 1997).

The growth of the medical sector around the world over the last decade (WHO, 2002; Karamouz *et al.*, 2007) combined with an increase in the use of disposable medical products has contributed to the large amount of medical waste being generated (Silva *et al.*, 2005).

Kendie (1999) also argued that, the recent increase in waste disposal problems stems from the fact that, "attitudes and perceptions towards wastes and the rating of waste disposal issues in peoples' minds and in the scheme of official development plans have not been adequately considered". One estimate shows that some 5.2 million people (including 4 million children) die each year from waste-related diseases (Akter, 2000).

Medical wastes, due to its hazardous nature, pose serious threats to environmental health (Klangsin and Harding, 1998; Levendis *et al.*, 2001). The hazardous substances consist of pathological and infectious material, sharps e.g. needles and chemical wastes (Askarian *et al.*, 2004; Henry and Heinke, 1996). In hospitals, different kinds of therapeutic procedures (i.e. cobalt therapy, chemotherapy, dialysis, surgery, delivery, resection of gangrenous organs, autopsy, biopsy, para clinical test, injections etc.) are carried out and result in the production of infectious wastes, sharp objects, radioactive wastes and chemical materials (Prüss *et al.*,1999). Medical waste may transmit germs of diseases such as hepatitis B and AIDS. In developing countries, medical waste has not received much attention and it is disposed of together with domestic waste (Almuneef and Memish, 2003; Patil and Pokhrel, 2005).The waste produced in the course of healthcare activities "carries a higher potential for infection and injury than any other type of waste. Therefore, wherever it is generated, safe and reliable methods for its handling are essential. Inadequate and inappropriate handling of healthcare waste may have serious public health consequences and a significant impact on the environment" (Giroult, *et al.*, 1999).

Mismanagement of healthcare waste poses health risks to people and the environment by contaminating the air, soil and water resources. Hospitals and healthcare units are supposed to

safeguard the health of the community. However, healthcare wastes if not properly managed can pose an even greater threat than the original diseases themselves (PATH, 2009).

Estimates on the amount and types of clinical waste produced by healthcare establishments vary, in no particular order, according to clinics, health centres and hospitals depending on the size and capacity (number of beds) and types of services on offer. The inclusion of other factors such as country, location of the facility (remote or urban) and access in terms of roads further compounds this variability. A joint report by the WHO and the World Bank stated that small rural clinics generate small amounts of waste, usually <10 kg of sharps per month; small district hospitals generate 1 kg/bed/day; general hospitals generate 2 kg/bed/day while tertiary or major teaching hospitals generate 4 kg/bed/day (WHO and World Bank, 2005).

Between 15% and 35% of Hospital waste is regarded as infectious waste. This range is dependent on the total amount of waste generated (Glenn and Garwal, 1999). These wastes now threaten the public since, healthcare foundations are situated in the heart of the city and therefore medical wastes, if not properly managed can cause dangerous infections and pose a potential threat to the surrounding environment, persons handling it and to the public. Health and environmental effects, uncertainty regarding regulations and negative perceptions by waste handlers are some important concerns in healthcare waste management in a country (Freeman, 1998).

The sustainable management of healthcare waste has continued to generate increasing public interest due to the health problems associated with exposure of human beings to potentially

hazardous wastes arising from healthcare (Tudor *et al.*, 2005; Ferreira and Veiga (2003); Da Silver *et al.*, 2005).

Wastes produced in healthcare facilities in developing countries have raised serious concerns because of inappropriate treatment and disposal practices (Diaz *et al.*, 2005). An increase in the understanding of health hazards posed by poorly managed healthcare waste has influenced many countries to develop national and local strategies in an effort to better manage their waste (Al-Zahrani *et al.*, 2000). In developing countries, hospital waste has not received sufficient attention. In many countries, hazardous and medical wastes are still handled and disposed of together with domestic waste, thus creating a great health risk to municipal workers, the public, and the environment (Bdour *et al.*, 2006).

A considerable gap exists with regard to the assessment of healthcare waste management practices. The nature and quantity of healthcare wastes generated as well as institutional practices with regards to sustainable methods of healthcare waste management, including waste segregation and waste recycling are often poorly examined and documented in several countries of the world despite the health risks posed by the improper handling of healthcare waste (Farzadika *et al.*, 2009; Oke, 2008).

The World Health Organization estimates that each year there are between 8 and 16 million new cases of Hepatitis B virus (HBV), 2.3 to 4.7 million cases of Hepatitis C virus (HCV) and 80,000 to 160,000 cases of human immune deficiency virus (HIV) due to unsafe injections and mostly due to very poor waste management systems (WHO, 1999; Townend and Cheeseman, 2005).

Even though reliable records of the quantity and nature of healthcare wastes and the management practices to adequately dispose of these wastes has remained a challenge in many developing

countries of the world, it is believed that several hundreds of tons of healthcare waste are deposited openly in waste dumps and surrounding environments, often alongside non-hazardous solid waste (Alagoz and Kocasoy, 2007; Abah and Ohimain, 2010).

According to the Ghana Health Services, 2002, medical wastes generated in Accra was estimated to be 5.2 tons per day (not including all private health care facilities) and this implied that over 1850 tons of health care wastes were generated annually with over 330 tons being potentially hazardous, given the assumption that 18% of waste generated was hazardous.

There is no specific law that deals with healthcare waste management in Ghana; the existing laws and policies assign certain functions to certain institutions such as the Environmental Protection Agency (EPA) and district assemblies through EPA Act 490 (1994) and the national sanitation policy (1999) (Ghana MOH, 2006).

However, there were no explicit provisions for dealing with healthcare waste in a comprehensive manner, hence, in 2006; the issue attracted the attention of the Ministry of Health which prepared a policy and guidelines for health institutions in Ghana (Ghana MOH, 2006). The policy seeks to "ensure that healthcare waste is managed effectively in compliance with existing laws and regulations and others to be passed in the future in order to protect healthcare workers, their clients (patients, care givers and visitors) and the environment from potentially disease causing waste materials". There is however very little documentation on the efficiency of this policy in Ghana.

1.2 Objectives of Study

The main objective of the study was to determine the waste management practices, awareness and attitudes of health care workers at selected Hospitals in Tema.

The specific objectives of the study were to:

- determine the type and quantity of waste generated at the selected hospitals
- determine the modes of disposal of these wastes
- determine the environmental implications
- evaluate the awareness regarding the waste management policy of the Ministry of Health of Ghana through observation and the use of structured questionnaires
- evaluate the awareness and attitudes of the healthcare workers on the modes of disposal and management of these waste.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Definition of Medical Waste

A waste is a discarded material, which has no value to the one who disposed of it. Once another person picks it up and puts it to use it becomes a resource (Botkin and Keller, 2003). "Very broadly medical waste is defined as any solid or liquid waste that is generated in the diagnosis, treatment or immunization of human beings or animals, in research pertaining thereto, or in the production or testing of biologicals" (BAN and HCWH, 1999). Many synonyms to medical waste exist, and they are currently used interchangeably (Moritz, 1995) in different parts of the world and in different scientific journals. Some of the common synonyms are clinical waste, hospital waste and bio-medical waste. Al-Mutair *et al.* (2004) defined clinical waste as any solid or liquid waste, capable of causing infectious diseases, generated as a result of patient diagnosis, treatment and through the immunization of humans or animals or in related research. Phillips (1999) defined clinical waste as waste arising from the investigation, treatment or medical care of patients, while Abor and Bouwer (2008) focused their definition to include all types of wastes produced by health facilities such as general hospitals, medical centres and dispensaries. World Health Organization (WHO, 1999) defines healthcare waste as total waste generated by hospitals, healthcare establishments and research facilities in the diagnosis, treatment, or immunization of human beings or animals and other associated research and services.

2.2 Classification of Medical Waste

According to Eigeheer and Zanon (1991), medical waste may be classified according to their liquid and solid state as well as their sources and risks posed (Table 1).

Table 1: Classification of medical waste

TYPE	TYPICAL EXAMPLES
Liquid Wastes	
Biological waste	Blood, excrement, body fluid etc.
Chemical waste	Solutions, inorganic salts etc.
Over-date medicines	Over-date drugs, unused drugs
Radioactive waste	Wastes from radiology (iodine 125, Iodine 131 etc.)
Solid Wastes	
Perforating and cutting wastes	Needles, syringes, scalpels, blades, broken glass, vials
Non-perforating and non-cutting wastes	Wastes from treatment (dressings, stool napkins, plaster cast etc.)
	Parts of the body: organs, placentas, tissue etc.
	Household-type wastes: other wet and dry waste
	Over-date medicines (Expired drugs)

Source: Eigeheer and Zanon (1991)

The basic new issue in the classifications of healthcare waste is the unified approach, which requires the classification of waste on the basis of hazardous characteristics and point of production (Costa-Font. *et al.*, 2008), In this respect, the unified approach recognizes only two types of health care wastes, hazardous and non-hazardous regardless of the waste category.

The hazardous healthcare waste can be categorized into different groups as presented in Table 2.

Table 2: Healthcare waste categories and description

Waste category	Description and examples
Infectious waste	Waste suspected of containing pathogens e.g. laboratory cultures, waste from isolation wards, tissues, materials or equipment having been in contact with infected patients, excreta
Pathological waste	Human tissue or fluids e.g. body parts, blood and other body fluids, human fetuses
Sharps	Sharp waste e.g. needles, infusion sets, scalpels, knives, blades, broken glass, etc.
Pharmaceutical Wast	Waste containing pharmaceuticals e.g. pharmaceuticals which are expired or no longer needed, items contaminated or containing pharmaceuticals (bottles, boxes)
Genotoxic waste	Waste containing substances with genotoxic properties e.g. waste containing cytotoxic drugs (often used in cancer therapy), genotoxic chemicals
Chemical waste	Waste containing discarded chemical substances e.g. laboratory reagents, film developer, disinfectants which are expired or no longer needed, solvents
Wastes with high content of heavy metals	e.g batteries, broken thermometers, blood pressure gauges
Pressurized Containers	e.g. gas cylinders, cartridges and aerosol cans
Radioactive waste	Waste containing radioactive substances e.g. unused liquids from radiotherapy or laboratory research, contaminated glassware, packages or absorbent paper, urine and excreta from patients treated or tested with unsealed radionuclides

Source: WHO (1999)

2.3 Nature of Medical Waste

The World Health Organization suggests that around 80% of clinical wastes are non-hazardous (comparable to domestic waste), 15% are infectious (cultures and stocks of infectious agents, wastes from infected patients, wastes contaminated with blood and its derivatives, discarded diagnostic samples, infected animals from laboratories, and contaminated materials and equipment) and anatomic (recognizable body parts and carcasses of animals) wastes and the remaining 5% is made-up of sharps (1%), toxic chemicals and pharmaceuticals (3%) and genotoxic and radioactive waste (1%) (WHO, 2007). These traditional estimates, according to Azage and Kumie (2010), are not consistent for many developing countries. According to them, 25% of clinical waste produced in Pakistan is hazardous, 26.5% in Nigeria and 2-10% in other sub-Saharan Africa countries. Manyele and Lyasenga (2010) stated that urban health centres in Tanzania generate 50% of the country's clinical hazardous waste. Sakar *et al.* (2006) identified higher clinics and diagnostic centres as being responsible for 36.03% of hazardous clinical waste produced in Bangladesh. Recording daily hospital averages of clinical waste, including the specific amount produced per bed/day and factoring this amount into relative mathematical equations is a major way of quantifying the amount of clinical waste produced in hospitals. However, since health care establishments differ in ways previously mentioned, including size of medical staff and proportion of reusable items used in the establishment, such a technique produces results relative to each healthcare establishment (Tsakona *et al.,* 2007). In the United States of America, about 15% of hospital waste is considered as infectious; however, in India this could range from 15 to 35% depending on the total amount of waste generated (BAN and HCWH, 1999).

To add to the above, about 20% of hospital waste is found to be potentially infectious or hazardous in Pakistan (Agarwal, 1998) whiles the total garbage generation in Dhaka city is 3500

mt per day from which only 5.7 % comes from medical establishments (Asaduzzaman and Hye, 1997). US hospitals generate an estimated 6,670 tons of clinical waste per day (Rutala and Mayhall, 1992), 3.8 kg/bed/day in Portugal (Alvim Ferraz *et al.*, 2000) and 1 kg/bed/day is generated in Thailand (Kerdsuwan, 2000).

2.4 Potential Risks Associated With Medical Waste

2.4.1 Environmental Hazards Associated With Medical Waste

Dumping of healthcare waste in uncontrolled areas can have a direct environmental effect by contaminating soils and underground water. During incineration, if no proper filtering of flue gases is done, air can be polluted causing illnesses to the nearby populations. This has to be taken into consideration when choosing a treatment or a disposal method by carrying out a rapid environmental impact assessment (UNEP/WHO, 2005). In addition to health risks to patients and personnel, consideration should be given to the impact of healthcare waste on human health and the environment outside the healthcare establishments (Rutala and Mayhill, 1992). At the level of the built environment, the size and structure of a settlement has an important influence on the character and urgency of waste management needs. In urban areas, the physical characteristics of a settlement including such factors as density, width and condition of roads, topography, etc., need to be considered when selecting and/or designing waste collection procedures and equipment such as containers and vehicles (Peter *et al.*, 1996). At the level of natural systems the interaction between waste handling procedures and public health conditions is influenced by climatic conditions and characteristics of local, natural and ecological systems.

The degree to which uncontrolled waste dump sites become breeding grounds for insects, rodents and other disease vectors and a gathering place for dogs, wild animals and poisonous reptiles

depends largely on prevailing climatic and natural conditions. In practical terms climate determines the frequency with which waste collection points must be serviced in order to limit negative environmental consequences (Peter *et al.*,1996). In the last few years there has been growing debates over the incineration of healthcare waste. Under some circumstances, including when wastes are incinerated at low temperatures or when plastics that contain polyvinyl chloride (PVC) are incinerated at low temperatures, dioxins, furans and other toxic air pollutants may be produced as emissions and/or in bottom or fly ash (ash that is carried by air and exhaust gases up the incinerator stack). Exposure to dioxins, furans and co-planar Polychlorinated Biphenyls (PCBs) may lead to adverse health effects (WHO, 2006).

2.4.2 Health Risks Associated With Medical Waste

According to Akter *et al.* (1998), there were several incidents (10 cases out of 17) of injury due to exposure to medical wastes within or outside of hospital premises. These are hand injuries as a result of handling broken glass, injuries by needles and fingers permanently damaged/ became curved, paralysis of the right hand as a result of injury by a needle, paralysis of two legs due to injury by the needle, skin diseases on legs and hands or body, pus resulting from injuries and ulcer infections on legs.

The occupational health effects of medical and other hazardous wastes depend on the duration of exposure and the dose of toxic components that enters the worker's body from the waste. Unmanaged hospital waste constitutes a hazard to the personnel because it contains toxic chemicals and pathogens ready to enter the human body through different routes of exposure (Griffin, 1990). Health effects and potential hazards from clinical wastes are shown in table 3.

Table 3: Health effects and potential hazards from clinical wastes

Potential hazards	Health effects
Infectious agents	Respiratory infections, genital infections, skin infections, meningitis, AIDS, Viral Hepatitis A, B and C
Radioactive	Cancer, burn and skin irritation, headache, dizziness, and Vomiting
Sharps	Double risk: injury and potential transmission routes for HIV and Hepatitis B and C from contaminated sharp
Pressurized containers	Injury from explosion
Hazardous chemicals	Intoxication, burns and skin irritation, pollution of groundwater, surface water and the air, possibility of fire, poisoning
Pharmaceuticals	Ineffective medical care from consumption of expired pharmaceuticals, pollution of groundwater, surface water and air
Genotoxic waste	Carcinogenic and mutagenic, skin or eyes irritation, nausea, headache, or dermatitis

Source: WHO (1999)

Sharp objects such as syringes and needles have the maximum disease transmission potential amongst all categories of medical waste. Almost 85% of sharp injuries are caused between their usage and subsequent disposal. More than 20% of those who handle them encounter 'stick' injuries (BAN and HCWH 1999).

