

## Case Report

# Waste Management Practices of a Regional Hospital in Ghana: A Case Study

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**Abstract:** The Ministry of Health (MOH), Ghana has provided the policy and guidelines for the management of healthcare waste in health facilities. The focus of the study was to assess the compliance of a regional hospital to the provision made and also to evaluate and rate the practices using a modified Townend and Cheeseman Guidelines. This study was undertaken as a descriptive cross sectional study at the Regional Hospital of Greater Accra in Ghana. Critical observations were made of each department and ward for documentation of practices. Questionnaires based on MOH's Policy and Guidelines were responded by health facility workers who handled day-to-day solid hospital waste. The number of respondents were proportional to the total number of healthcare workers found in each unit. Descriptive statistics were calculated using the Statistical Package for Social Sciences (SPSS) version 16.0 software program. There were 300 respondents from the health facility. Health workers that knew about the existence of the MOH Policy and Guidelines on Healthcare waste management were 59.3%. Sixty one percent of the respondents had received training on proper management of hospital waste, and the rest, 39% were either new staff or had not received any training at all. Waste containers were available in varying shapes and colours with plastic linings. The very important persons (VIPs) ward, was the only unit that had their waste lining corresponding to the appropriate colour coded waste containers. Waste handlers did not use complete personal protective equipment. Measured against the modified Townend and Cheeseman Guidelines checklist, from 0-4, the best achieved by the facility was 1, operating in an unsustainable manner, however there was some evidence of awareness and willingness to change. Majority of the healthcare facility workers had knowledge on appropriate ways of healthcare wastes (HCW) management but there was absence of compliance due to lack of materials and equipment and the enforcement by hospital authorities. There should be continuous education of hospital staff on the management of waste. Demonstrative programs need to be carried out for employees who handle waste directly to give an understanding of the risks and the importance of health and safety measures during handling and segregation.

**Keywords:** Waste Management Practice, Regional Hospital, Ghana

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## 1. Introduction

The World Health Organisation (WHO) released the first global and comprehensive guidance document on safe management of wastes from healthcare activities in 1999. This document addressed aspects of regulatory framework, waste minimization, recycling, treatment and disposal options [1].

The motivation was derived from the global need of proper management of wastes generated from the provision of healthcare.

Developed countries seem well advanced in the handling and treatment of healthcare wastes (HCWs), though still faced with the challenges of the sheer volume of waste from the use of disposal items [2]. Vital steps are being adopted by all

medical institutions to manage healthcare wastes [3]. The best available technologies are used for the development of alternatives for the proper disposal of HCWs with minimum risks [4].

On the other side, developing countries, whose supplies are limited, are dealing with the challenges of sorting and disposal of all types of medical wastes in a sanitary manner [2]. Hazardous and HCWs have not received sufficient attention in these countries. Healthcare wastes are still handled and disposed of together with domestic wastes, posing a great health risk to municipal workers, the public and the environment [4, 5].

The Stockholm convention environmental treaty on persistent organic pollutants (POPs) signed in 2001, was aimed at protecting human health and the environment from chemicals that remain intact in the environment [6]. Although it is the responsibility of the countries who ratified the convention to ensure proper disposal of POPs, technologies required for such treatments cannot be afforded by most sub-Saharan African (SSA) countries [2].

The international policy that mandates the generator of wastes to be responsible for the proper management, treatment and disposal of the wastes generated, has remained on paper and yet to be implemented in many developing countries [7]. The notion that waste is the responsibility of the government has not enabled waste generators to appreciate the negative impact of improper waste management [8].

A number of studies have indicated that the inappropriate handling and disposal of HCWs poses health risks to health workers who may be directly exposed and to people near health facilities, particularly children and scavengers who may become exposed to infectious wastes and a higher risk of diseases like hepatitis and HIV/AIDS [2, 6, 8].

The most suitable option yet for treatment of such wastes in these countries are incineration using crude methods or mal functioning incinerators [9]. Incinerators being the main vehicle used to dispose of medical wastes in much of the developing world, especially in SSA, are sometimes inoperative or operating below standards [2]. Presently, there exists considerable gap with regard to the assessment of HCWs management practices in several SSA countries [5, 10]. Institutional practices with regard to sustainable methods of HCWs management including waste segregation and waste recycling are often poorly examined and documented in some parts of the world despite the health risks posed by the improper handling of HCWs [5].

