

# Knowledge and practice in respect of medical solid waste management among healthcare workers at Quang Nam Northern Mountainous Region General Hospital

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## Abstract

**Background:** Proper management of medical solid waste (MSW) is a complex global challenge that affects healthcare workers (HW), patients, and the environment. This study aims to evaluate the knowledge and practices of HW regarding MSW management and explore the factors associated with their knowledge and practices at the Quang Nam Northern Mountainous Region General Hospital in 2020. **Materials and method:** A cross-sectional study was conducted on 478 HW from June to December 2020. A self-administered questionnaire was used to collect general and knowledge information, while a checklist was used to assess their practices. Multivariate logistic regressions were conducted to identify the factors associated with knowledge and practices. **Results:** Out of the 478 respondents, 71.1% had good general knowledge, and 75.9% had good practices regarding MSW management. Multivariate logistic regressions showed that knowledge was significantly associated with age group (OR = 14.69; 95%CI = 5.87 - 36.77 and OR = 44.26; 95%CI = 12.04 - 162.74,  $p < 0.001$ ), occupation (OR = 22.78; 95%CI = 4.39 - 118.38 and OR = 18.09; 95%CI = 3.81 - 85.90,  $p < 0.001$ ), training courses (OR = 0.21; 95%CI = 0.09 - 0.45 and OR = 0.24; 95%CI = 0.09 - 0.65,  $p < 0.05$ ), and frequency of MSW monitoring activity (OR = 5.08; 95%CI = 2.18 - 10.87,  $p < 0.001$ ). Similarly, practices were significantly associated with age group (OR = 3.36; 95%CI = 1.35 - 8.38,  $p < 0.05$ ), working experience (OR = 0.49; 95%CI = 0.25 - 0.94,  $p < 0.05$ ), and frequency of MSW monitoring activity (OR = 2.81; 95%CI = 1.63 - 4.85,  $p < 0.001$ ). Furthermore, a positive association was observed between knowledge and practices regarding MSW management. **Conclusion:** Overall, the study found that the respondents had good knowledge and practices regarding MSW management. To maintain and improve this, the hospital should provide further training courses on MSW, ensure proper monitoring and supervision of managers and HW.

**Keywords:** *medical solid waste management, knowledge, practice.*

## 1. INTRODUCTION

Medical solid waste (MSW) poses a significant threat to human health and the environment due to its potentially hazardous germs and risk of infection transmission [1]. To prevent harmful consequences, proper MSW management is needed, which entails managing waste from generation, through separation, collection, transport, and treatment to their final disposal. According to the World Health Organization, there were about 5% of hazardous waste and 10% of the potentially infectious hazardous waste which account for approximately 10% - 25% of the total amount of MSW [2]. In Vietnam, medical facilities have generated a considerable amount of MSW, especially hazardous waste. The Environment Protection Report 2019 of the Vietnam Ministry of Health showed the average amount of MSW was more than 96 thousand tons/year and the total amount of hazardous waste was over 24 thousand

tons/year [3]. According to the results of The medical waste management Report in 2020 of the Quang Nam Northern mountainous region general Hospital, a grade II hospital, the total amount of MSW generated was more than 1,300 tons/year including 49 tons/year of infectious MSW and 1.4 tons/year of non-infectious MSW [4]. In addition, inadequate risk awareness and training, and lack of knowledge and practice in management, treatment, collection, and classification of MSW among HW are key factors leading to the mismanagement of infectious waste. Several studies conducted in Vietnam indicated HW have varying levels of knowledge and practice when it comes to MSW management. The studies report that the proportion of HW with good knowledge ranged from 45.4% to 78% [5-11], while the rate of good practice on MSW management ranged from 74.4% to 92.5% [8, 12, 13]. Although recent efforts have been made to improve MSW management,

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there are still many shortcomings. Given the lack of existing studies on MSW management in this hospital as well as in Quang Nam province, this study's objectives are to assess the knowledge and practice of HW regarding MSW management and identify their associated factors. Then, provide the current situation and assist the future planning of MSW management strategies in Quang Nam.

## 2. METHODOLOGY

### 2.1. Study subjects and setting

The study participants included nurses, midwives, medical technicians, and medical orderlies who worked at clinical and subclinical departments at Quang Nam Northern Mountainous Region General Hospital in 2020.

