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Knowledge and practice of solid healthcare waste management among waste handlers in hospitals in Southern Ghana: a qualitative study

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Abstract

Background Despite Ghana's healthcare waste management guidelines, improper solid waste management remains a public health concern. This study sought to assess the knowledge, and practices of waste handlers involved in solid healthcare waste management in selected health facilities in Accra, Ghana.

Methods This study employed a descriptive phenomenology study design. All 31 waste handlers from Korle Bu Teaching Hospital, Tema General Hospital, and Shai-Osudoku Hospital participated in this study. We employed a focus group discussion guide, transcribed the audio-recorded interviews, and then uploaded the data into NVivo 14 software for coding. We synthesized the output into themes, sub-themes, and verbatim quotes to support the sub-themes.

Results The waste handlers were able to describe the different types of healthcare waste, but they were unable to label the colour codes according to the national colours used to identify the waste as hazardous or non-hazardous. In many cases, there was no attempt at managing infectious and sharp wastes, which resulted in needle pricks, falls, or even injuries due to poor transport systems. Most of the waste handlers lacked infection-fighting vaccinations.

Conclusions For effective healthcare waste management, which heavily relies on waste handlers, it is essential to improve personal protective equipment, vaccinations, colour-coded containers, and a supply of disinfectants/soap to prevent infections. Hospital administrators must receive training on the importance of these logistics to streamline the work of waste handlers and promote public health.

Keywords Solid healthcare waste, Waste handlers, Medical waste handlers, Knowledge and practices

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Introduction

Waste handlers play a critical role in ensuring the cleanliness of healthcare facilities, including the safe disposal of waste for quality service delivery [1, 2]. However, their line of duty exposes them to injuries and other hazards during waste collection, transportation, and disposal [3]. Adequate knowledge and practices are key in protecting waste handlers against all forms of exposures [4] whereas in Low-and Middle-Income Countries (LMIC) this is in contrast. Consequently, in order to manage medical waste efficiently, waste handlers must have the necessary skills, knowledge, and behaviours [5]. Yet, studies on the knowledge and practices of waste handlers associated with hospital solid waste are sparse and mostly reported elsewhere [6, 7]. While there are extant studies on general waste management practices in Ghana [8–11], most of these studies are quantitative in nature. Similar studies focusing on waste handlers are scarce, especially studies using qualitative methodologies.

Healthcare waste can be categorized as 15% hazardous and the remaining 85% non-hazardous [5] but 49.65% of hazardous waste in Ghana is hazardous [2]. The hazardous component of the waste is associated with the risk of infections (hepatitis B virus (HBV), Hepatitis C virus (HCV), and Human Immunodeficiency virus (HIV), irritation, corrosion, burns, and cuts [2]. It is therefore important for all healthcare workers to handle this category of the waste with precautions. However, due to improper healthcare waste management, Healthcare Workers (HCWs), including waste handlers, are exposed to hazards from the waste through cuts, splashes, contact, inhalation, and ingestion [12, 13]. The surrounding community is also vulnerable to the adverse effects of improperly handled hazardous waste [14].

The challenges experienced by waste handlers can be averted if they have adequate knowledge of the protocols for handling healthcare waste and can practice them [2]. However, healthcare workers, including waste handlers, often understand waste categorization and management differently. While many HCWs can differentiate between general and hazardous waste, they might need to understand the subcategories thoroughly [15]. The key characteristic that identifies these wastes is that, in some way, it is potentially dangerous to humans and the environment, particularly when unsafely handled [16]. Examples of these wastes include infectious waste and household chemicals such as bleach, heavy metals, and asbestos. Improper waste management in health facilities increases the risk of infection among healthcare workers [17]. As a result, it is imperative to properly segregate waste at the point of generation in healthcare facilities. Personal protective equipment (PPE), such as gloves, masks, and boots, is essential for Waste handlers' safety. While

awareness of the importance of PPE is generally high, adherence to proper use is often suboptimal [18].

In Ghana, inadequate provision of waste bins, lack of enforcement of assembly by-laws, and inadequate training of waste handlers retard the effective management of PPE waste [19], while institutional policy, quality of PPE, and availability of PPE remain significant reasons for use in other areas [20]. Waste handlers are always found to be inappropriately dressed [21], and compliance with stipulated guidelines among waste handlers on healthcare waste management remains unacceptable [8]. Possessing sufficient knowledge, a positive attitude, and appropriate waste management techniques are critical for ensuring effective hazardous waste and safeguarding individuals from potential exposure to dangerous substances [6]. However, studies on the knowledge, attitude, and practices of waste handlers associated with hospital solid waste are sparse and mostly reported in advanced countries [6, 7].

Therefore, this study seeks to assess the knowledge and practices of solid healthcare waste among waste handlers at selected healthcare facilities in southern Ghana. Evaluating waste handlers' knowledge and practices related to solid healthcare waste management can inform the development of targeted interventions to address the waste handlers' salient behavioural, normative, and control beliefs and ultimately improve their solid healthcare waste management practices.

Study design

This study employed a descriptive phenomenology study design to explore the knowledge and practices of waste handlers related to solid healthcare waste management. The descriptive phenomenology design makes it easier to understand waste handlers' experiences, motivations, and actions with waste management practices. The researchers' bias and preconceived knowledge of solid healthcare waste management are vitiated by this design by focusing on the lived experiences of the waste handlers.

The study received ethical approval from the Ghana Health Service Ethics Review Committee (GHS-ERC) (GHS-ERC: 0233/06/22) and the Korle-Bu Teaching Hospital-Scientific and Technical Committee (KBTH-STC) (KBTH-STC 00065/2022).

