Journal of Health Science and Medical Therapy
E-ISSN 3024-8132 P-ISSN 3024-8116
Volume 3 Issue 03, September 2025, Pp. 218-233
DOI: https://doi.org/10.59653/jhsmt.v3i03.1737

Assessment of Knowledge and Attitudes toward Medical Waste Segregation among Nursing Students: A Case Study at Univerity in Vietnam

Tran Thi Thu Trang[1], Dang Vu Ha[2*]
Thanh Do University, Vietnam[1]
Thanh Do University, Vietnam[2]
Corresponding Email: dvha@thanhdouni.edu.vn*

Received: 01-06-2025 *Reviewed: 01-07-2025* *Accepted: 15-08-2025*

Abstract

Medical waste management is a critical component in safeguarding public health and environmental sustainability. It is also an essential factor in ensuring effective and safe operations at healthcare facilities, requiring a well-trained and competent workforce. This study aims to assess the current level of knowledge and attitudes of final-year nursing students at Nam Dinh University of Nursing, Vietnam, regarding medical waste segregation. A cross-sectional survey was conducted among 240 final-year nursing students. Data were collected using a self-administered questionnaire comprising three sections: personal demographic information, knowledge of medical waste segregation, and attitudes toward the practice. Descriptive statistics and inferential analyses, including t-tests and chi-square tests, were used to explore associations between knowledge and attitudes and factors such as gender, academic performance, and self-study habits. **Results:** Only 41.3% of students demonstrated adequate knowledge regarding medical waste segregation, and up to 65% exhibited negative or non-positive attitudes toward the issue. Academic performance and self-directed learning habits were significantly associated with both knowledge and attitudes. Students with higher academic achievement and regular self-study routines tended to have better knowledge and more positive attitudes. The findings reveal that both knowledge and attitudes toward medical waste segregation among nursing students at Nam Dinh University of Nursing remain limited. Enhancing the nursing curriculum, raising awareness, and providing specialized training sessions on medical waste management are essential steps to strengthen public health protection efforts.

Keywords: Knowledge, Attitude, Nursing Students, Medical Waste Segregation, Medical Waste Management, Nursing

Introduction

Medical waste management (MWM) plays an extremely important role in protecting public health and preserving the environment, particularly within healthcare facilities where large quantities of waste are generated daily (Meleko et al., 2018). This waste may include sharps, biomedical waste, hazardous chemicals, pharmaceuticals, and used medical products. If medical waste is not properly segregated and treated, it can pose numerous serious risks to both public health and the environment (Meleko et al., 2018) (Shikoska et al., 2016). In addition, medical waste management directly affects operational costs, occupational safety, and regulatory compliance in healthcare institutions. Therefore, proper segregation and treatment of medical waste not only helps minimize health risks, but also contributes to environmental protection by preventing pollution and the spread of infectious diseases (Akkajit & Sukkuea, 2024; Windfeld & Brooks, 2015). Although medical waste management has received increasing attention in many studies and training programs within healthcare settings, research on the knowledge and attitudes of nursing students in Vietnam regarding this issue remains limited.

Nam Dinh University of Nursing is one of the leading institutions for nursing education in Vietnam, providing a high-quality healthcare workforce that is well-prepared to meet the demands of the medical sector. The university has firmly established its reputation for producing competent professionals, particularly in the field of nursing, thereby making a significant contribution to public health care in Vietnam. At Nam Dinh University of Nursing, final-year students are those who are about to enter the professional nursing workforce and will be directly involved in patient care and the management of medical waste in hospitals. However, to date, no studies have been conducted to assess the current status of students' knowledge and attitudes toward medical waste segregation—a critical issue in healthcare service delivery. The absence of research creates a gap in assessing the preparedness of future healthcare personnel and the effectiveness of the university's nursing education and workforce development programs.

This study was conducted to assess the knowledge and attitudes of final-year nursing students at Nam Dinh University of Nursing regarding medical waste segregation. The results are expected to provide essential insights for enhancing educational and training activities, improving student awareness and competencies, and ultimately strengthening workforce quality, healthcare facility management, and public health protection.

