

Infectious Waste Management in General Hospitals in Lusaka, Zambia: Perspectives of Healthcare Workers

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ABSTRACT

Purpose: *Poorly managed infectious waste was the cause of majority of accidents and exposures to infectious waste in general hospitals in Zambia. The overall aim of this study was to appraise infectious waste management in the five general hospitals in Lusaka, Zambia.*

The study objectives included to determine the knowledge, attitude and practices of infectious waste management of healthcare workers in general hospital in Lusaka. To appraise the policy compliance levels of healthcare facility towards infectious waste management and to identify factors that impede a proper infectious waste management.

Methodology: *An explorative qualitative study was conducted to assess infectious waste management in in Lusaka, Zambia, nesting the perspectives of 21 healthcare workers drawn from five general hospitals in Lusaka district.*

Findings: *The results showed that, the state of infectious waste management in a cross-section of general hospitals in Zambia had fallen short of the World Health recommended standards. A myriad of contributing factors to poor waste management amplified included, lack of regular staff training, insufficient infectious waste management equipment and inadequate protective clothing for waste handling, stock out of color coded bin liners and bins was a common occurrence. Other key findings were, limited space for storing waste before disposal or transportation and the lack of awareness about segregation and waste management rules as well as the limited financial resource to procure standard infectious waste protection and disposal equipment.*

Conclusion: *Across the study area, the waste management recommendations, policies and guidelines on proper handling and management are still substantially undermined by a myriad interlinked factors such as inadequate knowledge levels, health workers attitude and practices towards infectious waste management, low policy compliance levels of healthcare facility towards infectious waste.*

1. INTRODUCTION

Medical waste, also referred to as healthcare waste (HCW) has been defined by the World Health Organization (WHO) as “all the waste generated within healthcare facilities, research centres, and laboratories related to medical procedures; including the same types of waste generated from other scattered sources and homes” (Olaniyi and Tshitangano, 2018). Waste management is all activities, administrative and operational, involved in the handling, treatment, storage, recovery and recycling (of healthcare general waste) and the disposal of waste (including transportation).

According to WHO, (2018) infectious waste is waste contaminated with blood and other bodily fluids, cultures and stocks of infectious agents from laboratory waste, autopsies and infected animals from laboratories or waste from patients with infections. Additionally, according to Oroei et al., (2014) infectious waste is anything potentially infectious, such as body fluids or secretions (e.g. blood, pleural fluid, semen, vaginal secretions, vomit, feces or urine), contaminated sharp objects (e.g. contaminated needles, syringes and surgical blades), biological laboratory waste (such as cultures, stocks and growth media), pathological waste (such as human tissue, organs or body fluids), and single use disposable equipment, utensils and instruments soiled with potentially infectious agents. Mainly the chief generators of infectious waste are healthcare workers in hospitals during provision of healthcare services such as screening, immunization, treatment of patients and research in hospitals. Other sources of infectious waste include; laboratories, mortuaries, autopsy centers, blood banks and nursing homes (Pepin et al., 2014; Makhura et al., 2016; Das et al., 2021).

About 10-25% of all the waste produced in hospital comprises of infectious waste, which however, is not disposed of with domestic waste due to its infectious and hazardous character. Infectious waste contains various liquid products from diseased human bodies that may contain bacteria, or viruses capable of being transmitted to others posing environmental and public health risks. Its management has been an imperative environmental and public safety issue and for this reason infectious waste management should be viewed seriously by all health care institutions in order to prevent infectious waste from becoming a source of health problems in the institution and exposing the community to infections (Dewi, 2020).

According to Das et al., (2021) healthcare waste categories include the following; Chemical waste, which is described as omnipresent in healthcare facilities and includes laboratory reagent, expired disinfectants, heavy metals such as broken thermometers, blood pressure

gauges and solvents, Infectious waste containing infective pathogens and it comprises of materials contaminated with blood and body fluids, human excreta, laboratory cultures and microbiological products, Pathological waste emanating from tissues or samples of tissues examined from the laboratory to diagnose or study diseased tissue, this category of waste is considered infectious, Radioactive waste which is a by- product of various nuclear technologies such as nuclear medicine, radio therapy and reagents for research, Sharps waste comprising of sharps such as hypodermic intravenous needles, scalpels, pipettes, surgical blades as well as broken glasses and the other category of health care waste include pharmaceutical waste (expired and contaminated pharmaceutical products) which is generated from pharmacies, distribution centers and hospitals.

According to (WHO, 2018) about 85% of generated waste is non-infectious while 15% is infectious WHO (2011), further alluded that the composition of infectious waste in a waste stream is 1% Sharps, 1% body parts, 3% chemical or pharmaceutical and 1% radioactive and cytotoxic waste or broken thermometers less than 1%. According to WHO injections with contaminated needles and syringes were still responsible for about 33,800 HIV infections, 1.7 million hepatitis B viral infections and 315,000 hepatitis C viral infections in low-income countries in 2010.

Das et al., (2021) hospital waste is classified as chemical waste, medical waste, radioactive waste, pharmaceutical waste and general waste. Medical waste which is also called infectious waste includes sharps (e.g. needles), laboratory waste (e.g. blood specimen), human tissue (e.g. placenta) and cadavers used for research purposes. Each category of waste therefore, must be disposed of correctly according to specific guidelines in order to protect health care workers, ward cleaners, laundry workers and patients from needle stick injuries and even biological hazards.

Healthcare waste management (HCWM) entails from point of generation to the point of disposal. Proper segregation of health care waste from point of production is very cardinal in its' management. The process of waste management involves correct disposal of infectious waste which is separated at the point of generation in colour-coded containers, followed by its disposal. Bins are therefore, provided in all locations where healthcare waste maybe generated for segregation purposes. These include; sharps bins and needle/hub for used needles, high risk waste bins for infectious waste such as cultures and general waste bins for recyclable waste. The practice offers prevention of needle sticks and illicit reuse of syringes. From the colour-

coded containers, infectious waste is disposed of through incineration, sterilization, chemical disinfection or burial in a secured landfill with enough space to avoid overflow and secured from unauthorized persons, pests and disease vectors. Sharps such as hypodermic needles, pipettes, scalpels, broken glass and blades are disposed of through incineration, chemical disinfection and autoclaving. Laboratory waste which includes body fluids, human tissue, fetuses, cadavers and cultures are as well disposed of through incineration or chemical disinfection (Makhuru et al., 2016). The process of disposal involves transportation of the infectious waste to the disposal site which is done through open trucks with potential to spread the infectious agents into the air and infect the hospitals and neighbouring surroundings (Thakur et al., 2021). It is therefore very cardinal to be compliant with national transport regulations during transportation of infectious waste. Furthermore, ensuring that infectious waste is separated out at the point of generation, appropriately treated and correctly disposed of is very essential (Makhura et al., 2016). This is in line with WHO policy and Environmental management Agency (EMA) guidelines on health care waste management.

