Assessment of Nursing Staff's Knowledge, Performance and Attitude about Biomedical Waste Segregation



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ABSTRACT

Background: Segregation of biomedical waste (BMW) is the foremost and prime step for effective BMW management. Inadequate knowledge or a lower level of skills among nursing staff in healthcare facilities has led to the failure of BMW management. Therefore, they should have competencies in knowledge, performance, and attitudes about BMW segregation in healthcare settings. **Aims:**The current study aimed to assess nursing staff's knowledge, performance, and attitude about BMW segregation. **Design**: A descriptive cross-sectional study design was used. **Setting**:The study was carried out at Mansoura Health Insurance Hospital, affiliated with the Ministry of Health and Population. **Sample**: In a convenient sample, all on-the-job nursing staff (300) were included **Tools for data collection**: A structured, self-administered questionnaire scale and an observation checklist were used for data collection. **Results**: The results showed that 64.3%, 100%, and 83.3% of the nursing staff had poor total knowledge, improper performance, and a positive attitude score levels, respectively, regarding BMW segregation. **Conclusion**: The study concluded that almost two-thirds, all of them as well as the majority, of the nursing staff have poor knowledge, improper performance, and positive attitudes, respectively, related to BMW segregation. **Recommendations:** The researchers recommend conducting on-the-job training programs for nursing staff on BMW segregation measures.

Keywords: attitudes, biomedical waste segregation, knowledge, nursing staff, performance

Introduction:

The World Health Organization ([WHO], 2017) has classified medical waste into eight categories: general waste, pathological waste, radioactive waste, chemical waste, sharps waste, pharmaceutical waste, pressurized container waste, and infectious to potentially infectious waste. Biomedical waste (BMW) means any waste that is generated during the diagnosis, treatment, or immunization of human beings or animals, or research activities related to that, or in the production or testing of biological or health products (Tebeu, 2020).

Hospital-generated waste constitutes nearly 85% general waste and about 15% biomedical waste, composed of 10% infectious waste and 5% non-infectious wastes like radioactive and chemical waste. In developing countries, especially in Africa, BMW has not received the attention it deserves (WHO, 2017). Bio-medical wastes represent the second-most hazardous waste globally after radiation. Biomedical waste is a relevant problem in several countries and poses serious public health threats worldwide (Sharma & Uppadhaya, 2019). Biomedical waste may pose an occupational hazard when managed incorrectly, for instance, viral infections such as acquired immunodeficiency syndrome (AIDS), viral hepatitis B (HBV), and viral hepatitis C (HCV) (Golandaj & Kallihal, 2021).

The process of biomedical waste management (BMWM) is the segregation, collection, storage, treatment, transport, disposal, and other safety measures of waste in health institutions (Mondal, Mishra, Pillai, & Sahoo, 2022). The key to minimization and effective management of BMW is the segregation of the waste at the point of generation; no matter what final strategy for treatment and disposal of waste is selected, it is critical that waste streams are separated to protect both humans and the environment (Sahiledengle, 2019).

Segregation reduces the amount of waste that needs special handling and treatment. Effective segregation prevents the mixture of medical waste like sharps with general municipal waste, prevents illegal reuse of certain components of medical waste like used syringes, needles, and other plastics, and provides another opportunity for recycling certain components of medical waste like

plastics after proper and thorough disinfection (Dehghani, Ahrami, Nabizadeh, Heidarinejad, & Zarei, 2019).

On the other hand, improper BMW segregation, which includes hazardous wastes (10–15%), mixed with non-hazardous waste (85–90%), can result in the whole bulk waste becoming potentially hazardous (Mekonnen, Solomon, & Wondimu, 2021).

Since different wastes are classified into different types, they must therefore be handled and disposed of according to their classification. The bins used for waste disposal in all healthcare facilities worldwide are always color-coded. Based on the rule of universality, bins are assigned a specific color, according to which the waste is segregated. This step helps avoid the chaos that occurs when all types of waste are jumbled, which can lead to improper handling and disposal and further result in the contraction of several diseases (Capoor & Parida, 2021).

