Healthcare Waste Segregation and Containerisation Practice among Nursing and Midwifery Students of Knust: A Cross-Sectional Study

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ABSTRACT

Background: Healthcare waste (HCW) generated in healthcare facilities poses significant public health risks if not properly managed. Effective waste treatment depends largely on proper segregation and containerisation. This study assessed the knowledge, attitudes, and practices of nursing and midwifery students at KNUST regarding HCW segregation and containerisation, and identified factors associated with improper practices.

Methods: A cross-sectional study was conducted among 270 nursing and midwifery students from the Department of Nursing, KNUST, comprising 90 second-year, 90 third-year, and 90 final-year students with clinical exposure. Data were collected using a structured questionnaire and analysed descriptively using SPSS.

Results: Overall, 56.3% of participants were aware of the different categories of HCW, but only 35.9% demonstrated correct segregation practice at source of waste generation. The proportion of respondents who disagreed with the statement that healthcare waste (HCW) segregation is not the responsibility of nurses increased progressively across academic years. Disagreement rose from 53.3% among second-year students to 66.7% among third-year students and 77.8% among fourth-year students. While students generally exhibited a positive attitude towards HCW segregation, only 30.7% reported regularly adhering to the correct colour coding during practice.

Conclusion: The study revealed generally low levels of knowledge and practice of HCW segregation and containerisation among nursing and midwifery students across all year groups, despite their positive attitudes. Continuous education and reinforcement of proper HCW management practices are recommended to improve compliance and reduce public health risks.

INTRODUCTION

Everyday human activities generate unwanted or used materials that are no longer of value and are therefore discarded; these are collectively referred to as waste (United Nations Environment Programme [UNEP], n.d.). Similarly, healthcare waste refers to materials produced within healthcare settings that have no immediate value and must be disposed of. The World Health Organization (WHO, 2014) defines healthcare waste as all waste generated by healthcare facilities, research centers, and laboratories related to medical procedures. This also includes waste produced from minor or decentralized sources, such as home-based care activities (e.g., selfadministration of insulin, home dialysis, or recuperative care) conducted within homes, communities, or health centers (WHO, 2014).

Healthcare waste is broadly classified into two categories: general (non-hazardous) waste and special (hazardous) waste. General waste poses no significant risk of infection and constitutes approximately 85% of healthcare-generated waste. Examples include packaging materials, bedding, and office supplies (Pépin et al.,

2014). In contrast, special or hazardous waste accounts for about 15% of healthcare waste and poses serious risks of infection and injury to healthcare providers, patients, and the community. This category includes sharps, body fluids or items contaminated with them, radioactive materials, infectious and pathological waste, chemical waste, and pharmaceutical waste (Pépin et al., 2014).

According to WHO (2014), low-income countries generate an average of 0.2 kg of healthcare waste per hospital bed per day. However, a study in Ghana reported a higher average of 1.2 kg per bed per day (Asante et al., 2014). Proper segregation of these wastes into appropriately color-coded containers is essential for safe disposal and treatment, thereby minimizing negative environmental and public health impacts. The healthcare waste management (HCWM) process involves several key stages: generation, segregation and containerization, storage, collection and transportation, treatment, and final disposal (MOH, Ghana, 2006; WHO, 2014). Among these, healthcare providers particularly nurses play a critical role in the initial stages of generation, segregation, and containerization, which are considered the most crucial steps in effective waste management. The Ministry of Health in Ghana (MOH, 2006) recommends a color-coding scheme comprising a bin with a yellow liner for infectious waste, a black liner for general waste, a brown liner for pharmaceutical waste, and a safety box for sharps. Failure to adhere to this system can result in contamination, converting 85% of non-hazardous waste into hazardous material and posing significant risks to both the environment and public health (Asante et al., 2013).

Despite global initiatives such as WHO and UNICEF training modules on best practices for healthcare waste management (WHO & UNICEF, 2015), evidence suggests that significant gaps persist in waste segregation and containerization. Mochungong, Gulis, and Sodemann (2010) found that many healthcare workers lack adequate awareness of the environmental and public health consequences of improper waste disposal and are often unfamiliar with policies governing safe clinical waste management. Furthermore, hazardous exposures occur through scavenging at disposal sites and manual sorting of healthcare waste, practices that remain prevalent in many low- and middle-income countries (WHO, 2018).

Several factors contribute to these poor practices, including inadequate facility systems, lack of motivation, and insufficient institutional support (Asante et al., 2013; Akulume & Kiwanuka, 2016). The absence of proper waste management systems, limited awareness of biomedical waste hazards, inadequate financial and human resources, and weak regulatory enforcement are among the most pressing challenges associated with healthcare waste (Mathur et al., 2011). Moreover, many waste management personnel lack formal training in waste handling techniques, and hospital administrations often pay insufficient attention to proper management of healthcare waste (Kuchibanda & Mayo, 2015).