Theoretical framework of the study

Theory of Planned Behavior (TPB) offers a framework for understanding waste handlers' behaviours and knowledge in the Greater Accra Region of Ghana regarding the management of solid healthcare waste [22]. TPB holds that attitude, subjective norms, and perceived behavioral control all have an influence on behavior (Fig. 1). Waste handlers' ability to effectively carryout their routine activities

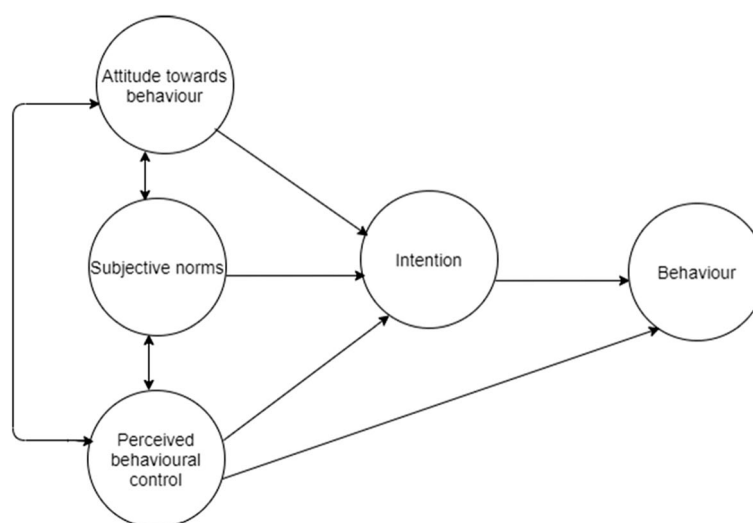


Fig. 1 Theory of planned behaviour [22] as adapted

are influenced by these factors. The beliefs that application of best practices in waste management helps to reduce the spread of infections and environmental effects influence their attitude [22]. Compliance is influenced by subjective norms, which are driven by institutional expectations, peer pressure, and supervisory pressure. The facilities management and the infection prevention and control committees' strong institutional culture that reinforces these standards through education, rules, and a focus on patient safety and healthcare outcomes [2, 23]. Normative beliefs about the management, colleagues and regulatory bodies additionally encourage compliance to appropriate procedures [22].

Perceived behavioral control is influenced by access to resources like PPE, waste bins, and facility management support. When these resources are available, waste handlers feel more capable of performing their duties effectively [22]. Training and knowledge development are crucial for building confidence. Initial training, followed by regular training, hands-on practice, and clear guidelines, enhances understanding of waste management principles, infection control, and environmental impact [24, 25]. Visual aids, colour-coded systems, and Standard Operating Procedures (SOPs) also reduce uncertainty and support decision-making.

The TPB has been successfully applied in studies, such as in Nigeria, to predict and explain healthcare waste management behaviours [26]. Deress et al. [5] emphasize that adequate knowledge, positive attitudes, and proper practices are critical for effective waste management. Resources like quality waste bins, PPE, and transportation tools boost confidence and perceived control [27]. The combination of waste handlers' attitudes, subjective

norms, and perceived behavioral control determines their intention to engage in proper healthcare waste management, which, along with perceived behavioural control, predicts actual behaviours [22].

Sampling

The Ghana health system encompasses a range of facility types organized into tertiary, secondary, and primary to provide a spectrum of healthcare services to meet the population's needs at various points of care [28]. We conducted three levels of sampling: facility-level sampling, departmental/unit-level sampling, and study participant sampling. We randomly selected a facility at each of the three hospital classification levels, as well as a high-risk and low-risk department in each facility (Supplementary material, Table S1). However, in each of the high- and low-risk departments, all the waste handlers who have served more than 6 months and agreed to participate in the study were recruited. These include 19 waste handlers at Korle Bu Teaching Hospital, 6 at Tema General Hospital, and 6 at Shai-Osudoku Hospital. A high-risk department is defined as one with a high risk of exposure to blood or body fluid through cuts, splashes, contact, and inhalation. These included the Accident and Emergency (A&E) as well as the Out-Patient Departments (OPD).

On the other hand, a low-risk department is one where there is a reduced risk of exposure to blood or body fluid [2]. At the Shai-Osudoku and the Tema General hospitals, the waste handlers work in both departments in shifts. Waste handlers are personnel involved in healthcare waste management. Their roles include lining waste bins with the prescribed liners, segregation,

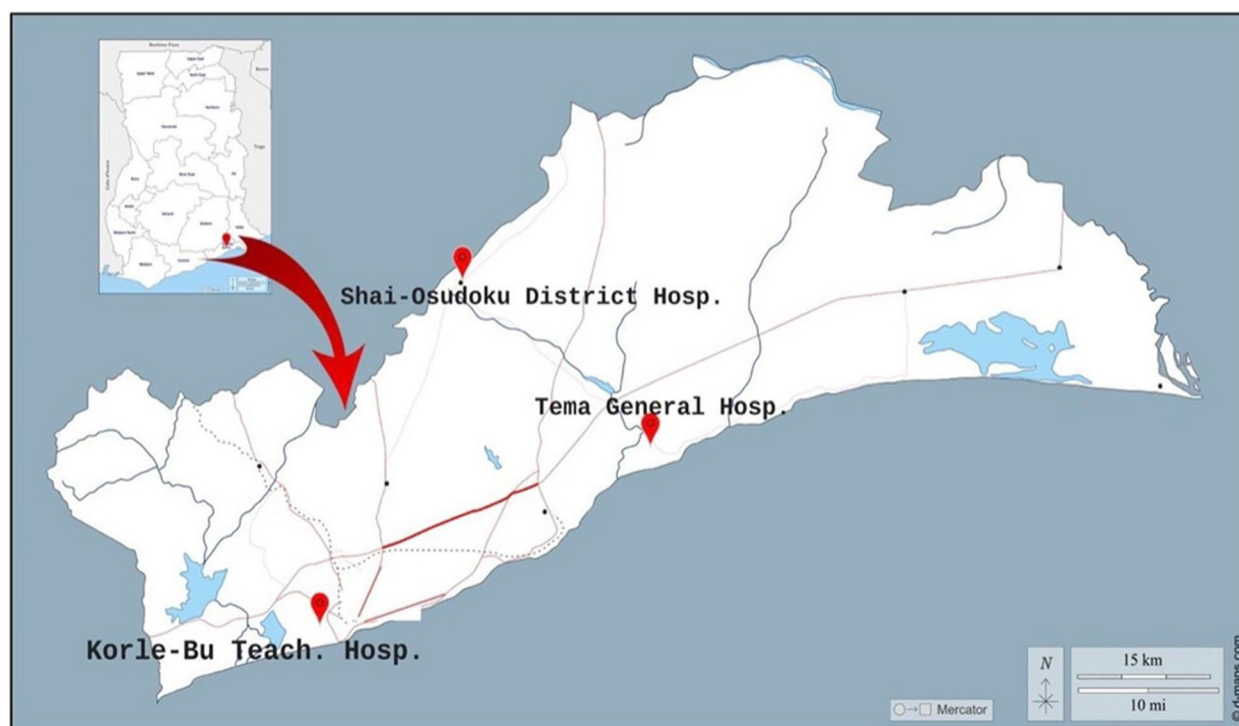


Fig. 2 Map of study sites in the Greater Accra Region

transportation, storage, treatment, and proper disposal of all types of waste generated.