Ghana, just like many other African countries, is striving to enhance its HCWs management plan and achieve good management system amidst many challenges. The Ghana Ministry of Health (MOH) reports that before the provision of the ministry's guidelines and policies, there were different systems in place for waste management. There were no colour coding in place and wastes were not labelled. Containers for wastes were unacceptable and not standardized. In addition, vehicles for transporting wastes were inadequate. In the midst of all these inadequacies, storage sites for wastes within the facilities were open, accessible to unauthorised persons and

animals and hence become favourable breeding grounds for flies, rodents and other insects. There were also reports of unacceptable ways of final disposal: burying, open burning, and open disposal of infectious waste [10].

Prior to 2002, there was no sector-wide waste management system in place with the result that individual health institutions devised their own methods and systems, some of which were crude and ineffective. There were no specific legislations, regulations or bye-laws for the management of HCWs in the country. However, there were policies and legal frameworks that addressed hazardous wastes in general. They included the National Environmental Sanitation Policy (1999) and the Local Government Act 462 (1993) [10].

The Ghana Environmental Protection Authority developed some guidelines for the management of healthcare and veterinary wastes in 2002 but there was no policy that provided the legal context for the guidelines to be implemented [11]. It is in this deficiency that the Ghana MOH developed the Policy and Guidelines for healthcare waste management in 2006 to ensure that healthcare waste is managed effectively in compliance with international best practices [11]. The policy specified that all health institutions shall have the responsibility to separate, store, label, treat, transport and dispose of all wastes in the manner prescribed by the policy, other laws and regulations regarding HCWs management so as to safeguard the safety of the workers, clients and the environment.

### ***1.1. The Ghana Ministry of Health's Policy and Guidelines on Healthcare Waste Management***

The manual provides all the necessary steps right from the point of generation to the point of disposal of wastes by the healthcare facility. The steps identified in the manual are: Waste Generation, Waste Segregation, Containerization, Internal Storage, Internal Collection and Transport, External Storage, External Transport, Treatment, Collection of Residues and Disposal. Each facility is required to estimate the amount of waste generated daily and that includes any clinical care, routine and mass immunization. Segregation of waste should be done at the point of generation by the waste producer into colour coded plastic bags and corresponding containers. The recommended colour coding scheme for Ghana, adapted from WHO [11] are as follows: BLACK-General wastes, YELLOW- Infectious wastes and radioactive wastes, and BROWN- Hazardous wastes such as expired drugs and vaccines. Labelling on waste receptors must be permanently done to identify source and content. In order to ensure safe management of wastes at the points of generation, internal storage should not exceed 24hours due to potential risk of infection to healthcare workers and waste disposal staff. Containers used for internal storage are required to be cleaned, disinfected and fumigated frequently. Spillage or loss of any kind during conveyance of wastes from generation points to external storage points within the hospital should be avoided completely; therefore proper handling is required. Facilities for external storage should be built away from service delivery areas, but be within the precincts of the health facility and

should be easily accessible to collection vehicles. Where necessary, bio-hazard marks and other warning signs shall be conspicuously posted on containers and doors. Where a health facility is not equipped to carry out on site treatment and disposal of healthcare wastes, collection, transportation and disposal of healthcare wastes shall be done by the District Assembly or their accredited Wastes Management Contractors.

At the institutional level, each facility shall have a Healthcare Waste Management (HCWM) Committee led by the head of the institution to supervise, advise and manage HCWs. The facility would develop a waste management plan which would specify written procedures for handling HCWs suited for that facility. The committee will also ensure strict adherence to the procedures. The facility will also provide resources for the acquisition of inputs in sufficient quantities for implementation of waste management activities on a sustainable basis. Also, the use of personal protection equipment such as gloves, masks, safety glasses and Wellington boots will be strictly ensured.