- Selection criteria: HW with working experience  $\geq 1$  year and agreeing to be reviewed.

- Exclusion criteria: HW who were not present at the hospital during the study period.

**2.2. Study period:** From June to December 2020

### 2.3. Study method

**2.3.1. Study design:** The study employed a cross-sectional study design.

### 2.3.2. Study sample

The study participants consisted of all 478 people who met the selection and exclusion criteria from a total of 529 HW in the sample frame, including:

- MSW sorting group: 434 HW including nurses, midwives, physician assistants, laboratory technicians, and medical orderlies who assumed responsibility for sorting MSW at source.

- MSW collecting and transporting group: 44 medical orderlies who collected and transported MSW.

### 2.4. Data collection methods

Study questionnaire and checklist on MSW management were developed based on the Joint Circular 58/2015/TTLT/BYT-BTNMT [14].

- General characteristics and knowledge regarding MSW management were collected via interview using a structured questionnaire which includes general characteristics items and 57 items relating to the knowledge aspect.

- Practice in respect of MSW management: A checklist was used to evaluate the performance of the research subjects when observing respondents practice classifying, collecting, and transporting MSW in the hospital. All study subjects were not aware that they were being observed for MSW management practice by the investigators, who

were HW in the nursing department or/and infection control department of the hospital.

## 2.5. Methods of measurement

### 2.5.1. Study variables

- General characteristics variables: Age group, gender, occupation, educational level, working experience, form of labor, number of MSW training courses attended, and the last MSW training attended.

- Knowledge regarding MSW management: Knowledge of MSW regulations, classification, instruments for MSW storage; collecting, storing, transporting, and reducing MSW.

- Assessment of practice in respect of MSW management was divided into two groups:

- + Practice in MSW classification: MSW classification of wastes at source and time of generation; classification of common wastes, recyclable waste; sharp and non-sharp instruments.

- + Practice in MSW collection and transport: Collect following each type of MSW; time of collecting infectious MSW; process of collecting MSW; indicating the generated place; frequency of collecting; vehicles to transport; the route for transporting; time for transporting to the storage area; properly transporting process; and sanitizing vehicles after transporting MSW.

### 2.5.2. Measurement of knowledge and practice of participants

- The knowledge regarding MSW management was measured based on a scoring system where each correct answer was awarded 1 point and each incorrect answer was awarded 0 points. For multiple-choice questions, all correct answers were given 1 point, while missing or incorrect answers were given as 0 points, the maximum score of knowledge was 57 points and the maximum score of knowledge was 57 points. If the score reaches 80% or more of the total score, it would be counted as good general knowledge [15].

- Practice in respect of MSW management was assessed based on the performance of the participants in observed MSW management activities, where 1 point was awarded for correct performance and 0 points for incorrect performance. Subjects to evaluate MSW management practices were divided into two groups: if the subjects were medical orderlies who collect and transport MSW: the general practice score was based on the total score of collection practice and transportation practices, with the minimum and maximum scores were 0 and 10 points, respectively. If the subjects were other HW (these subjects only performed the

MSW classification): general practice scores were based on the total classification practice scores, with the minimum and maximum scores were 0 and 5, respectively. If the score gets 80% or more of the total score, it would be assessed as good general practice [15]. The general practice assessment for all HW was counted as good if the subjects of collection and transportation practices had good the general practice or the subjects of the classification practice had a good general practice.

**2.6. Data processing and analysis**

- The data were input by Epidata 3.1 software and analyzed by the statistical software SPSS 20.0

- Variables that showed a statistically significant relationship in the Chi-square test ( $p < 0.05$ ) were selected in the multivariate logistic regression model to analyze the relationship. The results were expressed as OR, 95% CI, and p-value.

**2.7. Research ethics**

- The study followed the regulations of the Ethical Council, which has been approved by the Ethics Council of the University of Medicine and Pharmacy, Hue University. The researchers also obtained permission to conduct the study from managers of the General Hospital in the Northern Mountainous Region of Quang Nam.