Study site

The study was conducted in three categories of hospitals that provide care to different health outcomes in southern, south-eastern and south-western parts of Accra, Ghana. The categories included Korle-Bu Teaching Hospital (Tertiary), Tema General Hospital (Secondary), and Shai-Osudoku (Primary) (Fig. 2). The selected study sites provide a comprehensive oversight of how solid healthcare waste are managed at the tertiary, secondary and primary levels in health facilities. Additionally, all the selected healthcare facilities have high and low risk departments, making the efficiency of waste management practices integral in disease prevention.

Data collection

A Focused Group Discussion Guide (FGDG) was developed for this study with slight modifications [2] (see Supplementary material, Table S2). The FGDG served as a guide containing pre-determined questions for interviewing the waste handlers. It also helped in posing questions consistent with the study's objectives such as how do you collect infectious waste in your hospital? Why do you use the methods mentioned? How do you handle sharp waste? Are logistics for the safe collection of solid

waste always available? How do you handle waste accidentally mixed? Follow-up questions were posed where possible. The FGDG was piloted in selected departments of Ridge Hospital among 15 waste handlers. They were interviewed using the same FGDG used for the study. The results of the pilot study revealed that the practice questions, such as how many bin liners colours do you know? was re-worded as what are the colours to identify the waste types? Again, the challenges questions including 'when was the last time you were vaccinated?' was restructured as 'have you been vaccinated against Hepatitis B and C by the hospital?' for easy understanding. We arranged the participants in a circular configuration in a quiet hospital office on the day of data collection. The focus group had different participants in each hospital. At the Korle Bu Teaching Hospital, 19 waste handlers (11-Korle-Bu Polyclinic-OPD, 8-A&E) participated; 6 participated at Tema General Hospital and 6 at Shai-Osudoku Hospital. However, at the Shai-Osudoku and Tema General Hospitals, waste handlers at the OPD and the A&E were put together during the FGD.

Meanwhile, a recorder was placed in the center of the participants to ensure a clear capture of their responses. Two facilitators conducted the focused group discussion, one facilitating and the other taking field notes. One of the facilitators was multilingual (spoke at least three local languages: Twi, Ga, and Ga Adamgbe) and qualitative

research expert and the other was multilingual (English, Ewe, Ga, and Ga Adamgbe) and typing expert (type 100 words in one minute). The facilitator, taking note, observed participants' reactions during the ongoing discussion as the facilitator leading the discussion applied probing techniques and rephrasing questions to ensure clear comprehension.

During the focus group discussions (FGDs), which typically lasted approximately 90 min, the facilitator translated the questions into the local languages (Ga, Ga Adamgbe, and Twi) to facilitate comprehension. The FGDs allowed the researchers to interview all the waste handlers in less time, and it was cost and time-effective as the researchers gained detailed insights from all the waste handlers simultaneously. The different responses to questions also provided a diverse and interpersonal view on healthcare waste management. We listened to all audio after each interview to ensure clarity before departing the hospital. We transcribed the interviews verbatim after listening to them twice. The research team printed out the transcripts after reviewing them to uncover any inconsistencies that could be overlooked on the computer screen.

Data analysis

A codebook was developed based on the review of the data that was collected. The transcribed data was uploaded into NVivo 14 software for coding. Inductive thematic analysis was adopted for this study. The transcribed data from the FGDs were thoroughly reviewed by reading the texts to familiarize ourselves. Next, the data was coded by highlighting relevant and interesting responses from the transcribed data. All phrases and sentences matching the identified codes were highlighted, and all the data was collated into groups identified as codes. Descriptive coding was used to obtain codes arranged according to similarities and differences. Categories were compared, and meaningful and comprehensive categories were combined to form themes. The themes were then reviewed for usefulness and representativeness of the transcribed data. Themes were given under various sub-headings in the findings and interpretations. Direct quotes were used to reveal participants' viewpoints. To select the quotes, we examined the number of participants expressing similar ideas and their level of emphasis and tone of voice.

Results

Background characteristics of waste handler

Table 1 shows the background characteristics of hospital waste handlers. Most of the study participants were female and married. Most of them attained a secondary

level of education, with having worked for over ten years and a few less than 5 five years.

Thematic content analysis structure

The researcher employed thematic content analysis to generate three main themes with 12 sub-themes (Table 2). Sorting and coding were done for all three major themes.

Theme A: knowledge and practices of healthcare waste management

This theme emerged from five sub-themes (Table 2): colour coding of bins and segregation, handling of Infectious and sharp waste, transportation of healthcare waste, treatment of healthcare waste, and bin cleaning. Based on the accuracy of the opinions expressed by the waste handlers, knowledge and practice were considered low, moderate, and high. Knowledge and practices were considered low (3/7 questions), when the opinion shared by all the participants are not in line with best practices. Again, when the participants responded accurately to some of the knowledge and practice questions, they were considered as moderate (5/7 questions). Knowledge and practices were considered as high (7/7 questions) when all the participants responded accurately to all the questions posed to them (see Supplementary material, Table S3).

Colour coding and segregation of healthcare waste

In general, waste handlers could not identify all the various categories of waste with their corresponding national colour of bins and liners utilized for its storage and disposal. Some of the remarks made here reflect a moderate awareness of the different types of waste in the hospitals.