The District Health Management Team has the responsibility for co-ordination and supervision. At the regional and teaching hospital, clinical care units have the overall responsibility for ensuring the implementation of the policy. The MOH which has the ultimate responsibility for the implementation and monitoring of the policy, has the support of the Ghana Health Service and other agencies such as the Environmental Protection Agency [10].

Despite all these provisions made in the MOH Policy and Guidelines, current HCW management practices in Ghana as observed by Abor in 2012, are not the best and so demand improvement [9]. There seems to be no awareness created on the policies and legislative instruments that guide the handling, treatment and final disposal of this kind of waste [11]. In addition, there has been a report about the indiscriminate disposal of solid healthcare wastes at various points and landfill sites [12]. There has also been evidence of direct discharge of hospital wastes into our drainage system and also a report that at landfill sites, hospital waste and domestic waste are mixed, leading to direct exposure of solid hospital waste especially to landfill workers, scavengers and the general public [12]. The challenge has been the monitoring and the enforcement of the standards and regulations set by the policy and guidelines provided. Education and compliance by health facility workers amidst lack of funds for the acquisition of appropriate materials and setting up of efficient and effective technologies are other areas of deep constraints.

### **1.2. The Need for HCW Management**

Good management of hospital or healthcare wastes starts right at the point of generation. There is the need of HCW management, since 10-25% of hospital waste is hazardous and hence require special attention [13]. Such wastes include pathological waste, pharmaceutical waste, sharps waste (such as blades and syringes), non-sharps waste (such as swabs and bandages) and chemical wastes [14]. These wastes, when disposed of in an unsanitary manner, are potentially capable of transmitting communicable diseases [3].

The compliance and implementation of an effective HCW management policy is crucial for the prevention of the potential exposure of healthcare service workers, patients and the public to illnesses as well as the protection of the environment. However, as clearly stated, the ultimate responsibility for ensuring the disposal of wastes lies with the person or institution that generates the wastes in line with the 'polluter pays' principle [13]. The current study therefore sought to evaluate the practices regarding healthcare solid wastes management of a regional hospital in Ghana, and assess the level of compliance of the hospital to the Ghana MOH Policy and Guidelines provided with the aim that the findings will help the authorities develop better strategies to improve the situation in the future.

### **1.3. Objective**

This study aimed to assess the healthcare waste management practices of a regional hospital in Ghana and the knowledge of healthcare workers on proper management of solid wastes generated by the hospital.

## **2. Methodology**

### **2.1. Study Design**

A descriptive cross-sectional and observational study of a regional hospital was adopted [5, 15]. A modified Townend and Cheeseman Guidelines was used as a checklist for the practices adopted by the hospital in waste management (Table 1). The key characteristics used were general management strategy, wastes segregation, wastes collection, wastes storage, wastes recycling and onsite disposal [5]. An overall performance rating was then allotted using the guidelines [5]. These guidelines use a simple table format that links performance with a set of criteria to assess the level of sustainable development associated with the healthcare facility.

### **2.2. Study Site**

The hospital in this case study is a referral hospital with the catchment area being the whole of Greater Accra Region. The bed occupancy is above two-hundred and fifty and temporary provisions are made anytime there is an overflow of patients. The hospital has fifty units with a total of eight hundred and thirty one workers. Forty-one units with six hundred and ninety-eight workers handled solid healthcare wastes. The workload was eight hundred inpatient days per doctor and one hundred and twenty inpatient days per nurse as provided by the hospital's in-charge.

### **2.3. Population and Sampling**

Out of the fifty (50) health units with a total of eight hundred and thirty one (831) workers in the hospital, forty one (41) units with six hundred and ninety eight (698) workers handled medical wastes (Figure 1). Past studies of this nature with estimates for sampling were not available. Therefore, an initial pilot was carried out using one respondent from each

unit that handles medical wastes in order to estimate the overall proportion of workers who were “doing the right thing” handling medical wastes. This was done by generating scores of the responses in the questionnaires.

The resulting proportion of workers “doing the right thing” was found to be 26%, at a confidence level of 95% and margin

of error at 5%. This was then used in estimating the minimum sample size required as 295.6, which was rounded off to 300. The respondents were then selected proportionately from those medical units that handled hospital waste. Figure 1 shows the distribution of workers and the proportionate number sampled from each unit.