According to Thakur et al., (2021) the rate at which infectious waste is being generated is higher in developed countries in comparison with developing countries due to high usage of disposable instruments and increased level of packaging. The global health care system expands tremendously in many developed and developing nations allowing the provision of health care to cover a wide range of people and more sophisticated treatments are offered to the patients. However, with the advancement in health care, a silent and huge neglected crisis is unfolding of a growing amount of waste that is not being properly treated leading to excessive carbon emission and waste of resources causing enormous suffering and pollution to the environment. Environmental and public health are therefore threatened by the combination of toxic and infectious pathogens as well as other medical waste properties (Faiza et al., 2019).

Infectious waste management in developed nations is a human health and environmental burden that should be solved for improving sustainability (Ferronato et al., 2020). Many developing nations face various challenges in effective management of infectious waste, and most of these challenges lie within the healthcare facilities (Olaniyi et al., 2021). Furthermore, in low and middle income countries (LMICs), the management of HCW is particularly challenged. For example, according to Hangulu and Olagoke (2017), most African nations have insufficient knowledge on how to manage infectious waste among community health workers (CHWs) and even some staff working in health care settings.

Health care waste management has therefore been regarded as an increasingly cardinal issue in protecting the environment (Chen et al., 2021) and policy measures have been put in place to curb for the proper management of health care waste including infectious waste in order to provide a sound environment in line with Sustainable development goals (SDGs) in particular SDG number three (3). In addition, WHO in collaboration with other partners, developed a series of training modules on good practices in health-care waste management that covers all aspects of waste management activities from identification and classification of wastes to considerations guiding their safe disposal using both non-incineration or incineration strategies (WHO,2015). However, in most parts of the world, infectious waste management system is still poorly managed, and rules remain mainly on the papers (Thukar et al., (2021).

Zambia's general hospitals in Lusaka are no exceptional from the challenges faced with proper infectious waste management. Lusaka is the capital city of Zambia with a population of 3.36 million persons in 2020 growing at an average rate of 3.99% (<https://knoema.com>) with five (5) general hospitals that were upgraded in 2020 from first level hospitals in order to enhance service delivery and reduce the burden on tertiary hospitals (University Teaching Hospital and Levy Mwanawasa University Teaching Hospitals). The increase in population and the upgrade of the hospitals has led to an increase in the generation of healthcare waste leading to improper management of infectious waste. Most landfills and bins are open to unauthorized persons including the mentally ill and scavengers. Meanwhile, poor management of infectious waste has a number of negative effects on patients, healthcare workers as well as exposing the general public to injury (Hangulu and Olagoke, 2017). In health facilities improper disposal of infectious waste poses direct and indirect health impacts not only to those working in health facilities but also the environment and the neighbouring communities. Health workers including general workers are exposed to injury due to improper management of infectious waste and a number of health workers have been on Post Exposure Prophylaxis (PEP) due to improper storage and disposal of waste. Odonkor and Maami, (2020), alluded that the generation of infectious waste is an integral part of the healthcare operations and improper infectious waste management and disposal can be detrimental to humans and the environment at large. Therefore, health care workers have a huge responsibility to protect the community and other workers by correctly disposing of infectious waste. Correct disposal of infectious waste requires health workers involved to have adequate knowledge of the various disposal methods. However, some of the challenges encountered in the process of managing infectious waste include lack of knowledge resulting from ineffective and irregular training of healthcare

workers, lack of adequate funding and budget for infectious waste management, non-compliance to infectious waste management guidelines, insufficient bins, substandard central storage rooms, insufficient personal protective equipment and unavailability of Hepatitis B vaccine (Olaniyi, 2020). Other barriers to infectious waste management include ineffective infectious waste fee system, lack of trained manpower, inappropriate collection routes; unavailability of collection vehicles and illegal waste disposal (Ferejai and Chemed, 2021). According to Ferejai and Chemed (2021), the awareness of inhabitants on infectious waste management, poor household waste segregation practice, and disposing of an unsanitary landfill are revealing the main infectious waste management problems faced.

In Zambia, literature review shows dearth of information on infectious waste management, most studies conducted focused much on the Municipal waste apart from Ministry of Health (MoH) studies on healthcare waste. Hence the need for the researcher to carry out the study on infectious waste management.

Safe management of infectious waste is fundamental for the provision of quality, people-centred care, patient protection and staff safety as well as safeguarding the environment (WHO,2017). However, given the rising number of private clinics and the growing population the amount of waste generated from hospitals is exceptionally high leading to its improper management. This therefore, causes serious problems in the medical, social and environmental domains in healthcare facilities transmitting infectious diseases (HIV, HBV and HCV) not only among healthcare workers but also scavengers. This is against the WHO policy on prevention of health risks associated with exposure to healthcare waste for both healthcare workers and the public. Improper waste management serve as breeding sites for many vectors resulting in proliferation of vector borne diseases impeding the actualization of the United Nations SDGs in particular SDG number three (3) on health by predisposing individuals to malaria, water borne diseases and communicable diseases. In addition, SDG number six (6) on water and sanitation by polluting water, promoting dumping and the release of hazardous chemicals and materials in water. Furthermore, about 16 billion injections are administered worldwide every year and not all of these needles and syringes are properly disposed of after use Lemma et al., (2021), creating a risk of injury, infection and an opportunity for reuse. This therefore, impedes the actualization of SDG number twelve (12) that support healthcare waste management by reducing pollution and health impacts through an environmentally sound management of all waste throughout the product life cycle. However, health care waste management is an integral component of action to achieve the seventeen (17) SDGs.

Zambia has adopted Health Care Waste Management (HCWM) guidelines and policies in line with the Environmental Management Agency (ZEMA) No. 12 of 2011 and Ministry of Health (MOH) guidelines on waste segregation and bin colour coding. However, despite all these recommendations, policies and guidelines proper handling and management of infectious waste in these hospitals is still substantially undermined. A review of literature shows glaring gaps in the management of infectious waste at global level. Therefore, having information on effective management of infectious waste is cardinal to enhance proper management of infectious waste. Currently there is inadequate information on the management of infectious waste in the general hospitals in Lusaka. This study therefore, will investigate what is obtaining at general hospitals and document qualitative aspects of infectious waste management.

Infectious waste management can be detrimental if not properly management from point of generation to point of disposal. Poor management can cause harm to the environment and public health at large. The results of this study therefore revealed the knowledge levels, policy compliance, current practices and factors impeding a proper infectious waste management by healthcare workers. It is envisaged that findings from this study will help the health sector to come up with strategies to reinforce the already existing guidelines and policies towards infectious waste management. In addition, for results of a positive nature, implementations will be strengthened. The objectives of this study were as follows;

- (i) Determine the knowledge, attitude and practices of infectious waste management of healthcare workers in general hospital in Lusaka.
- (ii) To appraise the policy compliance levels of healthcare facility towards infectious waste management
- (iii) Identify factors that impede a proper infectious waste management

2.0. METHODOLOGY

2.1. Sampling

The researcher utilised snowball sampling to access the participants in the healthcare facilities. This is a type of purposive sampling used to recruit hidden populations (Naderifar et al., 2017). All participants were accessed through referrals by the senior medical superintendents (SMSs) of the facilities because the SMSs are responsible for all the activities that take place in the facilities. All the participants were chosen using purposive sampling method. This type of sampling technique was appropriate because it is used to recruit participants who can provide

in-depth and detailed information about the phenomenon under investigation (Rai et al., 2015). Qualitative study does not use large numbers Sim et al., (2018) because the aim is to have an in-depth insight into the study phenomena. Therefore, the researcher's sample size was determined by attaining saturation but minimum was 50 participants because each facility had about 23 participants as it was stated in the study population.