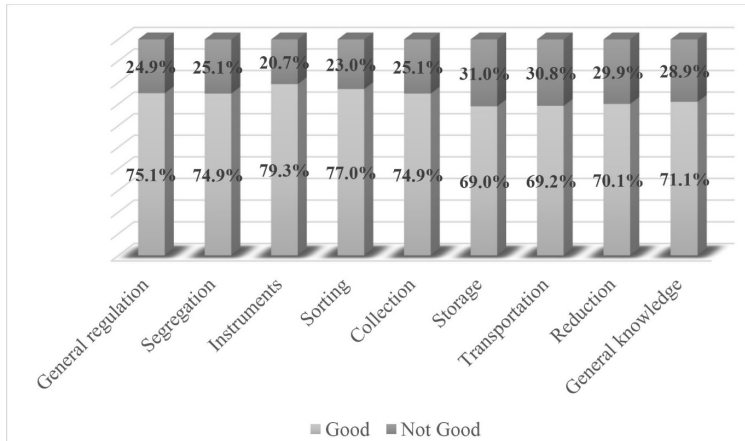
**3. RESULTS**

**Table 1.** General characteristics of respondents (n = 478)

Features	Results	
	n	%
Age group	≤ 30	253 / 52.9
	31 - 40	148 / 31.0
	> 40	77 / 16.1
Gender	Male	56 / 11.7
	Female	422 / 88.3
Occupation	Nurse/midwife	295 / 61.7
	Medical assistant/technician	125 / 26.2
	Medical orderly	58 / 12.1
Educational level	Bachelor’s degree and above	85 / 17.8
	Associate’s degree	259 / 54.2
	Some colleges and under	134 / 28.0
Working experience	< 5 years	138 / 28.9
	5 - 10 years	232 / 48.5
	> 10 years	108 / 22.6
Form of labor	Regular HW	188 / 39.3
	Contract HW	290 / 60.7
Number of MSW training courses attended	≤ 3 times	154 / 32.2
	> 3 times	324 / 67.8
Latest MSW training attended	No training	68 / 14.2
	≤ 12 months	342 / 71.6
	> 12 months	68 / 14.2
Frequency of MSW monitoring	Every week	362 / 75.7
	Every month or more	116 / 24.3

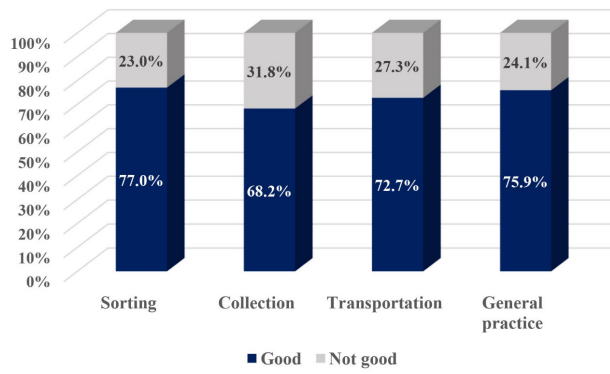
The majority of study subjects were female (88.3%) and more than 50% were under the age of 30. Nurses or midwives were the main occupation of the respondents (61.7%), and only a low percentage had a bachelor’s degree or higher (17.8%). The majority had 5 to 10 years of working experience (48.5%) and a higher proportion of respondents had contract labor (60.7% compared to 39.3%). More than two-thirds of

HW had received MSW training more than three times in the past five years (67.8%), and the majority (71.6%) had been trained within the past 12 months. The department was monitored weekly for MSW management by 75.7% of the respondents.



**Figure 1.** Knowledge regarding MSW management (n = 478)

HW with good general knowledge of MSW management made up 71.1%. Among them, knowledge about good MSW storage reached the lowest rate at 69.0%, while knowledge about MSW sorting, segregation, and equipment storage accounted for the highest rate with 79.3%.



**Figure 2.** Practice regarding MSW management

The percentage of HW with good general practice on MSW management was 75.9%. The collection process accounted for the lowest rate with 68.2% and the classification process accounted for the highest percentage with 77.0%.