*Table 1. Townsend and Cheeseman Guidelines.*

Sustainable level of practice	Operating performance	Characteristic
Level 0	Operating in a totally unsustainable manner with reluctance to change	No waste management strategy, only limited segregation of wastes. Storage containers are unspecific with no colour coding and waste likely to be dumped outside the hospital building. In addition waste is transported in open trucks, limited re-use of materials and no recycling at the facility. Waste treatment is limited to the simplest technologies such as crude incineration while if off-site disposal exists it will be mainly to a dumpsite or level 1 landfill with the attendant environmental hazards.
Level 1	Generally operating in an unsustainable manner, although there is some evidence of awareness and willingness to change.	Although having no specific waste management strategy, will have separate collection of segregated wastes in enclosed vehicles, autoclave of infectious waste and use single cell incineration plant
Level 2	Operating in a manner with some aspects that are considered sustainable and others that are considered unsustainable.	Waste management policy in place. Segregation of wastes and colour coding. Specified waste storage containers. Waste transported with enclosed compaction vehicles and separate vehicles for hazardous waste, some recycling at facility (paper, cardboard etc.), use of multi chamber incinerator plants and alternative modern technologies (such as microwave) to treat waste and disposal in level 2 landfill.
Level 3	Generally operating in accordance with sustainable development, but some aspects not ideal.	Local waste management policy and strategy in place. Full colour coding. Dangerous goods are stored in UN approved containers and packaging all waste in containers of approved standard and a dedicated waste handling facility. Re-use and re-cycling of materials (example, print, cartridges, oil), incineration of hazardous materials to EU Directive emission standards plus use of alternative technology and offsite disposal at a level 3 engineered landfill site.
Level 4	Operating in a way that displays all the characteristics normally associated with sustainable development.	Waste management policy in place. Full time waste manager. Full segregation of materials, full colour coding. Contracts with secondary raw materials industry. Storage in UN approved containers, all wastes in containers or sacks to an approved standard, and a dedicated well secured waste facility. Waste is transported in enclosed compaction vehicles. Basel convention applied to waste transport. Recycling of paper, glass, plastic, metal, construction waste, food waste, textiles etc. incineration of hazardous materials to EU Directive emission standards plus use of alternative technology. Hazardous waste to strictly controlled landfill sites and offsite disposal to level 4 engineered sanitary landfill.

#### 2.4. Questionnaire and Data Collection

For the sake of confidentiality, the name of the hospital is withheld. Part of the study involved using questionnaires to assess the knowledge of healthcare workers on proper management of solid hospital wastes. Primary data was collected from the questionnaires administered to authorities of the hospital, health workers and waste handlers. There was no provision made for names to be written on questionnaires to ensure the confidentiality and anonymity of respondents.

The questionnaire was developed from the Ghana Ministry of Health’s Guidelines for the Management of Healthcare Waste [13]. To pre-test the questionnaires, the in-charges of all units and wards were sampled. Pre-testing informed the final outcome of the questionnaire. Questions were formulated based on the important steps involved in waste management recommended by the Ministry of Health.

The other part of the study involved observations of the practices and procedures of waste management coupled with any binding rules or regulations in place. This was done by spending time in the different departments of the hospital recording observations and writing notes in a critical manner about the practices of the HCW management by staff

responsible for waste management.

The researcher made three visits weekly consistently to the hospital from January to June 2011. The units visited included the labour ward, medical emergency, casualty theatre and the disease control unit. The results obtained were discussed to evaluate the management of HCW in the light of written guidelines and procedures proposed by the Ministry of Health, Ghana [13]. Prior to the start of the study, written approval was sought from the management of the hospital.

#### 2.5. Data Analysis

Data from the survey were analysed using the Statistical Package for Social Scientist (SPSS) for Windows, version 16.0. Categorical responses were coded numerically and entered in SPSS. This was done twice and independently to ensure consistency in the descriptive statistical approach.