In light of these challenges, the present study seeks to assess the knowledge, attitudes, and practices of nursing and midwifery students regarding healthcare waste segregation, as well as the factors contributing to improper segregation. The findings aim to provide insights into existing gaps in knowledge and practices related to healthcare waste management, thereby informing strategies for improvement.

METHODS

Study design and setting

A descriptive cross-sectional study was conducted among nursing and midwifery students of KNUST during the 2018/2019 academic year. The Department of Nursing, located within the Faculty of Allied Health Sciences, trains students in general nursing, emergency nursing, and midwifery.

Study population and sampling

The target population comprised 822 students (583 nursing and 239 midwifery students). Inclusion criteria were second, third, and fourth-year students with prior clinical exposure. Using Slovin's formula at a 95% confidence interval, a sample size of 270 students was selected using quota sampling, ensuring equal representation across year groups (90 students each year group).

$$n = \frac{N}{1+N(e)_2}$$

Data collection procedure and instrument

A structured, self-administered questionnaire with 39 closed-ended items was distributed in classrooms to willing participants. The questionnaire assessed demographic information and KAP toward HCW segregation and containerisation. The medium of data collection was English.

Data analysis

Data were entered and analysed using SPSS version 20. Descriptive statistics (frequencies and percentages) were generated and results presented in tables.

Ethical consideration

Ethical clearance was obtained from the Committee on Human Research, Publications and Ethics (CHRPE) of KNUST. Permission was granted by the Department of Nursing. Participation was voluntary, and confidentiality was assured.

RESULTS

The total number of respondents was 270 across the second, third and fourth year.

Demographic features

The gender distribution of respondents indicated that female students constituted the majority at 80.4%, while male students accounted for 19.6%. With respect to the program of study, 51.9% of participants were enrolled in the BSc Nursing program, 44.4% in the BSc Midwifery program, and 3.7% in the BSc Emergency Nursing program. Additionally, the age distribution showed that 82.6% of the respondents were within the 19–24 year age bracket (Table 1).

Table 1: Demographic characteristics of Participants

Variables		Number of participants	Percentage (%)
Gender	Male	53	19.6
	Female	217	80.4
Age	Less than 19 years	4	1.5
	19-24 years	223	82.6
	25-30 years	24	8.9
	31-35 years	19	7.0
Level	200	90	33.3
	300	90	33.3
	400	90	33.3
Program	BSc. Nursing	120	44.4
	BSc. Midwifery	140	51.9
	Emergency Nursing	10	3.7
Marital status	Single	246	91.1
	Married	24	8.9

Knowledge on healthcare waste segregation and containerisation

An average of 56.3% of participants reported being aware of the WHO healthcare waste categories. Knowledge of the colour-coding system was highest among fourth-year participants (87.8%), followed by third-year (43.3%) and second-year students (37.8%) (Table 2).

Table 2: awareness of healthcare waste (HCW) colour codes

Variables	Year 2 (%)	Year 3(%)	Year 4 (%)	Total (average) (%)
Aware of colour coding for HCW	37.8	43.3	87.8	56.3
Aware HCW should be separated into different categories at source	66.7	72.2	93.3	77.4

Attitude toward healthcare waste segregation and containerization

The findings on participants' attitudes indicate strong agreement that healthcare waste (HCW) should be segregated at the point of generation. Specifically, 85.6% of second-year, 97.8% of third-year, and 95.6% of fourth-year respondents affirmed the importance of source segregation.

With respect to the perception that HCW segregation constitutes an additional burden for nurses, 50.0% of second-year, 44.4% of third-year, and 54.4% of fourth-year students disagreed, suggesting that a substantial proportion did not view segregation as an undue workload.

A progressive increase was observed in the proportion of respondents who disagreed with the assertion that HCW segregation is not the responsibility of nurses. Disagreement rose from 53.3% among second-year students to 66.7% among third-year students and 77.8% among fourth-year students, indicating growing acceptance of the professional responsibility for HCW management as students advanced in their training (Table 3).

Table 3: Attitude toward healthcare waste segregation and containerization

Attitude toward HCW segregation and containerisation.	Respondents n %								
	Year 2			Year 3			Year 4		
	A	N	D	A	N	D	A	N	D
Should HCW be segregated at source?	**85.6**	13.3	1.1	**97.8**	2.2	0	**95.6**	4.4	0
Waste segregation is a team work.	**74.4**	24.4	1.1	**92.2**	7.8	0	**91.1**	5.6	3.3
Labelling container is of any significance.	**92.2**	5.6	2.2	**96.7**	1.1	2.2	**92.2**	4.4	3.3
HCW segregation is an extra burden to the nurse.	18.9	31.1	**50**	32.2	23.3	**44.4**	25.6	20.0	**54.4**
HCW segregation is not the nurse's responsibility.	17.8	29.1	**53**	13.3	20.0	**66.7**	12.2	10.0	**77.8**
The Nursing department, KNUST should organise class on HCWM.	**70.0**	25.6	4.4	**85.6**	10.0	4.4	**70.0**	21.1	8.9

*A-Agree, N-Neutral D-Disagree

Practice of healthcare waste segregation and containerization

Only 30.7% of the participants consistently adhered to the color-coding guidelines during practice sessions (Table 4).