Individuals such as children outside the health care environment, who either handle such waste or are exposed to it as a consequence of careless management, further compound the challenge. Infectious components in clinical waste such as contaminated sharp objects and syringes pose the biggest health risks since they are usually directly exposed to pathogens in blood and other fluid from patients through percuteneous injuries (PI), abrasion and a cut in the skin. Pruss-Ustun *et al.* (2005) estimated that more than three million health care workers experience the stressful event of a percuteneous injury (PI) with a contaminated sharp object each year. Evidence from epidemiological studies indicates that a person who experiences a needle stick injury from a needle used on an infected source patient faces the risk of 30%, 1.8%, and 0.3% respectively of becoming infected with Hepatitis B Virus (HBV), Hepatitis B Virus (HCV) and Human Immuno deficiency virus (HIV), other routes of exposure are through the mucous membranes, inhalation and ingestion (Franka *et al.*, 2009; Pruss *et al.*, 1999). The particular concern about HIV, HBV and HCV is because of the high prevalence of these pathogens, especially in poorer regions of the world, supplemented by strong evidence of transmission via clinical waste (Sagoe-Moses *et al.*, 2001; Pruss *et al.*, 1999). HBV and HCV, including the Lassa and Ebola viruses for example, are endemic in sub-Saharan Africa (Sagoe-Moses *et al.*, 2001). In a study by Shiao *et al.* (2002), of the 7550 needle stick and sharp injuries reported by 8645 HCWs, 66.7% involved a contaminated hollow-bore needle. In the same study, 1805 blood samples from the healthcare workers were tested and 16.7% were seropositive for hepatitis B surface antigen, 12.7% were positive for anti-HCV and 0.8% was positive for anti-HIV. The authors estimated, that 308 to 924 health care workers were at risk for contracting HBV; 334 to 836 were at risk for contracting HCV; and, at the most, 2 were at risk for contracting HIV.

Jahan (2005) identified 73 injuries from needles and other sharp objects in a retrospective survey of all self-reported documents in Buraidah Central Hospital, Saudi Arabia. According to the author, nurses, physicians, technicians and non-clinical support staff were involved in 66%, 19%, 10% and 5.5% of the instances respectively. Most of the injuries, according to the author, occurred during recapping of used needles (29%); during surgery (19%); by collision with sharps (14%); disposal related (11%) as well as through concealed sharps (5%) while handling linens or trash containing improperly disposed needles.

Berger *et al.* (2000) identified that the risk of occupationally acquired infection with hepatitis B and hepatitis C among healthcare workers is as a result of the frequency of needle stick injuries with patient blood contact, the prevalence of patient virus carriers, the probability of transmission and the immune status of the personnel; in the case of HBV mainly the vaccination rate. In a study of occupational exposure to needle stick injuries and hepatitis B vaccination coverage among healthcare workers in Egypt, Talaat *et al.* (2003) reported that out of the 1485 health care workers interviewed, 529 (35.6%) were exposed to at least 1 needle stick injury during the past 3 months with an estimated annual figure of 4.9 needle sticks per worker. According to the authors, 15.8% of health care workers reported receiving 3 doses of hepatitis B vaccine, with vaccination coverage highest among professional staff (38%) and lowest among housekeeping staff (3.5%). The authors estimated that 24,004 HCV and 8617 HBV infections occur each year in Egypt as a result of occupational exposure in the health care environment. In a similar study in the United States, Simard *et al.* (2007) reported that among health care workers at risk, 75% had received 3 or more doses of the hepatitis B vaccine, corresponding to an estimated 2.5 million vaccinated hospital-based health care workers. According to the authors, the coverage levels was 81% among staff physicians and nurses and significantly lower among

phlebotomists (71.1%) and nurses' aides and/or other patient care staff (70.9%). Understanding the epidemiology of needle stick injuries in the target population is important in designing and implementing control measures (Jahan, 2005). Pruss-Ustun *et al.* (2005) suggested that strategies such as education of health care workers on the risks and precautions, reduction of invasive procedures, use of safer devices, and procedure and management of exposures are available to prevent infections due to sharps injuries. According to the authors, efficient surveillance and monitoring of occupational health hazards related to blood- borne pathogens in the industrialized world help to reduce the risk of transmission. On the other hand, the authors noted that, similar surveillance and monitoring systems are weak and dysfunctional and/ or sometimes completely absent in developing countries.

2.5 Segregation, Temporal Storage and Transport

Complete segregation and temporal storage of clinical waste into infectious and non-infectious components is an important process in any efficient medical waste management effort. The process guarantees reduction in the amount of infectious waste requiring special treatment and curbs potential occupational and operational risks to health care employees and by extension, the general public. Despite these merits, the process of segregation is overwhelmed with challenges that are pretty obvious in health care settings in the developing world.

Patil and Shekdar (2001) reported that lack of awareness and training in clinical waste segregation technique is the major reason why clinical waste is collected in mixed form in India. Similar observations were reported by Phengxay *et al.* (2005) in Lao People's Democratic Republic, Mbongwe *et al.* (2008) in Botswana and Bdour *et al.* (2006) in Jordan. Another challenge to a successful clinical waste segregation process is the waste receptacles at the

generation points and how to differentiate them according to the type of waste they receive. According to the US Congress Office of Technology Assessment (OTA, 1988), the integrity of packaging, particularly of such items as sharps, is critical to ensuring the containment of wastes during their collection, storage, and transportation. The WHO (WHO, 1985) and the U.S.EPA (U.S.EPA, 1986) as well as the Ghana Ministry of Health policy and guidelines for Health Institutions (Ghana MOH, 2006) recommend colour coded polyethylene bags with secure closure to facilitate segregation, storage and identification of infectious and non-infectious wastes. According to the Ghana Ministry of Health policy and guidelines for Health Institutions (Ghana MOH, 2006), the colour black should be used as the code for general waste (kitchen waste, paper, cardboard, sweeping etc.); furthermore the colour brown should be used as the code for hazardous waste and the colour yellow should be used as the code for infectious waste with the bio-hazard symbol and radioactive waste with the radioactive symbol.

Considering that infectious clinical waste can both be bulky (pathological waste, various absorbents and isolation wastes) and contain sharps such as lancets, scalpels and needles and blades, Rutala and Sarubbi (1983) and Slavik (1987) recommend that polyethylene bag be manufactured according to the American Society of Testing and Materials standard (no. D 1709-75) of tear resistance based on the mil gauge thickness and a dart drop test.

According to Luttrell *et al.* (2003), temporal storage refers to the interim period between generation and transportation either to an on-site treatment facility or to an off-site location. The space for temporal storage according to Marinkovic *et al.* (2008) and the Ghana Ministry of Health policy and guidelines for Health Institutions (Ghana MOH, 2006) should be out of the reach of patients and staff, properly marked and accessible only to authorized personnel. Rutala

and Sarubbi (1983) added that such a space should be disinfected regularly and be maintained at an appropriate temperature to guard against microbial putrefaction and growth (OTA, 1988). There is not yet a universally accepted standard period of time that the waste can be stored prior to treatment and disposal, but the U.S.EPA (U.S.E.P.A., 1986) recommends this time be kept as short as possible; the Ghana Ministry of Health policy and guidelines for Health Institutions (Ghana MOH, 2006) also recommends that the time should not exceed twenty four hours. Transportation of clinical waste in medical establishments occurs in two ways; the first is from the source of generation to an on-site treatment or disposal facility while the second involves removal from a source of generation to an on-site temporal storage facility before eventual transportation to an off-site treatment and disposal facility. On-site transportation of clinical waste in most cases depends on the time it takes for the receptacle in question to fill-up, and because this depends on issues such as the size and services offered by the facility and varies according to ward and units, it is not uncommon to find receptacles with over-filled waste (Coker *et al.*, 2009). On-site clinical waste transportation in Libya, as recounted by Sawalem *et al.* (2008), is done via uncovered trolleys while in Nigeria, Coker *et al.* (2009) reported that clinical waste in health care facilities is transported on shoulders or with bare hands. In an effort to minimize any potential risks involved in such practices, the Ghana Ministry of Health policy and guidelines for Health Institutions (Ghana MOH, 2006) recommends placement of wastes in rigid and leak proof or puncture resistant containers including the avoidance of activities that can rupture the container. Off-site transportation of clinical waste according to Luttrell *et al.* (2003), takes place on land using vehicles, even though there is a likely risk of accidental release of hazardous materials into the environment. According to the authors, the waste is typically contained in high-volume bulk storage tanks or low-volume storage drums and the storage

containers and vehicles transporting such wastes should be placarded with the bio-hazard mark while on transit. Other important issues in off-site clinical waste transportation according to the Ghana Ministry of Health policy and guidelines for Health Institutions (Ghana MOH, 2006) that need to be addressed include creating and constantly updating a database and keeping track of infectious clinical waste and the containment of the waste at transfer stations, hence, ensuring proper record keeping and documentation.

2.6 Effects of Improper Disposal or Non-Disposal of Medical Waste

Medical wastes are a source of contamination and pollution to both humans and nature. Improper disposal may be hazardous if it leads to contamination of water supplies or local sources used by nearby communities or wildlife (Akter *et al.,* 1998). Occasionally exposed waste may become accessible to scavengers and children if a landfill is not secured. Medical wastes are very capable of causing diseases and illness in man, either through direct contact or indirectly by contamination of soil, groundwater, surface water and air (UNEP/WHO, 2005). Wind blown dusts from these dumps also have the potential to carry pathogens and hazardous materials. Where domestic animals are allowed to graze in open dumps, there is a risk of reintroducing pathogenic micro-organisms into the food chain. Medical wastes therefore pose a risk to individuals, communities, and the environment if not carefully handled (Akter *et al.,* 1998).

Wastes attract scavenging animals and bats. As it ferments it gives off foul odours, favours fly feeding and contaminates both water and air. Piles of refuse or landfill during its decomposition process generate several gases, the most important among which are methane (CH_4), nitrogen (N_2) and occasionally hydrogen sulfide (H_2S). If burnt, carbon dioxide (CO_2) is released. CH_4 and CO_2 are greenhouse gases and have potential greenhouse effects. The soil underlying these wastes is typically contaminated by pathogenic micro-organisms, heavy metals, salts, and chlorinated hydrocarbons. These wastes also cause public nuisance by clogging sewers and open

drains, encroaching on roadways, diminishing landscape aesthetics and giving off unpleasant odours and dust (World Bank, 1991). Expired drugs pilfering from a stockpile of waste drugs or during sorting may result in expired drugs being diverted to the market for resale and misuse. Most pharmaceuticals past their expiry date become less efficacious and a few may develop a different adverse drug reaction profile. Medical waste incinerations are one of the largest sources of dioxin and mercury pollution in the United States.

According to the United States Environmental Protection Agency (USEPA), dioxin from medical waste incineration ends up in dairy foods and meat and both mercury and dioxin are taken up by fish and shellfish. When one eats these foods, one adds to the existing dioxin and mercury body burdens. Other than these, the ash from incinerator consists of both fly ash and bottom ash. The ash contains high levels of toxic substances such as heavy metals, dioxins and furans.

Ironically, as the air pollution equipment becomes more effective in removing particulate matter, the toxicity of the fly ash increases. One of the largest hospitals in Delhi, India was found to have lead in its incinerator ash at levels which would classify the ash as hazardous (BAN and HCWH, 1999).

In most cases, disposal of incinerator ash in landfills without a sufficient soil or other impermeable cover may cause leachate to contaminate groundwater. Incineration has specific health concern since it not only destroys the pathogen but also the material on which the pathogen resides, thus, those materials go under a process of transformation and dematerialization (McRae, 1997). In the process they transform solid and liquid toxic wastes into gaseous emissions and particulate matters. The acid gases (e.g. hydrogen chloride, nitrogen oxides and sulphur dioxides), can cause acute effects such as eye and respiratory irritation, can contribute to acid rain, and may enhance the toxic effects of heavy metals. Particulate matter can

cause chronic health effects. Burning of chlorine made material e.g. PVC, creates dioxin, a known animal carcinogen, and considered as human carcinogen (Agarwal, 1998).

2.7 Related Research on Medical Waste Management

In a comprehensive inspection survey conducted by Yong *et al.* (2009) at Nanjing, China for 15 hospitals, 3 disposal companies and 200 patients, the results indicated that the medical waste generation rate ranges from 0.5 to 0.8 kg/bed day with a weighted average of 0.68 kg/bed day. The segregated collection of various types of medical waste had been conducted in 73% of the hospitals, but 20% of the hospitals still used unqualified staff for medical waste collection, and 93.3% of the hospitals had temporary storage areas. Additionally, 93.3% of the hospitals have provided training for staff; however, only 20% of the hospitals had ongoing training and education. The results also suggested that there is not sufficient public understanding of medical waste management, and 77% of respondents think medical waste management is an important factor in selecting hospital services. Another study conducted by Mochungong *et al.* (2010), to evaluate hospital workers' awareness of health and environmental impacts of poor clinical waste disposal in three hospitals in the Northwest Region of Cameroon indicated that most of the respondents lacked sufficient awareness of any environmental or public health impacts of poor clinical waste disposal and had never heard of any policy, national or international on safe clinical waste management. Methods of collecting, segregating, transporting and disposing clinical waste at the three hospitals was poor.

A study conducted by Abah and Ohimain (2011) at a tertiary health facility (Teaching Hospital) in Nigeria showed that the average amount of Healthcare waste was 0.62 kg/person/day at the out-patient units and 0.81 kg/bed/day in the in- patient wards. The proportion of respondents who had received specific training in the management of Healthcare waste was 11.5% (6/52). The number who understood the importance of Healthcare waste management in the provision of

safety to the public was 46% (24/52). The level of healthcare waste management practice was found to be 0 (that is, unsustainable).

In a similar study conducted at a hospital in Allahabad city, India by Mathur *et al.* (2011), the results indicated that doctors, nurses, and laboratory technicians had better knowledge than sanitary staff regarding biomedical waste management. Knowledge regarding the colour coding and waste segregation at source was found to be better among nurses and laboratory staff as compared to doctors. Regarding practices related to biomedical waste management, sanitary staff were ignorant on all the counts. However, injury reporting was low across all the groups of health professionals. In another study conducted in Dhaka City, Bangladesh at 60 healthcare establishments by Hassan *et al.* (2008), the study revealed that there was no proper, systematic management of medical waste except in a few private Healthcare establishments that segregated their infectious wastes. Some cleaners were found to salvage used sharps, saline bags, blood bags and test tubes for resale or reuse.

A survey report on hospital waste management in Dhaka city by PRISM Bangladesh (2002) revealed that the level of awareness on clinical waste among waste handlers was not good enough to manage the waste systematically. The same report stated that the nurses and staff were aware of the health impacts of clinical wastes. The Bangladesh study, did not apply any objectives of knowledge. Based on anecdotal evidence, one can assume that the hospital workers with longer years of experience are more aware of the associated health impacts of clinical waste. The survey recommended that concerned staff need to take practical training, rather than the traditional theoretical training, before they are allowed to handle the waste. Some of the identified training needs involved good practices on clinical waste management such as the use for different bins and bags for different waste types and the use of personal protective

equipments such as aprons, gloves, gas masks and rubber booths at the appropriate stages of the waste management process.

Worldwide, information on the spread of infection resulting from waste handling is limited (Franka *et al.,* 2009). Salvaged injections (of which poor clinical waste treatment and disposal is a major component), according to some reports, accounts for up to 5% of HIV infections in Africa (Crabb, 2003; WHO, 2003). According to Blenkharn and Odd (2008) and Erdem and Talas (2006), injuries in the hospital environment can occur due to hypodermic needles from poorly closed overfilled containers or from other sharps inaccurately placed into thin-walled plastic bags. Increasing hospital workers awareness through repetitive training courses and programmes should be given priority in any clinical waste management policy.

Summers (1991) emphasized that hospital workers awareness, as a component of efficient clinical waste management goes beyond the drawing up and introduction of policies and laws. According to Sharma (2010), the awareness of these laws and policies among the general public as well as their involvement in the development and enforcement is essential.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3. 1 Description of the Study Area

Tema "metropolis" with a population of 506,400 in the 2000 census is almost completely urbanized. The major seaport in Ghana, the Tema harbour is in this municipality. There are, however, several completely rural communities in Tema especially in the areas where it borders the Dangme West and Ga districts. Tema has a government hospital, a government polyclinic, 3 health centres and numerous private hospitals and clinics (www.ghanahealth service.org).