Literature Review

Medical waste management (MWM) is a critical issue in healthcare facilities, as it affects not only public health but also the environment. Medical waste includes both hazardous and non-hazardous types, generated during diagnostic, therapeutic, and other healthcare-related activities (Kumar & Padmaja, 2017). Proper segregation and treatment of medical waste are essential to protecting public health and minimizing environmental pollution. A study by Ferreira and colleagues (2024) indicated that healthcare workers, particularly nurses, are aware of the importance of medical waste management. However, they still lack in-depth knowledge

on the subject, which directly impacts their waste segregation practices in hospital settings (Ferreira et al., 2024). Studies conducted in India have also revealed that only a small proportion of nursing students possess comprehensive knowledge of medical waste management, although the majority exhibit a positive attitude toward the issue (Siddharudha Shivalli & Vasudha Sanklapur, 2014). A study by Srinivasa Kumar (2017) indicated that third-year nursing students demonstrated higher levels of knowledge and more positive attitudes toward medical waste management compared to first- and second-year students. However, despite improvements in knowledge and attitudes, the rate of correct practical implementation remained low, particularly in real-world clinical settings (Kumar & Padmaja, 2017). In India, research conducted by Gursangeet Sidhu (2016) showed that only 27.6% of nursing students possessed accurate knowledge regarding the handling and segregation of medical waste. Nonetheless, a majority of students—up to 95.8%—expressed a positive attitude toward the issue. This study also revealed a positive correlation between students' knowledge and attitudes toward medical waste management, affirming that enhanced knowledge can lead to improved attitudes and practical performance (Sidhu & Kaur, 2016)

In Vietnam, a study by Tran Quynh Anh et al. (2020) indicated that although the proportion of hospitals implementing medical waste segregation was relatively high (95.6%), there were still significant limitations in correctly following waste segregation and treatment protocols, which adversely affected the effectiveness of public health protection efforts. Moreover, the proportion of healthcare workers and nursing students possessing accurate knowledge of medical waste segregation ranged from 51.8% to 90%. However, the rate of proper practice remained low—particularly in hospitals where staff had not received adequate training in medical waste management (Anh & Cảnh, 2020).

Schenk and colleagues (2023) also emphasized that nurses play a critical role in minimizing waste within healthcare environments, and that raising awareness about waste management is an essential factor in improving hospital waste management practices. The study further highlighted that waste reduction can help lower operational costs and enhance overall efficiency within the healthcare system. (Schenk et al., 2023)

Based on previous studies, although medical waste management (MWM) has received attention and been implemented in many healthcare facilities worldwide, significant limitations still exist regarding the knowledge and attitudes of healthcare workers, particularly nurses. Studies such as those by Ferreira and colleagues (2024) show that although healthcare workers are aware of the importance of medical waste management, their practical knowledge and hospital practices still do not meet the required standards (Ferreira et al., 2024). This is especially true for nursing students, who face a lack of in-depth knowledge about waste segregation and treatment in real-world healthcare settings.

In Vietnam, while the proportion of hospitals implementing medical waste segregation is relatively high, there are still challenges in correctly practicing waste segregation and treatment protocols. These challenges impact service quality, patient and staff safety, as well as the operational costs of healthcare facilities (Anh & Cảnh, 2020). Furthermore, numerous studies have shown that while healthcare workers and nursing students have a positive attitude

toward waste segregation, their knowledge remains insufficient, leading to errors in practice (Nyabaro et al., 2022) (Woromogo et al., 2020). This emphasizes the need for a study at Nam Dinh University of Nursing to evaluate students' knowledge and attitudes regarding medical waste segregation, so evaluate gaps in the teaching and practical training processes at the university, and propose solutions for improvement.

Therefore, this study on the knowledge and attitudes of final-year nursing students at Nam Dinh University of Nursing regarding medical waste segregation is essential in the current context. It will provide a clearer understanding of students' knowledge before graduation and their involvement in real-world nursing practice, and will propose appropriate human resource development solutions to enhance awareness of medical waste management in healthcare facilities, ultimately contributing to the improvement and sustainability of the healthcare system.

Research Methods

Study Population: The study population consisted of 240 final-year nursing students from Nam Dinh University of Nursing, selected randomly from classes in the final year of their program. These students had completed the theoretical coursework and were currently participating in clinical internships at hospitals, where they had the opportunity to directly engage in tasks related to medical waste segregation and treatment. These students had at least one year of direct exposure to the healthcare environment, including tasks related to medical waste segregation and treatment.

Study Duration: The study was conducted from March to June 2024.

Study Design: A cross-sectional descriptive design was used.

Data Collection Method: Data were collected through a self-administered questionnaire, which consisted of three main sections:

1. *Section 1: General Information about the Study Participants:* This section included questions on gender, age, place of residence, academic performance, and study habits, aiming to describe the characteristics of the study participants.
2. *Section 2: Knowledge of Medical Waste Segregation:* This section comprised 22 questions, divided into three main areas:

   a. Basic knowledge of medical waste segregation

   b. Knowledge of waste segregation in injection and dressing procedures

   c. Knowledge of waste segregation in other medical procedures

   Each knowledge question was scored as follows: a correct answer received 1 point, while an incorrect answer or “don’t know” response received 0 points. The maximum possible score was 22 points. Students were considered to have adequate knowledge if they scored 18 points or higher.

