An analytical cross-sectional study on the knowledge, attitudes, and practices (KAP) on biomedical waste management among nurses and medical technologists in the Philippines*

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Abstract

Introduction Unregulated biomedical waste management is an emerging public health problem in the Philippines. This study aimed to differentiate the knowledge, attitudes, and practices of nurses and medical technologists toward biomedical waste management.

Methods Using an analytic cross-sectional study design, an online survey of nurses and medical technologists from hospitals around the Philippines was conducted. A 27-item questionnaire covering knowledge, attitudes and practices was used. The percentages of correct answers and mean scores in each domain was compared between the nurses and medical technologists.

Results A total of 196 respondents consisting of 77 registered nurses and 119 medical technologists were included in the study. Medical technologists had significantly better knowledge scores than nurses on disposal procedures for expired blood units and by-products waste (55% vs. 19%, p – 0.026). Both had low correct responses on adequate disposal of human tissue remains, throwing blood waste into domestic waste, and throwing of expired medications in domestic waste. There was no significant difference in the attitude of nurses and medical technologists. Nurses had significantly better practice scores on disposal of liquid waste in bags (84.4% vs. 68.9, p = 0.018), but medical technologists fared better at disposal of human tissue together with other waste (13.0% vs. 2.5%, p = 0.006).

Conclusion Both nurses and medical technologists had adequate knowledge of some aspects but were lacking in others. There was no significant difference in the attitude of nurses and medical technologists towards biomedical waste management. Half of the respondents practiced proper biomedical waste management.

Key words: biomedical waste management, nurses, medical technologists, knowledge, attitudes, and practices (KAP)

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Biomedical waste from hospitals includes needles, scalpel blades, gloves, bandages, cotton, medicine, blood and body fluids, human tissues, radioactive substances, and chemicals. These objects may contain harmful organisms or contaminants that may adversely affect those who come into contact with these wastes. Improper or careless disposal poses a variety of health hazards, therefore they must be properly segregated and disposed. It is of utmost importance that those who handle these objects before disposal, including

nurses and medical technicians, have knowledge of the guidelines on how to properly dispose biomedical waste, have the right attitude towards handling waste, and apply their knowledge and attitude to proper handling procedures. However, studies have shown that not all of those who handle medical waste are aware of or follow these guidelines.

With the emergence of diseases that arise from numerous wastes from the surroundings, it is imperative to look into the Philippine health system's biomedical waste management. The World Health Organization (WHO) defines biomedical waste as composed of organisms that can infect medical personnel, health workers, patients, and the public. The hazardous nature of biomedical waste may be attributed to infectious agents, toxic or hazardous chemicals or pharmaceuticals, sharps, genotoxicity, and radioactive material. These outcomes may arise from inadequate training, absence of waste management or disposal systems, inadequate human and financial resources, and low priority given to biomedical waste management. According to the Department of Health (DOH), significant progress has been made on health care waste management. However, previous studies indicate the need to introduce modifications to existing health care waste management practices.

The objective of the study was to determine and quantify the knowledge, attitude, and practice of nurses and medical technologists regarding biomedical waste management during the 2nd quarter of 2020 in the Philippines. The study also aimed to differentiate the KAP of nurses and medical technologists toward BWM, by determining if there is a significant difference in the knowledge, attitude and practice mean scores between these two groups.

Methods

This is a cross-sectional analytic study to compare the knowledge, attitude, and practice (KAP) of nurses and medical technologists regarding biomedical waste management (BWM). Registered nurses and medical technologists, male or female, aged 21-60 years old, graduates of any school in the Philippines, employees of any hospital in the Philippines, and who practice biomedical waste management were recruited. Any nurse or medical technologist who has been part of their respective facility's waste management committee were excluded. Non-probability convenience sampling was done to acquire participants through online recruitment. The minimum required sample size is 260 each for nurses and medical technologists computed using a proportion of 32% for nurses and 20% for medical technologists with a 95% confidence level and a power of 80% based on a similar study by Olaifa.[1]

A modified survey tool consisting of 27 items (knowledge 11, attitude 4, practice 12) adapted from a questionnaire developed by Olaifa was utilized in this study.[1] Expert validation was conducted by the Chief Health Program Officer for Biomedical Waste of the DOH. Four items from the knowledge domain of the original questionnaire were omitted as advised by the expert since these items were not applicable in the Philippine setting and were not included in the latest DOH manual for biomedical waste. Data collection was conducted online via Google Forms. The responses for each domain were assigned a code and were recorded in Google Sheets. The questionnaire has score values for practices and knowledge domains as 2 for 'correct response', 1 for 'incorrect response', and 0 for 'I don't know response' whereas the score values for attitude domain were as follows: 5 as 'strongly agree' and 4 as 'agree' were coded as 2 for a correct response; 3 as 'disagree' and 2 as 'strongly disagree' were coded as 1 for an incorrect response; 0 for 'I don't know'. Reverse scoring applied for Item 8 on the practice domain and Items 14, 15, and 16 on the attitude domain.