The study was limited to 3 health care institutions in Tema metropolis, namely; Tema General Hospital, Tema Polyclinic and Manhean Health Centre

Tema General Hospital is a Metropolitan Hospital which is in the Greater Accra Region, the capital city of Ghana. The Hospital has a total bed space of 294 and ten wards. It offers both General and Specialist Care Services in all the major Clinical Disciplines including Internal Medicine, General Surgery, Paediatrics, Obstetrics and Gynaecology, Dental and Eyecare. The total Staff strength is about 680 and this includes 10 Specialists, 35 other Medical Doctors and 304 nurses according to the available records at the hospital.

Tema Polyclinic is located geographically at the South western part of Community Two (2). Established as an Urban Health Centre in 1962, it operated as such for 20 years and was upgraded to the status of a Polyclinic in 1982. It is 48 years old presently and is still operates as a Polyclinic. The institution serves 33 communities and provides preventive, curative and rehabilitative services to all age groups in its catchment area and beyond. The staff strength is about 283 according to the available records at the Polyclinic.

The Manhean Health Centre is located on the Eastern Plan of Tema Fishing harbour near Tema Naval Base. The catchment area share boundaries with Kpone on the East, Tema Community One on the West Industrial area on the North and Atlantic Ocean on the South. The staff strength is about 100. The centre is made up of the following Units and Departments, Out- patient Department, Maternity Ward, Maternal and child Health/ Family Planning Unit, Disease control Unit, TB/HIV department, Ear nose and throat department, Integrated management for Childhood Illnesses (IMCI), Eye Clinic, Nutrition unit, Birth and Death Registry, Community Psychiatry Unit and Administration according to the available records at the Health Centre.

3.2 Data Collection

Three methods were used for data collection. These were personal observation and measurement of waste using a hanging scale (plate 1); questionnaires (at Appendix 2) and interviews.

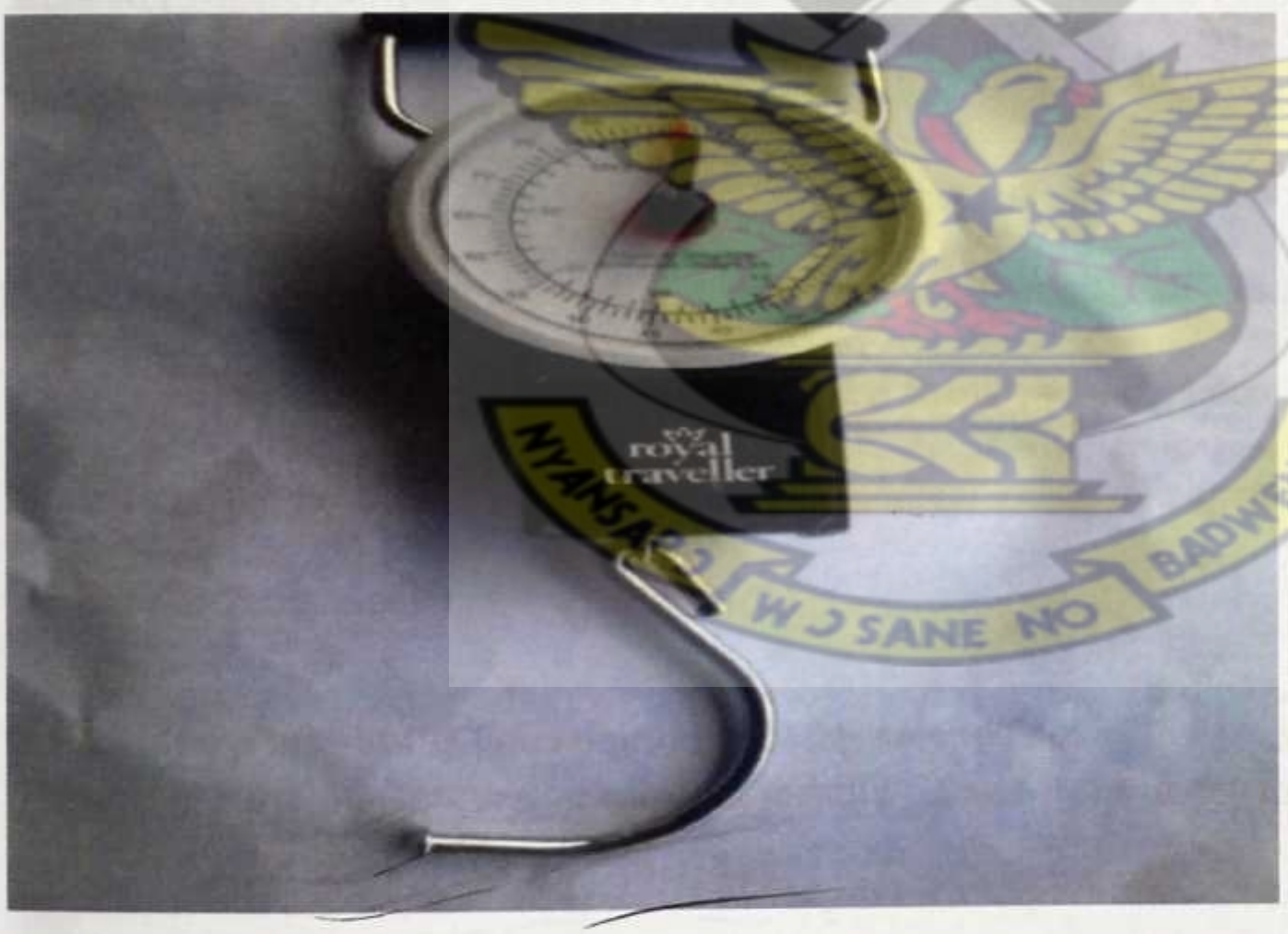

Plate 1: Scale used for weighing.

3.3 Waste Quantification

At Tema General Hospital and Manhean Health centre, the number of bins filled per department per day were weighed for a period of one week using a hanging scale and the average used to determine the estimated quantity of waste generated per day. At Tema Polyclinc bins were shared between sections or units, thus only the waste which was gathered at the temporal storage site (external storage) in the black and yellow polythene bags were weighed for quantification. A nose mask and gloves were used during the waste quantification as a safety measure.

3.4 Field Observations

Twenty visits were made to the various sites under study; six to each of the three Health care facilities and two to the Kpone landfill site from January to March, 2012. (This excludes the time used for the administration of the questionnaires). During this period, the modes of waste disposal such as waste bins used, segregation, placenta pits, incinerators and external storage areas were observed. The frequency of collection of waste from the external storage area was also observed.

3.5 Questionnaires

Self-completion questionnaires were distributed to different health facility workers in different departments of the selected health facilities. The focus was on evaluation of the awareness and attitudes of the healthcare workers on proper medical waste management in the selected health facilities in Tema municipality.

3.5.1 Major Parts of the Questionnaires/Assessment Tool

The major parts of the questionnaire (Appendix 2) and assessment tools are described in this section as follows.

3.5.2 General Information about Workers

This part of questionnaire mainly inquired on the general information such as the job function of the persons interviewed, educational background, age, gender and the accompanied departments in the health facilities.

3.5.3 Waste Management Policy

This section sought to evaluate the awareness of healthcare workers concerning the national policy and guidelines regarding hospital waste management and the availability of internal waste management plans and whether waste management responsibilities were included in the job descriptions of hospital supervisory staff.

3.5.4 Waste Management Practices

This part investigated the facilities available for waste management. Investigations were made to know if the facilities temporarily store waste before treatment and disposal, and if the waste is stored, for how long the facility stores that waste before further actions. Investigation was made on whether the facility practices waste segregation or not. Furthermore, the following were investigated: if the color coding system were used in managing waste in the facilities, the type of containers used in collection of waste in the health facilities, the frequency of waste audits and whether a register is maintained for waste disposal.

3.5.5 Employee Education

This section sought to evaluate whether the healthcare workers were trained on good practices in healthcare waste management, whether they had undergone any training programme on the subject and whether they were interested in attending a programme on hospital waste management.

3.5.6 Attitude Assessment

This section sought to use carefully constructed statements to evaluate the attitudes of the health care workers based on whether they 'agree', 'disagree' or 'no comment'

3. 6 Data Analysis

The numeric data collected from the selected health facilities in the Tema municipality was compiled and translated to frequencies using the Epi-info- 7 analytical tool.

3.7 Validity and Reliability

Validity, resolves the concerns of whether what a researcher states he or she is measuring is in fact what he or she is measuring (Bryman and Bell, 2007). Thus, efforts were made to ensure that data gathered were from authentic sources and questions that were used for the interview could elucidate responses to the research objectives.

3.8 Constraints

a) Some self–completion questionnaires could not be retrieved despite follow up efforts of contacting gatekeepers directly and by phone.

b) There was limited budget for the project work.

c) There was limited time for the dissertation due to work related pressures.

3.9 Ethical Considerations

The primary ethical concern was one of privacy/anonymity and confidentiality of participants. Participants engaged were aware that they could withdraw from the interviews at any time.

Due authorization was sought from the management of Tema General Hospital, Tema Polyclinic and Manhean Health Centre to access premises and records.

CHAPTER FOUR

4.0 RESULTS

4.1 Waste Generation at Tema General Hospital

It was revealed that main Outpatient Department (O.P.D) generated the most medical (25Kg) and general (18Kg) waste per day at the out-patient section, the physiotherapy unit generated the least medical (0Kg) waste followed by the chest clinic and dental clinic respectively (Table 4).

Table 4: Out-patient waste generation at Tema General Hospital from 25th to 31st March, 2012

Out-patient Section	Average Medical Waste Generated Per day (Kg)	Average General Waste Generated Per day (Kg)
Main OPD	25	18
Laboratory	10	6
Accident Centre	15	6
Physiotherapy	0	3
Dental clinic	1.25	1.5
Eye clinic	1.25	6
Antinatal clinic	5	9
Chest Clinic	0	1.5
Pharmacy	0	6

At the in-patient section, the Lying-in and 4th Stage wards generated the most medical (40Kg) and general (50Kg) waste per day followed by the labour ward which generated an average of 35Kg and 3Kg of medical and general waste respectively per day. The Main Children's Ward generated the least medical waste (2.5Kg) per day; however, the Kids Annex (Surgical) and

Neonatal intensive care unit (NICU) generated the least general waste of 1.5Kg each per day (Table 5).

Table 5: In-patient waste generation at Tema General Hospital from 25th to 31st March, 2012

In –patient Section	Average Medical Waste Generated Per day (Kg)	Average General Waste Generated Per day (Kg)
Fevers Unit	15	24
Main Children's Ward	2.5	6
Female Medical Ward	6.25	12
Male surgical Ward	10	6
General Male Medical Ward	15	12
Male surgical Ward (VIP)	10	6
Female surgical Ward	15	6
Kids Annex (Surgical)	15	1.5
Labour Ward	35	3
Gynaecology	15	6
Maternity Theatre	15	6
Lying in and 4th stage	40	15
Neonatal intensive care unit (NICU)	15	1.5

With the exception of the mortuary and the accident centre which generated an average of 15Kg each of medical waste per day, other sections of Tema General Hospital did not generate medical waste, however, the administration block and the kitchen generated the most general waste of 30Kg each (Table 6).

Table 6: Waste generation at other sections of Tema General Hospital from 24th to 30th March, 2012

Other sections	Average Medical Waste Generated Per day (Kg)	Average General Waste Generated Per day (Kg)
Administration	0	30
Kitchen	0	30
CSSD	0	1.5
Laundry	0	1.5
Mortuary	15	6

The in-patients section of Tema General Hospital generated the highest quantity of medical waste per day. The out-patients section generated a relatively lower quantity of general waste per day (Table 7).

Table 7: Average medical waste generation at Tema General Hospital per day from 25th to 31st March, 2012

	Quantity
Average Medical Waste Generated Per day (In-Patients)	208.75 Kg
Average Medical Waste Generated Per day (Out-patients)	57.5 Kg
Average Medical Waste Generated Per day (Mortuary)	15 Kg
Average Medical Waste Generated Per day at all sections	281.25 Kg

The average number of patients reporting per day during the period of study was 201; thus the average medical waste was 1.399 Kg /patient/day. The average number of occupied beds per day during the period of study was 63; hence, the total medical waste was 3.313 Kg/bed/day.

The in-patients section of Tema General Hospital generated the highest quantity of general waste per day. The out-patients section generated a relatively lower quantity of general waste per day (Table 8).

Table 8: Average general waste generation at Tema General Hospital per day from 25th to 31st March, 2012

Average General Waste Generated Per day (In-patient)	105 Kg
Average General Waste Generated Per day (Out-patient)	57 Kg
Average General Waste Generated Per day (Other sections)	69 Kg
Average Waste Generated Per day at all sections	231 Kg

4.2 Waste Generation at Tema Polyclinic

At Tema Polyclinic, the average general waste generated per day was relatively higher than the average medical waste generated per day (Table 9).

Table 9: Average medical waste generation at Tema Polyclinic per day from 11th to 17th March, 2012

Average General Waste Generated Per day	44 Kg
Average Medical Waste Generated Per day (Kg)	30 Kg
Average Waste Generated Per day (Kg)	74 Kg

The average number of patients per day during the period of analysis was 103; thus the estimated medical waste is 0.291 Kg /patient/day

4.3 Waste Generation at Manhean Health Centre

The labour ward generated the most quantity of general waste (2Kg) per day at Manhean Health Centre and the recovery and treatment room generated the highest quantity of medical waste (5Kg) per day at Manhean Health Centre. The Ear Nose and throat unit, laboratory, as well as the recovery and treatment room did not generate general waste, however, they generated some medical waste (Table 10).

Table 10: Average Medical waste generation at Manhean Health Centre from 4th to 10th March, 2012

Section	Average General Waste Generated Per day (Kg)	Average Medical Waste Generated Per day (Kg)
Administration	0.5	0
Ear Nose and throat	0	0.5
Chest Clinic	0.25	0.25
Family Planning	0	1
Consulting rooms	0.5	0
Laboratory	0	1
Accounts	1	0
Labour ward	2	4
Recovery and Treatment room	0	5
Pharmacy	1	0
Reproductive child health unit	1	0

At Manhean Health Centre, the average general waste generated per day was relatively lower than the average medical waste generated per day (Table 11).

Table 11: Average Medical waste generation at Manhean Health Center per day from 4th to 10th March, 2012

Average General Waste Generated Per day	6.25 Kg
Average Medical Waste Generated Per day (Kg)	11.75 Kg
Average Waste Generated Per day (Kg)	18 Kg

The average number of patients per day during the period of analysis was 51; thus the estimated medical waste is 0.23 Kg /patient/day

4.4 Major Types of Waste Generated

With the exception of the accidents and emergency unit which was only applicable to Tema General Hospital, it was observed that all three healthcare facilities generated similar types of wastes (Table 12).

Table 12: Major types of waste generated at Tema General Hospital, Tema Polyclinic and Manhean Health Centre

Health Facility	Outpatient Ward	Labour Ward	Other Wards	Accidents and Emergency Unit
Tema General Hospital	Waste paper, Hand gloves Swabs, needle and syringes, Used hand gloves, used i.v. fluid giving sets, food wastes	Placenta, soiled clothes and materials, Papers ,empty medicine bottles and packaging, Empty drip containers, Needle and syringes, used I.V fluid giving sets, Used dressing materials, hand gloves, glass, baby diapers	Swabs ,soiled clothing, used infusion and blood giving sets, soiled beddings ,Used dressing materials ,hand gloves	Swabs, needle and syringes, soiled clothing, used infusion and blood giving sets, Used dressing materials, Human tissue
Tema Polyclinic	Waste paper, Hand gloves Swabs, needle and syringes, Used hand gloves, used i.v. fluid giving sets, food wastes	Placenta, soiled clothes and materials, Papers ,empty medicine bottles and packaging, Empty drip containers, Needle and syringes, used I.V fluid giving sets, Used dressing materials, hand gloves, glass	Swabs ,soiled clothing, used infusion and blood giving sets, soiled beddings ,Used dressing materials, hand gloves	Not applicable
Manhean Health Centre	Waste paper, Hand gloves Swabs, needle and syringes, Used hand gloves, used i.v. fluid giving sets, food wastes	Placenta, soiled clothes and materials, Papers ,empty medicine bottles and packaging, Empty drip containers, Needle and syringes, used I.V fluid giving sets, Used dressing materials, hand gloves, glass	Swabs ,soiled clothing, used infusion and blood giving sets, soiled beddings ,Used dressing materials ,hand gloves	Not applicable

4.5 Observations

The following were also observed during visits to the three Health care facilities and Final dump site (Kpone landfill)

4.5.1 Modes of Disposal

4.5.1.1 Waste Bins

At all three health care facilities, segregation of sharps was done in the wards. No other form of waste segregation occurred at any level and no strategy is in place for waste minimization. Temporal storage of waste took place in receiving receptacles or waste bins which were emptied daily or more frequently depending on the filling rate. Waste was collected daily by auxiliary staff (orderlies) for dumping directly into large storage receptacles at Tema General Hospital.