"Before you get to the ward, they have labelled the bins over there, so no one will tell you this is this. They have labelled all the bins. The yellow one is for the theatre, and the black one is for the general waste, and then the red too is for the infectious." (FGD 4, KBTH A&E).

"wastes like used gauze, cotton with blood and others goes into the yellow bin while the sharp waste also goes into the sharp containers" (FGD1, SODH1).

"so for the sharp box I wear my gloves (Surgical gloves) and my nose mask so I pick the box and then put it in a black rubber and tie it then I take it to where we discard it" (FGD1, TGH).

All the waste handlers were aware of the shortcomings in managing healthcare waste in the hospital, which include intermittent 'littering and scattering of healthcare

Table 1 Background characteristics of healthcare waste handlers

Facility	No	Sex	Years of experience	Marital Status	Educational level
Shai Osu-doku (SODH)	1	Female	7	Married	JHS
	2	Female	5	Married	JHS
	3	Male	4	Married	JHS
	4	Female	4	Married	JHS
	5	Male	2	Married	SHS
	6	Male	2	Single	Dip Admin
Tema General Hospital (TGH)	1	Female	7	Married	JHS
	2	Female	7	Married	JHS
	3	Male	15	Married	SHS
	4	Female	10	Married	JHS
	5	Male	6	Married	JHS
	6	Female	9	Married	JHS
Korle Bu Polyclinic (KBPC)	1	Female	13	Married	SHS
	2	Female	1.5	Single	SHS
	3	Female	9	Married	SHS
	4	Female	25	Single	JHS
	5	Female	9	Married	SHS
	6	Female	22	Married	JHS
	7	Female	25	Single	JHS
	8	Male	1.5	Single	SHS
	9	Male	2.5	Married	JHS
	10	Male	24	Married	JHS
	11	Male	9	Single	SHS
Korle Bu Teaching Hospital Accident and Emergency (KBTHA&E)	1	Female	11	Married	JHS
	2	Female	27	Married	SHS
	3	Female	1.6	Single	None
	4	Female	7	Single	None
	5	Male	11	Married	SHS
	6	Male	16	Married	JHS
	7	Male	11	Married	SHS
	8	Female	13	Married	Primary

JHS Junior High School, SHS Senior High Schools, Dip Admin Diploma in Administration High School, SHS Senior High Schools, Dip Admin Diploma in Administration

waste in the hospital premises' instead of aggregating them at predefined storage places in a segregated form. They unanimously agreed that strict adherence to the suggested practice of segregation at the source is necessary and that the current practice of mixing and sorting waste should be completely prohibited.

"Even if I am to send you to the female ward right now, we will see some of the sharp objects on the floor. So, whenever I'm about to work, I always make sure that it has been cleared before I start work because even if you tell the nurses, they won't do it" (FGD 2, KBPC).

Using the same bin liners promotes infectious and non-infectious waste mixing. While this practice makes

infectious waste segregation and treatment before disposal difficult, it has the propensity to cause disease outbreaks such as typhoid and hepatitis B.

"We are supposed to have two bin liners so that we will see the difference, but we are using the same bin liner to do the infectious waste and the general waste, which is wrong. We have been complaining, but we are still not getting any response. Sometimes, after reporting to the person in charge so they would be aware of it, we would try as much as possible to put on your gloves and try to separate them to various other bins." (FGD 4, KBTH A&E).

"Sometimes some of the patients mix them [waste] up. For example, a patient will eat waakye (boiled

Table 2 Themes and sub-themes for the focused group discussion

Themes	Sub-themes	Verbatim Quotes
A. Knowledge and practices of healthcare waste management	• Colour coding of bins and segregation of healthcare waste • Handling of infectious waste and sharp waste • Transportation of healthcare waste • Healthcare waste treatment • Bin Cleaning	wave one bin for general waste, the yellow bin for infectious waste, and the black bin for general waste and hazardous waste (FDG1, SODH) Every day, you will find sharps on the floor (FGD 2, KBPC) Infectious waste must be kept in the yellow bins, but now, if you go around, you will see that they have mixed it with general waste (FGD1, SODH) At times we are using the Kuffour gallon (A plastic container used to store sharp waste in place of the sharp boxes due to shortages of the sharp boxes (FGD 4, KBTH A&E) We transport the infectious waste before the general waste (FGD1, SODH) When the car picks it up, they go and burn it; they have a bigger refuse dump where they burn all the waste (FGD1, SODH) We wash our dustbins every weekend, and we use the solution to wash them and dry them in the sun (FGD3, TGH)
B. Occupational health or risk associated with healthcare waste management	• Route of exposure • Needle pricks • Vaccinations	I get rashes on my body while sweeping and water splashed on my skin which led to this, so they gave me medication, so now it's gone (FGD3, TGH) Last time I got pricked by some of the needles when I was trying drop the liner. I got an injury on my foot. That is a very big challenge for us here (FGD 2, KBPC) I have only been vaccinated with tetanus, and it was free." (FGD3, TGH)
C. Challenges associated with healthcare waste management	• Disposal challenges • Logistic issues • Waste segregation-related challenges. • Sharp waste disposal-associated challenges	At times, the bins inwards can overflow, then they will come and call us, please come, and change the bin for us." (FGD3, TGH) At times, the bins inwards can overflow, then they will come and call us, please come, and change the bin for us." (FGD 2, KBPC) They put the infectious waste in the kitchen dust bin. Sometimes, too, they forget and put the sharps in the general waste." (FGD3, TGH) sometimes you will find some of the sharps on the floor especially when the box is full (FGD3, TGH)

rice and bins) after that, instead of putting it [wrapper] into the black dust bin, they rather put them into the yellow one because they see all the colours as the same dust bins. When you experience something like that, you can't remove the food because the infectious waste has already contaminated it, so you leave it like that." (FGD 2, KBPC).

"Okay, the Nurses are supposed to segregate the waste, but sometimes, before you realize it, they put general waste into infectious waste containers or vice versa. So that's one of the challenges we encounter, and sometimes, too, they don't segregate the waste well." (FGD1, SODH).

"I wear gloves and remove it from the general waste and put it into the rightful container." (FGD3,

TGH).