### 3. Results

#### 3.1. Efforts Made Towards Proper Management of HCW

The hospital started the training of the health workers on proper management of hospital wastes in 2009. That same

year the hospital began practising wastes segregation. There existed an environmental unit responsible for the collection, transportation and disposal of the HCWs generated. This unit consisted of two sanitation officers and a number of orderlies

or wastes handlers assigned to various units and wards for the day-to-day cleaning. A summary of the waste management practices are shown in Table 2.

*Table 2. Waste management practices of case study hospital.*

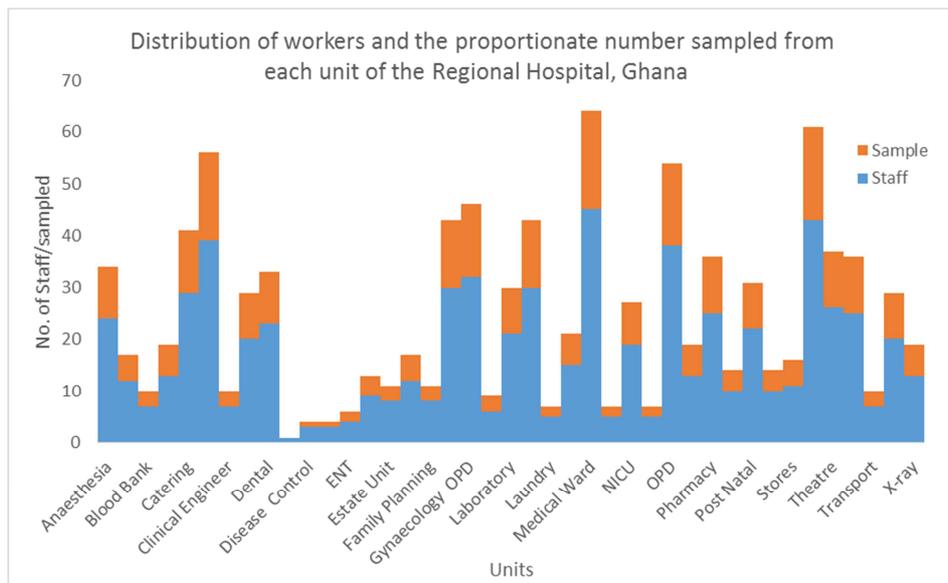
<b>Health Care Waste Management Criteria</b>	<b>Description of Existing Practice</b>
<b>GENERAL MANAGEMENT STRATEGY</b>	
Hospital waste management policy or strategy	Exist MOH Policy and Guidelines but no Healthcare Waste Management (HCWM) Committee. The facility had no management plan that specified written procedures for handling HCWs suited for their facility.
Special budget for waste management	No special budget.
Operative staff for waste management	Exist an Environmental Unit.
Training on waste management	Records of training at least once a year but staff say otherwise.
Personal Protective Equipment worn by operative staff	Personal Protective Equipment available but not used by waste handlers.
Patient load/ quantity of waste generated daily	Not known. No system in place to quantify waste generated per patient.
Local community preferences	Allow burning of certain kind of waste such as dead leaves. Allow mass burial of unidentified bodies.
<b>WASTE SEGREGATION, INTERNAL STORAGE AND TRANSPORTATION</b>	
Type of receptacles/storage containers (uniform or specific, varying types, sizes)	Varying types and sizes of non-specific waste containers.
Colour coding and legible labelling of receptacles	Some receptacles are colour coded.
Number/ adequacy of waste receptacles	Adequate in number but majority requires physical contact of fingers to open lid.
Segregation of sharps or infectious materials	Safety boxes or improvised ones are made available.
Is segregation done at source and regulated or controlled?	Only sharps are strictly segregated.
Does internal storage exceed 24hrs?	Sometimes but multiple daily removal of waste is encouraged.
<b>EXTERNAL STORAGE AND TRANSPORT</b>	
Are storage bins placed in roofed built-in areas?	No. Placed outside the wards and the units.
Are vehicles for transporting waste made of smooth surfaces for easy cleansing	Yes. Metal carts were used for transporting external storage receptacles.
Storage containers washed and disinfected frequently	No. Mass cleaning said to be done once in a while.
Waste packaged and transported separately based on the different classifications adopted	No. waste mixed together before hauling away.
<b>WASTE RECYCLING</b>	
Is there any form of recycling?	No form of recycling.
What is recycled?	Nothing.
Are syringes reused?	No.
What is re-used?	Empty carton boxes improvised into safety boxes.
<b>WASTE TREATMENT AND COLLECTION OF RESIDUES</b>	
Purpose built waste treatment facility	Yes. A single cell incinerator.
Waste dumped outside hospital premises	Waste burnt on hospital compound but away from busy area.
Open waste disposal	Yes. Dead leaves are collected for burning
Autoclaving of laboratory waste	Autoclaving of theatre gadgets.
Crude incineration outside	No.
Encapsulation of sharps	No.
Waste burial within healthcare facility	Yes. There existed placenta pit for organic waste.
Chemical disinfection of body fluids	Yes.
Other advanced technology	Not available.
<b>OFFSITE DISPOSAL</b>	
Waste disposal contracted out	Yes.