At Tema Polyclinic, the yellow and black polythene bags are removed and dumped directly on the ground at the external temporary storage area. Furthermore, at Manhean Health Centre, the waste was placed in larger bins (120L) at the external storage area, some of which had broken lids.

4.5.1.2 Segregation

It was observed that at Tema General Hospital, medical waste was frequently placed in yellow polythene bags lined in bins while general waste were placed in black polythene bags; however, at Tema Polyclinc and Manhean Health Centre, the adherence to colour coding was not regularly observed even though Tema Polyclinic performed better relative to Manhean Health Centre. All three Health care facilities did not segregate medical wastes into different category such as infectious medical waste and noninfectious medical waste. All three Healthcare facilities did not ~~label~~ infectious waste with the Biohazard symbol. No control measures exist for the management of these wastes. Separation of medical waste and general waste is however

practiced to a satisfactory extent at Tema General Hospital. In the wards, doctors and nurses who use sharps are required to drop them into safety boxes but this was not diligently followed. Users of sharps sometimes placed them together with medical waste in the yellow polythene bags.

4.5.1.3 Placenta Pits

The placenta pit at Tema General Hospital was not properly managed since the pit was not covered (Plate 2) and had non-biodegradable polythene bags dumped along with the placenta into the pit (Plate 3) which resulted in a foul odour ; the placenta pit at Tema Polyclinic was well managed (Plate 4) and lime was applied twice a week to prevent foul odour ; however, Manhean Health Centre did not have a placenta pit and therefore buried the placenta at a given location within the hospital premises (Plate 5).

Plate 2: Placenta Pit at Tema General Hospital (External View).

In Plate 2 the covering of the near side man-hole had degraded; thus the pit is exposed

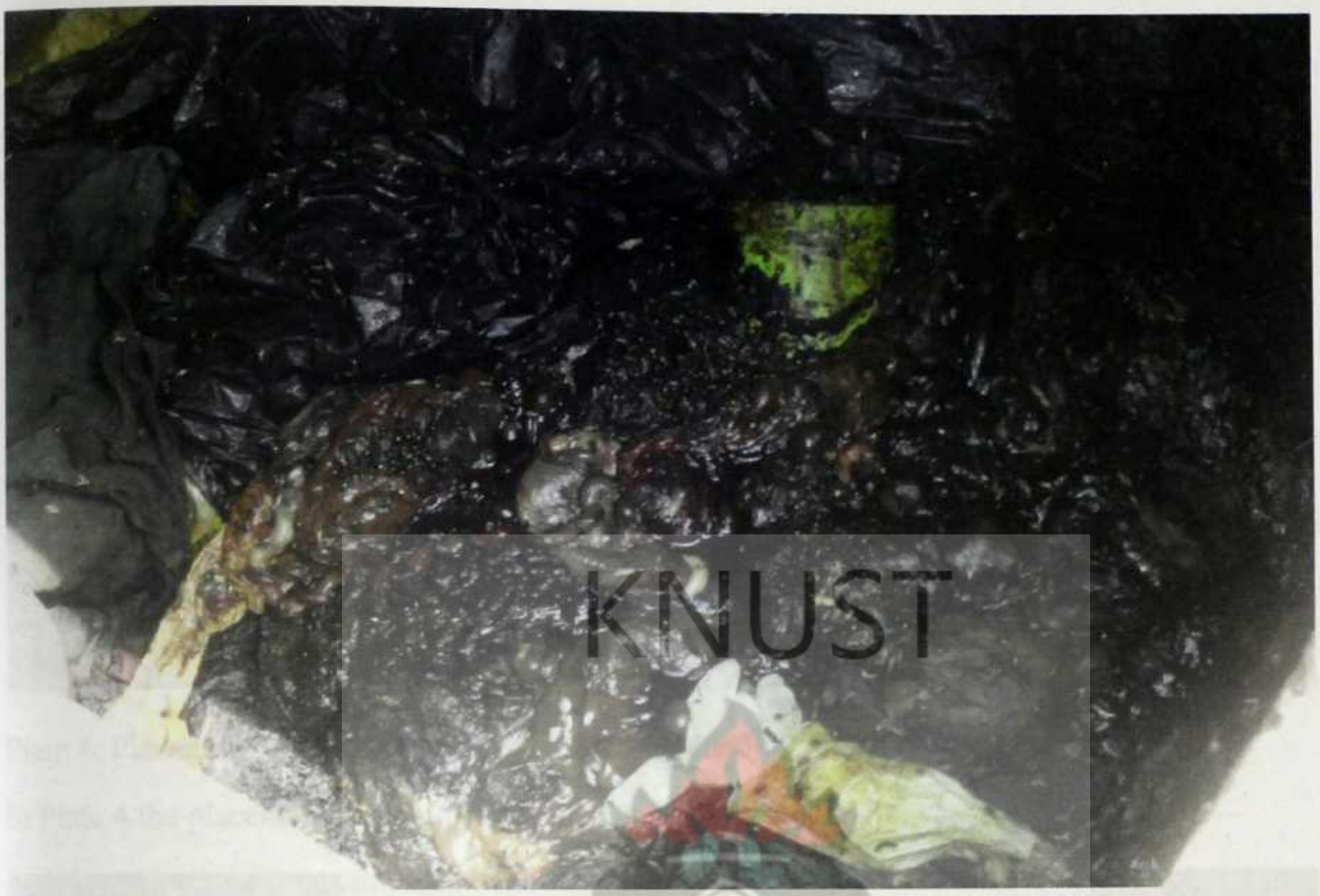

Plate 3: Placenta Pit at Tema General Hospital (Internal View)

Inside the man-hole are placenta that have been placed in non-biodegradable polythene bags as well as those that have been placed in without any covering

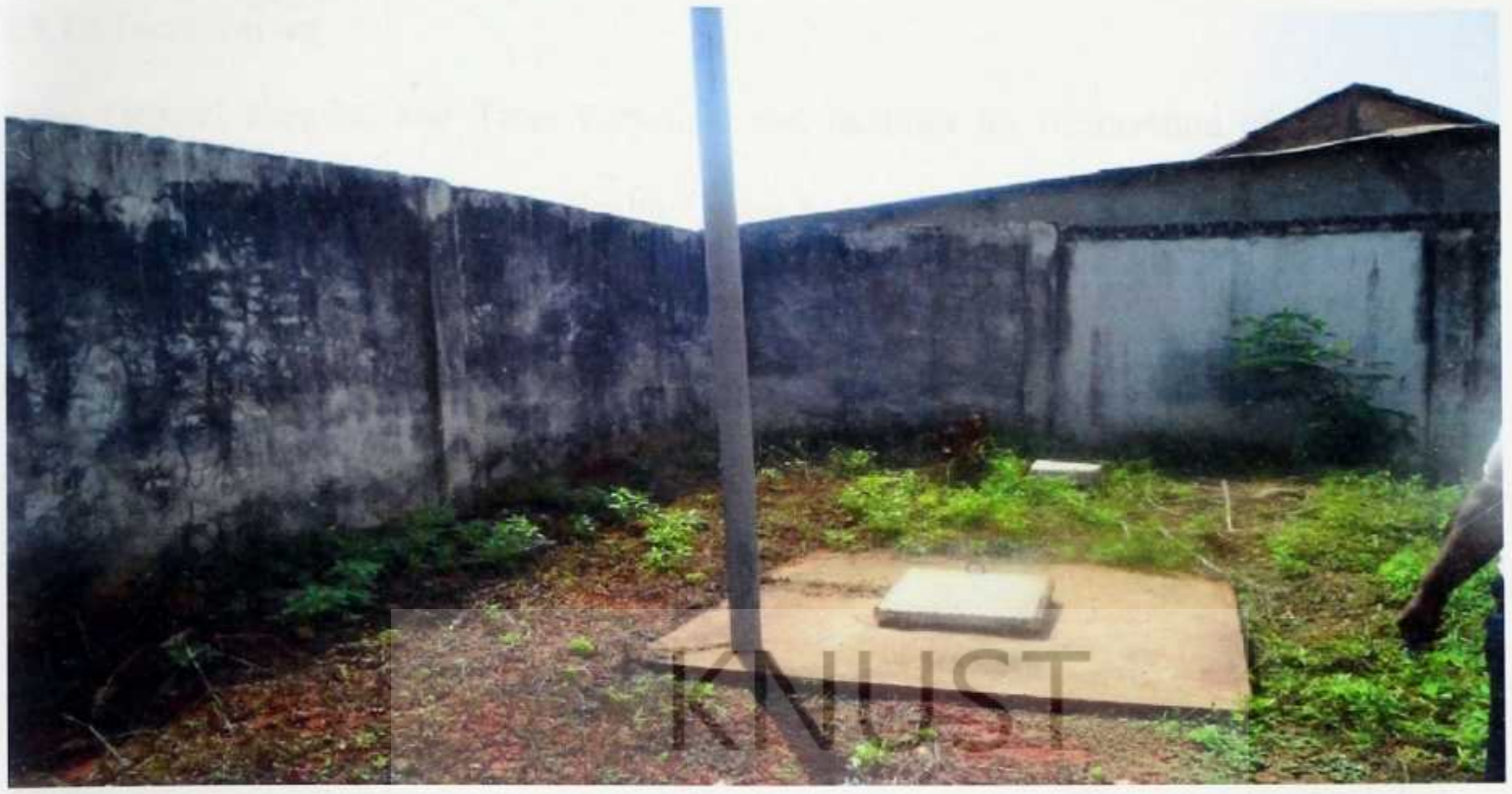

Plate 4: Placenta Pit at Tema Polyclinic (External View)

In Plate 4 the placenta pit is well managed and the pit is properly covered

Plate 5: Placenta burial location at Manhean Health Centre

4.5.1.4 Incinerators

Tema General Hospital and Tema Polyclinic had facilities for incineration of sharp objects (Plates 7 and 8); whilst, Manhean Health Centre had no such facility for incineration, hence, sharp objects are sent to Tema Polyclinic twice a week for incineration. Even though Tema General Hospital has an incinerator for other medical wastes, it was out of order, hence, could not be used (Plate 6).