3. *Section 3: Attitudes toward Medical Waste Segregation:*This section consisted of 11 questions using a 5-point Likert scale (strongly disagree, disagree, unsure, agree, strongly agree). Students were considered to have a positive attitude toward medical waste segregation if they scored 8 points or higher.

Data Processing and Analysis Method: The data collected from the questionnaires were compiled and analyzed using SPSS software version 27. Descriptive statistics were used to calculate the proportion of students with adequate knowledge and positive attitudes. The t-test and chi-square (X^2) tests were applied to determine the relationships between factors such as gender, academic performance, study habits, and understanding of medical waste segregation with students' knowledge and attitudes.

Research Ethics: This study adhered to ethical principles in scientific research. All students participating in the study were informed about the study's purpose, and participation was entirely voluntary. The personal information of the students was kept confidential and was used solely for research purposes.

Results

Characteristics of the Study Participants

Table 1: Characteristics of the Study Participants (n=240)

Information		Frequency	Percentage (%)
Gender	Male	33	13,75
	Female	208	68,25
Place of Residence	Urban/Town	93	38,8
	Rural	147	61,2
Academic Performance	Excellent	96	40
	Good	135	56,3
	Average/Weak	9	3,7
Study Habit (Daily Study Time)	About 1 hour	111	46,3
	About 2-3 hours	129	53,8
	More than 3 hours	0	0
Age	Mean (min - max)	22,13 ± 0,946 (21-24)	

Table 2: Characteristics of the Study Participants Regarding Medical Waste Segregation Information (n=240)

Information		Frequency	Percentage (%)
Source of Information about Medical Waste Segregation	Books, Newspapers, Magazines	24	10
	Family, Friends	3	1,3
	Healthcare Workers	72	30
	Self-Research	48	20
	Other Media Sources	93	38,8
	Yes	78	32,5

Frequency of Knowledge Update on Medical Waste Segregation and Treatment	No	162	67,5
History of Exposure to Infectious Diseases Due to Improper Waste Handling	Yes	15	6,3
	No	186	77,5
	Don't Remember	39	16,3
History of Improper Medical Waste Segregation	Yes	138	57,5
	No	90	30,5
	Don't Remember	12	5

Only 32.5% of students frequently update their knowledge on medical waste segregation and treatment. The most common source of information about medical waste segregation among students was media sources, accounting for 38.8%, followed by healthcare workers at 30%. A significant 57.5% of students reported having made mistakes in medical waste segregation. However, only 6.3% of students had been exposed to infectious diseases due to improper medical waste handling.

Knowledge of Medical Waste Segregation

Basic Knowledge of Medical Waste Segregation

Table 3: Knowledge of Medical Waste Segregation Among Students (n=240)

No.	Content	Number of Correct Answers	Number of Incorrect/Unaware Answers
A1.1	Yellow bag for infectious waste	228 (95%)	12 (5%)
A1.2	Black bag for non-infectious waste	237 (98.8%)	3 (1.25%)
A1.3	Green bag for household waste	216 (90%)	24 (10%)
A1.4	White bag for recyclable waste	234 (97.5%)	6 (2.5%)
A2	Non-infectious waste includes: chemicals and expired pharmaceuticals	156 (65.5%)	84 (35%)
A3	Infectious sharps waste includes infectious materials that can cause cuts or punctures	237 (98.8%)	3 (1.25%)
A4	Infectious waste is categorized into four groups	186 (77.5%)	54 (22.5%)
A5	Waste segregation should occur at the point of generation	225 (93.8%)	15 (6.25%)
A6	Waste must be contained in the appropriate bags or bins as per regulations	231 (96.3%)	9 (3.75%)
A7	Hazardous medical waste should be mixed with household waste	171 (71.3%)	69 (28.75%)

A8	If hazardous medical waste is accidentally mixed with household waste, the mixture must be treated as hazardous waste	75 (31.3%)	165 (68.75%)

The majority of students demonstrated correct basic knowledge regarding medical waste segregation. For instance, 98.8% of students correctly identified that sharp infectious waste is waste that can cause cuts or punctures, and that the black bag is for non-infectious waste. Additionally, 96.3% of students knew that waste must be contained in bags or bins according to regulations. However, only 31.3% of students were aware that hazardous medical waste, if accidentally mixed with household waste, must be treated as hazardous waste.