2.2. Instruments for Data Collection

2.2.1. One on one interviews

One on one face interviews occur when researchers ask one or more participants general, open-ended questions and record their answers. Usually audiotapes will be utilized to allow for more consistent transcription (Creswell,2012; Quad,2016). In this study one on one interview were used to collect in-depth qualitative data. The interviews were guided by an interview guide with open ended questions to allow the researcher to probe further and ask for clarity thereby reducing research information bias. By using this tool, participants were free to respond to the open-ended questions as they wished, and this allowed the researcher to probe the responses. This method therefore, provided a degree of relevancy to the topic as it measured what it was intended to measure (McIntosh and Morse, 2015).

2.2.2 Observations

Observations involves 'seeing' things- such as objectives, processes, relationships, events and formally recording the information. In this study the researcher directly observed the practice of waste disposal and categorized it in four steps namely; sources of infectious waste (point of generation), collection and segregation of infectious waste (using colour coded bins), transportation of infectious waste to the disposal site and the final disposal (method). This was helpful because it provided the researcher with factual data. All observations were guided by an observation guide.

2.2.3 Data Analysis

To analyse qualitative data from in-depth interviews each interview guide and audio file was given a unique number for the different study participants and groups. The study used thematic data analyses method. Thematic Analysis (TA) is a method for identifying and analysing patterns of meaning in a dataset (Vaismoradi et al., 2016). It illustrates which themes are important in the description of the phenomenon under study (Braun and Clarke, 2012). The

end result of a thematic analysis is to highlight the most significant patterns of meanings present in the dataset. Thematic analysis helped to move beyond just counting explicit words or phrases and focused on identifying and describing both implicit and explicit ideas within the data. There are various approaches used in conducting thematic analysis.

This study therefore, used the most common form following a six-step process:

Step 1: Familiarisation- this involved getting to know data collected through transcribing audio, reading through the text and taking initial notes.

Step 2: Coding-this involved coding the collected data by highlighting phrases or sentences and forming shorthand labels.

Step 3: Generating themes - this involved turning codes into themes.

Step 4: Reviewing themes - this involved making themes useful and an accurate representation of the collected data.

Step 5: Defining and naming themes – this involved naming and defining each theme.

Step 6: Writing up – this was the final step which involved writing up the data analysis.

Audio recordings and notes from the interviews were transcribed into Microsoft Word which was stored in a computer with a password and then exported to Nvivo version 12 for coding of themes and analysis. Finally, this was utilized in analyzing the phenomenon under study and an application theoretical framework on collaboration was utilised in analysing results.

3.0. Study Area

The study was conducted in all the five general (5) hospitals in Lusaka Zambia. These were Chilenje, Kanyama, Chipata, Chawama and Matero general hospitals. The general hospitals were chosen because they are the second level hospitals at provincial level intended to cater for a catchment area of 200,000 to 800,000 people. General hospitals provide services in internal medicine, general surgery, paediatrics, obstetrics and gynaecology, dental, psychiatry and intensive care services. These hospitals also act as referral centres for the first level institutions, including the provision of technical back-up and training functions. These

hospitals are located within the capital city of Lusaka and offer services to people with low and middle income populations (MOH, 2017).

4.0. Results

4.1. Participant Demographics

The section below shows the demographic characteristics of the respondents

4.1.1 Age

The findings from table 1 below show that from a majority (n=9; 34%) were aged between 25<30 years of age followed by those aged 31<36 (n=6; 29%). The least were those aged above 50 years (n=1; 5%), 18<24 (n=2; 10%) and 44<50 (n=2; 10%) respectively.

Table 1: Showing respondent's age

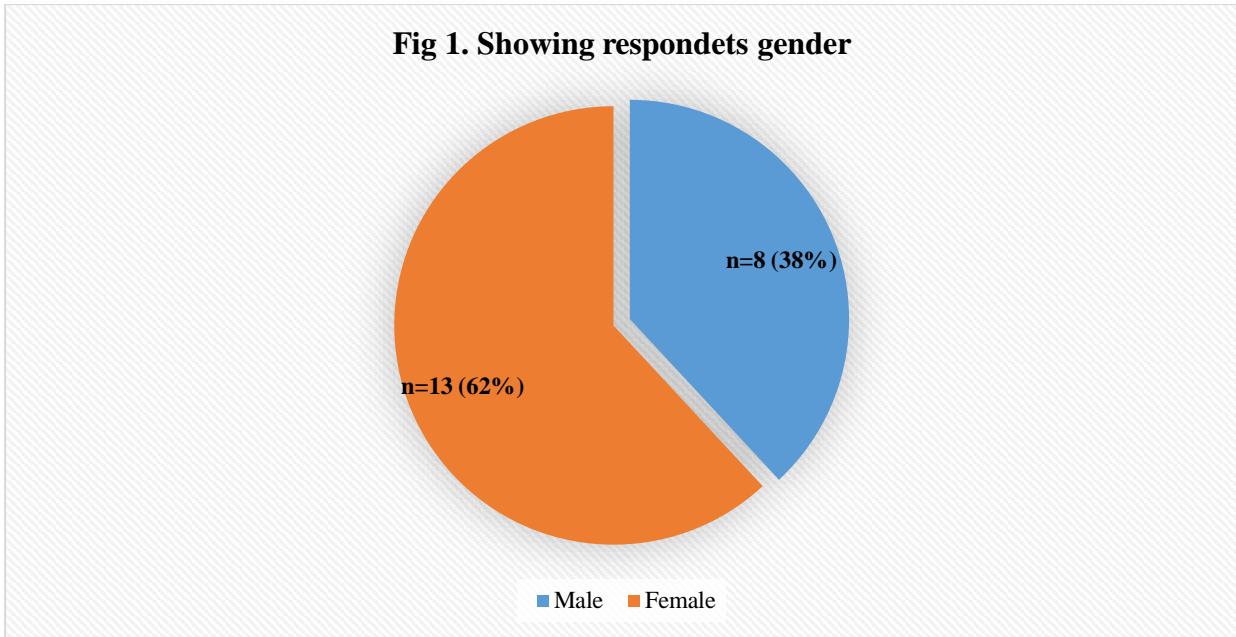
n=21 Variable	Frequency (x)	Percentage (%)
Participants Age in years		
18<24 yrs.	2	10
25<30 yrs.	9	43
31<36 yrs.	6	29
37<43 yrs.	1	5
44<50 yrs.	2	10
Above 50 yrs.	1	5
Total	21	100

Source: Author: field survey 2022

4.1.2 Gender

Findings in figure 1 below shows that majority of the respondents were Females (n=18; 62%) while males represented n=8 (38%) representing a gender ratio of 2.63 females to 1.62 males respectively.

