



# **Perceived Healthcare Waste Management Practices and Associated Risk Factors Among Healthcare Workers of Public Hospitals in the Philippines**

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## **ABSTRACT**

### **Background**

Health care waste (HCW) is ranked second most harmful waste after nuclear waste [5] therefore, HCW management (HCWM) needs special consideration and given top importance. An estimated 5.2 million people globally, including 4 million children, mortality every year because of improperly managed medical waste. [20] Between 20% and 60% of medical facilities in 22 developing nations in the Western Pacific Region lack appropriate systems for managing medical waste including effective waste segregation at the source, storage, collection, transportation, treatment, and disposal. [11,12] In the Philippines, dramatic increase in medical wastes during the pandemic was observed. [57] The majority of healthcare workers are aware of the requirements for medical waste management, [19] but due to negligence they are exposed to the risks. [18]

### **Methods**

This study is a cross-sectional hospital-based survey to healthcare workers from public hospitals of the Philippines. Through convenience sampling, there were 226 participants who responded to the survey-questionnaire which was conducted between October and November 2023. The data were analyzed using descriptive statistics and correlation analysis. Prior to the study, all participants were given full information about the research and their consent was obtained.

### **Results**

From the total participants, there were 41.8% age from 35–44, 67.1% female, 27.1% with 5 to 10 years length of service, 55.6% in permanent positions, 64.9% college graduates and most of them were nurses (55%) of the hospitals. Attendance at training/ orientation about HCWM interestingly showed that only 12% always attended. There are more participants with a high to moderate level of perception of proper practices (52.2% to 58.4%) and its associated risks (54.4% to 64.2 %) with lack of proper practice of healthcare waste management. Strong positive correlation was found between these perceptions on waste minimization/ reduction ( $r = 0.709^{***}$ ), waste identification ( $r = 0.809^{***}$ ), waste segregation ( $r = 0.854^{***}$ ) and waste disposal ( $r = 0.286^{***}$ ) implying that the higher the perception on the practices of proper HCWM, the higher the perception on the possible risks if there is a lack of it. The socio-demographics of the healthcare workers showed certain associations with the perceived waste management practices and its associated risks.

### **Conclusion**

The results of this study revealed the perceptions were directly related with each other such that proper HCWM partners higher awareness of the possible risks if there may be lack of proper practices. Significantly, despite the low attendance to training or orientation by the participants and no association with other socio-demographic data, the results showed a positive result implying safe practices and awareness of the risks.

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## **INTRODUCTION**

Health care waste (HCW) is ranked second most harmful waste after nuclear waste by the UN Basel Convention [5] therefore, HCW management needs special consideration and ought to be given top importance.[13] The normal work patterns of medical workers in healthcare facilities expose them to diseases, affecting about two million medical personnel worldwide. [1] The concern surrounding occupational injuries and exposures in the healthcare industry poses a risk to nations with rich and low incomes alike. Compared to poor nations where occupational health and safety are not given priority, industrialized countries have seen significant reductions in the incidence of exposure and advancements in methods of reducing the burden of exposure. [30-32]

Unfortunately, the Philippines is one of the countries belonging to the developing countries where there are greater concerns about the existing procedures and potential risks pertaining to the handling of medical waste specifically to public hospitals. Moreover, only few to nil published studies on healthcare waste management in the Philippines were observed during the course of this research and these studies did not represent the entirety of the region in terms of the issue.

The well-being of healthcare professionals, community safety, and environmental impact can all be safeguarded through proper handling of healthcare waste and its management. Because of the related risk considerations, the management of medical waste in public hospitals in the Philippines has drawn concerns. [42]

Various laws and rules govern the management of hospital wastes in the Philippines where hospitals are particularly bound by the rules outlined in the Department of Health's 2005 Revised Health Care Waste Management Manual (RHCWWM). [41] While the majority of healthcare professionals were aware of the requirements for medical waste management, it's possible that lax norms and regulations and a lack of government inspections contributed to the disregard for these recommendations. [19]

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## METHODS

### Study Design and Sites

This cross-sectional study design was conducted in public hospitals within the Philippines situated across the regions of Luzon, Visayas, and Mindanao for two (2) months, from October to November 2023.