### **3.2. Training, Knowledge and Practice of Health Workers**

Figure 1 below shows the number of staff in each unit with corresponding proportionate number of staff that were sampled.

The personnel that responded to the questionnaires were those that generated solid healthcare wastes during the course of their work or handled the wastes directly. Health workers that knew about the existence of the MOH Policy and Guidelines on Healthcare wastes management were 59.3%.

This percentage was in agreement with the 61.0% of health workers who responded that they had been trained on infectious wastes management by the hospital authorities. However, 39.0% had not received any training on wastes management. The assumption was that 34.3% of the workforce that had been working in the hospital for less than a year formed majority of those that had received no training on proper management of hospital wastes. Out of a total of three hundred respondents, 81.0% (243) knew of the presence of a centralized collection area for all the hospital wastes gathered.



**Figure 1.** The number of staff in each unit with corresponding proportionate number of staff that were sampled.

Those who responded that waste containers were not properly labelled were 23.7%. Fifty seven percent (171) responded that the amount of wastes generated in their departments were properly recorded. Of the three hundred (300) respondents, the surgery department had the highest number of personnel (21.3%) while the ENT (Ear, nose and throat) made up the least percentage of respondents (1.3%). The male workforce beat the female by 45.3%.

Two important steps before the collection of waste involves generation and segregation of waste. The Ministry of Health recommends that colour codes should be used for waste containers and plastic bags to facilitate efficient segregation of waste by different colour coding. The minority, 39.0% did not agree that yellow bags are used in collecting infectious waste. The assumption being that, though there has been training in the hospital, the appropriate use of colour coded plastics did not exist. However, 60.3% of the respondents agreed that infectious waste should be separated from regular waste and should be done promptly at the source of waste generation.

Of the respondents, 62.0% indicated that, in the management of solid waste, puncture proof containers should be used to keep sharp infectious waste. Eighty seven percent of the respondents (261) agreed that storage areas of waste should be prohibited to visitors and patients.

Waste handlers did not use complete personal protective equipment (PPE). The usual was a long sleeved shirt and wellington boots. Nonetheless gloves, aprons and mouth masks were provided but for sheer negligence, they were not used by the waste handlers.

### 3.3. Waste Segregation, Collection and Storage

At the time of study the hospital generated all the six types of waste classified by the Ghana Ministry of Health- general waste, infectious waste, pharmaceutical waste, chemical waste, radioactive waste and products of waste treatment. However,

there were no pre-recorded information on the amount of waste generated by any department or unit. Waste segregation, however was attempted to a certain degree. Black plastic bags were very common. Yellow plastic bags were also available for infectious waste containers. Brown plastic bags were rare, however some were available in the pharmaceutical and radioactive units. Waste receptacles were of varying colours and sizes. Those above 240litres were used for external storage whereas smaller capacities were used in the wards. The VIP ward was the only unit that had their waste plastic linings corresponding to the appropriate colour coded waste receptacles (Figure 2). Other units had receptacles of different colours and in some cases no lids (Figure 3). There were no legible labels or any biohazard sign on any waste receptacle as per recommendation. However, waste containers kept in the wards and units were emptied by orderlies and waste handlers into external larger waste receptacles. These containers were not lined but waste discharged into them were tightly sealed in plastic bags. However, these containers sometimes stored waste for over twenty four hours generating a foul smell when overdue. Cleaning, disinfection and fumigation of the waste receptacles were not frequently done at all.