Infectious and sharp waste management

The discussions on the management of healthcare waste suggested that waste handlers must be made aware of the appropriate way of managing infectious and sharp wastes and how they were disposed of, as they indicated.

"Wastes like used gauze, cotton with blood and others go into the yellow bin while the sharp waste also goes into the sharp containers. Sometimes, we have a shortage of bins, so we use other ways to collect the waste. So, the black bin has to be covered with black rubber before you put the waste inside, but because there are insufficient yellow bins, they turn to put the infectious wastes inside the black bins too." (FGD1, SODH).

There is an increased risk of needle pricks/injury that can lead to the contraction of infectious diseases, like HIV or hepatitis B, because the makeshift boxes are not designed for the collection and storage of sharps.

"For the sharps, we get a box and make a hole on the top, then we put the sharp inside, since the sharp boxes are insufficient." (FGD 4, KBTH A&E).

"This is because sometimes there is a shortage of sharp boxes, so they replace these stuffs with the normal gallons or boxes. We use the normal saline boxes for the sharps too." (FGD 2, KBPC).

"The sharp boxes are not available, so we use boxes from the finished drug, so it's a normal empty box with the needle waste. They don't wait for the bin to be full before they discard it, so it is not easy for it to tear in the process of picking it up or anything because the bin isn't full." (FGD1, SODH).

Transportation of waste

Waste handlers shared how the waste is transported from the wards to the final destination. They also indicated that the means of transporting waste could result in needle pricks, falls, or even injuries because of how they carry the liner with the waste on their back. According to some participants, they transfer infectious waste ahead of general waste. They also used wheelbarrows for internal transportation of healthcare waste. They added that in some cases, sharp boxes overflow and become torn, posing a risk during transportation.

This is the norm in transporting from the point of collection to the final disposal site. Ideally, the waste must be carried or wheeled on a trolley to the final waste disposal site but logistical inadequacy results in the waste handlers carrying the waste on their backs.

"The waste is already in rubber, so you have to take it from the bin; you have to be very careful that it will not hurt you because of what we said earlier concerning the mixture of both general and infectious waste. Maybe there is a needle in it, so you have to be very careful when taking the rubber out of the bin. It should be somehow far from you so that the needle will not prick you. The waste is dangerous, so we are always careful in handling it; we slip, we fall, it's normal, it's not really a serious thing. There is a process we use to tie it, so it gives us space to hold it, and it's easy that way" (FGD1, SODH).

"If I go and meet it like that, I will wear my gloves and then open the bin, then I will gather all the bin liner on the top then will hold it, then come outside

with the bin, then I will change it and put another bin liner into the bin. After, I will pick it up with my two hands and transfer it from the ward to the backyard of the building. I will put it in a wheelbarrow and then throw it away" (FGD 4, KBTH A&E).

"The dust bin is covered with a bin liner, so we just tie the liner from the dust bin and lift it; after tying the liner, we just pick it to where the car will come and collect them; we have a particular place that we keep all rubbish then a car will come and pick it up. If the sharp container overflows or gets torn in the process, we leave it there and then go for another rubber to come and collect it" (FDG1, SODH).

Waste treatment

During the discussion, participants shared their facility's system used to treat healthcare waste before disposal. Even though the waste handlers seem to have a fair knowledge of the treatment process used by the facility, majority do not have information on whether the waste is treated or not. Even though there was an incinerator present for treating waste in one of the hospitals, the participants said they do not treat their waste but rather burnt it. They mentioned that most solid healthcare waste is treated onsite in some cases and offsite in others through incineration. They also confirm the risk associated with untreated waste.

"As for this hospital, we have the incinerator, so we don't treat it. We take it there for it to be burnt, which is the general and infectious waste. A car picks [up] the general waste to discard it (FGD3, TGH).

"It's done with a machine. It's around the old hospital; they have a place where they burn the waste using a machine. They even reopen one here" (FGD1, SODH).

They also shared how these actions are unhealthy for the environment and the health of those who live near where these wastes are disposed of.

"it can bring diseases; you know this waste contains blood and other infectious waste, so it's been carried untreated throughout the town. It can cause disease even from inhaling the smell of it." (FGD3, TGH).

Bin cleaning

The waste handlers provided insights into the practices employed in cleaning healthcare waste bins to mitigate the risk of infections. They emphasized that cleaning these bins constitutes a significant aspect of their responsibilities as waste handlers. They provided specific details

regarding the frequency and duration of bin washing and cleaning, as outlined below:

"We do that every weekend, even if I am not the one on duty. The person washes the bin every weekend and holidays because those days aren't busy" (FGD3, TGH).

Waste handlers from FGD1 indicated that the bin is only washed when stained, as they narrated.

"in case after removing the rubber out of the bin and the container is stained, we take a dust bin and wash; if you take the rubber out and you find out that the bean is dirty, then you wash it, so if you see that is dirty every day then you will have to wash the bin every day" (FGD1, SODH).

Waste handlers also shared processes by which the bin cleaning is done and the detergents used.

"We wash the dust bins with liquid soap while using the mob to clean inside, then you rinse it about 3 times, and the bin will be cleaned, then bend it to dry well. When it dries, then you put the rubber inside then return it to the place for use" (FGD1, SODH).

"I wash them with bleach and then leave it to dry in the sun before I use it to line the dustbin" (FGD3, TGH).

Theme B: occupational health or risk associated with healthcare waste management

This theme emerged from three sub-themes: the subject of the route of exposure, needle prick, and vaccination. This theme aims to assess the various routes of exposure to hazards from the handling of solid infectious waste, evaluate the management of needle pricks in hospitals, and the frequency of screening or vaccination of the Waste handlers against infectious illnesses, specifically Hepatitis A, B, and C. These diseases pose a significant risk to Waste handlers due to the inherent nature of their occupation. Waste handlers share some of the risks associated with their field of work.