IBM SPSS version 23 was used for the statistical analyses of the encoded responses. Descriptive statistics were used to determine the frequencies and proportions of the nurses and medical technologists' responses for the knowledge, attitudes, and practices in the provided questionnaire. To see if there was a significant difference in the responses per item in each domain of the questionnaire, the chi-square test was utilized with a 95% confidence interval ($p = 0.05$).

The study was approved by the UERM Ethics Review Committee. All participants were required to answer an online informed consent approved by the RIHS ERC before proceeding to the questionnaire. Privacy was ensured by restricting access to the files containing the responses to the researchers alone. Social desirability bias was controlled by providing descriptive questions to verify the respondents' knowledge, attitudes, and practices.

Results

Table 1 shows the demographic data of the study participants which consisted of 77 nurses and 119 medical technologists. Seven out of 10 respondents were female, 70% were 21-25 years old, and almost a third had been working for two years or less. A little more than a third of respondents (34.7%) had received formal training on biomedical waste management.

Table 2 shows that there is a significant difference in the knowledge of nurses and medical technologists concerning the following items: medical technologists had a higher proportion of correct answers on adequate disposal procedures for expired blood units and by-products waste (55% vs. 19%, p = 0.026); more medical technologists received supervision (79% vs 36%, p = 0.008); however, both nurses and medical technologists had low correct responses on the adequate disposal procedures for expired medicines (nurses 33% vs. medical technologists 28%, p = 0.007). Both nurses and medical technologists had low correct responses concerning the following items: the adequate disposal of human tissue remains (nurses 23.4%, medical technologists 26.1%, p = 0.737), throwing blood waste into domestic waste (nurses 7.79%, medical technologists 7.56%, p > 0.999), and throwing of expired medications in domestic waste (nurses 6.49%, medical technologists 12.6%, p = 0.228).

Table 3 shows that there is no significant difference in the attitude of nurses and medical technologists; however, there was a small proportion of both nurses and medical technologists who believe that the containment of sharps does not help in the management of hospital waste (nurses 37.66%, medical technologists 26.89%, p = 0.230). Table 4 shows a significant difference in the practice of nurses and medical technologists concerning the following items: more nurses than medical technologists practice the disposal of liquid waste in bags (nurses 84.42% vs. medical technologists 68.91, p = 0.018); and more nurses disposed of human tissue together with other waste (nurses 12.99% vs. medical technologists 2.52%, p = 0.006). Smaller proportions of nurses and medical technologists disposed of liquid waste together with other wastes (nurses 13.0%, medical technologists 7.6%), disposed of blood waste with other wastes (nurses 9.1%, medical technologists 2.5%), and disposed of expired medicines together with other wastes (nurses 18.2%, medical technologists 10.9%). Table 5 shows that the medical technologists had significantly higher overall mean scores (medical technologists 18.95, nurses 18.09, p = 0.028).

Table 1. Demographic characteristics of nurses and medical technologists (n = 196).

	Nurses	Medical Technologists	Total
Sex			
Female	60 (77.92%)	78 (65.55%)	138
Male	17 (22.08%)	41 (53.25%)	58
Age			
21-25	39 (50.65%)	99 (83.20%)	138
26-30	22 (28.57%)	15 (42.02%)	37
31-35	10 (12.99%)	4 (3.36%)	14
36 and older	6 (7.79%)	1 (0.84%)	7
Biomedical waste management training			
Received training	27 (35.06%)	41 (34.45%)	68
1-2 days	20 (25.97%)	32 (27.59%)	52
3-5 days	6 (7.79%)	4 (3.36%)	10
1 week or longer	0	2 (1.68%)	2
Not indicated	1 (1.30%)	3 (2.52%)	4
No training	50 (64.94%)	78 (65.55%)	128
Duration of present employment			
Less than 1 year	19 (24.68%)	35 (29.41%)	54
1-2 years	22 (28.57%)	50 (42.02%)	72
2-4 years	18 (23.38%)	15 (12.61%)	33
More than 4 years	17 (22.08%)	14 (11.76%)	31
Not indicated	1 (1.30%)	5 (4.20%)	6

Table 2. Comparison of the proportion of appropriate responses to knowledge questionnaire between nurses and medical technologists