Owing to nursing staff supervising the work of various housekeeping and other staff working in their areas (Haider et al., 2015), otherwise BMWM cannot be obtained without the cooperation of each employee and patient, nursing staff play a vital role in this whole process.

2.2 Aim of the Study

The current study aimed to assess nursing staff's knowledge, performance and attitude toward BMW segregation.

3. Method

3.1 Design: A descriptive cross-sectional study design was used.

3.2 Setting: This study was conducted at Mansoura Health Insurance Hospital, affiliated with the Ministry of Health and Population. All departments in the hospital were included, which were the intensive care units (ICUs), general wards, emergency room, and operative room.

3.3 Sample: A convenient sample of all nursing staff (n = 300) who were on duty at Mansoura Health Insurance Hospital during the data collection period with different qualifications was assigned to give direct care to patients, with at least one year of experience, and from both genders.

3.4 Data collection tools

Data was collected by two tools, which include:

Tool I: It consisted of three parts as follows:

Part (1): Nursing staff's sociodemographic and occupational characteristics self-administrated structured questionnaire. This part included the socio-demographic and occupational characteristics of the nursing staff, which were composed of nine closed-ended questions covering gender, age, marital status, residence, education level, year of experience, and attendance at training programs.

Part (2): Nursing staff's knowledge selfadministered structured questionnaire. The researchers developed this questionnaire based on Ndapandula (2016) and Hassan (2012) to assess the nursing staff's knowledge levels regarding BMW segregation. It comprised 25 questions (multiple choice questions), covering the definition of BMW, the types of BMW, the definition of BMW segregation, the BMW segregation method, and the steps of the BMW segregation process.

Nursing staff's knowledge scoring system. The total scores of the nursing staff's knowledge were 25 marks. The researchers gave the correct response to each question a "one" mark, and the incorrect or not known as a "zero." The score was transformed into a percentage. The researchers' cutoff point classified the nursing staff's knowledge level into three categories, as follows: poor: less than 60% (less than 15), fair: 60 to less than 80% (15 to less than 20), and good: 80% or more of the total score (20 to 25).

Part (3): Nursing staff's attitude selfadministrated scale (Appendix II-E). The researchers developed this scale based on Ndapandula (2016) and Hassan (2012) to assess nursing staff's attitudes toward BMW segregation, which include benefits, barriers, and the concept of biomedical waste segregation.

Nursing staff's attitude scoring system. The total score of the nursing staff's attitude was 36 marks, with the items rated on a 4-point Likert scale from one to four (strongly disagree = 1, disagree = 2, agree = 3, strongly agree = 4). Based on the researchers' cutoff point, the attitude levels were categorized into two categories: negative and positive, as follows: negative: less than 60% of the total score (less than 21.6 marks), and positive: 60% of the total score and more (21.6 marks or more).

Tool II: Nursing staff's performance observational checklist (Appendix II-D). The researchers developed this observational checklist based on Ndapandula (2016) and Hassan (2012) to assess the nursing staff's performance regarding BMW segregation. It covered the following items: usage of black bags (8 items), usage of red bags (4 items), usage of yellow bags (3 items), usage of a cardboard box with blue marking /sticker (2 items), usage of a white PPC (3 items), and how to handle waste (20 items).

Nursing staff's performance scoring system. The total scores of the nursing staff's performance were 40. The researchers awarded a "one" mark for each proper step and a "zero" for an improper or not-done step. According to (**Benner 1984**), in acquiring and developing a skill, a nurse passes through five levels of proficiency: novice, advanced beginner, competent, proficient, and expert. The researchers' cut-off point classified nursing staff's performance into four categories, as follows: advanced beginners: less than 60% (less than 24), competent: 60% to less than 75% (from 24 to less than 30), expert: 75% to less than 85% (30 to less than 34), and proficiency: 85% (34).

3.5 Ethical consideration.

The Faculty of Nursing Research Ethics Committee, Mansoura University, approved the study. The researcher obtained written informed consent from the participants. The researchers introduced themselves and provided the participants with a brief explanation of the study's aim. The researchers assured the participants that their participation was entirely voluntary and that the information gathered would be kept confidential and used to improve healthcare services. The researchers informed the participants that they had the right to ask any question related to the study and withdraw at any time from the study without any responsibility or giving any reason.