Fig 1. Showing respondents gender



Source: Author: field survey 2022

4.1.3 Respondents distribution by health facility, current roles and department

The table below show that Environmental Health Technologist represented the majority of those interviewed (n=8; 38%) compared to lab technologist who represented n=5; 24%, and Registered Nurses representing n=5; 24%, as well as Clinical Officers representing n=2; 10%. The least were the Maids who just represented n=1; 5%. By observation key department that produces or handled infectious waste were represented in all the general hospitals where study participants were drawn.

Table 2: Showing Respondents distribution by health facility current roles and department

Participant Number	Current Role	Department	Health facility
P1	Environmental Health Technologist Zonal	Environmental Health	Matero General Hospital
P2	Environmental health technologist	Environmental Health	Matero General Hospital
P3	Environmental health technologist	Environmental Health	Kanyama General hospital
P4	Environmental health technologist	Environmental Health	Kanyama General Hospital

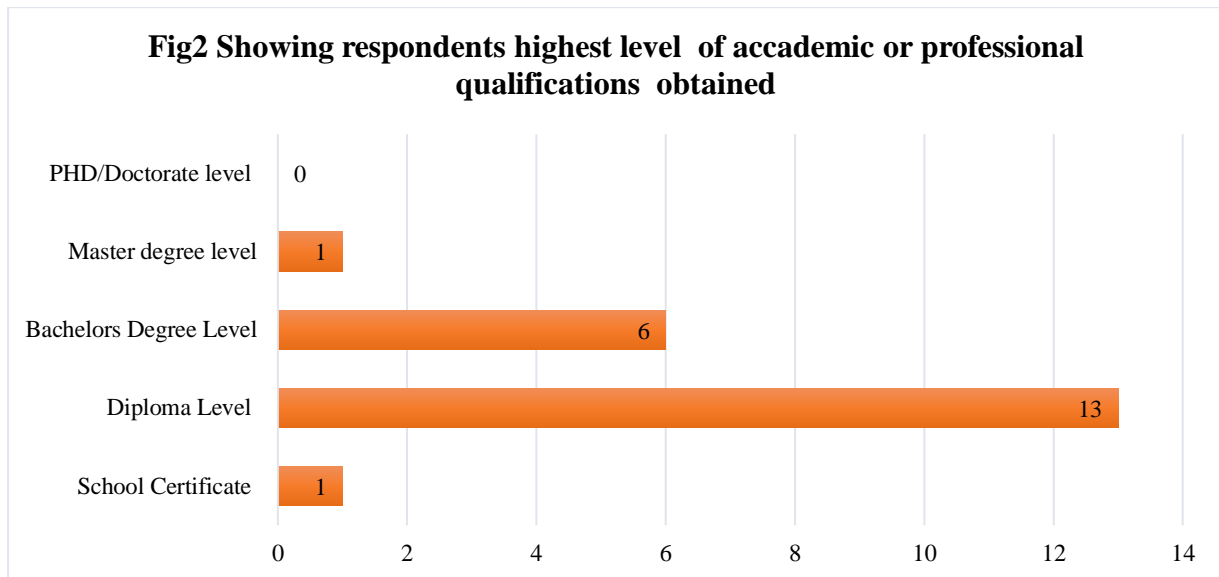
P5	Clinical Officer	Outpatient department	Kanyama General Hospital
P6	Clinical Officer	Outpatient department	Chawama General Hospital
P7	Environmental Health Technologist	Environmental Health	Chipata General Hospital
P8	Environmental Health Technologist	Environmental Health	Chipata General Hospital
P9	Biomedical Technologist	Laboratory	Chipata General Hospital
P10	Lab scientist	Laboratory	Matero General Hospital
P11	Biomedical Technologist	Laboratory	Kanyama General Hospital
P12	Medical Lab Technician	Laboratory	Chawama General Hospital
P13	Environmental health technologist	Public Health	Chawama General Hospital
P14	Environmental Health Technologist	Environmental Health	Chilenje General Hospital
P15	Registered Nurse	In patient	Kanyama General Hospital
P16	Registered Nurse	Labour ward	Matero General Hospital
P17	Registered Nurse	Outpatient department	Chipata General Hospital
P18	Maid	Physiotherapy	Chilenje General Hospital
P19	Registered Nurse	Maternal Child Health	Chilenje General Hospital
P20	Biomedical Technologist	Laboratory	Chilenje General Hospital
P21	Registered Nurse	Paediatrics	Chawama General Hospital

Source: Author: field survey 2022

4.1.4 Highest level of academic or professional qualification obtained

The findings in Figure 2 below show that from a majority (n=13; 62%) were diploma Holders while n=6; 28% were holders of a Bachelor's degree and the least (n=1; 5%) had a master degree and a school certificate respectively. Overall it was observed that these qualifications

were enough to warrant good understanding about infectious waste management in the general hospitals.

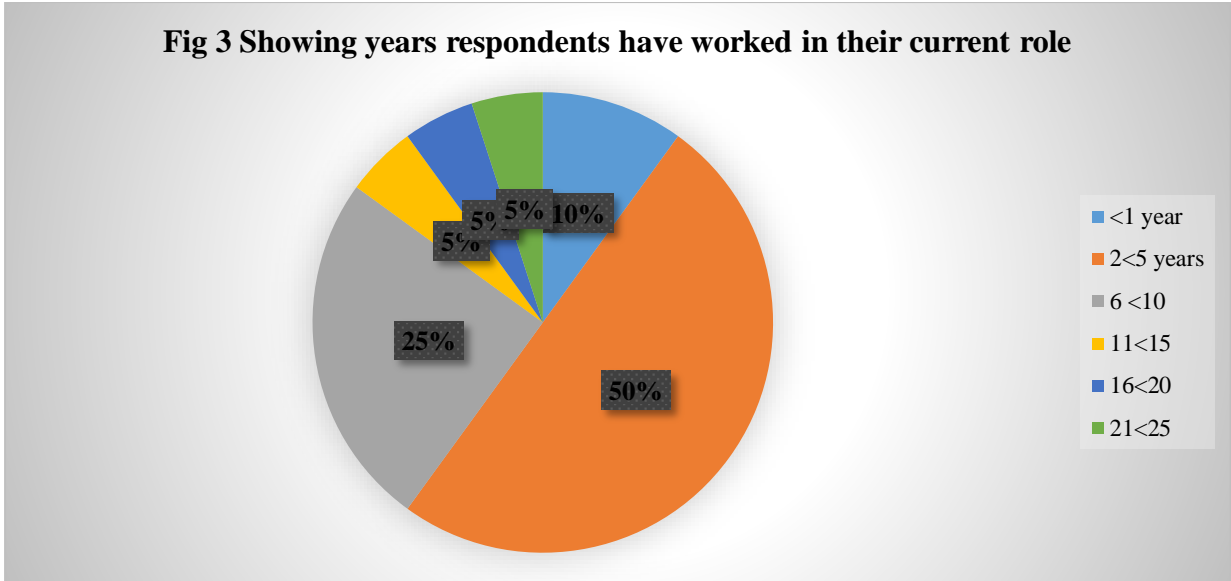


Source: Author: field survey 2022

4.1.5 Years respondents worked in current Role

The finding in fig 3 below revealed that majority n=10; 50% of the respondents have worked 2<5 years in their current role while n=5 25% have worked 6<10 (n=years with the least being those that have served n=11<15 yrs., n=1; 21<25 yrs., and n=1; 16< 20 yrs., respectively. Only n=2; 10% of the respondents had served <1 year work experience in their role as compared to the minority (n=6; 28%). The findings also validate that, each health facility has very well experienced environmental health technologist with vast knowledge of infectious waste management in general hospitals in Zambia.