### Participants and sampling

The target participants were healthcare workers from the participating public hospitals located in the three (3) Philippine major island groups. Due to the proximity of the researchers from other public hospitals, the survey was conducted through in-person survey and also online. 226 responses gathered based on the inclusion criteria which were as follows: a) healthcare workers who are currently employed at public hospitals; b) encompasses both the clinical and the administrative staff of the hospital; and c) willingness to participate by the participant.

### Data collection procedures

The printed questionnaires were distributed upon securing approval from the Chief of the participating public hospitals while Google Form were disseminated through personal contacts by word of mouth, emails and social media platforms, such as Facebook. Meanwhile, answered questionnaires (printed) were collected 3-4 days after the distribution. Participants were ensured the confidentiality and privacy of their responses to reduce potential bias introduced by self-reported data.

### Tool development and measures

The questionnaire was adapted from the WHO recommendation assessment tool and DOH Health Care Waste Management Manual Fourth Edition 2020. This was initially presented to three (3) validators who are experts in the field. As recommended by one of the validators, the questionnaire, which was initially crafted in English, was translated into Filipino language. Then, pilot testing was conducted to 30 from different public hospitals to test its reliability and validity. Using Cronbach's  $\alpha$  (alpha), the value of 0.980 was obtained which signified an exceptionally high degree of uniformity and dependability in the measurement of the intended concept.

The questionnaires included questions and statements related to the perceived risk factors and potential health risks associated with improper healthcare waste management. The survey-questionnaire is comprised of four sections, namely: (a) socio-demographic information of the participants which includes age (continuous), sex (male, female), length of service (continuous), employment status (permanent, job order/ contract of service), designation (Clinical Staff, Admin Staff), educational attainment (Elementary, Elem Graduate, High School, HS Graduate, College Graduate, Post-graduate), attendance to training/ orientation on healthcare waste management and associated risk factors (Never, Rarely, occasionally, frequently, always); (b) assessing the perception on their practices in health care waste management and (c) gauging their perception of the associated risks of health care waste management on healthcare workers and; (d) their recommendations for improvements on healthcare waste management in their respective workplaces.

### Statistical analyses

The analysis of demographic characteristics, perceptions regarding HCWM practices and risk factors among healthcare workers involved utilizing descriptive statistics and frequency distributions. Additionally, correlation analysis is used to gain insight into relationships. Moreover, regression analysis is used to determine the significance of variables, which revealed connections between demographic profiles and perceptions. The data were analyzed using statistical application named Jamovi (version 2.4.11).[60]

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## RESULTS

### *Socio-Demographic Profile Healthcare Workers*

The socio-demographic profile presented in Table 1 provides a comprehensive overview of the healthcare workforce, offering valuable insights into the diverse characteristics of its members. The *age* distribution reveals a workforce spanning multiple generations signifying a dynamic blend of fresh

perspectives and seasoned expertise, with a substantial bulk falling within the 35–44 age range (41.8%). In a study in Cameroon, participants aged (30–45) linked to a greater rating of having sufficient knowledge, attitudes, and practices regarding biomedical waste management. [27] *Sex/ Gender* distribution emerges as a critical aspect, emphasizing a notable majority of female healthcare workers (67.1%) which has the same finding in Southwestern Ethiopia [23] and Bangladesh. [62] The *length of service* introduces another layer of complexity, illustrating a workforce with diverse levels of experience. A significant proportion boasts 5 to 10 years of service (27.1%) with the same result to Andama, Ethiopia [28] and India [63]. This mix of experienced professionals and those relatively new to the field suggests a dynamic exchange of skills and knowledge, potentially impacting the adaptability and resilience of the healthcare workforce. The *employment status* of healthcare worker reveals a predominant majority in permanent positions (55.6%) which is consistent with the result in the same study in Ethiopia [45], Bangladesh [62], Nigeria and Pakistan [40]. These variations in employment status could influence job satisfaction, commitment levels, and consequently, the degree of engagement with healthcare waste management practices. *Designation and Educational attainment* to which observed in the study were appropriately related with each other. Most of the participants were college graduates (64.9%) and most of them were nurses (24.4%). The same result found in India [63], Bangladesh [62] and Adama, Ethiopia [28]. *Attendance at training or orientation about healthcare waste management* interestingly showed that only 12% always attended, comparable to 20.4% claimed who never attended where India [63] and Pakistan [40] have higher results.