Knowledge of Medical Waste Segregation in Injection and Dressing Procedures

Table 4: Knowledge of Medical Waste Segregation in Injection and Dressing Procedures **(n=240)**

No.	Content	Number of Correct Answers	Number of Incorrect/Unaware Answers
A9	Used syringe and intravenous catheter disposed in yellow bag	24 (0.1%)	216 (90%)
A10	Used butterfly needle placed in puncture-resistant container	235 (97.5%)	5 (2.08%)
A11	Used vials, drug containers, and other items from chemotherapy disposed in black bag	138 (57.5%)	102 (42.5%)
A12	Used glass drug containers and distilled water vials disposed in puncture-resistant container	218 (91.3%)	22 (9.17%)
A13	Used blood transfusion equipment (including blood bags) disposed in yellow bag	156 (65%)	84 (35%)
A14	Used intravenous solution bottles containing hazardous chemicals disposed in black bag	168 (70%)	72 (30%)
A15	Used intravenous solution bottles and regular medication vials disposed in white bag	96 (40%)	144 (60%)
A16	Used plastic wrappers for syringes, needles, and intravenous tubes disposed in green bag	105 (43.8%)	135 (56.25%)
A17	Used medicine boxes made of paper or cardboard disposed in white bag	120 (50%)	120 (50%)
A18	Used cotton pads and gloves from patient care disposed in yellow bag	186 (77.5%)	54 (22.5%)

The majority of students demonstrated correct knowledge about medical waste segregation in injection procedures. 97.5% of students correctly identified that used butterfly needles should be placed in a puncture-resistant container, and 91.3% knew that used glass drug containers and distilled water vials should be disposed of in puncture-resistant containers. However, only 10% of students knew that used syringes and intravenous catheters should be disposed of in yellow bags.

Knowledge of Medical Waste Segregation in Other Medical Procedures

Table 5: Knowledge of Medical Waste Segregation in Other Medical Procedures

No.	Content	Number of Correct Answers	Number of Incorrect/Unaware Answers
A19	Used aspiration needles and surgical blades disposed in puncture-resistant container	228 (95%)	12 (5%)
A20	Used sputum suction tubes, urinary catheters, gastric tubes, and drainage tubes disposed in yellow bag	159 (66.3%)	81 (33.75%)
A21	Used urine bags from patients disposed in yellow bag	210 (87.5%)	30 (12.5%)
A22	All blood-soaked waste and other biological fluids from patients disposed in yellow bag	198 (82.5%)	42 (17.5%)

The majority of students demonstrated correct knowledge regarding medical waste segregation in medical procedures. For example, 95% of students knew that used aspiration needles and surgical blades should be placed in puncture-resistant containers, and 87.5% knew that used urine bags should be disposed of in yellow bags.

Average Knowledge Score on Medical Waste Segregation Among Students

Table 6: Average Knowledge Score on Medical Waste Segregation Among Students **(n=240)**

Content	Mean ± SD	Min	Max
Basic knowledge of medical waste segregation	6.4 ± 1.43	1	11
Knowledge of medical waste segregation in injection and dressing procedures	5.95 ± 2.27	2	10
Knowledge of medical waste segregation in other medical procedures	3.31 ± 0.99	0	4
Total Knowledge Score	**18.41 ± 3.34**	6	24

The average knowledge score on medical waste segregation among students was 18.41 ± 3.34 points, which represents 73.6% of the maximum possible score. The lowest total score was 6, and the highest was 24. Among the three areas, the highest average score was observed in the field of medical waste segregation in other medical procedures, which achieved 82.75% of the maximum possible score for this area.

Assessment of Students' Knowledge on Medical Waste Segregation

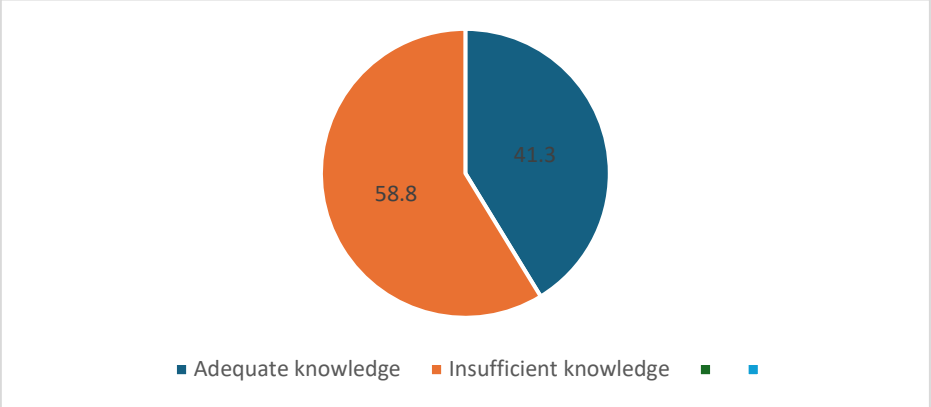

Figure 1: Assessment of Students' Understanding of Medical Waste Segregation

The results of the study show that 41.3% of students have adequate knowledge of medical waste segregation, while 58.8% lack sufficient knowledge on the topic