Plate 6: Brocken down incinerator at Tema General Hospital

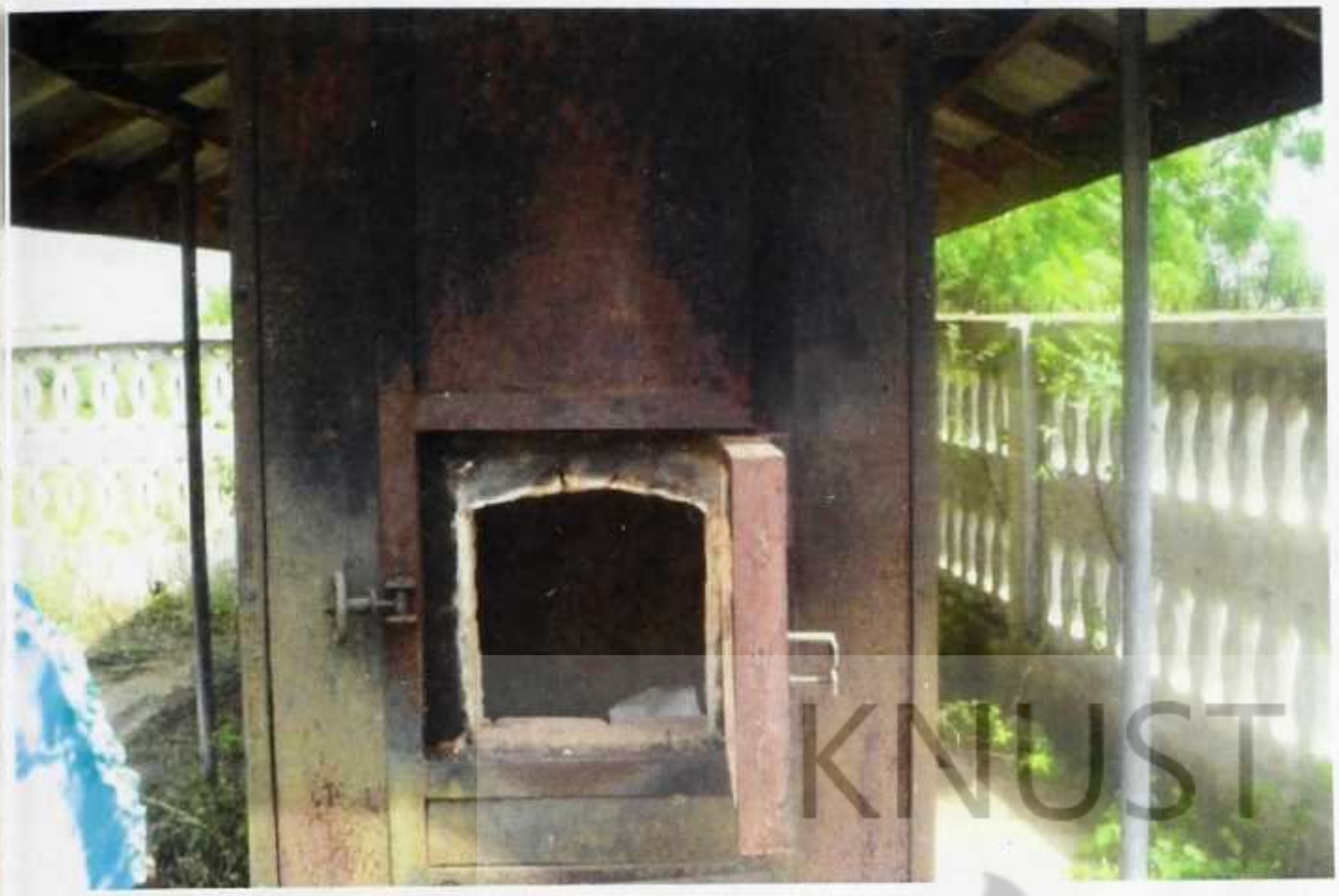

Plate 7: Functional incinerator for sharps at Tema General Hospital

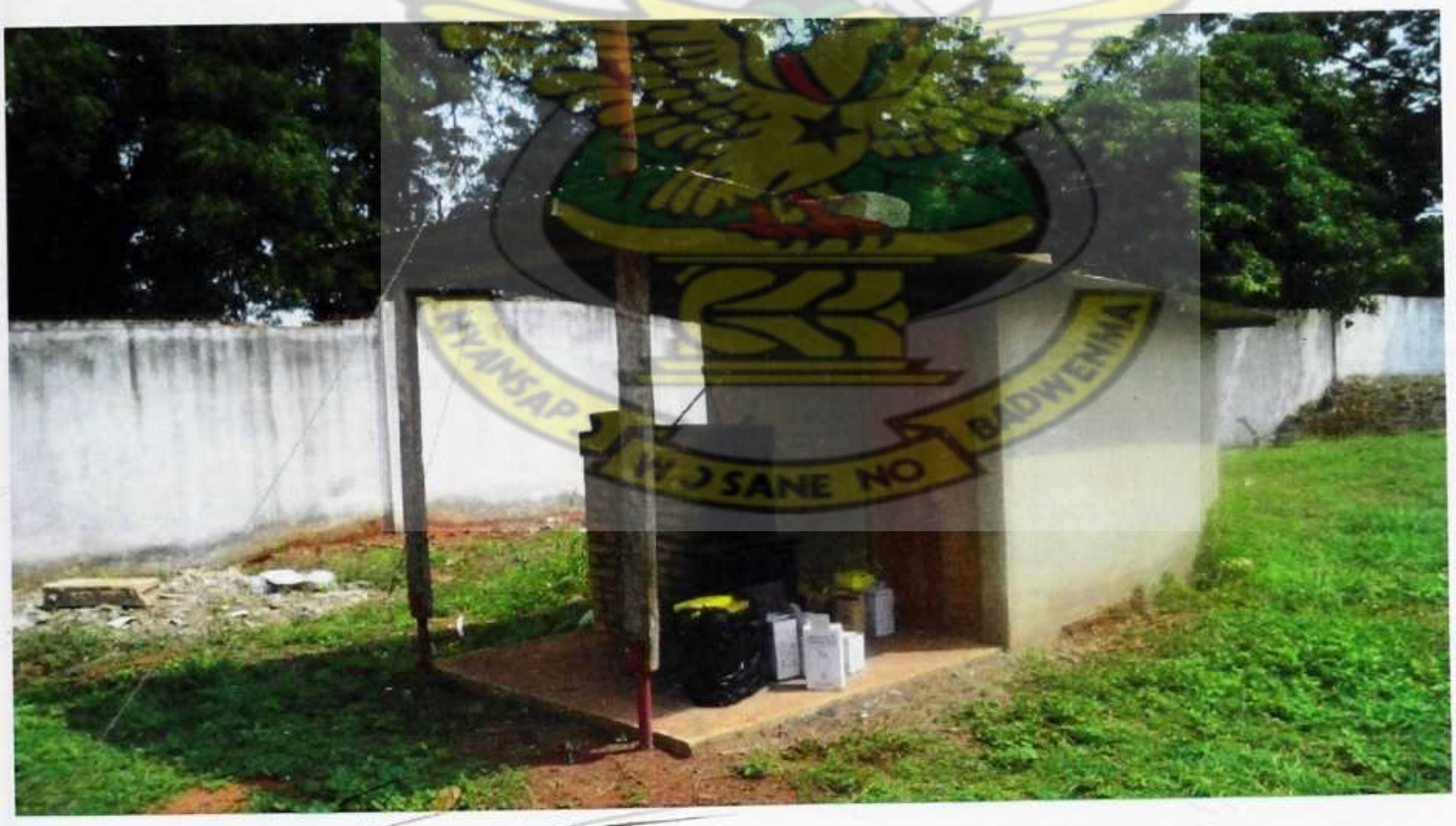

Plate 8: Functional incinerators for sharps at Tema Polyclinc

4.5.1.5 External Storage Area

It was observed that all three Health care facilities did not have any proper facility for external storage of medical waste before final disposal; hence, wastes awaiting collection were exposed to the environment. When the waste was eventually collected, periodically, some of the debris of medical waste at all three healthcare facilities were left behind. These wastes were sometimes burnt at the external storage area by the orderlies but sometimes left on the ground unattended to (Plates 10 and 11). The external storage areas are shown in plates 9, 12 and 13.

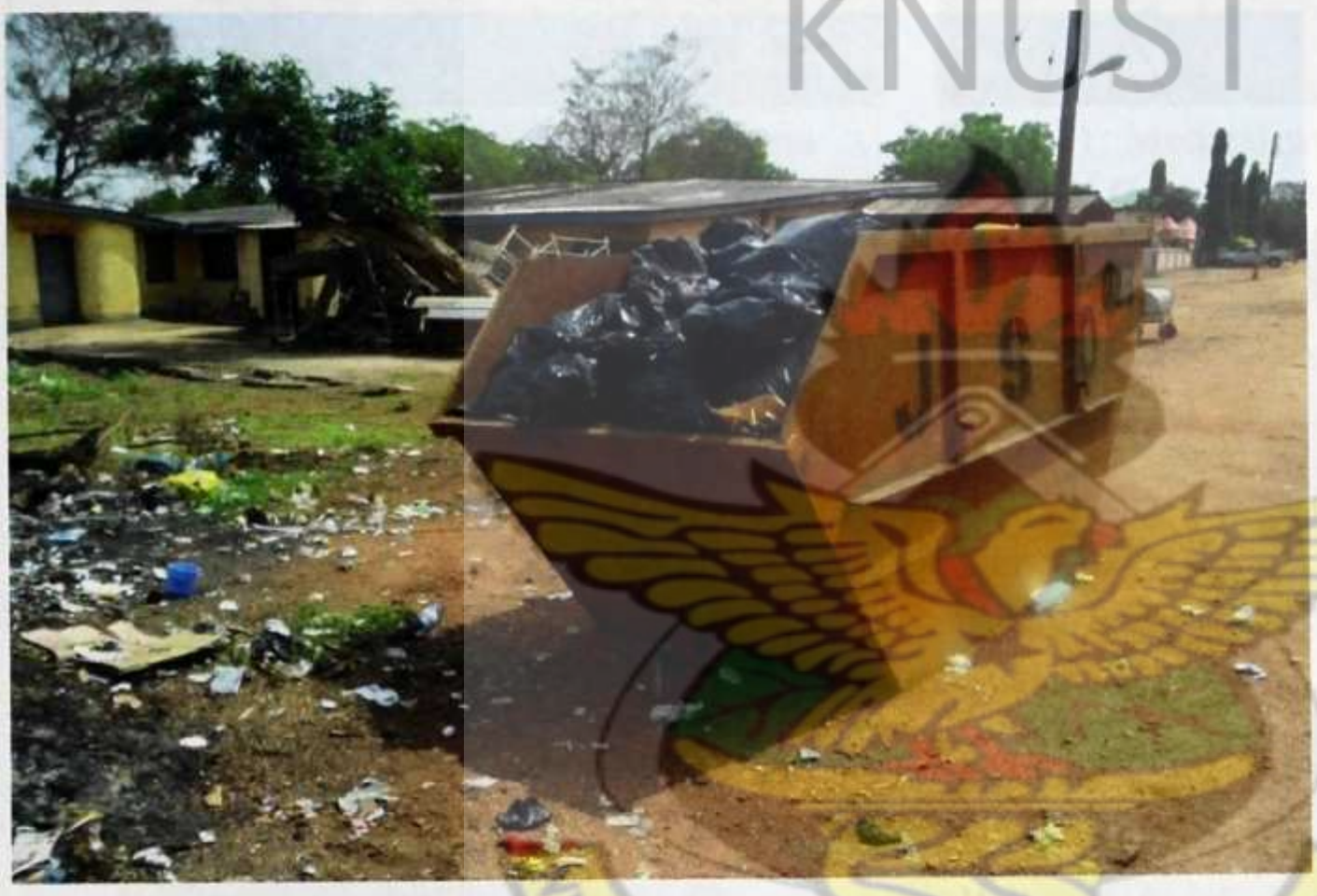

Plate 9: External storage area at Tema General Hospital

Plate 10: Medical waste left behind at Tema General Hospital after off-site transportation

Plate 11: Medical waste left behind at Tema General Hospital after off-site transportation

Plate 12: External storage area at Tema Polyclinic

Plate 13: External storage area at Manhean Health Centre

4.5.1.6 Frequency of collection of waste from External Storage Area

Observation indicated that waste was picked twice a week at Tema General Hospital by Stanley J. Owusu and Co. Ltd, three times a week at Tema Polyclinic by Tema Metropolitan Assembly and twice a week at Manhean Health Centre by Zoomlion Ltd.

4.5.2 Waste Disposal Register

It was observed that there was no register for waste disposal at all three Health care institutions and there was no indication of plans towards obtaining a waste register. It was therefore not possible for the Healthcare workers to accurately provide information on the weight of disposed waste.

4.5.3 Transportation of Medical Waste to Landfill Site

It was observed that the medical waste was loaded together with municipal waste to the landfill site.

4.5.4 Final Disposal Site

It was observed that the final disposal site for all three Healthcare facilities was the Kpone landfill. None of the health institutions surveyed treated its wastes before disposal into the municipal dumpsites. A visit to the landfill revealed that the medical waste was mixed with municipal waste, dumped directly on the site and burnt together in the open air. Several Human scavengers were seen at the landfill amidst the smoke gathering items without any limitation. The Kpone landfill site is shown in plates14, 15, 16, 17 and 18.

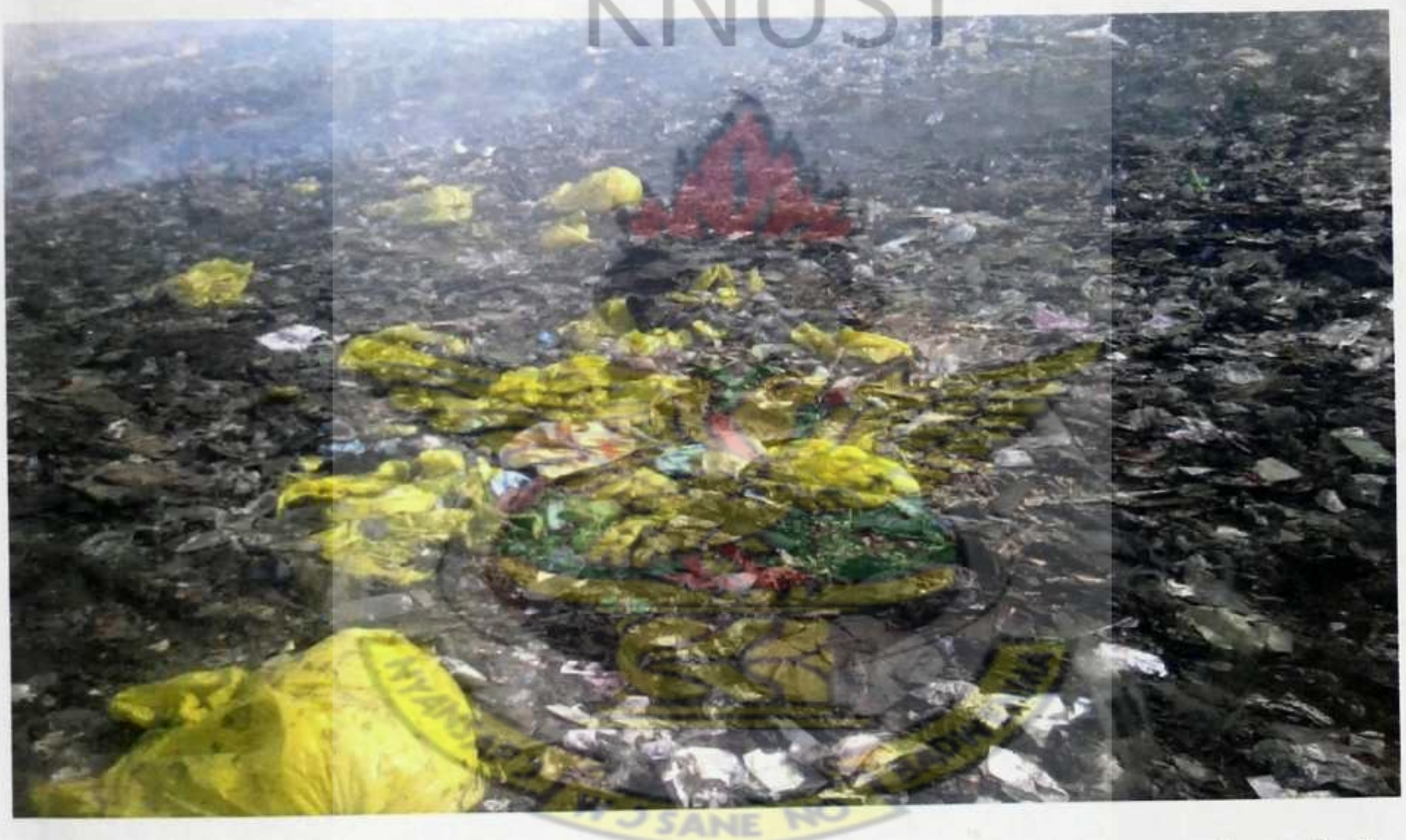

Plate 14: Scenes at Kpone landfill site. The Yellow polythene bags used to contain medical waste.

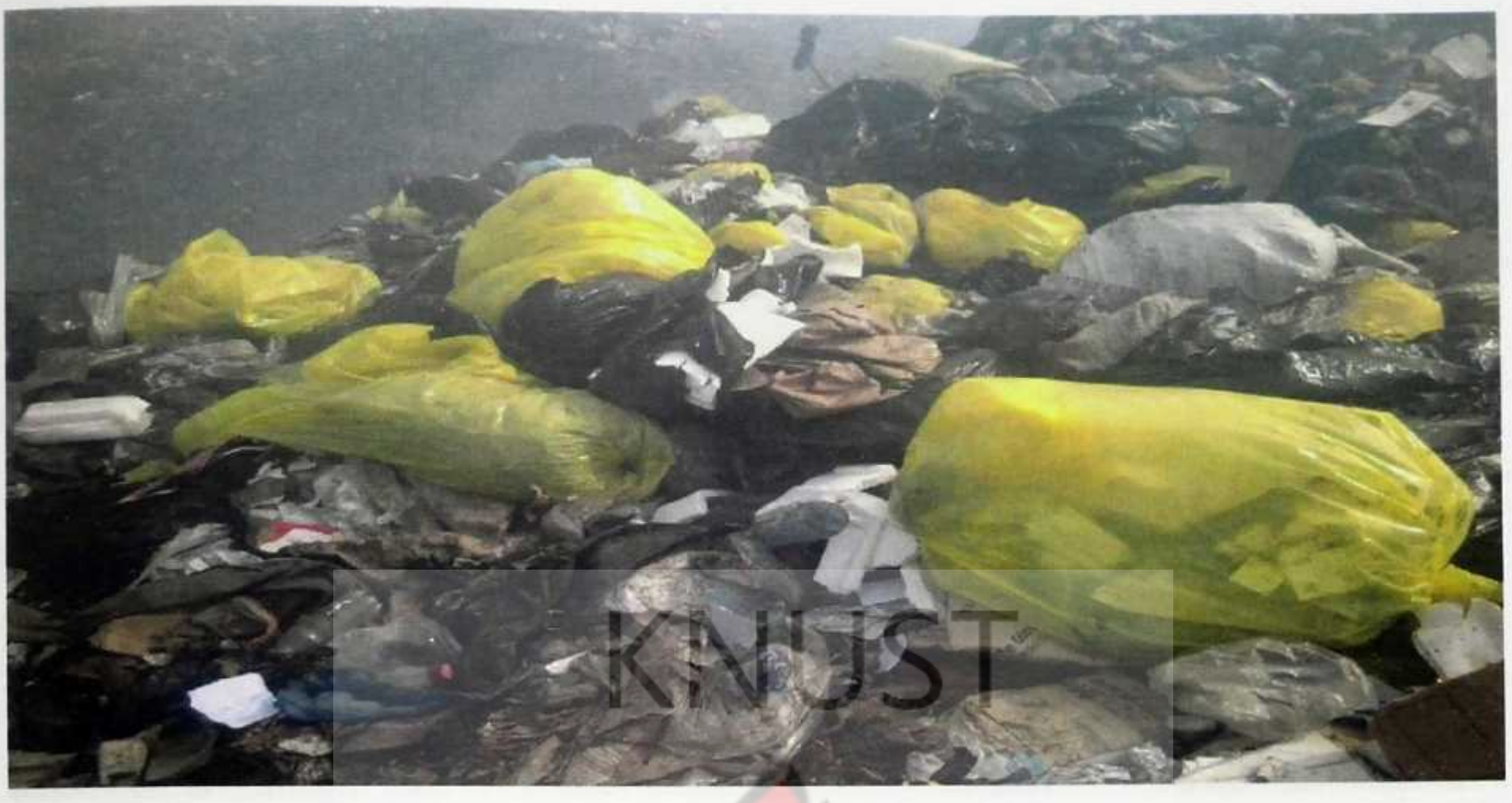

Plate 15: Scenes at Kpone landfill site. The medical waste mixed with municipal waste.