Fig 3 Showing years respondents have worked in their current role



Source: Author: field survey 2022

4.2. Knowledge levels of health workers regarding infectious waste

Overall, the findings in all health facility revealed rich knowledge about infectious waste by the n=21; 100% respondents. They had adequate information on the importance of infectious waste management and the effects of poor infectious waste management on their own health and the environment.

However, the general observation and commentary by the respondents was that not all health workers had demonstrated a sense of responsibility towards safe handling and disposal of infectious waste. On participant remarked:

“While we are all aware of the types of waste generated in the health facility yet the attitude and behavior of many..... in the way we handle or treat medical waste suggest a lack of awareness about the health hazards related to health-care waste.” **Provider at Kanyama General Hospital**

It was also observed and verified that most of the health workers did not have adequate training in proper waste management, as expressed by some health workers interviewed:

“No I didn’t receive any training on handling infectious waste..... but sometimes we have in house training we are just taught by maybe the EHT’s or maybe a few people from PHO just

to teach us a few things In house training is not so often, I can say maybe once in 6 months.”

One provider Remarked, Chipata General Hospital

“The maids or general cleaners are the ones that help us to clean the floor and are the ones that are responsible to empty the waste. Am not aware if they are trained in handling infectious waste or if there is that proper formal training for them.” Remarked one **provider at**

Chawama General Hospital

4.3. Common type of waste generated in the health facility by health workers

The findings in table 3 below reveals that while waste was generated at all lines of duty, the opinion of the majority (n=13; 61.91%) was that radioactive waste was the least (lowest) generated. Nevertheless, it was clear from the findings in the table below that infectious waste and biohazard waste was the most frequently generated in all departments by health workers while performing their duties.

4.3.1 Table 3: Waste generated by health workers while performing their duties

n=21 Variable	Lowest	Low	High	Highest
Rank the type of Waste generated you while performing your line of duty in the order of lowest to highest				
General waste	5 (23.81%)	3 (14.29%)	4 (19.05%)	9 (42.85%)
Infectious waste	2 (9.52%)	3 (14.29%)	11(52.38%)	5 (23.81%)
Biohazard waste	3 (14.29%)	3 (14.29%)	7 (33.33%)	8 (38.10 %)
Radioactive waste	13 (61.91%)	6 (28.58%)	1 (4.76%)	1 (4.76%)

Source: Author: field survey 2022

Table four (4) above also revealed general waste was also generated and was actually the most predominantly visible waste within the hospital setting yet only n=9 (42.85%) acknowledged producing this kind of waste in their line of duties. A further interrogation revealed that health workers regarded generation of this kind of waste as a collective responsibility of health staff across all departments and by the general health clientele (Patients and the community members visiting the Hospitals).

Nevertheless, concerning general waste respondents were aware that it was potentially an issue in effective medical waste management with some respondents having remarked that:

“In most cases while it is not an infectious waste this kind of waste still pose both environmental and health risks as most of it was disposed of by burning in open pits or in incinerators causing pollution.” **Respondent at Matero General Hospital**

“.... and if not disposed properly it attract scavengers both human and animal that are keen to salvage anything that they think is of potential value to them rendering it a vehicle for some infectious agents in the community.” **Respondent at Chipata General Hospital**

“The risk of this king of waste was that if not sterilized before disposal as such, it has potential to be contaminated by infectious agents within the hospital settings and if not collected or disposed of properly it attracts zoonotic animals and vectors that in turn transmit some of the vector and zoonotic infections.” **Respondent at Chilengje General Hospital**

4.3.2 Attitude of health providers towards infectious waste management

The scores relating to the attitude of the respondents to infectious waste are summarized (Table 4). It was found that majority n=18 (85.7) % of the respondents had a positive attitude towards medical waste management. 62%).

Table 4 Attitude of health providers towards infectious waste management

The responses to the items relating to the respondents’ attitude towards IWM.	
Attitudes towards IWM	(n = 21), n (%)
Positive	3(14.3%)
Negative	18 (85.7%)
Undecided	0 (00%)

Source: Author: field survey 2022

The findings show that the majority (n=18; 85.7%) of the respondents had demonstrated a negative attitude toward infectious waste management. Majority argued it was a preserve of

the environmental health technologist and maids when in fact it was them health providers producing various kind of medical waste in their line of duty. Some participants categorically said:

“The attitude of health workers at our facility when it comes to handling infectious waste from my experience is negative you have to remind them every now and then... some of them are very good and some of them of course they may have the ‘I don’t care attitude,’ but if you remind them continuously they learn eventually they do what they are supposed to do but its continuous Said one **participant, Matero General Hospital**

“” Like the one who just discussed the attitude of staff..... sometimes the bin is there some wont segregate, the sharp box is there someone wont segregate or the sharp box is there someone won’t just put in the sharp box they will mix the waste but of course if you talk to them they change **Participant Chawama General Hospital**

4.4.1 Waste management practices in the various department

4.4.2 Waste handing containers and bin liners

It was clear from observations that there was no standard waste handling containers in all the general hospitals departments. Stock outs and under supplies of standard waste handling containers necessitated various inter departmental innovation just to ensure that waste was somehow handled with less chances of having it mixed-up.





Photo of indoor medical waste management practices in the study area picture taken by Author 2022

Conversely, when the participant were interrogated whether this lack of on standard waste handling vessels was posing any problem for them. This is what they had to say:

“Labelling the containers when one colour code was not an option was common, however, these kind of initiatives often led to frequent mixing of infectious waste with other medical waste and often resulted in one kind of occupational health and safety accidents such as getting pricked with contaminated sharps that have wrongly been mixed with general waste.” Said one

Participant at Kanyama General Hospital

“Some of us have ended up taking Post Exposure Prophylaxis (PEP), Hepatitis or Tetanus injections because of frequently falling victims of pricks from contaminated sharps while handling waste that was not properly separated at the point of generation.” Lamented **one Maid at Chilenje General Hospital.**

4.4.3 Amount of waste generated per month at each general hospital

Table 5. Showing the amount of infectious waste generated in a month and weighing practice

n=21 Variable	Estimated quantity (Kgs)
How much infectious waste does your hospital generate in a month?	
Matero General Hospital	50

Chipata General Hospital	20	
Chilenje General Hospital	Not data	
Chawama General Hospital	Not data	
Kanyama General Hospital	400	
n=21 variable	Freq.	Percentage
How often is medical waste weighed before disposal at department level/or collectively as a hospital		
Always		
Sometimes	5	24
Never at ALL	14	67
Don't Know	2	10
Total	21	100

Source: Author: field survey 2022

The findings revealed that health facilities were not weighing the waste they generated in their facilities as such it was difficult for them to produce data regarding the quantities of waste rather just estimates.