Table 4: Practice of healthcare waste segregation and containerization

Variables	Year 2 (%)	Year 3 (%)	Year 4 (%)	Total (average)
Regularly follow colour coding for HCW	21.1	24.4	46.7	30.7
Segregate into different categories at source	23.3	30.0	54.4	35.9
Recap needles after use	37.8	34.4	33.3	35.2

Factors that contribute to improper segregation and containerization

A total of 38.9% of respondents reported that healthcare waste is improperly segregated, while an additional 44.8% indicated that improper segregation occurs occasionally. The most significant contributing factor

identified was inadequate knowledge of the color-coding system for waste bins, followed by a complete lack of awareness regarding the prescribed colour codes.

DISCUSSION

With the aim of assessing and comparing the knowledge, attitude, and practice of students regarding healthcare waste (HCW) segregation and containerization, the findings of this study revealed a level of awareness of WHO color-coding protocols that was lower than that reported by Amin et al. (2018). Similarly, Mathur et al. (2011) documented low knowledge levels among healthcare staff, consistent with the present study. Students' responses concerning correct color-coding procedures were also suboptimal, a trend likewise observed by Uddin et al. (2014). One possible explanation for this pattern may be the limited coverage of healthcare waste management (HCWM) in the nursing curriculum. Inadequate opportunities for continuing education and insufficient reinforcement by clinical staff at practice sites may further contribute to this outcome.

In contrast to the findings of Deress et al. (2018), the present study demonstrated a predominantly positive and favourable attitude among participants. Approximately 93% agreed that HCW should be segregated at the point of generation, and a high proportion acknowledged that HCW segregation is a collective responsibility, with only a few considering it an additional burden. These attitudes may be influenced by participants' awareness of the implications of improper segregation. Consistent with Shivali et al. (2014), the majority expressed the need for refresher training while on clinical rotation.

Regarding practice, 30.7% of participants reported regular segregation of HCW, which is comparable to the findings of Muluken et al. (2013). This may be linked to the fact that a significant proportion of students in the present study had not yet received formal instruction on HCWM within their nursing curriculum. In contrast, a higher level of practice was documented by Deress et al. (2018), potentially attributable to differences in educational level, work experience, prior training, and the availability of biomedical waste management (BMWM) guidelines in their clinical environment. Poor practice in the current study may also reflect inadequate implementation and reinforcement of HCWM protocols by nursing administrators.

Furthermore, inadequate knowledge emerged as the most common factor contributing to improper segregation, aligning with the findings of Gitonga (2017), who attributed this issue to insufficient training and lack of awareness. A similar observation was reported by Njagi et al. (2012), where the absence of HCWM content in the curriculum was identified as a key barrier. Collectively, these findings suggest that delayed or insufficient integration of HCWM, climate change and sustainability courses within nursing education may contribute to persistent knowledge and practice gaps (Yeboah et al., 2023; Yeboah et al., 2024).

LIMITATIONS

A primary limitation of this study is that participant selection was based on convenience sampling, as individuals were recruited according to their availability at the research sites rather than through a randomized selection process. This may limit the generalizability of the findings.

RECOMMENDATION

This study has significant implications for nursing education, clinical practice, administration, and future research. The current timing of course delivery within the nursing curriculum appears suboptimal, as the topic is taught in the second semester of the third year, whereas students commence clinical practice as early as the long vacation following the second semester of the first year. It is therefore recommended that nursing education programs reconsider the structure and sequencing of the curriculum, ensuring that essential content related to the study topic is delivered prior to students' initial clinical placements. Additionally, nursing administrators should prioritize the implementation and reinforcement of the study topic within clinical settings to support students' learning and adherence to best practices. Nursing services should also place greater emphasis on healthcare waste (HCW) segregation to promote safe, effective, and high-quality nursing and midwifery care. Future research is warranted to further examine HCW segregation practices among students, nurses, midwives,

and other healthcare professionals, with the aim of enhancing care quality and safeguarding the public from the adverse consequences associated with improper HCW management.

CONCLUSION

The findings of the study indicate that students' overall knowledge and practical adherence to healthcare waste (HCW) segregation and containerisation were generally low across all year groups (second to fourth year). Despite this, students consistently demonstrated a positive attitude toward HCW segregation. Notably, secondyear students exhibited the lowest levels of knowledge and practice, which may be attributed to their limited exposure to, and familiarity with, the subject matter.

A substantial proportion of students reported not engaging in proper HCW segregation. This underscores the need for strengthened educational interventions and continuous reinforcement to enhance compliance with recommended HCW segregation and containerisation practices.

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Conflict of Interest

No competing interest among authors

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