Route of exposure

Waste handlers shared how they are exposed to healthcare waste in their line of duty within the health facility. From the discussion, the most common routes of exposure indicated were skin and eye contact through splashes. They also indicated the effects of this exposure on their health and the immediate actions they take upon exposure. The participants' responses are indicated below; *"yes, water can splash to my legs, but we*

were warned to wear socks while working. When I come into contact with blood, I will wash it. I first wash it with water. After that, I will add soap to wash it away, then dry the place with a dry towel" (FDG1, SODH).

The complaint from the participants about the materials they use and its effect on their health is described as:

"The chemical (bleach) I used for scrubbing the washroom is very strong, so one day when I used it affected my eyes, which got me tearing the whole day" (FGD3, TGH).

Needle pricks

Waste handlers shared their experiences with needle prick injuries and the various measures they adopted when the event happened. They indicated that anytime they have needle prick injuries, they wash the site under running water and finally make an official complaint to the in charge for clinical actions to be taken. Some of their responses are captured below,

"If you have a needle prick injury, you just wash it under running water and then make a complaint to the in-charge where you will be sent to the public health unit for an injection, which is for free" (FGD 4, KBTH A&E).

"The incident happened on Saturday, so on Monday, I reported the case to my boss, who directed me to the public health unit. They gave me a form, which I brought for them to fill out. Then, I went to run some lab tests to see whether the needle had infected me with any disease. After, by the grace of God, when the results came, the doctors said I was fine, and there was nothing to worry about" (FGD 2, KBPC).

Waste Handlers express that the absence of hospital waste segregation poses a significant challenge within the hospital setting, rendering them vulnerable to infection during their duties as hospital cleaners. The type of infections or incident associated with this issue and how severe the problem is is explained in ensuing quote from one of the participants as.

"I even encountered some this morning, which I found a used syringe in a locker. They leave it everywhere, and we have spoken about it for a long time. Sometimes, when you are cleaning the bed, there will be a syringe on it, and sometimes you will open lockers, and there will be a used string in them" (FGD 2, KBPC).

"The nurses just dropped the needle into the dust bin after using it, so when I was removing the rubbish from the dust bin, I got scratched by the needle.

When it happened like that, I applied bleach, and then later I applied spirit to it" (FGD 2, KBPC).

Vaccination

During the discussions, the level of knowledge among waste handlers regarding available vaccinations against infections was examined. The participants intimated that the hospital have not vaccinated them against infectious diseases apart from COVID-19. They provided reasons for not getting vaccinated, citing financial constraints and insufficient salary to cover the cost of the vaccines. Consequently, most waste handlers work without protection against infections such as Hepatitis A, B, and C.

"At times, between two to three months, they will call all of us to come for the screening, then they will inject us. I learnt it is every four months, but it is not continuous. We will be there, and then we will be called to come and screen. Yellow fever is normally treated in the public health unit. If you want to do it, you will pay 80cedis, but hepatitis B is free, and Covid-19 too is free." (FGD 4, KBTH A&E).

"No. It is only COVID-19 that we have been vaccinated against. Apart from that, hepatitis B, even with that one, I used my own money. It's been three years since I started working here. The only vaccination I have had is the COVID vaccination. It's God who is protecting me" (FGD 2, KBPC).

"... about the vaccines, when we go to take them, they say it's not free, and the amount we are paid isn't enough for us to use some for vaccination; we have children and families to care for, and this work requires a lot of energy. You have to be satisfied before you can work, but since our money isn't enough, we can't even eat well, and we have been complaining about our pay, and nothing has been done about it, so we are pleading that something should be done about our money" (FDG1, SODH).

Theme C: challenges associated with healthcare waste management

Participants observed that the organization's attitude towards HCWM needed to be improved due to the absence of work protocols. These challenges were sub-themes such as logistic-related, infectious waste disposal challenges, patient-related challenges, sharp waste disposal, and motivation.

Waste disposal challenges

Hospital Waste handlers discussed how the bins can remain full for days without emptying, which deters

them. They said that this practice raises the risk of diseases within the hospital and exposes it to possible visitors who may come into contact with hospital waste.

"Sometimes, when the dust bin is full, the trucks responsible for emptying the waste arrive late to pick up the rubbish. This delay encourages unauthorized persons to access the storage bins to pick up materials" (FGD 2, KBPC).

Logistic related challenges

Healthcare Waste Handlers also expressed that most challenges are associated with inadequate logistics, such as the absence of colour-coded bags in the respective bins, failure to provide Personal Protective Equipment, and inadequate supply of disinfectants/soap. Therefore, these practices are considered significant factors contributing to inadequate hospital-based healthcare waste management (HCWM).

"Inside the theatre, the work we do is blood work, so we are supposed to use utility gloves but no utility gloves, so we normally use surgical gloves. We put on two or double because our work is blood. When they finish the cases, then we will remove all the blood stains inside the gowns. So, our work is risky, but we don't have utility gloves to work with it. We don't have the materials for the work so we are always complaining. Can you believe that the whole week they can give us five bin liners to use for the whole week? So, we are suffering here, so when you people come here, try and help us" (FGD 4, KBTH A&E).

"Again, Sometimes, the equipment that we are supposed to use to work is difficult to access, and even getting detergents to work is very difficult, so we have to mix liquid soap with water and use it as a detergent for cleaning without any para zone [disinfectant] so please try and do something about it for us" (FGD 2, KBPC).

"..... Also, the apron given to us did not help us; they gave us the rubber apron, but we wanted something heavy. It's very light and can't really cover us; it can easily fly away when the wind blows. The scrubs that are given to us aren't enough when you come fresh, and they give you two, that's all, and now the scrubs alone are expensive its 70 to 120cedis (4–8 US Dollars) which we have to buy ourselves, so we want them to supply it to us" (FDG1, SODH).

"Sometimes, when you don't have logistics and you ask the in-charges, they will insult you. So, we have managed and done the work like that by finding

ways and means to do the work.

Then we must buy washing powder (Omo) and add it to the water to clean it with any bleach or chemicals. We know that bleach, even if you mob 100 times, is still ineffective, so after cleaning, the place will still look unclean, and then they will blame the cleaners. Sometimes, we cut carbolic soap into smaller pieces and use them to clean. We don't have masks, and if you ask your In-charge, they will also ask if stores didn't give you, so you have to use your money to buy masks. If not, you will have to work without a mask, which is not good. As we say now, my mob bucket is broken, and when I asked for a new one, they couldn't get me one, and they are not willing to give me money to go and buy a new one too, so I now have to leave the bucket outside and mob without it. This is a very big challenge for us" (FGD3, TGH).