Plate 16: Scenes at Kpone landfill site. The medical waste is burnt alongside municipal waste at the Kpone landfill in the open air

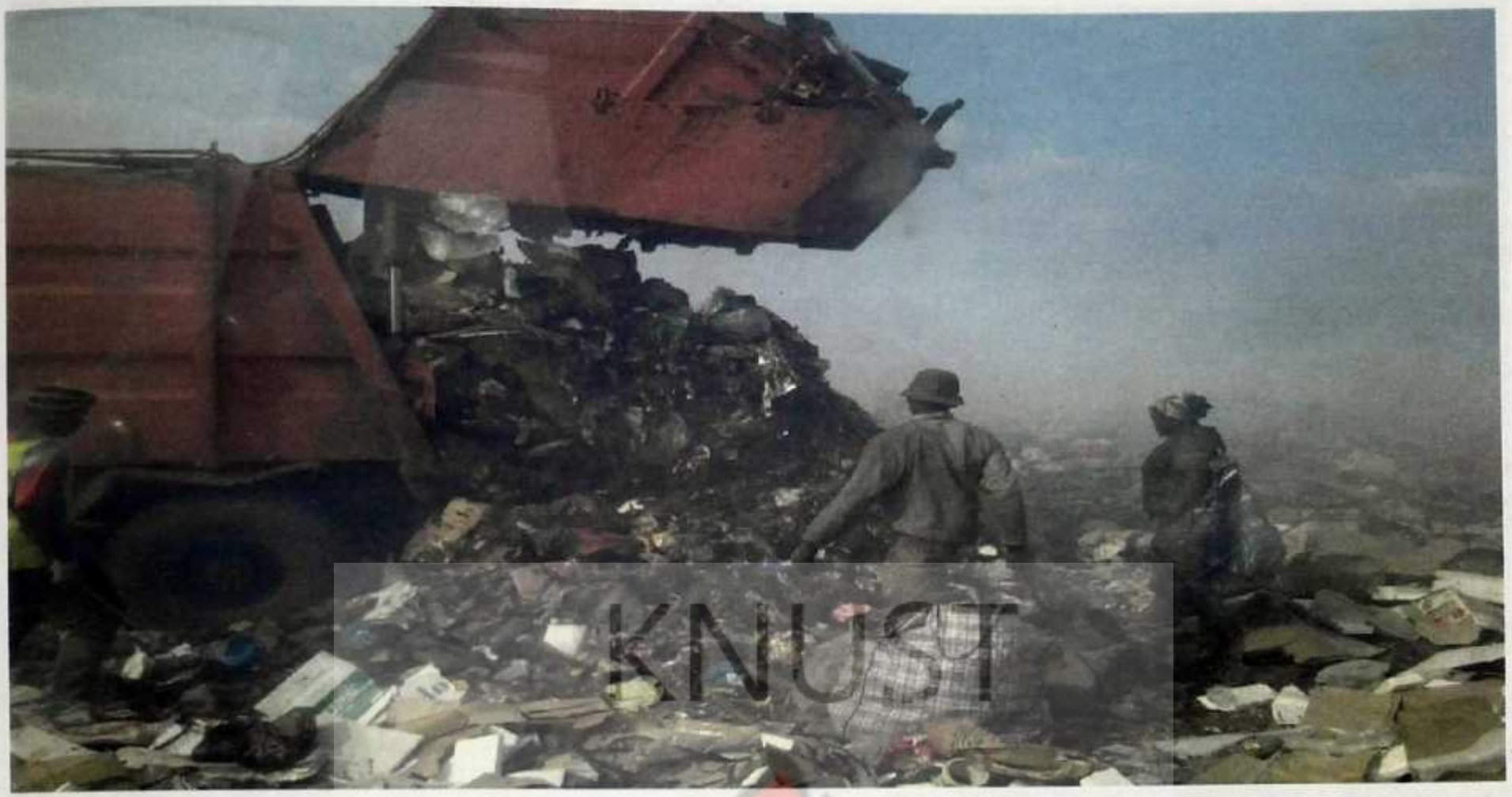

Plate 17: Scenes at Kpone landfill site. Scavengers eagerly wait to collect some waste upon arrival at Kpone landfill

Plate 18: Scenes at Kpone landfill site. Scavengers collecting some waste

4.6 Demographic Characteristics of Respondents

4.6.1 Demographic Characteristics of Respondents at Tema General Hospital

The response rate of respondents of the questionnaire at Tema General Hospital was 85.20%. Majority of the respondents were female (66.20%) and a very significant percentage of the respondents were nurses (48.83%), followed by auxiliary staff (28.64%) and doctors (10.80%). In descending order, the minority of the respondents were the Disease Control Officers (0.47%), Physiotherapists (0.94%), Environmental Officers (1.41%) laboratory technicians (2.35%), pharmacy assistants (2.82%) and pharmacists (3.76%). The demographic data of respondents are shown in Table 13 and 14.

4.6.2 Demographic Characteristics of Respondents at Tema Polyclinic

At Tema Polyclinic, the response rate of respondents of the questionnaire was 83.30%. Majority of the respondents were female (56.80%) and a very significant percentage of the respondents were nurses (46.40%), followed by auxiliary staff (44.80%) and doctors (4.80%). The minority of the respondents were the pharmacy assistants (0.80%), laboratory technicians (0.80%), and pharmacists (2.40%). The demographic data of respondents are shown in Table 13 and 14.

4.6.3 Demographic Characteristics of Respondents at Tema Polyclinic

The response rate of respondents of the questionnaire at Manhean Health Centre was 76%. Majority of the respondents were female (78.95%) and majority of the respondents were nurses (60.53%), followed by auxiliary staff (35.53%). The minority of the respondents was the laboratory technicians (1.32%), and doctors (2.63%). The demographic data of respondents are shown in Table 13 and 14.

Table 13: Percentage Response and Demographic data of respondents (Gender)

(18th January to 30th March, 2012)

	Tema General Hospital	Tema Polyclinic	Manhean Health Centre
Total Questionnaires distributed	250	150	100
Respondent (Total number and % of respondents to questionnaires issued)	85.20% (213)	83.30% (125)	76 (76%)
Male	33.80% (72)	43.20% (54)	21.05% (16)
Female	66.20% (141)	56.80% (71)	78.95% (60)

Table: 14 Demographic data of respondents (18th January to 30th March, 2012)

	Tema General Hospital	Tema Polyclinic	Manhean Health Centre
Doctors	10.80 % (23)	4.80% (6)	2.63% (2)
Physiotherapists	0.94% (2)	0% (0)	0% (0)
Nurses	48.83% (104)	46.40% (58)	60.53 % (46)
Pharmacists	3.76% (8)	2.40% (3)	0% (0)
Pharmacy Assistants	2.82% (6)	0.80% (1)	0% (0)
Auxiliary staff	28.64% (61)	44.80% (56)	35.53% (27)
Laboratory Technicians	2.35% (5)	0.80 % (1)	1.32% (1)
Environmental Officers	1.41% (3)	0% (0)	0% (0)
Disease Control Officers	0.47%(1)	0% (0)	0% (0)

4.6.4 Age Range of Respondents at Tema General Hospital

The highest percentage of the respondents (38.50%) at Tema General Hospital were between 18 to 28 years; followed by those between the ages of 29-39 years (38.03%). The minority of the respondents were between the ages of 40-49 years (11.27%) and 50-59 years (12.21%). The range of ages of the respondents are shown in Table 15.

4.6.5 Age Range of Respondents at Tema Polyclinic

A significant percentage of the respondents (38.40%) at Tema Polyclinic were between 29 to 39 years; followed by those between the ages of 40-49 years (25.60%) and then those between the ages of 18-28years (21.60%). The minority of the respondents were between the ages of 50-59 years (14.40%). The range of ages of the respondents are shown in Table 15.

4.6.6 Age Range of Respondents at Manhean Health Centre

A significant percentage of the respondents (40.79%) at Manhean Health Centre were between 18 to 28 years; followed by those between the ages of 29-39 years (36.84%) and then those between the ages of 40 to 49 years (14.47%). The minority of the respondents were between the ages of 50-59 years (7.89%). The range of ages of the respondents are shown in Table 15.

Table 15: Age Range of Respondents (18th January to 30th March, 2012)

	Range of ages				
	18-28years	29-39years	40-49years	50-59years	60-69years
Tema General Hospital (TGH)	38.50% (82)	38.03% (81)	11.27% (24)	12.21% (26)	0% (0)
Tema Polyclinic (TP)	21.60% (27)	38.40% (48)	25.60% (32)	14.40% (18)	0% (0)
Manhean health Centre (MHC)	40.79% (31)	36.84%(28)	14.47% (11)	7.89% (6)	0% (0)

4.6.7 Educational background of Respondents at Tema General Hospital

The highest percentage (32.86%) of respondents at Tema General Hospital had a diploma; 29.58% had a first degree and 24.88% had secondary school education. None of the respondents were illiterates; 4.69% had primary education and 7.98% had post graduate qualifications (Table 16).

4.6.8 Educational background of Respondents at Tema Polyclinic

The highest percentage (44.80%) of respondents at Tema Polyclinic had a first degree; 28.80% had secondary school education and 20.80% had a diploma; 2.40% of the respondents were illiterates; 2.40 % had post graduate qualifications and 0.80% had primary education (Table 16).

4.6.9 Educational background of Respondents at Manhean Health Centre

The highest percentage (48.68%) of respondents at Manhean Heath Centre had a diploma; 44.70% had secondary school education and 6.58% had a first degree. None of the respondents were illiterates; had primary education or post graduate qualifications (Table 16).

Table 16: Educational Background of Respondents (18TH January to 30TH March, 2012)

	Illiterate	Primary	Secondary	Diploma	First degree	Post graduation
Tema General Hospital (TGH)	0% (0)	4.69% (10)	24.88% (53)	32.86% (70)	29.58% (63)	7.98% (17)
Tema Polyclinic (TP)	2.40% (3)	0.80% (1)	28.80% (36)	20.80% (26)	44.80% (56)	2.40% (3)
Manhean health Centre (MHC)	0% (0)	0.00% (0)	44.70% (34)	48.68% (37)	6.58% (5)	0.% (0)

4.7 Awareness of Waste Management Practices

At Tema General Hospital, 56.34% of the respondents indicated that they were aware of the national policy and guidelines regarding hospital waste management; similarly, 48.80% and 51.32% of the respondents at Tema Polyclinic and Manhean Health Centre respectively also indicated that they were aware of the national policy and guidelines regarding hospital waste management. When asked whether the healthcare setting had a waste management plan, 94.30% of the respondents from Tema General Hospital indicated 'Yes' as well as 63.20% and 31.08% from Tema Polyclinic and Manhean Health Centre respectively.

When asked whether there were waste management responsibilities included in the job descriptions of hospital supervisory staff; 45.07%, 9.60% and 21.05% indicated 'Yes' from Tema General Hospital ,Tema Polyclinic and Manhean Health Centre respectively with 52% and 60.53% also indicating 'not sure' from Tema Polyclinic and Manhean Health Centre respectively. The vast majority of respondents at Tema General Hospital (99.53%), Tema Polyclinic (72.00%) and Manhean Health Centre (86.84%) indicated that waste should be segregated.

Table 17: Awareness of Waste Management Practices

Awareness	Tema General Hospital			Tema Polyclinic			Manhean Health Centre		
	Yes	No	Not Sure	Yes	No	Not Sure	Yes	No	Not Sure
National policy and guidelines on hospital waste management	56.34% (120)	43.66% (93)	0.0% (0)	48.80 % (61)	51.20% (64)	0% (0)	51.32% (39)	48.68% (37)	0% (0)
Availability of waste management plan	94.30% (201)	5.36% (12)	0% (0)	63.2% (79)	36.80% (46)	0% (0)	31.08% (23)	68.92% (51)	0% (0)
Are there waste management responsibilities included in job descriptions of hospital supervisory staff	45.07% (96)	19.72% (42)	35.2% (75)	9.60% (12)	38.40% (48)	52.00% (65)	21.05% (16)	18.42% (14)	60.53% (46)
Should waste be segregated into different categories	99.53% (212)	0.47% (1)	0% (0)	72% (90)	20% (35)	0% (0)	85.53% (65)	14.47% (11)	0% (0)

4.8 Waste Management Education

When the respondents were asked whether they had undergone training in Hospital waste management, majority of the respondents at Tema Polyclinic (84%) and Manhean Health Centre (90.79%) indicated 'No', however, most of the respondents at Tema General Hospital (58.22%) indicated 'Yes'. Most of the respondents at Tema General Hospital (64.32%) indicated that the hospital provided annual education on waste management for employees, however; only 27.20% and 9.21% of respondents from Tema Polyclinic and Manhean Health Centre respectively indicated that the hospital provided annual education on waste management for employees. The majority of respondents from Tema General Hospital (95.77%), Tema Polyclinic (83.20%) and Manhean Health Centre (93.42%) reported that they would like to attend a program on hospital waste management (Table 18).

Table 18: Waste Management Education

	Tema General Hospital		**Tema Polyclinic**		**Manhean Health Centre**	
	Yes	No	Yes	No	Yes	No
Have you undergone training in Hospital waste management	58.22% (124)	41.78% (89)	16.00% (20)	84.00% (105)	9.21% (7)	90.79% (69)
Does the hospital provide annual education on waste managent	64.32% (137)	35.68% (76)	27.2% (34)	72.80% (91)	9.21% (7)	90.79% (69)
Would you like to attend a programme on hospital waste management	95.77% (204)	4.23% (9)	83.2% (104)	16.8% (21)	93.42% (71)	6.58% (5)

4.9 Attitude Assessment of Respondents at Tema General Hospital, Tema Polyclinic and Manhean Health Centre

The greater portion of respondents from Tema General Hospital (84.04%) and Manhean Health Centre (67.11%) disagreed that 'safe management of health care waste was not an issue at all', however, the highest percentage of the respondents from Tema Polyclinic (49.60%) agreed with 12.80% indicating 'no comment'. Most of the respondents from Tema General Hospital (78.87%), Tema Polyclinic (59.20%) and Manhean Health Centre (64.47%) disagreed that 'safe management of health care waste was the responsibility of government'. More than half of respondents from Tema General Hospital (52.11%), Tema Polyclinic (53.60%) and Manhean Health Centre (80.26%) agreed that 'waste management was team work and no single class of people is responsible for safe management' however, a significant section of respondents in Tema General Hospital (42.25%) and Tema Polyclinic (23.20%) disagreed. Majority of respondents from Tema General Hospital (59.62%) and Manhean Health Centre (51.32%) agreed that 'management efforts by the hospital increased financial burdens on management' however, 52% of respondents from Tema Polyclinic disagreed. Most of the respondents from Tema General Hospital (59.62%) and Tema Polyclinic (53.60%) disagreed that 'safe management of health care waste was an extra burden on work' however; majority of the respondents at Manhean Health Centre (52.63%) agreed (Tables 19 and 20).

Table 19: Attitude Assessment of Respondents at Tema General Hospital, Tema Polyclinic and Manhean Health Centre

	Tema General Hospital			Tema Polyclinic			Manhean Health Centre		
	Agree	Disagree	No comment	Agree	Disagree	No comment	Agree	Disagree	No comment
Safe management of Health care waste is not an issue at all	9.86% (21)	84.04% (179)	6.10% (13)	49.60% (62)	37.60% (47)	12.80% (16)	3.95% (3)	67.11% (51)	28.95% (22)
Safe Management of Health care waste is the responsibility of government	13.62% (29)	78.87% (168)	7.51% (16)	28.00% (35)	59.20% (74)	12.80% (16)	15.79% (12)	64.47% (49)	19.74% (15)
Waste management is team work/no single class of people is responsible for safe management	52.11% (111)	42.25% (90)	5.63% (12)	53.60% (67)	23.20% (29)	23.20% (29)	80.26% (61)	15.79% (12)	3.95% (3)

Table 20: Additional Attitude Assessment of Respondents at Tema General Hospital, Tema Polyclinic and Manhean Health Centre

	Tema General Hospital			Tema Polyclinic			Manhean Health Centre		
	Agree	Disagree	No comment	Agree	Disagree	No comment	Agree	Disagree	No comment
Management efforts by hospital increases financial burden on management	59.62% (127)	23.94% (51)	16.43% (35)	24.00% (30)	52.00% (65)	24.00% (30)	51.32% (39)	22.37% (17)	26.32% (20)
Safe management of Health care waste is an extra burden on work	30.99% (66)	59.62% (127)	9.39% (20)	34.40% (43)	53.60% (67)	12.00% (15)	52.63% (40)	40.79% (31)	6.58% (5)
Management efforts by hospital increases financial burden on management	59.62% (127)	23.94% (51)	16.43% (35)	24.00% (30)	52.00% (65)	24.00% (30)	51.32% (39)	22.37% (17)	26.32% (20)

4.10 Waste Management Practices at Tema General Hospital, Tema Polyclinic and Manhean Health

When asked whether the national waste management policy was available to staff, the greater proportion of respondents at Tema General Hospital (55.87%), Tema Polyclinic (70.40%) and Manhean Health Centre (84.21%) indicated 'No'. Majority of respondents in both Tema Polyclinic (76%) and Manhean Health Centre (84.21%) reported that they did not colour code the waste for disposal, however, the vast majority of respondents from Tema General Hospital (94.84%) indicated that they colour coded waste for disposal. More than half of the respondents from Tema General Hospial (57.28%), Tema Polyclinic (56.80%) and Manhean Health Centre (78.95%) reported that the infection waste was not labeled with a biohazard symbol. The greater portion of the respondents at Tema General Hospital (97.18%) and Manhean Health Centre (82.89%) reported that waste bags awaiting collection are safely stored away from the public, however, more than half (57.60%) of the respondents at Tema Polyclinic reported that waste bags awaiting collection were not safely stored away from the public. To add to the above, the vast majority of respondents at Tema General Hospital (88.21%), Tema Polyclinic (65.60%) and Manhean Health Centre (93.42 %) clearly reported that there was no register for waste disposal for waste disposal (Table 21).