3.6 Data collection:

Literature review. The researchers used scientifically published articles, internet searches, and sourcebooks, as well as a literature review of national and international articles on the various aspects of BMW segregation. This review served as a guide for creating the study tools.

Tools' face and content validity. The researchers submitted the study tools to a jury panel of five professors in community health nursing at the Faculty of Nursing, Mansoura University. To achieve the criteria of trustworthiness, the professors evaluated these tools for appropriateness and relevance and elicited responses that either agreed or disagreed on face and content validity.

The pilot study. The researchers conducted the pilot study with 10% (30 nursing staff) of the study sample to assess the clarity and applicability

of the tools as well as to estimate the time required for response. The nursing staff involved in the pilot study was included in the main study sample.

Tools reliability. The researchers checked the internal consistency of the tools using Cronbach's alpha. It was 0.91 for the nursing staff's knowledge self-administered structured questionnaire, 0.89 for the nursing staff's performance observational checklist, and 0.88 for the nursing staff's attitude self-administered scale. It was an acceptable measure for the internal consistency of tools (**Tavakol & Dennick, 2011; Vaske, Beaman, & Sponarski, 2017).**

Field Work: The researchers started the study in April 2021 and ended it in June 2021, passing through two phases. In the administrative phase, the responsible authority, the Faculty of Nursing, issued an official letter to the director of Mansoura Health Insurance Hospital, affiliated with the Ministry of Health and Population, to permit the researchers to conduct the current study. The letter informed the director about the aim of the study and its process to gain their cooperation and support during the data collection.

In the implementation phase, the researchers collected data three days per week (Saturday, Monday, and Wednesday), covering different work shifts. The researchers guided the nursing staff to self-administered fill out the structured questionnaire to identify socio-demographic and occupational characteristics and assess knowledge and attitude, which took about 15 to 20 minutes per nursing staff using Tool I. The researchers observed and documented the nursing staff's performance regarding BMW segregation using Tool II.

3.7 Statistical analysis

All statistical data were analyzed using SPSS for Windows, version 25.0 (SPSS, Chicago, IL, USA). All continuous data were normally distributed and are expressed in mean and standard deviation (SD), whereas the categorical data are expressed in numbers and percentages. As mentioned above, the reliability (internal consistency) test for the used tool was calculated.

4. Results

Table (1) shows that 86.7% and 36.7% of nursing staff are women and aged from 30 to 40 years, with a mean age of 35.33 (8.37), respectively. Related to marital status and residence, 83.4% and 70% were married and residents in rural areas, respectively. Finally, 60% of nursing staff had a technical nursing diploma.

Table (2) reveals that 20% and 56.7% of nursing staff worked in the operating room and had from 5 to 10 total years of experience in general, with a mean of 8.26 (3.37) years. Related to attending courses regarding biomedical waste segregation, 66.7% and 86.7% of nursing staff received a course for more than three months, respectively.

Table (3) illustrates that 46.7%, 33.3%, 73.3%, 84.3%, and 80% of the nursing staff had poor knowledge related to the definition of BMW, types of BMW, the definition of BMW segregation, the steps of BMW segregation, and the technique of BMW segregation, respectively. Finally, 64.3%

of the nursing staff had a poor total knowledge score.

Table (4) demonstrates that 64.3% of the nursing staff had a poor total knowledge score level regarding BMW segregation, with a mean of 12.66 (4.29).

Table (5) reports that improper score levels ranged from 23.3% to 100% of the nursing staff's performance regarding BMW segregation and represent all of them at the total score level with a mean of 22.46(3.69).

Table (6) presents that 83.3% of the nursing staff had a positive attitude toward BMW segregation, with a mean of 25.63 (3.29).