Waste segregation-related challenges

Hospital Waste Handlers face difficulties when patients and staff mix up segregated waste, compelling them to retrieve it and store it in the appropriate bins. They also share the mixture of waste that may impact outsiders after it has been disposed of in the refused dump, as other people go to the refused dump to search for items.

"Okay, the nurses are supposed to segregate the waste, but sometimes, before you realize it, they put general waste into infectious waste containers or vice versa. So that's one of the challenges we encounter, and sometimes, too, they don't segregate the waste well." (FDG1, SODH).

"Sometimes even with the general waste, there could be a needle in it so if they dump it on the refuse dump and maybe those children who search for things, the needle can hurt these children and he or she will become sick" (FGD 4, KBTH A&E).

"Sometimes, when patients come to the hospital and feel like vomiting, they vomit into rubber and then dump it into the dust bin in the wards, and the nurses' put gloves and other waste in the general waste bin. Same as when the patients eat soupy foods; they drop the liquid waste into the dust bin instead of the gutter. So, when you are going to pick that waste, you wouldn't know it contains that, so it can splash on you" (FGD 2, KBPC).

Sharp waste disposal

Waste handlers thoroughly discussed the difficulties surrounding needle stick injuries, inappropriate sharps

disposal, and the necessity of establishing protocols for safety measures both before and during injection administration. Among the concerns raised were that sharps are kept in the dustbin rather than in a sharps box. Waste handlers stated that picking up the waste is when they sustain injuries more regularly. They explained how taking such action leads to problems with occupational health. Sharps disposal on the floor was brought up as another concern.

"One of our challenges is that sometimes when the Nurses are done using the syringes, they put them into the dust bin instead of the sharp box. So, sometimes, when we are going to empty the dustbin, we come into contact with these things, and then they scratch us. Again, the syringes that are being dumped into the dustbin are very risky for us. I work at the ward. The issue of this syringe is rampant in various health centres. I would also like to address the syringe issue because it is very risky. You can even find some on the sinks." (FGD 2, KBPC).

"So, for the sharp box, I wear my gloves (Surgical gloves) and my nose mask so I pick the box and then put it in a black rubber and tie it then I take it to where we discard it" (FGD3, TGH).

Discussion

This study aimed to assess the knowledge and practices of waste handlers involved in solid healthcare waste management in selected health facilities in Accra, Ghana. Findings from the present study revealed an overall moderate knowledge of healthcare waste management practices among waste handlers in the selected hospitals, as some of the waste handlers from TGH could not identify all the various categories of waste with their corresponding national colours of bins and liners. This is consistent with a study conducted in India, which reported that participants exhibited knowledge of four-colour and three-colour bin codes in the hospital. However, some respondents incorrectly identified the bags as a different colour [29]. Also, our finding is consistent with a study conducted in Ethiopia indicating that merely half of the healthcare waste handlers were unable to successfully segregate healthcare waste in the various coloured bins. Furthermore, the finding corroborates that healthcare waste segregation procedures were inadequate [30]. The similarities in the findings imply that waste handlers are not adequately trained and monitored in the discharge of their duties. This laxity can be attributed to logistical bankruptcy in most healthcare facilities in Ghana, which rubs off badly on the knowledge of waste handlers in waste categorization and corresponding national liners.

Our findings also showed that healthcare professionals and patients, particularly at SODH and TGH, do not separate their waste, which puts them at risk as they are 'forced' to segregate and store in the right bins, especially with sharp waste. This corresponds with a case study at the Ho teaching hospital which reveals that waste segregation at source and the use of colour-coded waste receptacles were not strictly followed by healthcare professional and patients [8]. Irrespective of the final waste treatment and disposal method, it is imperative to segregate waste streams to safeguard human health and the environment [31]. Irrespective of waste handlers' years of experience (Table 1), often, they are hampered in the discharge of their duties by logistical inadequacy due to poor procurement decisions by most healthcare facilities. Regulatory agencies' negligence emboldens this challenge because healthcare facilities are state-owned. To correct this anomaly, it is binding on the Ghana Health Service and Health Facilities and Regulatory Agency to heighten monitoring and apply sanctions without favour.

We also found that waste handlers in KBTH and SODH experienced needle pricks which are associated with diseases, such as HIV, Hepatitis B, and C [32]. The incidence of needle pricks and lack of HBV vaccination was prevalent as most waste handlers in KBTH and SODH were not vaccinated. However, waste handlers outlined various post-exposure prophylaxis measures which is consistent with the national policy and guidelines of infection prevention and control [33]. Further, our findings agree with a case study done in Ho Teaching Hospital, which shows about 77% of waste handlers always sustained sharp injuries [8]. Studies have also shown a high prevalence of hepatitis B virus among healthcare workers more than other healthcare professionals [34, 35]. The similarities in the findings underscore the need for hospital administrators to prioritize the safety of waste handlers by vaccinating them against infections. Stated differently, the work done by waste handlers are not appreciated enough to allocate funds to vaccinate them against infectious diseases. Even though their low level of education (Table 1) could explain why they do not appreciate the post-exposure prophylaxis protocols, their role in disease containment should guarantee intermittent vaccinations. Furthermore, working without the required logistics, is a swift route to being infected, therefore, the provision of PPE, will provide adequate protection for waste handlers. It is imperative for the Ministry of Health to ensure compliance by enforcing punishment.