Attitudes Toward Medical Waste Segregation and Medical Waste Containers

Table 7: Correct Attitudes of Students Toward Medical Waste Segregation (n=240)

No.	Content	Correct Attitude	Incorrect Attitude
B1	Segregating medical waste at the point of generation reduces the risk of injury to waste handlers	219 (85.9%)	21 (8.75%)
B2	Preventing injury from sharps helps improve hospital waste management safety	72 (30%)	168 (70%)
B3	Infectious waste should be collected in yellow plastic bags with the hazardous biological symbol	213 (88.7%)	27 (11.25%)
B4	Measures to ensure occupational safety for those segregating and handling medical waste are necessary	69 (28.8%)	171 (71.25%)
B5	Ordinary medical waste not intended for recycling should be placed in green plastic bags	170 (70.8%)	70 (29.17%)
B6	A color-coded system should be used to distinguish different types of medical waste	78 (32.5%)	162 (67.5%)
B7	Reporting sharp object accidents to responsible personnel, managers, or instructors is necessary	174 (72.5%)	66 (27.5%)
B8	Hepatitis B vaccination helps prevent transmission due to improper waste segregation and handling	111 (46.3%)	129 (53.75%)
B9	Post-exposure prophylaxis should be started as soon as possible	129 (53.8%)	111 (46.25%)

B10	Those involved in medical waste segregation and handling should be trained on hazards, control measures, and precautions	141 (58.8%)	99 (41.25%)
B11	Additional training on knowledge and skills for medical waste segregation is necessary	223 (92.9%)	17 (7.08%)

The question regarding ensuring occupational safety for waste handlers received the lowest correct attitude response at 28.8%. On the other hand, the question regarding the need for further training on medical waste segregation knowledge and skills received the highest agreement, with 92.9% of students answering correctly.

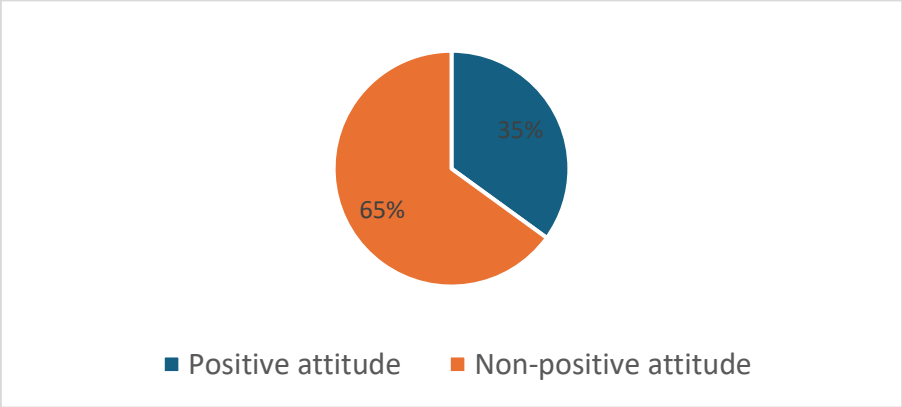

Figure 2: Classification of Students' Attitudes Toward Medical Waste Segregation (n=240)

The average attitude score of students toward medical waste segregation was 4.5 ± 0.23, with the highest score being 9 and the lowest score being 0. The majority of students (65%) exhibited a non-positive attitude toward medical waste segregation.

Factors Associated with Knowledge and Attitudes Toward Medical Waste Segregation

Relationship Between General Characteristics of Participants and Knowledge of Medical Waste Segregation

Table 8: Relationship Between General Characteristics of Participants and Knowledge of Medical Waste Segregation (n=240)

Biến số	**Phân loại**	**Kiến thức**		**p**
		Đạt	**Chưa đạt**	
Place of Residence	Urban/Town	66 (71%)	24 (29%)	0,067
	Rural	72 (48,98%)	75 (51,02%)	
Academic Performance	Excellent	57 (59,4)	39 (40,6%)	0,001
	Good	36 (26,7)	99 (73,3%)	
	Average/Weak	0 (0%)	6 (100%)	
Daily Study Habit	About 1 hour	81 (72,9%)	30 (27.1%)	0,000
	About 2-3 hours	27 (20,9%)	102 (79,1%)	
Frequency of Updating Knowledge	Yes	42 (53,8%)	36 (46,2%)	0,3523
	No	99 (61,1%)	63 (38,9 %)	
Exposure to Infectious Diseases	Yes	12 (80%)	3 (20%)	0,250
	No	87 (53,2%)	99 (46,8%)	