4.4.3 Waste Disposal storage management practices observed onsite



Photo of indoor medical waste management practices in the study area picture taken by Author 2022

The pictures above clearly reveal that waste management practices in the general hospitals is poor and below the standards set in the WHO and national medical waste management guidelines. From the pictures it is clear that surrounding communities and the natural environment health workers and customers are at potential health risk.

4.4. Policy compliance levels of health workers towards infectious waste management

The findings show that only one health facility had written policies and protocols stack on the walls out of the five general hospitals. Even then, the policies, were only stack in selected departments mainly in the Environmental Health Technologist (EHT) department. It was however, noted that health workers were dependent on the environmental health technologist or officials from the ministry of health and stakeholders to remind them of the policy, an event which was dictated by availability of funds. Most policies are still on soft copies and books which not everyone easily had access to.

Table 6. Showing responses on policy compliance levels of healthcare facility towards infectious waste management

n=21Variable	Frequency	(%)
Policy compliance levels of health workers towards infectious waste management		
Very High	2	10

High	3	14
Low	16	76
Very low	0	0
Total	21	100

Source: Author: field survey 2022

The majority of health workers were of the perception that policy compliance levels of the health care facility toward infectious waste management was low (n=16; 74%). This was further amplified by respondent’s remarks such as:

“Yes! there is need for the rules and regulations to be improved, maybe mentoring people more because we are having many new people on the ground every day and they don’t have this knowledge, so at least if we can mentor these people every time we have a new group of staff and also maybe pictures that would be of help” Respondent at Chilenge General hospital

“Just go round the health facility and tell me whether what you see at the storage and disposal facilities is how standard medical waste management looks like..... Management need to increase support to the environmental health department and ensure everyone is inducted in policy and standard waste management.” Respondent at Chipata General Hospital

4.5. Factors impeding proper infectious waste management

The findings relating to the factors impeding a proper infectious waste management and challenges facing health workers in handling infectious waste generated while performing their duties are summarized (Table 7).

Table 7. Showing responses of factors impeding a proper infectious waste management

n=21 Variable	Weighted score (21/21)	Percentage (%)

Factors impeding a proper infectious waste management		
Limited storage space before collection and transportation to the disposal site.	10	6
Stock out of colour coded bin liners and Bins	17	10
Poor attitude of infectious waste generators	16	9
Inadequate of protective clothing for waste handling	17	10
Poor understanding of infectious medical waste management practices	16	9
Mixing of infectious waste with general waste poses a great risk for me	13	7
Inconsistent waste collection schedules	16	9
Poor understanding of infectious waste	3	2
Poor compliance to waste management guidelines	12	7
Lack of regular training	21	12
Substandard central storage rooms	16	9
Insufficient infectious waste management equipment	19	11
Total	176	100

Source: Author: field survey 2022

It is clear from the findings in the above table that majority needed regular training (n=21; 12%). On the other hand there was insufficient infectious waste management equipment (n=19; 11%) at the same time protective clothing for waste handling was inadequate. Stock out of colour coded bin liners and bins was a common occurrence (n=17; 10 %).

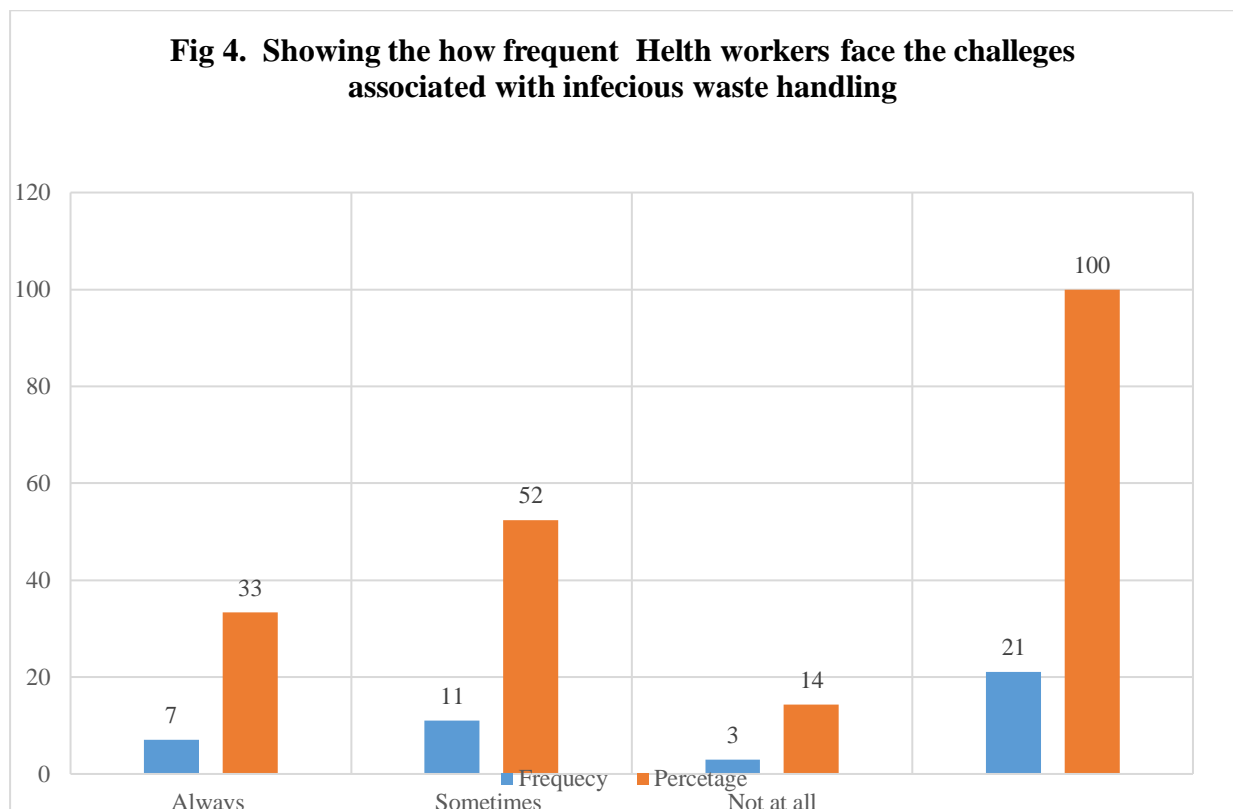
Furthermore, the available central storage rooms were of substandard (n=16; 9%). Additionally, inconsistent waste collection schedules, poor attitude of infectious waste generators and poor understanding of infectious medical waste management practices was identified among factors impeding a proper infectious waste management (n=16; 9%) respectively.