The study findings revealed that due to a shortage of logistics and how uncomfortable the PPE can be, most of the waste handlers from all the hospitals failed to wear them to work. This agrees with a study conducted

in the United Kingdom, where most waste handlers do not wear the appropriate gloves for handling waste because certain types of ballistic gloves are uncomfortable when used for extended periods and have been associated with interdigital skin abrasions due to elevated internal stitching [36]. The lack of PPE and its use thereof, exposed waste handlers, particularly in TGH and SODH, to frequent splashes of contaminated droplets on the legs and the chest during the work. This agrees with a study [36], where all waste handlers reported frequent splash or droplet contamination while handling waste sacks. Chest, arms, and legs were the common sites for splash contamination. Also, our finding resonates with a case study conducted in Ghana where only 11% of the waste handlers were always completely dressed in PPE [8]. It is essential to note that harmful and infectious diseases can spread through infectious waste, therefore, the use of PPE should be monitored continuously in the discharge of their duties in the hospital. Sadly, the significance of waste management in the spread of diseases is relegated in most hospitals. It is important for the waste Handlers Association of Ghana to demand for the provision of PPE and other logistics for their members to protect them against infections.

We found that waste management in all the hospitals is confronted with several challenges which include disposal, sharp waste disposal and waste segregation (see Table 2). We found that hospital waste is kept in the hospitals for hours before being disposed of at TGH and SODH. This concurs with a study in Tanzania waste is kept long and breed infection in the hospital, putting both the patients and professionals at risk of hospital-acquired infections [37]. Sharps injuries among waste handlers are deemed excessively elevated due to the lack of logistics including coloured bin liners, waste bins, safety boots and hand gloves. This corroborates that inadequate handling of hospital waste can result in significant occupational, environmental, and public health risks for hospital staff, patients, and communities globally [12]. The similarities in the findings highlights the importance attached to waste management practices in Ghana and beyond. It is possible that hospital administrators do not understand harmful composition of medical waste and its antecedent health risks. The poor understanding or lack of knowledge on the part of hospital administrators could account for the neglect. Apart from the public health implications of the challenges experienced by the waste handlers, there is the risk antimicrobial resistance. An effective monitoring system and the provision of logistics in a timely manner will thwart these challenges and make the hospital safe for patients, workers and health professionals.

Methodological validity and limitation

The study's utilization of a descriptive phenomenology study design was one of its strengths. This method allows the waste handlers to share their experiences enabling an in-depth examination of their knowledge and behaviours in line with the goals of the study. Furthermore, the findings were guaranteed to be representative of waste handlers in the Greater Accra region and can be generalized to facilities in the region. The utilization of three-level sampling approach is one of the studies strength. For example, the facility-level sample method, which involved the selection of waste handlers from all three levels of care, made sure that tertiary, secondary, and primary healthcare settings were included, representing the many strata within the Ghanaian health system. Each facility's departmental/unit-level sample, which focused on both high-risk and low-risk departments based on the possibility of coming into contact with blood or bodily fluids, increased the validity of the results. Additionally, the administration of the focus group discussion guide reinforced the legitimacy of the data collection method. The focus group discussions were carried out in a controlled setting, which encouraged candid and open communication among participants. Participants were arranged in a circle, local language translations were used, and two facilitators; one facilitating the conversation and the other taking thorough field notes ensured that the conversations were not only thorough but also accurately recorded. By rewording questions and using probing tactics, it was possible to gain a deeper knowledge of the participants' experiences while minimizing misunderstandings.

Despite these strengths, there were still limitations. The smaller facilities at the community level were not considered so the study cannot be generalized for primary facilities smaller than district hospitals. These facilities were scattered in the communities and due to financial constraints, the research could not include them. Due to the small number of sample size for the departments in the primary and secondary facilities (Shai-Osudoku and Tema General Hospitals), the participants were put together during the FGD even though responses were captured on department specific.

Conclusions

This study revealed how waste handlers' knowledge and practices significantly influence the overall effectiveness of solid healthcare waste management. However, a lack of logistics and poor knowledge and practices on safe healthcare waste management predispose waste handlers to infections. Our study highlights the hazardous nature of the work of waste handlers who need to be vaccinated and provided with the required logistics to keep them

safe. Hospital administrators must make vaccinations against hepatitis A, B, and C free and compulsory for waste handlers. It is recommended that regular training programs be organized for waste handlers to emphasize the importance of proper waste disposal and adherence to safety protocols. Health managers should develop plans to conduct quarterly evaluations of waste handlers' work practices across healthcare facilities. These will reveal existing gaps for urgent redress. Additionally, future studies should assess the health and safety concerns among waste handlers.

Abbreviations

A&E	Accident and Emergency
FGDs	Focus Group Discussions
FGDG	Focused Group Discussion Guide
HBV	Hepatitis B Virus
HCWs	Healthcare Workers
HCWM	Healthcare Waste Management
HIV	Human Immune Virus
IPC	Infection Prevention and Control
KBPC	Korle Bu Polyclinic
KBTH	Korle Bu Teaching Hospital
OPD	Out-Patient Departments
PPE	Personal protective equipment
SODH	Shai Osu-duke Hospital
TGH	Tema General Hospital
TPB	Theory of Planned Behavior
WHO	World Health Organization

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12889-025-21874-6>.

Supplementary Material 1.

Acknowledgements

We thank all study participants and participating healthcare facilities.

Authors' contributions

RQ and MA: Conceptualization, Methodology, Visualization, and supervision, MA.: Formal analysis and wrote manuscript, EAU, FOK, PT, PKB, EA, TA, EKP, HYA and GB: Resources, RQ and MA: Data curation, MA: Writing-original draft, EAU, FOK, PT, PKB, EA, TA, EKP, HYA and GB: Writing review and editing. All authors contributed to manuscript revision, read and approved for submission.

Funding

The West African Health Organization funded MA. The funding bodies had no role in the study's design, data collection, analysis, interpretation, or manuscript writing.

Data availability

Data can access from the first author and corresponding author upon request.

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki. Participants received oral and written information about the study. Informed consent was obtained from all study participants, and they were given the opportunity to withdraw from the study at any time. The identity of participants was deleted in the dataset used for the analysis and the data was analyzed by an independent researcher who did not take part in the data collection. The study received approval from the Ghana Health Service

Ethics Review Committee (GHS-ERC) (GHS-ERC: 0233/06/22) and the Korle-Bu Teaching Hospital-Scientific and Technical Committee (KBTH-STC) (KBTH-STC 00065/2022).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Received: 23 September 2024 Accepted: 10 February 2025

Published online: 20 February 2025

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