	Nurses (n = 77)	Medical Technologists (n = 119)	p-value
Are you able to identify the types of medical waste?	74 (96.10%)	119 (100%)	0.059
Do you recognize the need to sort medical waste during collection?	74 (96.10%)	117 (98.31%)	0.383
Do you know the reason behind sorting (separation of) medical waste?	70 (90.90%)	115 (96.64%)	0.115
Are you aware of risks in dealing with medical waste?	66 (85.71%)	110 (92.44%)	0.151
Have you ever received any formal training on medical waste handling?	22 (28.57%)	45 (37.82%)	0.218
Do you know adequate disposal procedures for expired blood units and by-products waste?	19 (24.68%)	55 (46.22%)	0.003
Do you know adequate disposal procedures for human tissue remains?	18 (23.38%)	31 (26.05%)	0.737
Do you know adequate disposal procedures for expired medicine?	33 (42.68%)	28 (23.53%)	0.007
Do you believe that throwing blood waste into domestic waste is an adequate disposal procedure?	6 (7.79%)	9 (7.56%)	>0.999
Do you receive any form of supervision on the way you handle wastes?	36 (46.75%)	79 (66.39%)	0.008
Do you believe that throwing expired medicine into domestic waste is an adequate disposal procedure?	5 (6.49%)	15 (12.60%)	0.228

Table 3. Comparison of the proportion of appropriate responses in attitude questionnaire between nurses and medical technologists based on the median score.

	Nurses (n = 77)	Medical Technologists (n = 119)	p-value*
Segregation of waste at source increases risk of injury to waste handlers.	47 (61.04%)	75 (63.03%)	0.718
Containment of sharps does not help in safe management of hospital waste.	29 (37.66%)	32 (26.89%)	0.230
Hepatitis B immunization prevents transmission of hospital-acquired infections.	57 (74.03%)	95 (79.83%)	0.300
Reporting of needle-stick injury is an extra burden on work.	61 (79.22%)	103 (86.55%)	0.275

* Chi-square test

Table 4. Comparison of the proportion of appropriate responses in practice questionnaire between nurses and medical technologists

	Nurses (n = 77)	Medical Technologists (n = 119)	p-value*
Do you sort medical waste at source?	77 (100)	118 (99.16)	> 0.999
Do you separate sharp waste from blunt waste?	76 (98.70)	117 (98.34)	> 0.999
Do you use personal protection tools?	77 (100%)	119 (100%)	> 0.999
Do you think the number of people employed to handle waste in the hospital is adequate?	47 (61.04)	89 (74.79)	0.056
Do you dispose of liquid waste in bags?	65 (84.42)	82 (68.91)	0.018
Do you dispose of blood waste in bags?	62 (80.52)	99 (83.19)	0.704
Do you dispose of human tissue remains in separate bags?	63 (81.82)	91 (76.47)	0.476
Do you dispose of liquid waste with other waste?	10 (12.99)	9 (7.56)	0.225
Do you dispose of blood waste together with other waste?	7 (9.09)	3 (2.52)	0.051
Do you dispose of human tissue remains together with other waste?	10 (12.99)	3 (2.52)	0.006
Do you dispose at the source the expired medicines together with other waste?	14 (18.18)	13 (10.92)	0.202
Do you dispose of liquid waste into the sewage system?	27 (35.06)	54 (45.38)	0.182

* Chi-square test

Table 5. Comparison of the mean scores of nurses versus medical technologists on knowledge, attitude, and practice

	Nurses (n = 77)	Medical Technologists (n = 119)	Mean Difference	p-value*
Knowledge	18.09 (2.966)	18.95 (2.389)	0.859 ± 0.385	0.027
Attitude	11.39 (2.014)	11.19 (1.879)	-0.196 ± 0.283	0.488
Practice	19.69 (2.429)	19.32 (2.600)	-0.369 ± 0.371	0.321

* Chi-square test

Discussion

Knowledge

A high proportion of both nurses and medical technologists demonstrated knowledge regarding the identification of different types of medical waste. For nurses, the type of medical waste they could identify the most were sharp wastes, and the least were non-hazardous wastes. Medical technologists were most able to identify infectious wastes and the least able to identify cytotoxic wastes. Tayaben stated that nurses sustain the highest number of percutaneous injuries related to sharps and needles among all surveyed health care workers and this may be linked to the nature of their work and the frequency of needle use.[2] Hence, they are more likely to identify sharp wastes above other types of medical wastes. Rajan found that medical technologists are most likely to identify infectious wastes because the nature of their work is to process and examine body fluids such as blood, serum, urine, sputum, and muscle tissues.[3] They are exposed to these infectious wastes from collection, reception, and up to the examination of the potentially infectious samples.