**Table 1.** *Socio-Demographic profile of the healthcare workers.*

<b>Socio-Demographic Profile</b>	<b>Freq</b>	<b>%</b>
<b>Age</b>		
Under 25	13	5.8
25 – 34	75	33.3
35 – 44	94	41.8
45 – 54	32	14.2
55 or above	11	4.9
<b>Gender</b>		
Female	151	67.1
Male	74	32.9
<b>Length of Service</b>		
6 months to 1 year	18	8.0
Less than 6 months	18	8.0
2 to 5 years	52	23.1
5 to 10 years	61	27.1
More than 10 years	46	20.4
<b>Employment Status</b>		
Contract of Service	40	17.8
Job Order	60	26.7
Permanent	125	55.6
<b>Designation</b>		
Administration	56	24.9
Cook/ Food Server	6	2.7
Driver	2	0.9
Laundry	4	1.8
Nurse	55	24.4
Paramedical/ Allied	54	24.0
Physician	26	11.6
Security Guard	7	3.1
Utility	15	6.7
<b>Educational Attainment</b>		
College	21	9.3
College Graduate	146	64.9
Elem Graduate	1	0.4
Elementary	1	0.4
HS Graduate	13	5.8
High School	4	1.8

Post-graduate	39	17.3
<b>Attendance to training or orientation on HCWM and associated risks</b>		
<i>Always</i> : I consistently attend every relevant training or orientation session.	27	12.0
<i>Frequently</i> : I attend these sessions regularly, at least several times a year.	19	8.4
<i>Occasionally</i> : I attend these sessions from time to time, but not regularly.	63	28.0
<i>Rarely</i> : I attend such sessions infrequently or on a very irregular basis.	70	31.1
<i>Never</i> : I have never attended any training or orientation sessions. (0%)	46	20.4

### Healthcare Workers'

#### Levels of Perceptions of Healthcare Waste Management Practices

Healthcare workers' perceptions of proper healthcare waste management practices are presented in Table 2, which provides an analysis of responses across important dimensions, such as percentages and frequencies. Waste reduction/minimization, waste identification, waste segregation, and waste disposal are all included in the subscales of the survey questionnaire. Interestingly, there were high levels of perception to all the categories of the healthcare waste management ranging from 52.2 % and 58.4 % except for a moderate level of perception to waste minimization/reduction (50.9 %) contrary to the claim that Asian developing countries which include the Philippines commonly fail to practice appropriate healthcare waste management. [25] Same study mentioned that proper segregation of waste can help improve healthcare waste management, along with a disposal cost reduction.

**Table 2.** Healthcare Workers' Levels of Perceptions of Healthcare Waste Management Practices.

Statements	Frequency	Percentage
1. <i>Perceived practices on waste reduction/ minimization</i>		
High	86	38.1 %
Moderate	115	50.9 %
Low	25	11.1 %
Very Low	0	0.00
2. <i>Perceived practices on waste identification</i>		
High	132	58.4 %
Moderate	79	35.0 %
Low	15	6.6 %
Very Low	0	0.00
3. <i>Perceived practices on waste segregation</i>		
High	131	58.0 %
Moderate	78	34.5 %
Low	16	7.1 %
Very Low	1	0.4 %
4. <i>Perceived practices on waste disposal</i>		
High	118	52.2 %
Moderate	87	38.5 %
Low	19	8.4 %
Very Low	2	0.9 %

### Healthcare Workers' Levels of Perceptions on the Associated Risk with the

#### Lack of Proper Healthcare Waste Management Practices

Table 3 explores how healthcare workers view the risks connected to improper healthcare waste management practices. With regard to waste reduction/minimization, waste identification, waste segregation, and waste disposal, the data is categorized into risk levels and both frequencies and percentages were given. Regarding perceived risks related to lack of proper practices of these waste management revealed the highest level of perception was observed in waste identification and segregation with 64.2 %.