Previous Improper Waste Segregation	Yes	114 (82,6%)	24 (17,4%)	0,000
	No	24 (26,7%)	66 (73,3%)	

The results of the study show that 57% of students with excellent academic performance had adequate knowledge of medical waste segregation, while as many as 73.3% of students with good academic performance had insufficient knowledge. The difference is statistically significant with p=0.001<0.05. Additionally, 75% of students who studied for about 1 hour per day had adequate knowledge of medical waste segregation, while 77.3% of students who studied for 2-3 hours had insufficient knowledge. This difference is statistically significant with p=0.000<0.05. Furthermore, 82.6% of students who had previously made mistakes in medical waste segregation showed adequate knowledge, while 73.3% of students who had not made mistakes had insufficient knowledge. This difference is statistically significant with p=0.000<0.05. There was no significant difference in knowledge between the group that frequently updates their knowledge and the group that does not.

Relationship Between General Characteristics of Participants and Attitudes Toward Medical Waste Segregation

Table 9: Relationship Between General Characteristics of Participants and Attitudes Toward Medical Waste Segregation (n=240)

Variable	**Category**	**Attitude**		**p-value**
		Positive	**Non-Positive**	
Place of Residence	Urban/Town	39 (41,9%)	54 (58,1%)	0,169
	Rural	45 (30,61%)	102 (69,39%)	
Academic Performance	Excellent	57 (59,4%)	39 (40,6%)	0,000
	Good	27 (20%)	108 (80%)	
	Average/Weak	0 (0%)	6 (100%)	
Daily Study Habit	About 1 hour	54 (48,4%)	57 (51,4%)	0,027
	About 2-3 hours	30 (25%)	90 (75%)	
Frequency of Updating Knowledge	Yes	45 (57,7%)	33 (42,3%)	0,241
	No	51 (31,5%)	111 (68,5%)	
Exposure to Infectious Diseases	Yes	6 (60%)	9 (40%)	0,472
	No	54 (29%)	132 (71%)	
Previous Improper Waste Segregation	Yes	66 (47,8%)	72 (52,2%)	0,000

The results of the study show that 59.4% of students with excellent academic performance demonstrated a positive attitude toward medical waste segregation, while 80% of students with good academic performance showed a non-positive attitude. The difference was statistically significant with p=0.000<0.05. For students who studied for about 2-3 hours per day, 75% exhibited a positive attitude, while 48.4% of students who studied for about 1 hour per day had a non-positive attitude. The difference was statistically significant with p=0.027<0.05.

Moreover, 47.8% of students who had previously made mistakes in medical waste segregation demonstrated a positive attitude toward waste segregation, while 90% of students who had not made such mistakes showed a non-positive attitude. This difference was statistically significant with p=0.000<0.05.

Relationship Between Knowledge and Attitudes of Students Toward Medical Waste Segregation

Table 10: Relationship Between Knowledge and Attitudes of Students Toward Medical Waste Segregation (n=240)

Knowledge	Attitude		OR (95%CI)	p
	Positive	Non-Positive		
Inadequate	13 (12,17%)	101 (87,83%)	0.063 (0.012 - 0.316)	0,012
Adequate	84 (85,7%)	41 (32,8%)		

**OR (95% CI)" stands for Odds Ratio with 95% Confidence Interval*

The result shows that there is a statistically significant relationship between knowledge and attitude, with p=0.012<0.05, indicating that students with adequate knowledge were more likely to have a positive attitude toward medical waste segregation.

Discussion

Current Status of Students' Knowledge and Attitudes Toward Medical Waste Segregation

The research findings indicate that final-year nursing students at Nam Dinh University of Nursing possess basic knowledge of medical waste segregation. However, only 41.3% of students demonstrated adequate knowledge regarding medical waste segregation. The average knowledge score of students was 18.41 ± 3.34, which represents 76.8% of the maximum possible score. Among the different areas of knowledge, the highest score was achieved in the field of waste segregation in other medical procedures, with 82.75% of the maximum score for this area. This is a relatively low percentage, reflecting deficiencies in teaching and the accessibility of information related to medical waste segregation.

While most students demonstrated correct basic knowledge about medical waste segregation, such as knowing that yellow bags are used for infectious waste and black bags are for non-infectious waste, they still encountered difficulties in segregating waste during medical procedures and intravenous techniques.