Medical technologists have a higher proportion of correct answers than nurses concerning the adequate disposal procedures for expired blood units and by-products waste (55% vs. 19%). In a similar study by Mugabi, nurses had poor knowledge on proper disposal of expired units which was attributed to not having formal training on BWM.[4] In the study, nurses and medical technologists, in general, had poor knowledge regarding the presence of recycling services (e.g., waste disposal) in the hospital. Likewise, previous training, availability of training, and awareness of recycling of medical waste scored lowest despite them being knowledgeable on the basics of BWM and handling (e.g., categorization/disposal of waste).

More medical technologists received supervision compared to nurses (79% vs. 36%). Results are in contrast with that from Olaifa who found that lack of supervision and monitoring of BWM practices are common.[1] A reason for this may be that since medical technologists are situated in only one common workplace, the laboratory, more frequent and easier supervision is done by their superiors, compared to the nurses roaming around the hospital.[5] Among nurses, however, the majority stated that they lack supervision; this is congruent with the findings of Olaifa, Sobh, and Muthoni.[1,6,7] These studies indicate that there may be an inadequate effort made to ensure proper knowledge of and compliance with hospital policies on BWM, concluding that there is a need to supervise all aspects of BWM. The difference in response of both groups may be explained by their response on the item where they stated that there are not enough people employed to handle biomedical waste.

However, both nurses and medical technologists had low correct responses on the adequate disposal procedures for expired medicines, though more nurses responded correctly (33% vs. 28%). Although the DOH Manual states that expired medicine should be disposed of in the yellow container with a black band, results showed otherwise.[8] Aside from both groups handling patients, most hospitals have pharmacists and inspectors who facilitate the quality assurance of each medicine dispensed. The primary role of the inspectors is to evaluate drug manufacturing processes and final products in order to ensure their safety and quality. According to the WHO, inspectors should have previous training and practical experience in the manufacture and/or quality control of pharmaceutical products and should be knowledgeable on the procedures for handling returned and time-expired drugs resulting in both respondents not having adequate knowledge on the disposal of expired

medicines.[9] Agaceta found that pharmacists are also in charge of pharmaceutical care (medication counseling and clinical pharmacy).[10]

Similarly, both nurses and medical technologists had low percentage of correct responses on the following items: the adequate disposal of human tissue remains (nurses 23.4%, medical technologists 26.1%), throwing blood waste into domestic waste (nurses 7.8%, medical technologists 7.6%), and throwing of expired medications in domestic waste (nurses 6.49, medical technologists 12.60%). Studies by Jahan, and Adogu and Ubajaka had similar results in which a lower percentage of nurses and medical technologists had knowledge on the use of a yellow disposal container assigned to human tissue remains and infectious material, compared to other biomedical wastes.[11,12] In addition, nurses and medical technologists had poor knowledge of recycling services (e.g., waste disposal) in the hospital.[2] Since the majority of nurses and medical technologists did not receive any formal training on waste management, this resulted in poor knowledge on the proper disposal of human tissue remains for both nurses and medical technologists, which is congruent with responses to the question if both groups received formal training in this matter. Thus, the lack of adequate training on healthcare waste management may also result in inadequate knowledge on pathological (e.g., human tissue remains) waste disposal.

Attitudes

Nurses and medical technologists had the same attitude towards BWM. The results of this study are similar to the findings of Olaifa.[1] This study also showed that both nurses (37.7%) and medical technologists (26.9%) scored low on the negative attitude that containment of sharps does not help in the safe management of hospital waste. Injuries from sharps is a known safety hazard in BWM. Cruz showed that various health consequences related to biomedical waste exposure include sharps injuries.[14] The respondents, therefore, believe that the containment of sharps is necessary and contributed to the safer management of hospital waste.

Practices

More nurses than medical technologists practice the disposal of liquid waste in bags (84.4% vs. 68.9). Both groups comply with the practice of disposing of liquid waste in bags to avoid leakage and is in accordance with the Department of Health Healthcare Waste Manual that waste should be packaged in sealed bags or containers to prevent spillage during handling and transportation for off-site collection.[8] The results are similar to those of Abrol, wherein the majority of healthcare personnel disposed of these wastes in separate puncture-proof bags.[15]