**Table 3.** *Healthcare Workers' Levels of Perceptions on Risk Associated with Lack of Proper Practices*

Statements	Frequency	Percentage
1. <i>Perceived risk associated with lack of proper practices on waste reduction/minimization</i>		
High	123	54.4 %
Moderate	87	38.5 %
Low	14	6.2 %
Very Low	2	0.9 %
2. <i>Perceived risk associated with lack of proper practices on waste identification</i>		
High	145	64.2 %
Moderate	67	29.6 %
Low	12	5.3 %
Very Low	2	0.9 %
3. <i>Perceived risk associated with lack of proper practices on waste segregation</i>		
High	145	64.2 %
Moderate	68	30.1 %
Low	12	5.3 %
Very Low	1	0.4 %
4. <i>Perceived risk associated with lack of proper practices on waste segregation</i>		
High	144	63.7 %
Moderate	70	31.0 %
Low	10	4.4 %
Very Low	2	0.9 %

**Test on the Relationship of Healthcare Workers' Level of Perceptions on the Proper Healthcare Waste Management Practices and Associated Risk with the Lack of Proper Healthcare Waste Management Practices**

Table 4 shows that there is a strong positive correlation between the perceived proper healthcare waste management (HCWM) practices to the perceived risks on waste minimization/ reduction ( $r = 0.709^{***}$ ), waste identification ( $r = 0.809^{***}$ ), waste segregation ( $r = 0.854^{***}$ ) and waste disposal ( $r = 0.286^{***}$ ). In the Philippines, there is a need to revisit and reassess the current healthcare waste management practices among healthcare workers because of the increasing data on these wastes particularly during the pandemic period. Interestingly, this study revealed that there was a high level of perception towards proper HCWM practices and its risks if there is a lack of proper waste management.

**Table 4.** *Relationship between the perceived healthcare waste management practices and associated risks with improper practices by category obtained from the responses of the healthcare workers from public hospitals in the Philippines.*

Perception		Risks on HCW Minimization/ Reduction	Risks on HCW Identification	Risks on HCW Segregation	Risks on HCW Disposal
Waste Minimization/ reduction practices	Pearson's r	0.708***			
	df	224			
	p-value	<.001			
Waste Identification practices	Pearson's r	-	0.809***		
	df	-	224		
	p-value	-	<.001		
Waste Segregation practices	Pearson's r	-	-	0.854***	
	df	-	-	224	
	p-value	-	-	<.001	

Waste Disposal practices	Pearson's r	-	-	-	0.286***
	df	-	-	-	224
	p-value	-	-	-	<.001

Note \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

***Test of Relationships of Healthcare Workers' Socio-Demographic Characteristics and Levels of Perceptions of Healthcare Waste Management Practices and its Associated Risks with Lack of Proper Practices***