Table 21: Waste management Practices

	Tema General Hospital		Tema Polyclinic		Manhean Health Centre	
	Yes	No	Yes	No	Yes	No
Is the national waste management Policy available to staff?	44.13% (94)	55.87% (119)	29.60% (37)	70.40% (88)	15.79% (12)	84.21% (64)
Do you color code the waste for disposal?	94.84% (202)	5.16% (11)	24.00% (30)	76.00% (95)	15.79% (12)	84.21% (64)
Is the infection waste labeled with the Bio-hazard symbol?	42.72% (91)	57.28% (122)	43.20% (54)	56.80% (71)	21.05% (16)	78.95% (60)
Are waste bags awaiting collection safely stored away from the public?	97.18% (207)	2.82% (6)	42.40% (53)	57.60% (72)	82.89% (63)	17.11% (13)
Do you maintain a register for waste disposal?	11.79% (25)	88.21% (187)	34.40% (43)	65.60% (82)	6.58% (5)	93.42% (71)

4.11 Awareness of Facilities Available for Waste Management

Most of the respondents in Tema Polyclinic (50.89%) and the highest percentage of respondents at Manhean Health Centre (36.57%) indicated containment as the most frequently used facility for waste management, however, at Tema General Hospital the highest percentage of the respondents (35.54%) indicated segregation as the most frequently used facility for waste management (Table 22).

Table 22: Awareness of Facilities Available for Waste Management

	Tema General Hospital	Tema Polyclinic	Manhean Health Centre
Segregation	35.54 %	10.65%	6.86%
Containment	28.11 %	50.89%	36.57%
Incineration	12.05 %	7.69%	0%
Autoclaving	10.44 %	4.14%	20.57%
Burning	8.63 %	16.57%	33.71%
Deep Burial	5.22 %	10.06%	2.28%

4.12 Awareness of Who Does Segregation

More than half of the respondents from Tema General Hospital (51.17%) and Tema Polyclinic (52.00%) reported that auxillary staffs were responsible for segregation of waste; however, majority of respondents from Manhean Health Centre (59.21%) did not know who was responsible for segregation of waste (Table 23).

Table 23: Awareness of Who Does Segregation

	Tema General Hospital	Tema Polyclinic	Manhean Health Centre
Doctor	0% (0)	0.80% (1)	2.63% (2)
Nurse	2.82% (6)	8.00 % (10)	2.63% (2)
Auxiliary staff	51.17% (109)	52.00% (65)	34.21% (26)
Do not Know	9.39% (20)	39.20% (49)	59.21% (45)
All staff	36.62% (78)	0% (0)	1.32% (1)

4.13 Awareness of Disposal of Medical Waste and Frequency of Waste Audits

Most of the respondents at Tema General Hospital (46.37%) and Manhean Health Centre (69.74%) indicated that biomedical waste is dumped into corporation bins; however, most of the respondents from Tema Polyclinic (49.6%) indicated that biomedical waste is disposed by any authorized hospital waste collection (Table 24).

Table 24: Disposal of Biomedical waste

	Tema General Hospital	Tema Polyclinic	Manhean Health Centre
Dumping in corporation bin	46.37%	42.40%	69.74 %
House to house waste collection	8.06%	8.00%	14.47%
Any authorized hospital waste collection	45.56%	49.60%	15.79%

The vast portion of the respondents at Tema General Hospital (39.44%) indicated that a waste audit was conducted 'more than 6 months ago' with 38.50 % indicating 'less than 6 months ago', however, the highest percentage of the respondents at Tema Polyclinic (49.60%) and Manhean Health Centre (40.79%) indicated that a waste audit was conducted 'less than 6 months ago' (Table 25).

Table 25: Last Time Waste Audit was Conducted

	Tema General Hospital	Tema Polyclinic	Manhean Health Centre
More than 6 months ago	39.44% (84)	23.20% (29)	25% (19)
Less than 6 months ago	38.50 % (82)	49.6% (62)	40.79% (31)
Last 2 years	1.88% (4)	8.00% (10)	1.32% (1)
More than 2 years ago	20.19% (43)	19.20% (24)	32.89% (25)

4.14 Awareness on Frequency of Pick- up of Biomedical Waste

Most of the respondents at Tema General Hospital (81.22%) indicated that waste was picked every day; majority of the respondents at Tema Polyclinic (50.40%) indicated that waste was picked 'twice a week' and more than half of the respondents at Manhean Health Centre (63.74%) indicated that medical waste was picked 'once a week' (Table 26).

Table: 26 Frequency of Pick-up (Medical Waste)

Frequency	Tema General Hospital	Tema Polyclinic	Manhean Health Centre
Every day	81.22% (173)	8.00% (10)	5.26% (4)
Every other day	1.88 % (4)	6.40% (8)	0% (0)
Once a week	2.82 % (6)	35.20% (44)	75% (57)
Twice a week	14.08% (30)	50.40% (63)	19.74%(15)

4.15 Knowledge on Usage of Bins

When asked whether the bins or compactor of solid waste containers were shared by other businesses, majority of the respondents at Tema General hospital (55.40%), Tema Polyclinic (62.40%) and Manhean Health Centre (64.47%) indicated 'No' (Table 27).

Table 27: Knowledge on Usage of Bins

	Tema General hospital			**Tema Polyclinic**			**Manhean Health Centre**		
	Yes	No	Not Sure	**Yes**	No	Not Sure	**Yes**	No	Not sure
Are the bins or compactor of solid waste containers shared by other businesses	6.57% (14)	55.40% (118)	38.03% (81)	5.60% (7)	62.40% (78)	32.00% (40)	6.58% (5)	64.47% (49)	28.95% (22)

CHAPTER FIVE

5.0 DISCUSSION

5.1 Quantity of Medical Waste Generated

Surveys have showed that the total amount of Health care waste generated in a hospital in an industrialized country is approximately two to more than seven times that generated in developing countries. The relatively large amounts of wastes generated in hospitals in developed countries come mostly from the very heavy reliance on disposable instruments and materials, and on increased packaging of the products used (Shaner and McRae, 2002). Bdour *et.al.* (2006) have reported the average waste generation in European Healthcare establishments to be 3.9 kg bed-1 day-1 (Norway), 4.4 kg bed-1 day-1 (Spain) and 3.3 kg bed-1 day-1 (UK and France). Results from this study revealed that the estimated medical waste per patient per day was 3.313 Kg/bed/day at Tema General Hospital, 0.291Kg/patient/day at Tema Polyclinic and 0.23/patient/day at Manhean Health Centre. The results from Tema General Hospital contradicts the results of Shaner and McRae (2002) since the estimated waste generated per bed per day is equivalent to the waste generated in Healthcare establishments in UK and France. Also the variation in waste generation observed among the three healthcare categories is expected. This largely depends on a number of factors such as the type or level of technology employed in its services and sometimes the location and reputation of the hospital. This observation corroborates the assertion of various authors in similar studies (Coker *et al.*, 1999; Mato and Kaseava, 1999; Pruss and Townsend, 1998; Waseem *et al.*, 1995). They affirmed that the variation in waste generation rate from one ward or unit to another within each hospital is dependent upon the nature of activities or services in that particular ward.

5.2 Type of Waste Generated, Storage, Transportation and Environmental Implications

The major types of waste generated in Tema General Hospital, Tema Polyclinic and Manhean Health Centre were similar, the absence of premium waste segregation at all three health care facilities studied imply that the estimates of the various categories of general and medical waste may not be precise since medical waste may have been carelessly placed in black polythene bags , nonetheless it provides a useful guide for the assessment of the different waste streams generated many of which are hazardous in nature requiring special handling to avoid health consequences.

Tema General Hospital and Tema Polyclinic indicated segregation and containment as the most frequently used waste management facility with Manhean Health Centre indicating containment and burning as the most frequently used facility for waste management. Open air burning does not guarantee proper incineration, and releases toxic fumes (dioxin) into the atmosphere from the burning of plastics (Akter, 2000). Furthermore, Tema General Hospital and Tema Polyclinic had facilities for incineration of sharp objects; whilst, Manhean Health Centre had no facility for incineration, hence, sharp objects are sent to Tema Polyclinic twice a week for incineration. According to BAN and HCWH (1999), approximately 85% of sharp injuries are caused between their usage and subsequent disposal and more than 20% of those who handle them encounter 'stick' injuries, hence, it was important for Manhean Health Centre to construct an incinerator for incineration of sharp objects. Even though Tema General Hospital has an incinerator for other medical wastes, it is out of order, hence, cannot be used. Ashes from the incinerators were buried at specified locations at the Tema General Hospital and Tema Polyclinic. Kuo *et al.* (1999) reported that high levels of Ni, Cr and Fe in ash samples from clinical waste incinerators in Taiwan could be due to the fact that the hospitals do not grind or melt down needles or syringes at high

concentrations; hence, it can be deduced that there will be high concentrations of Ni, Cr and Fe in the locality where the ashes from the incinerators are buried.

Vast majority of respondents at Tema General Hospital (99.53%), Tema Polyclinic (72%) and Manhean Health Centre (86.84%) reported that waste should be segregated; more than half of the respondents from Tema General Hospital (51.17%) and Tema Polyclinic (52%) reported that auxiliary staffs were responsible for segregation of waste; however, majority of respondents from Manhean Health Centre (59.21%) did not know who was responsible for segregation of waste.

Patil and Shekdar (2001) reported that lack of awareness and training in clinical waste segregation technique is the major reason why clinical waste is collected in mixed form in India. Similar observations were reported by Phengxay *et al.* (2005) in Lao People's Democratic Republic, Mbongwe *et al.* (2008) in Botswana and Bdour *et al.* (2006) in Jordan. It was observed at all three Healthcare facilities that doctors and nurses who use sharps are required to drop them into safety boxes but this is not diligently followed. A similar situation was uncovered in India where used cotton, dressing materials blood, needles and syringes are not segregated from the general waste pile (Gupta and Boojh, 2006). In Tanzania, Mato and Kassenga (1997) uncovered that segregation of wastes takes place in only 56.5% of healthcare facilities. Similar observations have been made elsewhere. In a study conducted in 21 healthcare facilities in Northern Jordan for example, Abdulla *et al.* (2008) uncovered non-segregation of chemical wastes in 76% of hospitals. Similar trends have been uncovered in Iran (Askarian *et al.*, 2004), Turkey (Alagoz and Kocasoy, 2008) and Brazil (Da Silva *et al.*, 2005).

The greater portion of respondents from Tema General Hospital (94.84%) indicated that they colour code waste for disposal as against 76% and 84.21% of respondents from Tema Polyclinic and Manhean Health Centre respectively who reported that they do not colour code waste for disposal. It was observed that at Tema General Hospital medical waste was more frequently placed in yellow polythene bags lined in bins whilst general wastes were placed in black polythene bags lined in bins, however, at Tema Polyclinic and Manhean Health Centre the adherence to colour coding was not regular even though Tema Polyclinic performed better relative to Manhean Health Centre. All the doctors that responded at Tema General Hospital and Manhean Health Centre indicated that they colour coded waste for disposal; on the contrary, all the doctors that responded at Tema Polyclinic indicated that they did not colour code waste for disposal. The results from Tema Polyclinic corresponds with a similar study conducted in Allahabad city, India by Mathur *et al* (2011),where knowledge regarding the color coding and waste segregation at source was found to be better among nurses and laboratory staff as compared to doctors.

More than half of the respondents from Tema General Hospital (57.28%), Tema Polyclinic (56.8%) and Manhean Health Centre (78.95%) reported that the infection waste was not labeled with a biohazard symbol. It was observed that in all three health care settings the biohazard symbol was not used frequently, this is not acceptable since if infectious wastes were not separated from other wastes, the wastes would be considered as hazardous or infectious (WHO, 2005)

The greater proportion of the respondents at Tema General Hospital (97.18%) and Manhean Health Cemtre (82.89%) reported that waste bags awaiting collection are safely stored away from the public, however, more than half (57.6%) of the respondents at Tema Polyclinic reported that waste bags awaiting collection were not safely stored away from the public. According to the

Ministry of Health Policy guidelines for Health Institutions, "facilities for external storage should be enclosed and surrounded by an impervious wall of appropriate height and provided with a gate and lock", however, it was observed that, all three Health care facilities had no such facility, hence, waste awaiting collection was accessible from the environment and both infectious and non-infectious wastes were mixed together even though they were tied in different bags. The results contradicts a similar study conducted by Abor (2007) at Kotobu hospital in South Africa where the infectious and non-infectious wastes are kept in separate containers and were not mixed together in the hospital's own temporary storage area. Furthermore, when the waste was eventually collected some of the debris of medical waste at all three healthcare facilities were left behind periodically. These wastes are sometimes burnt at the external storage area by the orderlies and sometimes left on the ground. This debris can be easily picked by scavengers and cause infections.

It was observed that both Tema General Hospital and Tema Polyclinic had a placenta pit, however, Manhean Health Centre did not have a placenta pit and buried the placenta at a given location within the hospital premises. On-site disposal of biomedical waste at generation points is recommended as a suitable option especially in developing countries (Pruss *et al.*, 1999). In cases where on-site burial is carried out, the burial site must be restricted to authorized personnel and also, adequate steps must be taken to prevent pollution and contamination of ground and surface water sources (Pruss *et al.*, 1999), however, at Manhean Health Centre the location for burial was not restricted to authorized personnel and no steps were taken to prevent environmental pollution. The placenta pit at Tema Polyclinic was well managed and lime was applied twice a week, however, the placenta pit at Tema General Hospital was not properly managed since the pit was not covered and had non-biodegradable polythene bags dumped along with the placenta into the pit which resulted in a foul odour thus causing air pollution.

Most of the respondents at Tema General Hospital (81.22%) indicated that waste was picked every day; majority of the respondents at Tema Polyclinic (50.4%) indicated that waste was picked 'twice a week' and more than half of the respondents at Manhean Health Centre (63.74%) indicated that medical waste was picked 'once a week'. It was observed that waste was picked twice a week at Tema General Hospital by Stanley J. Owusu and Co. Ltd, three times a week at Tema Polyclinic by Tema Metropolitan Assembly and twice a week at Manhean Health Centre by Zoomlion Ltd. Safe and secured storage of biomedical pollutants is essential for the mitigation of risks to the environment and public health (Pruss *et al.*, 1999), thus the frequency of collection was not adequate in all three health care facilities and should be improved.