**Table 2.** The multivariate logistic regression model determined the factors associated with general knowledge regarding MSW (n = 478)

Variables	OR	95%CI		p	
		Lower limit	Upper limit		
Age group	≤ 30	1	-	-	
	31 - 40	14.69	5.87	36.77	< 0.001
	> 40	44.26	12.04	162.74	< 0.001
Gender	Female	1	-	-	
	Male	1.32	0.66	2.64	0.509

Occupation	Medical orderly	1	-	-	-
	Physician assistant/ technician	22.78	4.39	118.38	<0.001
	Nurse/midwife	18.09	3.81	85.90	<0.001
Working experience	< 5 years	1	-	-	-
	5-10 years	0.61	0.27	1.37	0.317
	> 10 years	1.64	0.62	4.33	0.406
Latest MSW training attended	Never	1	-	-	-
	≤ 12 months	0.21	0.09	0.45	0.001
	> 12 months	0.24	0.09	0.65	0.020
Form of labor	Regular HW	1	-	-	-
	Contract HW	2.14	0.86	5.33	0.171
Frequency of MSW monitoring	Every week	1	-	-	-
	Every month or more	5.08	2.18	10.87	<0.001

*\*Note: The reference group for the dependent variable is the group with poor general knowledge.*

The study found that age group, occupation, latest training time, and the frequency of monitoring MSW were statistically significant factors associated with the study subjects' knowledge of MSW management ( $p < 0.05$ ). Accordingly, the older the age of the HW, the higher the rate of poor knowledge ( $p < 0.001$ ). The research subjects with occupations such as physician assistant/technician and nurse/midwife had 22.78 and 18.09 times higher rates of poor knowledge compared to those with medical orderly, respectively. Study subjects who had not received any training in MSW management had 4.76 times higher rates of poor general knowledge compared to those who had been trained in the past 12 months ( $p = 0.001$ ) and 4.17 times higher than the group who had been trained for more than 12 months ago ( $p = 0.02$ ). Additionally, HW who had a monthly or longer frequency of monitoring MSW management in their department had poor general knowledge rates 5.08 times higher than the group with a weekly frequency ( $p < 0.001$ ).

**Table 3.** The multivariate logistic regression model determined the factors associated with practice regarding MSW (n = 478)

Variables	OR	95%CI		p	
		Lower limit	Upper limit		
Age group	≤ 30	1	-	-	
	31 - 40	1.28	0.59	2.76	0.532
	> 40	3.36	1.35	8.38	0.009
Educational level	Bachelor's degree and above	1	-	-	
	Associate's degree	1.58	0.77	3.23	0.210
	Some colleges and under	1.73	0.74	4.03	0.207
Working experience	< 5 years	1	-	-	
	5-10 years	0.49	0.25	0.94	0.032
	> 10 years	0.43	0.09	2.00	0.283
Form of labor	Regular HW	1	-	-	
	Contract HW	0.91	0.42	1.97	0.805
Frequency of MSW monitoring	Every week	1	-	-	
	Every month or more	2.81	1.63	4.85	< 0.001

Number of MSW training courses attended	≤ 3 times	1	-	-	-
	> 3 times	0.79	0.19	3.35	0.750
Latest MSW training attended	Never	1	-	-	-
	≤ 12 months	0.91	0.36	2.29	0.838
	> 12 months	1.52	0.49	4.69	0.469

*\*Note: The reference group of the dependent variable is the group with poor general practice*

Age group, working experience, and frequency of MSW monitoring were found to be statistically significant factors related to respondent's general practice regarding MSW management ( $p < 0.05$ ). Accordingly, the group of HW over 40 years old had a 3.36 times higher likelihood of having poor general practice in MSW management compared to those  $\leq 30$  years old ( $p = 0.009$ ). Research subjects with over 10 years of working experience had a 2.04 times higher likelihood of having poor general practice in MSW management compared to those with 5 - 10 years of experience ( $p = 0.032$ ). Those who had a monthly or less frequent monitoring frequency of MSW management by the department had a 2.81 times higher likelihood of having poor general practice compared to the group with weekly monitoring ( $p < 0.001$ ).

#### 4. DISCUSSION

The results of the study involving 478 HW, including nurses, midwives, laboratory technicians, physician assistants, and medical orderlies at the General Hospital in the Northern mountainous region of Quang Nam in 2020, showed that the group of HW aged 30 and below accounted for the highest rate ( $> 50\%$ ), this can be advantageous for the hospital's MSW management since youthful personnel can be extremely active, quick to learn, and have numerous good MSW management ideas; female group accounted for the majority. Nurses and midwives accounted for nearly 2/3 of respondents, as they played a vital role in generating, managing, and classifying MSW in the hospital. Medical orderlies made up a small proportion of the total HW (58/741), but ensuring human resources for collecting, transporting, and classifying MSW at the storage. The majority of HW had been trained more than three times on MSW management, and the last training within the last 12 months was reported by 71.6% of the respondents. Training on MSW management for HW is critical, it is one of the most essential components for excellent MSW management performance at the hospital.