The Chi-square test was employed to assess the association between each socio-demographic characteristic and the perceived waste management practices. Upon examination, Table 5 showed certain associations between socio-demographic characteristics and perceived waste management practices. In the context of the level of perception on proper waste reduction/minimization ( $p = 0.10$ ) and waste identification ( $p = <.001$ ) and its associated risks on lack of proper waste identification ( $p = 0.030$ ) to attendance to training of the healthcare workers, it exhibited statistically significant association despite the lesser number of participants with excellent attendance to training or orientation regarding HCWM. However, in a study conducted both in Ethiopia, they revealed that healthcare workers are 9.23 times more likely to safely practice HCWM compared to those who did not have training on HCW management. [34] In terms of the length of service, it showed statistical significance to the level of perception on the risk if there is a lack of proper HCWM in all categories such as waste reduction/minimization ( $p = 0.043$ ), waste identification ( $p = 0.002$ ), waste segregation ( $p = 0.27$ ) and waste disposal ( $p < 0.001$ ). According to one study, healthcare workers with more than 10 years of professional experience had better knowledge of biomedical waste management. [27] Designation of work in this study also showed a significant relationship to the level of perception to proper HCWM practices in terms of waste minimization/ reduction ( $p < 0.027$ ). Nurses comprised the bulk of this study where it was found out in one study that they tend to adhere to HCWM practices more frequently than other waste handlers in other departments. They were more inclined to segregate the hazardous waste because there were HCW segregation containers available on-site at the locations where they generated waste. [48] Conversely, for perceived practices on waste segregation and waste disposal, none of the socio-demographic characteristics demonstrated a statistically significant association. However, it cannot be concluded that because some of the socio-demographics did not have significant association to the level of perception, the participants have meager perception on the proper HCWM practices. Furthermore, this study provides insight that the healthcare workers currently working in their respective public hospitals have a high level of perception to proper healthcare waste management and a high level of perception to risks if there is a lack of it.

**Table 5.** *Test of Relationships of Healthcare Workers' Socio Demographic Profile and Levels of Perceptions on Healthcare Waste Management Practices and its Associated Risks with Lack of Proper Practices*

Perception		SOCIO-DEMOGRAPHIC PROFILE						
		Age	Sex	Length of Service	Employment Status	Designation	Educational Attainment	Attendance to training/ orientation
Waste reduction/ minimization practices	Chi-square	9.99	2.31	18.8	6.32	28.6	17.0	23.2
	df	8	2	10	4	16	12	10
	Sig	0.266	0.315	0.043	0.175	0.027	0.150	0.010
Waste identification practices	Chi-square	12.9	0.782	28.1	3.94	14.2	7.31	38.3
	df	8	2	10	4	16	12	10
	Sig	0.115	0.676	0.002	0.414	0.583	0.836	<.001
Waste segregation practices	Chi-square	8.30	0.588	20.8	2.67	27.0	17.3	22.0
	df	12	3	15	6	24	18	15
	Sig	0.762	0.899	0.142	0.849	0.304	0.504	0.108
Waste disposal practices	Chi-square	10.2	2.24	22.7	2.48	24.3	19.4	18.0
	df	12	3	15	6	24	18	15
	Sig	0.602	0.482	0.090	0.871	0.444	0.367	0.262

Waste reduction/ minimization risk	Chi-square	7.33	1.18	28.0	6.58	34.6	16.3	18.4
	df	12	3	15	6	24	18	15
	Sig	0.835	0.757	0.022	0.362	0.074	0.571	0.241
Waste identification risk	Chi-square	20.2	5.14	42.6	9.28	19.5	10.2	26.8
	df	12	3	15	6	24	18	15
	Sig	0.063	0.162	<.001	0.158	0.727	0.926	0.030
Waste segregation risk	Chi-square	7.84	4.99	40.8	12.3	21.7	12.5	19.9
	df	12	3	15	6	24	18	15
	Sig	0.797	0.173	<.001	0.055	0.597	0.819	0.176
Waste disposal risk	Chi-square	14.5	4.15	41.3	10.1	22.2	15.2	18.3
	df	12	3	15	6	24	18	15
	Sig	0.270	0.245	<.001	0.120	0.567	0.647	0.247

## DISCUSSION

The socio-demographic profile results provided insight about the healthcare workforce. Despite few of these data having significant association with the perception of practices and to its risk, the level of their perception showed commendable results. Higher perception to proper waste management equals safe practice which was revealed in this study. 52.2% to 58.4% is much higher compared to the result in Bangladesh (54%), [62] Adama Hospital, Ethiopia, 34.9%, [28] Gondar Town, Ethiopia 31.5%, [47]. However, these results are lower compared to findings in Nigeria 62%, and Pakistan 66.6% [40]. Further, a high perception on the risks if there is a lack of proper HCMW suggests that a combination of knowledge and ideas gained as a result of having an experience in relation to proper management is commendable. This current study has higher results in terms of the risks associated with lack of proper HCWM compared to Gondar Ethiopia [47] and Bangladesh [62].