On the other hand, mixing of the waste and poor compliance to waste management guidelines was perceived as another challenge of moderate parlance (n= 12; 7%). Additionally, the finding

revealed that, understanding of infectious waste was not considered a key challenge as most health worker understood clearly what an infectious waste was.

4.5.1 How often challenges associated with infectious waste handling and management affect health worker in there line of duty

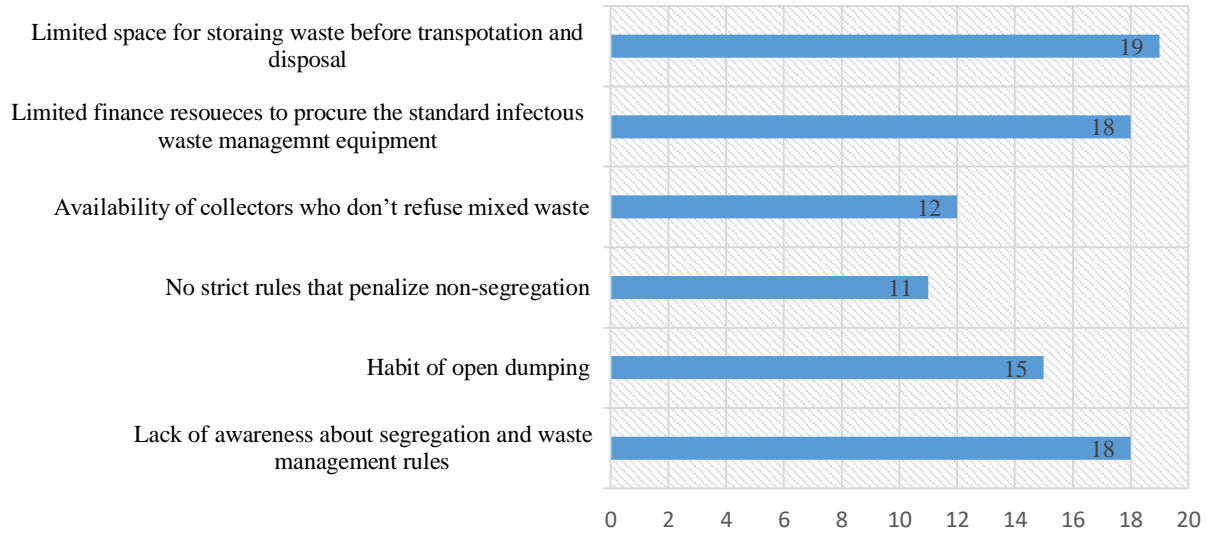
The general responses of the majority as shown in Figure 4 below was that n=18 (86%) did agree that the challenges associated with infectious waste handling did affect them while performing their duties. Some of the most observed challenges included coming into contact with infectious waste accidentally or during handling or transportation to the refuse bay. Other are just administrative such as stock out of gloves, bin liners and broken down incinerators and delay in collection of waste which sometimes attract scavengers from the communities who puts others at risk in the community by taking infectious waste to their homes.



Source: Author: field survey 2022

4.5.2 The reasons for having such challenges regarding handling of infectious waste

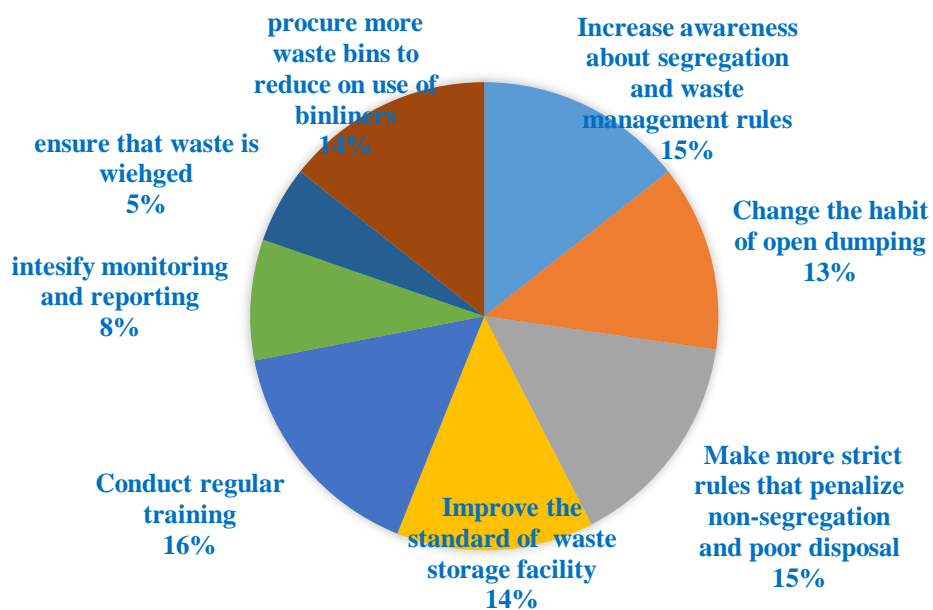
Fig 5 Showing reasons for having such challenges regarding handling of infectious waste



Source: Author: field survey 2022

A myriad of reasons for having such challenges regarding handling of infectious waste were advanced. Those amplified are given in fig 5 below. It is clear that limited space for storing waste before disposal or transportation (n=19; 90.1%) and the lack of awareness about segregation and waste management rules (n=18; 86%) as well as the limited financial resource to procure standard infectious waste equipment (n=18; 86%) emerged among the major reasons for the challenges health workers are facing in infectious waste management.

Fig 6 Infectious waste management improvement plan



Source: Author: field survey 2022

The respondents have revealed that regular training for health workers was of high currency (n= 21; 16%) this was followed by the following suggestions: make more strict rules that penalize non segregation and poor disposal of medical waste (n=20; 15%) increase awareness about segregation and waste management rules (n=19 (15%) improve the standard of waste storage facility (n=18; 14%) and change the habit of open dumping (n=17; 13%) respectively weigh the waste and intensifying monitoring and reporting were the least among responses. This clearly begs a question into the waste management practices.