Figure 1 demonstrated that 71.1% of HW had good general knowledge of MSW management, which was lower than Le Chinh Phong's research in 2016 (78.0%), but comparable to studies by Le Giang Linh in 2018 (72.6%) and Lam Hoang Dung (68.2%) [7 - 9]. This result was lower than that of Le Chinh Phong, which may be attributed to the fact that in our study, the cut-off point for the general knowledge score was set at 80%, but in Le Chinh Phong's study, the cut-off point was set at 70%. Our

study's findings were higher than those of Nguyen Thi Canh in 2018 (64.7%), Nguyen Van Thanh in 2017 (65.6%), and significantly higher than those of Do Thi Nga at three hospitals in Kien Giang province in 2018 (58.4%) and Pham Duc Khang in 2016 (45.4%) [5, 6, 10, 11]. This difference could be attributed to a variety of factors such as the manager's concern, training program regarding MSW management, and monitoring process.

Figure 2 shows that there was 75.9% of respondents had good general practice in MSW management, which was similar to that in studies by Le Chinh Phong (74.4%) and Hoang Thi Dinh (74.7%), but lower than that in Nguyen Xuan Chi's study (92.5%) (8, 12, 13). Therefore, HW must be reminded and rigorously inspected by the Department of Infection Control to strictly comply with the regulations for collecting, classifying, and transporting waste from the source to the storage.

Multivariate logistic regression model was used to determine the factors associated with general knowledge regarding MSW (table 2). The results show that HW in the age groups of over 40 and 31 - 40 years old had poor general knowledge about MSW management, with odds ratios of 44.26 (95% CI: 12.04 - 162.74) and 14.69 (95% CI: 5.87 - 36.78), respectively, compared to those aged 30 years and under. This difference might be explained by the fact that younger employees might be more active, keep up with new information more easily, and take part in numerous knowledge competitions that integrate MSW management information. The nurses/midwives and physician assistants, laboratory technician group also had poorer general knowledge compared to medical orderlies, with odds ratios

of 18.09 (95% CI: 3.81 - 85.90) and 22.78 (95% CI: 4.39 - 118.38), respectively ( $p < 0.001$ ). The medical orderlies group is managed by the Department of Infection Control, which provides training and guidance on MSW management. These findings are consistent with previous studies (Rawat Ranu et al., Lam Hoang Dung, Dao Thi Tham, Dinh Van Quy, and Do Thi Nga) [6, 7, 16-18]. Inspection and monitoring were the final stages of the MSW management process, particularly at departments where waste is generated, collected, and transported. To improve HW's knowledge, department leaders should enhance inspections, monitoring, and reminders for MSW management.

The multivariate logistic regression model determines the factors related to the general practice of MSW management of the respondents in Table 3. It shows that HW in the group over 40 years old were more likely to have a general practice that had not met the standards, with an odds ratio of 3.36 (95% CI: 1.35 - 8.38,  $p < 0.05$ ) compared to those aged 30 and under. Younger people aged 30 and under, most of them are contract workers who strive to excel in recruitment exams, while individuals over 40 years old may benefit from increased awareness,

responsibility, and knowledge. Moreover, HW with more than 10 years of experience had better general practices than those with 5-10 years of experience, with an odds ratio of 2.04 (95% CI: 1.06 - 4.00,  $p < 0.05$ ). There was a statistically significant difference between the general practice of MSW management and the frequency of monitoring. Therefore, regular inspection and monitoring of MSW management for HW in hospitals should be strengthened.

## 5. CONCLUSION

The study conducted on 478 HW at the General Hospital in the Northern mountainous region of Quang Nam in 2020 revealed that the percentage of HW with good general knowledge and practice regarding MSW management reached 71.1% and 75.9%, respectively. The multivariate logistic regression model shows that factors such as age group, occupation, training time, and frequency of MSW monitoring of the relevant faculty/departments were related to the general knowledge of the research subjects, while age group, working experience and frequency of MSW monitoring of the relevant faculty/departments were associated with the general practice of the HW.

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