Regarding attitudes, the average attitude score among students was 3.58 ± 2.66, which is 39.8% of the maximum possible score. As many as 65% of students exhibited a non-positive attitude toward medical waste segregation. This may be due to students not fully realizing the importance of medical waste segregation for public health and environmental protection. Moreover, the absence of comprehensive training programs on safety measures may have contributed to students' failure to follow proper segregation protocols. Both students' knowledge and attitudes have not reached the required level for individuals entering healthcare professions, indicating a need for improvement through awareness-raising measures and specialized training.

Relationship Between Various Factors and Students' Knowledge and Attitudes Toward Medical Waste Segregation

The research findings indicate that certain factors are clearly associated with students' knowledge and attitudes toward medical waste segregation. First, academic performance is an important factor influencing students' knowledge level, with students who have excellent academic performance (40%) showing a significantly higher percentage (59.4%) of adequate knowledge compared to students with good and average academic performance. This suggests that the ability to acquire knowledge and the level of interest in learning are closely related to the quality of knowledge regarding medical waste segregation. Students with good and average academic performance have a higher rate of inadequate knowledge about medical waste segregation, which should be addressed in teaching and student assessment processes.

Furthermore, self-study habits also have a significant impact on students' academic performance. Students who dedicate more time to self-study (1-2 hours per day) tend to have higher rates of adequate knowledge compared to students who spend less time on self-study. However, it is worth noting that despite dedicating significant time to self-study, the rate of updating information about medical waste segregation remains low (only 32.5%), indicating that students are not proactive in seeking out and enhancing their knowledge from sources outside the classroom.

Finally, there is a clear relationship between attitudes and behaviors. Students who have made mistakes in medical waste segregation tend to have a lower rate of positive attitudes compared to those who have not encountered this issue. Specifically, among those who have made mistakes in medical waste segregation, 47.8% exhibited a positive attitude, whereas 73.3% of students who had never made such mistakes had a positive attitude. This indicates that real-life experiences can help students gain a deeper understanding of the importance of proper medical waste segregation, thus fostering a more positive attitude toward this task. However, the relatively high rate of students who have neither been exposed to nor made mistakes in waste segregation highlights a lack of emphasis on practical application and the use of knowledge in real-world settings.

It is worth noting that the study was conducted on final-year full-time nursing students who had completed extended clinical internships, been involved in patient assessment, care, and performed numerous medical procedures, particularly intravenous procedures, which students carry out on a daily basis. However, the results of the study show that only 41.3% of students had adequate knowledge about waste segregation, and only 35.5% of students had a positive attitude toward medical waste segregation. Several key factors contribute to this situation:

- Limitations in Teaching and Learning Methods: In modern teaching trends, which focus on student-centered learning and the development of self-learning skills, the teaching time available from instructors is often limited. This can prevent some students from conducting adequate independent research, leading to knowledge outcomes that fall short of expectations. Particularly, students with excellent academic performance tend to score

higher in medical waste segregation knowledge, indicating that proactive learning positively influences academic results.

- Lack of Supervision in Practice: Although students are involved in clinical internships and participate in various care procedures, the lack of close supervision from instructors can result in mistakes in medical waste segregation. These mistakes can become ingrained habits that are difficult to change if not detected and corrected promptly.
- Impact of Information Technology and Social Media Platforms: The rapid development of information technology and social media platforms such as Facebook, Zalo, Tiktok, and YouTube presents both opportunities and challenges for students' learning. While these platforms facilitate easy access to medical information, they can also contribute to misconceptions if students access unverified or unofficial sources. This may lead to an inaccurate understanding of medical waste segregation, negatively affecting students' attitudes and behaviors toward this important issue.

Conclusion

This study reveals that final-year nursing students at Nam Dinh University of Nursing have limited knowledge and insufficient attitudes toward medical waste segregation. While most students demonstrated basic knowledge of medical waste segregation, only 41.3% of students demonstrated adequate knowledge, and only 35.5% had a positive attitude toward the issue. Factors such as academic performance, self-study habits, and practical experience were significantly associated with students' understanding and attitudes, highlighting a challenge in workforce development for the healthcare sector. Therefore, there is a need to improve the curriculum, enhance specialized training, and raise awareness and practical skills among students. These measures are necessary and practical to enhance the capacity of the future healthcare workforce, contributing to improved operational efficiency, risk management, and safety in healthcare facilities, while also protecting public health.