Table (1): Nursing Staff's Socio-demographic Characteristics

Characteristics	N=(300)	%
Age		
20 -	100	33.3
30-	90	30
40 +	110	36.7
Mean (SD) 35.33(8.37)		
Gender		
Man	40	13.3
Woman	260	86.7
Residence		
Rural	210	70
Urban	90	30
Marital status		
Single	40	13.3
Married	250	83.4
Divorced	10	3.3
Qualification		
Technical Nursing Diploma	180	60
Bachelor's degree (BSc)	40	13.3
Postgraduate degree (Diploma, MSc, Ph.D.)	80	26.7

Table (2) Nursing Staff's Occupational Characteristics

Items	N=(300)	%
Department		
Emergency	40	13.3
ICU	40	13.3
Operating room	60	20
Internal medicine	30	10
Dialysis unit	30	10
Others	100	33.4
Years of experience		
<5 years	40	13.3
5-<10 years	170	56.7
≥10years	90	30
Mean (SD) 8.26 (3.37)		
Training courses about biomedical waste segregation		
One	200	66.7
Two	10	3.3
More than two	90	30
The last training courses about biomedical waste segregation		
< 3 months ago	40	13.3
> 3 months ago	260	86.7

Items	Items N= (300)					
	Poor		Fair		Good	
	Ν	%	Ν	%	Ν	%
Definition Biomedical waste score= (5)	140	46.7	90	30	70	23.3
Mean (SD) 2.66(0.94)						
Types of biomedical waste score= (8)	100	33.3	100	33.3	100	33.3
Mean (SD) 4.70(2.10)	Mean (SD) 4.70(2.10)					
Definition of biomedical waste segregation	220	73.3	00	00	80	26.7
score= (2)						
Mean (SD) 0.97(0.73)	Mean (SD) 0.97(0.73)					
The steps of biomedical waste segregation	253	84.3	45	15	2	0.7
score= (6)						
Mean (SD) 2.56(1.12)						
The technique of biomedical waste segregation	240	80	10	3.3	50	16.7
score= (4)						
Mean (SD) 1.76(1.23)						

Table (3) Nursing Staff's Scores Levels of Knowledge Regarding Biomedical Waste Segregation

Table (4) Nursing Staff's Total Score Levels of Knowledge Regarding Biomedical Waste Segregation

Items	N= (300)	%	
Total knowledge score= (25)			
Poor	193	64.3	
Fair	106	35.3	
Good	1	0.4	
Mean (SD) 12.66(4.29)			

Table (5) Nursing Staff's Scores Levels of Performance Regarding Biomedical Waste Segregation

Items		N= (300)			
		Improper		Proper	
	Ν	%	Ν	%	
Usage of black bags score=(8)	130	43.3	170	56.7	
Mean (SD) 5.46(1.36)					
Usage of red bags score=(4)	10	3.3	290	96.7	
Mean (SD) 3.43(0.80)					
Usage of yellow bags score=(3)	290	96.7	10	3.3	
Mean (SD) 1.20(0.87)					
Usage of cardboard box with blue marking /sticker score=(2)	250	83.3	50	16.7	
Mean (SD) 0.7(0.73)					
Usage of white puncture proof container (PPC) score=(3)	70	23.3	230	76.7	
Mean (SD) 2.76(0.42)					
Steps of handling waste score=(20)	300	100	00	00	
Mean (SD) 8.90(1.94)					
Total performance score = (40)	300	100	0	0	
Mean (SD) 22.46(3.69)					

Nurs	ing Stan's Total Level of Attitude Regarding Biomedical waste S	egregation	
	Items	N=(300)	%
	Negative attitude≥ 60% of the total score	50	16.7
	Positive attitude< 60% of the total score	250	83.3
	Total attitude score= (36)		
	Mean (SD) 25.63 (3.29)		

Table (6) Nursing Staff's Total Level of Attitude Regarding Biomedical Waste Segregation

Discussion

Since nursing staff play an important role in regulated BMW segregation, it is important to have a high level of knowledge, adequate skills in safety procedures, and a positive attitude related to the process of BMW disposal and segregation (Padmanabhan & Barik, 2019; Ali, Salih, Mostafa, & Fahmy, 2022).

In this study, less than half and one-third of the nursing staff have poor knowledge regarding the definition and types of BMW. In addition, the percentage ranged from less than three-fourths to the majority stating poor knowledge related to the definition of BMW segregation, its steps, and method. These findings agree with the findings of (Mostafa, Shazly, and Sherief2008), who, in their study on waste management, reported that the majority of the doctors, nurses, and housekeepers had unsatisfactory knowledge about BMW segregation. Oppositely, these findings disagree with the findings of (Basavaraj, Shashi Bhushan, and Sreedevi 2021), who reported that all the studied nurses were well aware of BMW segregation.