Diaz *et al.* (2005) identified some of the more common treatment and disposal methods utilised in the management of infectious medical wastes in developing countries to include autoclaves and retorts; microwave disinfection systems; chemical disinfections; combustions (incineration); and disposal on land (dump site, controlled landfill, pits and sanitary landfill). Similarly, it was observed that the final disposal site for all three Healthcare facilities was the Kpone landfill. None of the health institutions surveyed treated its wastes before disposal into the municipal dumpsites. A visit to the landfill revealed that the medical waste was mixed with municipal waste, dumped directly on the site and burnt together in the open air. Several Human scavengers were seen at the landfill amidst the smoke gathering items without any limitation. Human exposure to contaminated blood and body fluids can cause infections due to the possible presence of blood or liquid-bourne pathogens (Diaz *et al.*, 2005; Socunya *et al.*1997; Pruss *et al.*, 1999). Infections can also be caused by sharp objects contained in biomedical waste such as used needles, syringes, blades, knives, saws, scalpels or glass materials which were not properly segregated at the generation point.

Open air burning of the medical waste alongside the municipal waste at the landfill site can cause chlorine and sulphur which are chemically bound within most materials that constitute clinical waste to subsequently oxidize into Hydrogen Chloride (HCl) and Sulphur dioxide (SO_2) during combustion (U.S. EPA, 1988) thus resulting in the pollution of the environment. This can have a negative impact on aquatic life in terms of reproduction and development (Fong, 1998; Jobling *et al.*, 1998). In Accra, Ghana for example, Boadi and Kuitenan (2002) had suggested that the improper disposal of untreated biomedical pollutants contributed to the loss of aquatic life in the Korle Lagoon.

Under conditions of mismanagement, human and animal anatomical parts contained in medical may cause environmental nuisance and attract disease causing vermin (Nemathaga *et al.*, 2007). Despite the risks posed by biomedical pollutants to the environment, a paucity of information regarding cause and effect relationships contributes to high degrees of uncertainty (Muhlich *et al.*, 2003). The disposal of medical waste at the land fill site together with municipal waste can result in several risks to the environment and human health since landfills produce leachates which contains pollutants such as, dissolved organic matter, inorganic macro components, heavy metals and xenobiotic organic compounds (Bagchi, 1990; Koerner and Daniel, 1997) and the presence of medical waste will intensify the toxicity of the leachates. These substances are known to have subtle and long term effects on ecosystems and human health (Read *et al.*, 1998; Walsh and Lafleur, 1995).

It was observed that tracking of hazardous wastes at Tema General Hospital, Tema Polyclinic and Manhean Health Centre is often complicated by lack of available records on waste generation. Such data collected by this process can be used to produce a hospital waste bank on which further researchs on hospital waste management could hinge upon. This corresponds with the assertion by

Coker and Sangodoyin (2000) that the management of health facilities is hampered by lack of basic waste generation data.

5.3 Awareness of Waste Management Policies and Practices

At Tema General Hospital, 56.34% of the respondents indicated that they were aware of the national policy and guidelines regarding hospital waste management as against 48.8% and 51.32% of the respondents at Tema Polyclinic and Manhean Health Centre respectively. The results from Tema General Hospital and Manhean Health Centre contradicts a study conducted by Mochungong *et al.* (2010) in three hospitals in the Northwest Region of Cameroon where most of the correspondents had never heard of any policy either nationally or internationally on safe clinical waste management.

Out of the respondents, 44.13%, 29.6% and 15.79% indicated that the national waste management policy is available to staff at Tema general hospital, Tema polyclinic and Manhean health Centre respectively. This indicates that only few staff knew the Ministry of Health policy and guidelines for waste management.

The vast majority of respondents at Tema General Hospital (88.21%), Tema Polyclinic (65.6%) and Manhean Health Centre (93.33%) reported that there was no register for waste disposal. It was observed that there was no register for waste disposal at all three Health care institutions; this clearly contradicts the Ghana Ministry of Health Policy and guidelines for health care institutions (2006) which states that "all health institutions and waste management companies shall keep accurate records on waste management activities".

When asked whether the healthcare setting had a waste management plan, 94.3% of the respondents from Tema General Hospital indicated 'Yes' as against 63.2% and 31.08% from Tema

Polyclinic and Manhean Health Centre respectively who also indicated 'Yes'. The results obtained for Manhean Health Centre is alarming since more than half of the respondents were not aware of any waste management plan. Interviews with environmental officers indicated that there was no properly documented waste management plans in all three healthcare facilities.

With regards to waste audits, the vast portion of the respondents at Tema General Hospital (39.15%) indicated that a waste audit was conducted 'more than 6 months ago' with 38.68 % indicating 'less than 6 months ago', however, most of the respondents at Tema Polyclinic (49.6%) and Manhean Health Centre (40.79%) indicated that a waste audit was conducted 'less than 6 months ago'. Interviews with the environmental officers in all the three healthcare facilities indicated that a waste audit was conducted more than two year ago.

The greater portion of respondents at Tema General Hospital (58.22%) reported that they had undergone training on medical waste management as against the vast majority of respondents at Tema Polyclinic (84%) and Manhean Health Centre (90.79%) who reported that they had not undergone any training on medical waste management. The results from Tema Polyclinic and Manhean Health Centre correspond with a similar study conducted by Abah and Ohimain (2011) at a tertiary health facility (Teaching Hospital) in Nigeria where the proportion of respondents who had received specific training in the management of Healthcare waste was 11.5% (6/52).

Most of the respondents at Tema General Hospital (64.32%) indicated that the hospital provided annual education on waste management for employees, however; only 27.2% and 9.21% of respondents from Tema Polyclinic and Manhean Health Centre respectively indicated that the

hospital provided annual education on waste management for employees. The results from Tema Polyclinic and Manhean Health Centre contradict a comprehensive inspection survey conducted by Yong *et al* (2009) at Nanjing, China for 15 hospitals, where 93.3% of the hospitals provided training for staff; however, only 20% of the hospitals had ongoing training and education; Summers (1991) emphasizes that hospital workers "awareness", as a component of efficient clinical waste management goes beyond the drawing up and introduction of policies and laws. Sharma and Mathur (1989) also argued that sustained awareness generation is essential, thus, the management of the hospital should organise awareness programmes, especially for the auxiliary staff.

The majority of respondents from Tema General Hospital (95.77%), Tema Polyclinic (83.2%) and Manhean Health Centre (93.42%) reported that they would like to attend a program on hospital waste management. This clearly indicates a gap in terms of willingness and availability of training programs.

Results from the attitude assessment revealed that the greater portion of respondents from Tema General Hospital (84.04%) and Manhean Health Centre (67.11%) disagreed that 'safe management of health care waste is not an issue at all', however, most of the respondents from Tema Polyclinic (49.6%) agreed with 12.8% indicating 'no comment'. This clearly revealed the inadequate training on medical waste management provided at Manhean Health Centre. Most of the respondents from Tema General Hospital (78.87%), Tema Polyclinic (59.2%) and Manhean Health Centre (64.47%) disagreed that 'safe management of health care waste is the responsibility of government' and this had a direct reflection since more than half of respondents from Tema General Hospital (52.11%), Tema Polyclinic (53.6%) and Manhean Health Centre (80.26%) agreed that 'waste management is team work/no single class of people is responsible for safe management'. As was expected

majority of respondents from Tema General Hospital (59.62%) and Manhean Health Centre (51.32%) agreed that 'management efforts by hospital increases financial burden on management' however, 52% of respondents from Tema Polyclinic remarkably disagreed. Most of the respondents from Tema General Hospital (59.62%) and Tema Polyclinic (53.6%) disagreed that 'safe management of health care waste is an extra burden on work' however, majority of the respondents at Manhean Health Centre (52.63%) agreed. The attitude assessment clearly reflected the observations that there is the need for management of all three healthcare facilities to improve supervision and increase training on medical waste management.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

Tema General Hospital generated the highest quantity of waste followed by Tema Polyclinic and Manhean health centre respectively; the types of wastes generated in all the three facilities were similar. Even though all three Healthcare facilities made efforts to segregate waste and use colour coding, workers at Tema General Hospital were more consistent in waste segregation.

The final disposal site of waste at Tema General Hospital, Tema Polyclinic and Manhean Health Centre is the Kpone land fill and the waste was carried together with municipal waste to the final disposal site.The disposal of medical waste at the land fill site together with municipal waste, without segregation, can result in several risks to the environment and human health, particularly as there are several scavengers who wore no protective clothing at the dump sites.

The study revealed that there was varying awareness among workers at the Health institutions which were studied in Tema. Generally, only few staff were aware and had access to the Ministry of Health Policy and Guidelines for health institutions.

The research revealed that there were varying awareness and attitudes of medical waste management among workers at the Health institutions which were studied in Tema. It was clear that even though most of the hospital staff were interested in acquiring knowledge on medical waste management, only Tema General Hospital provided regular training on the subject. Staff at Tema General Hospital had a higher awareness to medical waste management followed by Tema Polyclinic and then Manhean Health Centre, however, staff of Manhean Health Centre had a greater sense of team work in promoting medical waste management even though they had limited facilities. Even though majority of respondents from all three Healthcare facilities did not find

waste management of medical waste as an extra burden on work, relevant percentages indicated otherwise and observation clearly indicates the need for improving attitudes.

6.2 Recommendations

On the basis of the conclusions, it is recommended that:

1. Capacity of staff on medical waste management should be enhanced;
2. Facilities for medical waste management at all three health facilities should be improved;
3. Access to copies of the Ministry of Health Policy and Guidelines on management of medical waste should be increased to all healthcare workers.
4. Increase education of health workers to improve attitudes towards medical waste management and maintenance of associated facilities.
5. Improve supervision and practices at the landfill site at Kpone to reduce environmental pollution and public health risks.
6. Researchers should do further studies involving assiduous segregation of medical and general waste in the methodology.

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APPENDICES

Appendix 1a: Letter seeking permission for research to Tema General Hospital and response

ACCRA OFFICE

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Tel. 0302 946384-5
0302 250708
Fax: 0302 250707

Accra Office
Accra Guest House
Distance Learning Centre
P. O. Box GP 4100, ACCRA

Our Ref. IDL/ST/1.1

Date 16th NOVEMBER, 2011

Chief Administrator
Tema General Hospital
Tema

LETTER OF INTRODUCTION – Mr. LLOYD KOFI SUTHERLAND

This is to confirm that the above-named is a student pursuing Msc Environmental Science at the Institute of Distance Learning, KNUST (Accra Centre).

As part of the requirements for graduation Mr. Sutherland has to complete a project on "Awareness and Attitudes of Healthcare Workers on Proper Medical Waste Management, Tema".

Consequently, the Institute would appreciate your kind assistance to enable him solicit information from your organization to enable him complete the project.

Thank you in anticipation of your cooperation.

Kofi Adu
Accra Coordinator
For: Dean, IDL

Min (2) DDNS
SHSA
Pls assist.
16/1/12

D/A. Coordinator
Kindly assist.
17.1.12

(2) BHS
Pls accord
...
17/01/12

Guest House (Front Desk): 0302-250708/946384. **Head, Accra Office:** 0302-946385/946383

Appendix 1b: Letter seeking permission for research to Tema Polyclinic and response

ACCRA OFFICE

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Tel: 0302 946384-5
0302 250708
Fax: 0302 250707

Accra Office
Accra Guest House
Distance Learning Centre
P. O. Box GP 4100, ACCRA

Our Ref. IDL/ST/1.1. Date 23RD JANUARY, 2012

TEMA POLYCLINIC RECEIVED 26 JAN 2012 P.O. BOX ..... BAG, TEMA

The Chief Administrator
Tema Polyclinic
Tema

LETTER OF INTRODUCTION – MR. LLOYD KOFI SUTHERLAND (0265793592)

This is to confirm that the above-named is a student pursuing Msc. Environmental Science at the Institute of Distance Learning, KNUST (Accra Centre).

As part of the requirements for graduation, Mr. Sutherland has to complete a project on "Awareness and Attitudes of Health Care Workers on Proper Medical Waste Management in Tema".

Consequently, the Institute would appreciate your kind assistance to enable him solicit information from your organization to complete the project.

Your kind cooperation is anticipated, please.

Kofi Adu
Accra Coordinator
For: Dean, IDL

AH: SHSA/Env. Olf c/c
Kindly coordinate
30/1/12

Appendix 1c: Letter seeking permission for research to Manhean Health Centre and response

ACCRA OFFICE

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Tel: 0302 946384-5
0302 250708
Fax: 0302 250707

Accra Office
Accra Guest House
Distance Learning Centre
P.O. Box GP 4100, ACCRA

Our Ref IDL/ST/1.1.

Date 23RD JANUARY, 2012

The Chief Administrator
Manhean Health Centre
Tema

LETTER OF INTRODUCTION–MR. LLOYD KOFI SUTHERLAND

This is to confirm that the above-named is a student pursuing Msc. Environmental Science at the Institute of Distance Learning, KNUST (Accra Centre).

As part of the requirements for graduation, Mr. Sutherland has to complete a project on "Awareness and Attitudes of Health Care Workers on Proper Medical Waste Management in Tema".

Consequently, the Institute would appreciate your kind assistance to enable him solicit information from your organization to complete the project.

Your kind cooperation is anticipated, please.

Kofi Adu
Accra Coordinator
For: Dean, IDL

KWAME NKKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Name of Hospital.....
.....

Health care setting:
1. Government Hospital. ☐

2. Private Hospital ☐

2. a) Person interviewed:
A. Doctor. ☐

B. Nurse. ☐

C. Pharmacist. ☐

D.Student ☐

E. Auxillary Staff. ☐

F. Other.....

b) Education:
A. Post Graduation. ☐

B. Graduation. ☐

C. Secondary ☐

D. Primary ☐

E. Illiterate ☐

3. a) Age. ☐ b) Sex ☐

4. What is the quantity of waste generated every day in your health care setting?
.....

Waste Management Policy:

1. Are you aware of any National Policy and guidelines regarding hospital waste management?
Yes ☐ No ☐

2. If yes, is the National waste management policy available to staff?

Yes ☐ No ☐

3. Does your health care setting have a waste management plan?

Yes ☐ No ☐

4. Are there waste management responsibilities included in the job descriptions of hospital supervisory staff (Head of hospital, Department Heads, Nursing superintendent? Pharmacist, Lab Supervisor etc)
Yes ☐ No ☐ Not sure ☐

Waste Management Practices:

5. Tick the facilities available for Waste Management.

Segregation	Containment.	Deep Burial .	Burning	Incineration	Autoclaving

6. Should waste be segregated into different categories?
Yes ☐ No ☐

If yes, who does the segregation

☐

1. Doctor

2. Nurse ☐

3. Auxillary staff ☐

4. Do not Know ☐

5. Other.....

7. Do you color code the waste for disposal?
Yes ☐ No ☐

8. Is the infection waste labeled with the Bio-Hazard Symbol?
Yes ☐ No ☐

9. Where do you dispose Biomedical Waste?

1. Dumping in corporation bin ☐

2. House to House Waste collection ☐

3. Any authorised hospital waste collection ☐

4. Any other specify ☐

10. Are waste bags awaiting collection safely stored away from the public?

Yes ☐ No ☐

11. Do you maintain a register for waste disposal?
Yes ☐ No ☐

12. When was the last time a waste audit was conducted in your healthcare setting?
a. More than 6months ago ☐ ess than 6months ago ☐

b. last 2 years ☐ d. more than 2 years ago ☐

13 What company is your current Solid Waste Hauler?

_____

14 What type & size (bin(s) or compactor) of Solid Waste Container(s) are used? _____

15 Is it shared by other businesses? _____

16 What is the frequency of pick up?
a. every day ☐ c twice a week ☐

b. every other day ☐ d once a week ☐

Other.....

Employee education:

17. Have you undergone any training programme on hospital waste management?
Yes ☐ No ☐

18. Does your hospital provide annual education on waste management for employees?

Yes ☐ No ☐

19. Would you like to attend a programme on Hospital Waste Management?

Yes ☐ No ☐

Attitude Assessment

20. a) Safe management of health care waste is not an issue at all. Agree ☐ agree ☐

No comment

b) Safe management of health care waste is the responsibility of government. Agree ☐ Disagree ☐

No comment ☐

c) Waste management is team work / no single class of people is responsible for safe management. Agree ☐ isagree ☐

No comment ☐

d) Safe management efforts by hospital increases financial burden on management. Agree ☐

Disagree ☐ No comment ☐

e) Safe management of Health Care waste is an extra burden on work. Agree ☐ Disagree ☐

No comment ☐

Thank you for your Co-operation.