Recommendations

Based on the results and analysis above, we present several recommendations and proposals to improve the current status of students' knowledge and attitudes toward medical waste segregation as follows:

1. *Revise the curriculum to align with the specific needs of learners, focusing on enhancing competencies:* The curriculum on medical waste segregation needs to be adjusted and updated, with special emphasis on intravenous techniques. Hospital-based practice sessions should be organized more rigorously, with continuous supervision and reminders from instructors about the actual waste segregation processes.
2. *Develop a competency development roadmap for learners, focusing on foundational knowledge:* The research results show that students with strong knowledge of medical waste segregation tend to have a more positive attitude. Therefore, enhancing knowledge is a critical factor in forming the correct attitude and effective practices. Furthermore, during hospital practice, review sessions on medical waste segregation should be

organized. This will help students reinforce their knowledge, correct errors, and improve practical skills. Instructors should closely monitor and support students in applying the correct waste segregation protocols.

3. *Improve students' professional attitudes toward the importance of medical waste segregation:* Students need to be educated on the importance of segregating medical waste at the point of generation to reduce injury risks and protect public health. The curriculum should emphasize the urgency of following proper protocols, helping students develop positive attitudes and a sense of responsibility toward this task. Additionally, awareness campaigns (such as sharing sessions, online courses, or articles on social media platforms) should be organized to raise awareness about medical waste segregation among students, healthcare staff, and the general public.
4. *Apply comprehensive competency assessment methods:* The university should implement a regular assessment system to evaluate not only theoretical knowledge but also attitudes and practical abilities of students. Tests, case studies, and group activities are effective tools to ensure students can apply their knowledge in real-life situations.
5. *Create a friendly and safe learning and working environment:* It is essential to ensure that learning and practice facilities are adequately equipped with safety measures when handling medical waste. Providing protective equipment for students and healthcare staff, and raising awareness about medical waste segregation from the start of their studies, is necessary to ensure a safe and effective learning environment.

References

Akkajit, P., & Sukkuea, A. (2024). Medical Waste Classification Using Convolutional Neural Network. *E3S Web of Conferences*. https://doi.org/10.1051/e3sconf/202453004001

Anh, T. Q., & Cảnh, N. T. (2020). Kiến thức về quản lý chất thải rắn y tế của cán bộ y tế tại ba bệnh viện đa khoa tuyến tỉnh năm 2018.

Ferreira, M. J. C., Ventura, C. A. A., Valadares, G. V., Mendes, I. A. C., Silva, T. P. d., & Silva, Í. R. (2024). Nursing and waste management in health services: unveiling meanings in the hospital context. *Revista Gaúcha de Enfermagem*, *45*, e20230136.

Kumar, P. V. S., & Padmaja, P. (2017). Knowledge, attitude, practices of biomedical waste management among nursing students and staff in a tertiary care hospital.

Meleko, A., Tesfaye, T., & Henok, A. (2018). Assessment of healthcare waste generation rate and its management system in health centers of Bench Maji Zone. *Ethiopian journal of health sciences*, *28*(2), 125-134.

Nyabaro, P., Shitemi, F., Keter, M., & Kaimuri, M. (2022). Assessment of knowledge, attitude, and practices of health care waste management among nurses in Nyambene Level 4 hospital. *African Journal of Science, Technology and Social Sciences*, *1*(1).

Schenk, E. C., Johnson, S., Kelley-Gustafson, B., & Turley, O. (2023). Nursing waste reduction for a healthy environment. *Journal of Radiology Nursing*, *42*(1), 57-61.

Shikoska, B., Dimova, C., Schumanov, G., & Vankovski, V. (2016). Biomedical Waste Management. *Macedonian Medical Review*, *70*, 1-7. https://doi.org/10.1515/mmr-

2016-0001

Siddharudha Shivalli, S. S., & Vasudha Sanklapur, V. S. (2014). Healthcare waste management: qualitative and quantitative appraisal of nurses in a tertiary care hospital of India.

Sidhu, G., & Kaur, A. (2016). Knowledge and attitude of students regarding bio medical waste management. *Asian Journal of Nursing Education and Research*, *6*(1), 123-126.

Windfeld, E. S., & Brooks, M. (2015). Medical waste management - A review. *Journal of environmental management*, *163*, 98-108. https://doi.org/10.1016/j.jenvman.2015.08.013

Woromogo, S. H., Djeukang, G. G., Yagata Moussa, F. E., Saba Antaon, J. S., Kort, K. N., & Tebeu, P. M. (2020). Assessing Knowledge, Attitudes, and Practices of Healthcare Workers regarding Biomedical Waste Management at Biyem-Assi District Hospital, Yaounde: A Cross-Sectional Analytical Study. *Advances in public health*, *2020*(1), 2874064.