### 3.4. Waste Treatment and Disposal

An external storage area called the dumpsite was situated away from the areas of intense public activities but within the precincts of the health facility. Within this area were also a Demontfort Single Cell Incinerator and a storage room for the temporary keeping of safety boxes. At the dumpsite, were two very large waste containers in which waste from all corners of the hospital were finally disposed of. However, waste sealed in plastic linings were mixed with other waste materials such as dead dried leaves, empty water bottles and plastic water sachets. It was observed that the waste in these containers are hauled away by a private waste management

company every three days.

The facility carried out incineration as its major option for infectious waste materials such as sharps and ampoules. Incineration was done every two weeks by the maintenance team that also saw to the proper running of the incinerator. Human body parts such as the placenta were discharged in a well-constructed placenta pit. Used swabs and dressings as well as pharmaceutical waste were disposed with general waste. Sharps were collected in safety boxes and disposed by incineration.



*Figure 2. Waste containers in the VIP ward.*



*Figure 3. Waste containers used in other wards.*

## 4. Discussion

It is important that personnel that work in hospitals have knowledge of the Ministry of Health (MOH) Policy and Guidelines because apart from the fact that it is a requirement by the Ministry of Health, it clearly provides the legal context within which healthcare waste is managed and also provides standards, procedures, and processes for handling healthcare waste [13]. Training of both the technical and the non-technical staff is critical to gain knowledge on the proper and appropriate management of healthcare waste [15].

The findings of the study revealed that majority of staff (59.3%) had knowledge of the Ministry of Health (MOH) Policy and Guidelines on Healthcare Waste Management, which is higher than those obtained from other studies in Nigeria [5,6], and other studies conducted in India [15,16]. Low level of knowledge is mainly attributed to poor training facilities and also to a relatively low educational level of sanitary staff [16].

From the results of this study, 60.3% of respondents agreed that infectious waste should be separated from regular waste and should be done promptly at the source of waste generation. This result is lower than that obtained in a similar study conducted in a health facility in Bangalore, India (87.5%) [17]. However, there was a general attitude of non-compliance similar to the findings of Abor in 2007 who reported that in Tygerberg hospital, South Africa, doctors and nurses who use sharps do not drop them into appropriate containers [18].

Poor segregation practices are therefore a major problem in some hospitals. Of the respondents, 38.7% indicated that waste needs no segregation before disposal, which was reflective in the manner the waste were mixed at the source of generation. It was observed that in some of the wards when the general waste container gets full, the infectious waste container becomes the receptacle for general waste. On several occasions, nurses were found mixing the waste at the source of generation. It is worth knowing that good segregation practice which is the responsibility of the producer will ensure a reduction in the quantity of healthcare waste which is more expensive to manage [5]. It should therefore be emphasized that segregation of waste would result in a clean solid waste stream which could be easily, safely and cost-effectively managed through recycling, composting and land filing [7, 8].

Of the respondents, the majority, 54.3% agreed that yellow bags are used to collect infectious waste and black bags for general waste. However, observations revealed otherwise. In the absence of yellow bags, brown or black bags were used for the collection of infectious waste. This finding is consistent with that observed in Botswana [19], where black and red bags were used interchangeably, often when red bags were out of stock.

Instructive posters were on display at some locations in the facility. Though the manual was not diligently practised, it, at least, provided guidelines for reference. The use of instructive posters are important to achieve effective

segregation of waste [7]. However, in a case study hospital in Nigeria, there was no healthcare waste management manual and instructive posters were also not available [7].

In the departments of the case study hospital in the current study, it was observed that waste receptacles were not properly labelled. No single waste container was labelled with the biohazard sign as recommended by MOH, Ghana. Furthermore, it was observed in the gynaecology and obstetrics department that knives and hypodermic needles were put in brown coded containers unlike other departments where safety boxes and improvised ones are used.