The results implied that the higher the perception by the healthcare workers on the practices of proper HCWM, the higher the perception on the possible risks if there is a lack of proper practices of it. In other words, should there be any lack of practices in one of these stages of waste management, the greater the chance that the hospital is of higher risk in posing hazard to its clients, environment and even to its very own reputation as a healthcare institution hence, a domino effect.

## STRENGTHS AND LIMITATIONS

The primary objective of this research was to gauge the level and the relationship of healthcare workers' socio-demographic profiles, between their perception towards healthcare waste management practices and associated risk factors in public hospitals in the Philippines. The responses were statistically tested showing that individual responses were unique or the responses were significantly different from one item to another hence, randomized output was achieved. It was important to note that the findings of this study pertain exclusively to government hospitals and their staff, and their applicability should not be extended to private or non-government hospitals and/or to the entirety of all public hospitals of the Philippines.

## CONCLUSION

The result of this study revealed a high level of perception to proper healthcare waste management practices (58.4%) and perception of risks if there is a lack of it (64.2%) in terms of waste minimization, identification, segregation and disposal. Moreover, it was also found in this study that there was a strong relationship between the two perceptions implying a direct proportional correlation and a domino effect hence, the higher perception on the proper practice, the higher the perception on the risks of there is a lack of proper healthcare waste management. Not all of the socio-demographic data were statistically associated with the perception however, this was not detrimental to the positive result. Furthermore, this study provides insight that the participants currently working in their respective public hospitals have a high level of perception in terms of the proper healthcare waste management practices and its risks. The results on the perception have higher findings compared to the same study in Ethiopia [28, 47] and Bangladesh [62] but a lesser result versus in Nigeria and Pakistan [40].

## RECOMMENDATION

The researchers also solicited recommendations from the participants obtaining from the last part of the survey-questionnaire for improving healthcare waste management and addressing potential risk factors applicable in their workplace as follows: (a) compulsory or mandatory attendance to trainings on healthcare waste management as well as annual training/ orientation of the healthcare workers; (b) conduct of frequent orientation on proper waste disposal to watchers and patients; (c) regular monitoring of the healthcare waste management; (d) proper signages with vernacular translations about the cause and effect of improper healthcare waste must be visible within the premise of the hospital and (e) doing risk assessment periodically in terms of the probability of occurrence, severity, possible exposure and control measures in the place. For further related studies, the researchers suggested for more participants that will statistically represent the regions coming from Luzon, Visayas and Mindanao. The study also recommended that a comparative study on private and public hospitals in the Philippines is sought.

## AVAILABILITY OF DATA AND MATERIALS

The data relating to this manuscript are available upon request.

## ABBREVIATIONS

HCW	Healthcare waste
HCWM	Healthcare waste management
HCFs	Healthcare facilities
HCP	Healthcare professionals

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### **CONTRIBUTIONS**

All of the researchers conceived and designed the study. ZOD, FCM and VVD initiated validation of the questionnaire. ZOD ran the reliability test of the questionnaire. JCS checked for plagiarism test of the research. ZOD, FCM, VVD, JEC and JCS collected the data. ZOD and a certified statistician conducted the statistical analysis and interpretation of the findings. All of the researchers wrote the initial draft. ZOD, JCS and EMF critically reviewed and finalized the manuscript. All authors read and approved the final version of this manuscript.

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## **ETHICS DECLARATIONS**

The research was conducted in accordance and adherence to the Belmont report in terms of the respect for individual participants, beneficence and justice to safeguard the rights and confidentiality of participants. In-person data collection, approval was sought initially from the Chiefs of the Hospitals and/or Medical Directors who were the heads of the ethical committees and authorities of the involved institution. Both on-line and in-person data collection, all participants were given full information about the research and their consent was obtained prior to the study. The collected data were secured and anonymized to protect the privacy of the participants.