Furthermore, these results are inconsistent with Ali et al. (2022), who mentioned that more than half of the studied nurses had average and good general knowledge about BMW segregation. (Also, Golandaj and Kallihal 2021) showed that near to half of the respondents were aware of the correct categorization and segregation. As well, Sobh et al. (2018) assessed the knowledge and practice of staff nurses related to healthcare waste management in El-Zohor Hospital and found that more than one-third of the studied nurses had satisfactory general knowledge about waste segregation.

The results of the current study show that almost two-thirds of the nursing staff have a poor total score level of knowledge regarding BMW segregation. This finding contradicts a study carried out by Patel and Patel (2023), which assessed knowledge, attitude, and practice regarding BMW amongst nursing professionals and concluded that almost two-thirds of the nursing staff had good to excellent knowledge regarding BMWM and disposal. Also, (Akkajit et al. 2020) reported that the majority of their participants had good knowledge about BMW segregation.

In the current study, more than half, most, and more than three-fourths of the nursing staff demonstrate a proper performance score level regarding the usage of red, black, and white constraints for waste segregation, respectively. These findings agree with the finding of (Sobh et al. 2018), who reported that almost two-thirds of the studied nurses had adequate practices regarding separating hazardous and non-hazardous waste into red and black bags, respectively.

These results contradict (Leonard et al. 2022), who conducted a study in fifty government hospitals and health posts from five provinces in Zambia to identify the knowledge, attitudes, and practices of healthcare workers on hospital waste management and concluded that more than half of the studied facilities demonstrated poor waste segregation practices regarding the usage of infectious waste bags (red or orange bin liner) and a black bag for general waste.

The findings of the present study reveal that all of the nursing staff demonstrates an improper total score level of performance related to BMW segregation. This finding agrees with (Ibrahim, Kebede, and Mengiste 2023), who revealed that healthcare waste segregation practices were unacceptably poor and recommended addressing the identified factors through ongoing enforcement of healthcare BMWM rules and regulations by providing training, instructive posters around the work area, and making color-coded bins available. (Leonard et al. 2022) indicated that poor healthcare BMW segregation practices are mainly due to a lack of proper BMWM tools, especially at health centers.

The researchers argue the results because one-third of nursing staff belonged to young adults (20-> 30 years old), less than two-thirds have a technical nursing diploma, and less than threefourths have less than 10 years of experience. All those contribute to poor knowledge, which occasionally overlaps with improper performance.

The researchers find that the majority of the nursing staff has a positive total attitude score level towards BMW segregation. This result is similar to the results of Patel and Patel (2023), who stated that almost two-thirds of the professional nurses had an average to excellent attitude regarding BMWM.

This finding is also consistent with the study, which was carried out in primary healthcare centers in southeast Nigeria and targeted 150 healthcare facilities by Okechukwu and Abanobi (2020), who reported that many of their studied waste handlers showed a strong positive attitude.

This finding disagrees with the findings of **(Deress, Hassen, Adane, and Tsegaye 2018)**, which assessed knowledge, attitude, and practice about BMWM and associated factors among healthcare professionals and concluded that the level of their studied healthcare providers' attitudes was low.

6. Conclusion:

In light of the present study findings, the researchers conclude that almost two-thirds, all of them as well as the majority, of the nursing staff have poor knowledge, improper performance, and positive attitudes, respectively, related to BMW segregation.

7. Recommendations :

In light of the study's findings, the following recommendations are suggested:

- Conduct on-the-job training programs for nursing staff on BMW segregation measures.
- Adopt written policies for BMW segregation in healthcare facilities and orient nursing staff to them.
- Permit BMW segregation steps to be visualized as a reminder to nursing staff.
- Equip and supply healthcare facilities with all the requirements that enable nursing staff to segregate BMW.
- Supervise and monitor nursing staff to ensure they follow BMW regulations.

8. Funding

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9. References

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