More nurses than medical technologists disposed human tissue together with other waste (13.0% vs. 2.5%). This is in connection with responses on the type of waste the respondents were able to identify, wherein a lower frequency of nurse and medical technologists identified pathological waste. Deress and colleagues stated that the difference might come from the educational level, previous training, use of visual aids, presence of color-coded bins, and presence of guidelines in the department.[17] Jahan had similar results in which a lower percentage of nurses and medical technologists had proper knowledge of the yellow disposal container assigned to human tissue remains and infectious material, compared to other biomedical wastes such as radioactive wastes and sharps.[18] Similarly, Adogu and Ubajaka found that nurses and medical technologists had poor scoring of infectious waste segregation at 24% and 33% of the total respondents, respectively.[10]

Smaller proportions of nurses and medical technologists disposed of liquid waste together with other wastes (nurses 13.0%, medical technologists 7.6%), dispose of blood waste with other wastes (nurses 9.1%, medical technologists 2.5%), and disposed of expired medicines together with other wastes (nurses 18.2%, medical technologists 10.9%). This is consistent with the results of Parida establishing that primary healthcare workers practice segregation of infectious and non-infectious waste.[19] This was attributed to the fact that these healthcare workers were well versed with waste segregation, color coding, and the important health hazards of biomedical waste.[19] If the liquid and blood wastes are infectious, then these wastes should be carefully placed in clearly labeled containers separated from other wastes. This is to decrease health hazards resulting from poor waste management as not only the medical staff are at risk of injury or infection, but also the general public.[20] Expired medicines must not also be disposed of with other wastes as some drugs, such as antineoplastic drugs, may be unstable and may have serious effects

when disposed improperly into the environment with other wastes.[21] Results here are parallel with the knowledge of the participants regarding these disposal procedures. Since they have scored less on knowledge, they also practice less. However, despite the majority of nurses and medical technologists stating they have no knowledge regarding procedures on how to adequately dispose of liquid wastes, the majority of these healthcare workers claim that they practice disposing of these wastes in bags which is in accordance with the DOH guidelines. The result of having poor knowledge but good practice may be attributed to the presence of guidelines, the use of visual aids, and the availability of properly labeled color-coded bins in the facility which have been identified as key factors for effective BWM.[16] The scores may reflect that handling certain types of wastes, despite it being part of hospital policies based on DOH guidelines, are not in the scope of the job of the nurses and medical technologists, as these are usually being handled by nurse aides. This study has identified a knowledge gap that may expose these healthcare workers to occupational risks which appropriate training has the potential to prevent as in a study by Nwanko on hospital cleaners.[22]

Knowledge, Attitude, and Practice

According to Mathur, the knowledge about BWM rules among hospital personnel such as doctors, nurses, and medical technologists is high.[23] A significant difference was found in the knowledge of nurses and medical technologists which may be attributed to the varying scopes and job descriptions within the hospital. The revised Organizational Structure and Staffing Standards for Government Hospitals show that protocols, number of staff, and service structures vary per hospital level, therefore hospitals may not have a standardized protocol on BWM (e.g., bins, treatment facility), and the number of supervisors per department varies per hospital level.[24]

On the other hand, there is no significant difference in the attitude and practices of both nurses and medical technologists regarding biomedical waste management. Hospital protocols, guidelines from the Health Care Waste Management Manual of the DOH, and Ordinance No. 16 Series of 1991, which regulates the management, collection, and disposal of hospital waste and similar institutions in Metro Manila, could be possible explanations as to why healthcare workers have the same attitude and practices of BWM.[25] Since practices of nurses and medical technologists do not differ greatly, this may explain why they have the same attitude towards BWM as well.

In conclusion, the assessment of the participants' knowledge showed that both nurses and medical technologists were able to identify types of medical waste, sort medical waste, state the reasons for waste sorting at the site, and name risks associated with medical waste; however, a significant number of participants did not have knowledge with regards to disposal procedures of expired medicine and expired blood units. The knowledge of nurses and medical technologists differed only regarding their knowledge of supervision. As for attitude, it has been found that there is no significant difference in the attitude of nurses and medical technologists towards biomedical waste management. Lastly, the assessment of the participants' practices has shown that half of the participants practice proper biomedical waste management in terms of sorting waste at source, separating sharp waste from blunt waste, using personal protection tools, and disposing of blood/liquid/human tissue remains in separate bags. The practices of nurses and medical technologists differed only in the disposal of human tissue remains together with other waste.

Given these, the researchers recommend that hospitals of all levels, laboratory clinics, and other medical facilities conduct formal training on medical waste handling as a requirement for all nurses and medical technologists; multiple training sessions may be necessary for the effective and complete practice of biomedical waste management. Topics on medical waste handling should also be included as part of the undergraduate curriculums of colleges and universities not only for nurses and medical technologists but for all other allied healthcare professionals as well. Strict supervision and surveillance should be followed in waste management activities in the hospital.

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