No records of amount of waste generated in each department were kept. Similar to a study conducted in Nigeria, all four health facilities assessed on the management of waste kept no records of the amount of waste generated [3]. It was also discovered that Tygerbeg hospital in South

Africa, could not give accounts of records of the amount of waste generated by each department let alone the amount of waste generated by the hospital at any point in time [18].

The findings from this study confirm the general lack of implementation of the Ghana MOH Guidelines. Measured against the modified checklist, from 0-4 [5], the best achieved by the facility is 1, operating in an unsustainable manner. However there was some evidence of awareness and willingness to change as shown in Table 3. There is the awareness of do's and don'ts but adherence was absent probably because there was no form of enforcement with penalties attached. A monitoring programme or otherwise, a healthcare waste management plan was not in place and that gave room for workers to do what they deemed right. Results revealed that there was more room for improvement in order to get to Level 4 of the guidelines.

**Table 3.** Application of Townend and Cheeseman Guidelines.

Waste Management Criteria	Description of Existing Practice	Townend and Cheeseman Criteria	Corresponding Sustainable Level of HCW Management at Study Site
Waste management responsibility, segregation, storage, and packaging.	There were two sanitation officers in charge of sanitation of the facility. MOH Policy and Guidelines known but implementation has been challenging. Waste were segregated to some extent but put together at the dumpsite except sharps. Waste stored in unlabelled plastic and metal bins. Few bins had no lid.	Limited segregation of waste. Storage containers are unspecific with no colour coding. Limited re-use of materials and no re-cycling at the facility.	0
Waste transport	Waste collected in bins and transported manually to dumpsite inside hospital. Hauling of waste from hospital premises contracted out to private entity.	Municipal solid waste collection (MSW) and transport with closed topped vehicles used for all waste by private company.	1
Waste recycling and re-use of some theatre materials and beddings	Limited re-use of materials and no recycling at the facility. Safety boxes were sometimes improvised from disposable paper cartons.	Limited re-use of materials and no re-cycling at the facility,	0
Waste Treatment and collection of residue	The use of a single cell incinerator. Open burning of dried leaves and other flammable materials.	Use of single cell incinerator.	1

## 5. Conclusion

The study sought to assess the healthcare solid waste management practices of healthcare workers in a regional hospital of Ghana. Despite the fact that there were rules and guidelines for the segregation of the waste, the study confirmed that waste separation was not strictly adhered to. One common instance was the discharge of needles and syringes. Some health workers were observed to detach the needles from the syringes and then discarding them into wrong containers. In the case of protection, waste handlers preferred to use their improvised wears instead of the appropriate PPE's provided. However, majority of the healthcare facility workers had knowledge on appropriate ways of HCW management but there was the general absence of compliance due to lack of materials and equipment and enforcement by hospital authorities.

From the study, the practices regarding HCW management is generally below standard. Using a modification of Townend and Cheeseman Guidelines, the practices were ranked '0' (a level of unsustainable healthcare waste management) and '1' (generally operating in an unsustainable manner, although

there is some evidence of awareness and willingness to change).

Continuous education of hospital staff on the management of waste is highly recommended. Demonstrative programs should be carried out often for employees who handle the waste directly to give a better understanding of the risks and the importance of health and safety measures during handling and segregation. Posters that educate the health workers and the public on waste management should be pasted at every location of a waste receptacle and not just some few places as was observed. Healthcare waste management committee must be set within every health facility. Further research on healthcare waste management practices is also strongly recommended.

## 6. Limitations

Firstly, some doctors and nurses were not co-operative in the study. This made interviews difficult and close to impossible. Secondly, being a cross sectional descriptive study, cause effect relationship could not be ascertained in this study. Thirdly, since it is a case study, results obtained from the study cannot be generalised to other settings.

## Authors' Contributions

ATA conceptualised the study, collected data, wrote the manuscript; MD designed the questionnaire; TG analysed the data; DC also helped in designing the questionnaire; EC facilitated the structuring of the study and provided relevant documents; EET critically reviewed the manuscript. All authors approved the final manuscript.

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