The study also identified other practices that needed to be improved. One respondent had this to say:

“Collection of waste is done once in a week for both domestic and infectious waste, collection is done every day every morning in all the departments from our refuse bay it’s done once in a week so I would say twice because domestic is collected on a different day, infectious is collected on a different day.” **Participant** at Matero General Hospital

“Refuse bay this is where we throw the waste be it infectious, domestic, sharp it’s a place where we store all that is waiting for transportation to disposal site. No, we don’t dispose-off our waste, our incinerator is down so we just hire a company to collect the waste, we have a company for domestic and a company for infectious waste.” **Participant** at Chilenje General Hospital

“At first, I used to hear there is a place somewhere in Chunga right now I don’t know where the company takes the waste, they have an incinerator that side for sharps. They come with a van big van and then they put the bags in the van, every week they come.” **Participant** at Kanyama General Hospital

“We don’t have proper transportation for waste, the ideal we are supposed to have a trolley where it is well covered it does not allow any leakages of waste in case they are fluids they is no leakages from the point of generation to the point of disposal. The waste is stored in plastics you find that they put them on the wheel chair they transport which is not ideal.” **Participant** at Chipata General Hospital

5.0. Discussion

5.1. Knowledge, Attitude and Practice of Infectious Waste

In this study, the overall picture was that health care workers in the professional stratum such as nurses, laboratory technicians, environmental technicians, clinician's, doctors among others, underplayed health disposal practices despite them being the producers of such waste and health professional forerunners. This created an impression that the practice to dispose and transport infectious waste was not a collective responsibility but rather was a preserve of the environmental health technologist, occupational health and safety officer and the hospital maid or general workers. Unequivocally, the maids had no formal training in medical waste management and mostly were not adequately provided with personal protective clothing's as such they would not risk segregating the waste bare handed.

Across the study area the waste management recommendations, policies and guidelines on proper handling and management of infectious waste (such as waste segregation and bin colour coding, transportation, disposal and storage) are still substantially undermined by a myriad interlinked factors such as inadequate knowledge levels, health workers' attitude and practices towards infectious waste management, low policy compliance levels of healthcare facility towards infectious waste. The findings are similar to that of (Makhura et al., 2016) which showed that there was insufficient knowledge of infectious waste disposal among healthcare workers. The practice of engaging a small private sector to participate in transporting hospital waste management was encouraging but adopting new technologies including innovation such as waste recycling development are potential to address storage and disposal issues as well as improve environment outcomes associated with ground water and air pollutions as well as climate change. Failure to which will result in catastrophic health consequences for the health workers and communities around them.

Studies that support the findings of this study hold proper management of infectious waste in high escrow, as it is the only sure way of controlling its corresponding risks on health and to prevent the transmission of infectious conditions such as hepatitis, AIDS, and typhoid including the Covid-19 pandemic which has led to increases in patient and healthcare activities and increased the waste generation and the proportion of infectious waste in the landfill (Peng et al., 2019–2020; Wang et al., 2020).

The current state of affairs observed in this study provide an opportunity for understanding the gray areas in infectious waste that are usually taken for granted. The study has shown that for most healthcare workers having knowledge was not indicative of their change in waste management practices as attitude and policies did have their fair toll on overall perception of waste management. Thus, a key challenge to deal with, in the longterm including transforming the mindset of health worker towards infectious waste management through training and policy compliance monitoring. This is because “poor management of infectious waste potentially exposes health care workers, waste handlers, patients and the community at large to infection, toxic effects and injuries, and risks polluting the environment. These findings are also in line with that of Hangulu (2017) and Kusilika (2021) which stated that poor infectious waste practices pre-disposes healthcare workers and the surrounding community to infectious diseases. It is essential that all medical waste materials are segregated at the point of generation, appropriately treated and disposed of safely.

Conversely the malfunctioning waste system that this study validated is a wakeup call for government and stakeholders to act now before lest the country reach the tipping end waste management crisis in the health care units.

5.2. Policy Compliance Levels of Healthcare Facility Towards Infectious Waste

This study validated that, the state of infectious waste management in general hospitals in Zambia are still short of the World Health Organisation recommended standards. It is evidenced from the study findings that despite Zambia having adopted Health Care Waste Management (HCWM) guidelines and policies in line with the Environmental Management Agency (ZEMA) No. 12 of 2011, segregation, collection, transportation, storage and disposal of infectious waste and policy compliance was below expected standards.

Clearly, what was observed in this study, shows that having policies on paper or on soft copies was not adequate in changing health care workers’ attitudes towards infectious waste management in health facilities. This study revelation were also uncovered by Thukar et al., (2021) in India and in the WHO (2015) report which reported that, “in almost every part of the world, the management of infectious waste is very poor with most and rule and policies serving as a mere smoke screen and by and large, remain mainly on the paper.”

5.3. Factors Impeding a Proper Infectious Waste Management

This study enunciated a series of decomposing factors of interest to the public health systems zeroing in those that primarily impeded proper infectious waste management in Zambia. Those amplified in this study include lack of regular training, insufficient infectious waste management equipment and inadequate protective clothing for waste handling, stock out of colour coded bin liners and bins was a common occurrence. Kenny and Priyadarshini (2021), alluded that the incorrect disposal of waste is as a result of a wide range of potential factors, such as lack of facilities, equipment and lack of education and training and also a study by Olaniyi et al., (2021) on challenges of effective management of medical waste in poor low-resource setting .The major challenges also included limited space for storing waste before disposal or transportation and the lack of awareness about segregation and waste management rules as well as the limited financial resource to procure standard infectious waste protection and disposal equipment. These findings relate well to Hassan et al., (2018) and Yazie et al., (2019) that factors attributing to improper disposal include; lack of awareness of waste segregation and inappropriate waste management utilities. Others observed included, inadequate management of infectious waste mainly due to inadequate waste collection vessels such as bin liners and bins lack, shortage of manpower and above all the improper management of waste in the health care sector. These observations were also noted in the literature of Bhardwa and Joshi (2016) and were considered to be of primary concern to hospital and communities at large.

In common parlance the revelation in this study begs a strong political will and further scientific inquiry into the interrelationships between various variable such as knowledge, policy, and waste management practices challenges and attitude. Studies that have been done in the past have demonstrated that public health medical waste management infrastructure was under prioritized in a number of settings in Africa and developing countries. To change the status quo government have a key role in strengthening and building trans-disciplinary teams of health sector human resource base with a transformative leadership abilities responsible enough to safeguarding their own health and the promoting population wide health of their communities (WHO 2015).

6.0. Conclusion

Infectious waste management in general hospitals in Lusaka, Zambia was investigated nesting the perspectives of healthcare workers. Health workers acknowledged that while they were

primary producers of infectious waste, their attitude towards waste management was negative. Most health workers did not take full responsibility when it came to waste disposal transportation, and segregation contrary to the policy requirements.

Thus, this study found effective, health care workers training, community awareness raising, policy compliance monitoring, financing, infrastructure development, innovation and nuanced technology development/ acquisition, behavior change to be areas of administrative and policy focus. These are key ingredients of a well-functioning infectious waste management systems.

Basing on the research findings, there is need to conduct longitudinal studies across hospitals to establish the impact of waste management practices and its corresponding health risks. The government should effectively fund hospitals to enable them train health workers, procure adequate infectious waste management equipment among others in case of delayed supplies from or the central supply chain and to sub contract the private sector or social entrepreneurs to management waste on behalf of hospitals to address the current challenges facing the general hospitals while seeking for sustainable longterm solutions. Furthermore, there is need to increase the operational capacity of Zambia Environmental Management Agency (ZEMA) to enhance effective monitoring of Health Care Institutions over Health Care Wastes compliance and surveillances.

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